A New Vertical Handover Mechanism among Heterogeneous Wireless Networks in PMIPv6

A.Maheswari, T.Mithila

***Abstract*— In wireless networks during data transmission Mobile Nodes (MN's) seamless connectivity becomes a very challenging issue among heterogeneous wireless networks. When MN moves from home network to foreign network, it performs handover which is referred as vertical handover. Proxy MIPv6 (PMIPv6), a network – based mobility management protocol does not require the involvement of MN during handover. On behalf of the MN to perform the mobility-related signaling, network entities are allocated by the PMIPv6. In my proposed work, a new vertical handover decision algorithm is proposed to optimize the performance of the handover. A new entity called Inter-domain Router is proposed which performs the functionalities of both Local Mobility Anchor and Mobile Access Gateway. The proposed mechanism is expected to reduce the handover latency, packet loss and increases the throughput during handover comparatively with the existing handover decision algorithms which will be shown in the performance analysis.**

***Index Terms*—PMIPv6, Vertical Handover, Heterogeneous wireless networks**

I. Introduction

In Heterogeneous wireless networks, continuity of service among various networks is eminent. The integration [10] , [14] of heterogeneous wireless networks is one of the most important features that will ensure anytime anywhere access in next generation wireless networks (NGWN). Handover is a process that provides the continuity of service without any disruptions. Internet access ubiquity [9] for mobile users requires seamless mobility management supported by effective handover mechanisms. The Internet protocol [11] IPv4 has been slowly progressing toward IPv6, and during this period both protocols have become a part of the Internet service infrastructure. Efficient handover should provide the continuity connection that the IP address should not be changed and the continuity should not break anywhere while transferring the data and it is transparent to upper layers. Handover [19] is the process when the mobile node transfers from one wireless network to another wireless network. Handover is performed either in Horizontal or vertical handover process, horizontal handover is one in which the data are move around between the same network (i.e. intra domain), and in vertical handover [6] the data are move around between different networks (i.e. inter domain). It is [7] commonly known that the nature of NGWN makes performing vertical handoff more difficult, than performing horizontal handoff. IPv6 (Internet Protocol Version 6) is readily available to anyone and easy to configure. Ipv6 is the extension of IP Version4 networks. It is a protocol used for Internet Networking. Ipv6 offers better addressing, security and other features to support large world wide networks compared to Ipv4. The 802.16, also [17] known as WiMAX [16] , aims to develop architecture for fast and efficient handover in an operator's network to maximize the performance of the mobility management as a whole. Some of the benefits of Ipv6 are the size of the routing table is reduced and the routing is done more efficiently, the packet header used in Ipv6 makes the packet processing efficient. Ipv6 supports Multicast, Address auto-configuration and services like VoIP and QoS. Ipv6 are of two types host based and network based. The host based protocols such as hierarchical and mobile protocols are involved at IP layer and the Network based protocols such as Proxy Mobile protocol and they are explained below.

Host based protocols forces the MN (Mobile node) to perform the handover and needs modifications in it. To satisfy[13] the needs of mobile users, IETF has proposed MIPv6 MIPv6 [5] (Mobile Ipv6) protocol needs MN modifications during handover and kicks the MN when it decides to change its point of attachment from one network to another or from one subnet to another. When the MN moves to a new network, it tries to acquire an Ipv6 address either by using stateful or stateless Ipv6 configuration. In a stateful configuration, the IP address is obtained from a DHCP server. While in a stateless configuration, the IP address is generated by the MN from the prefixes provided by the gateway/router. When an MN enters a new network, the existences of the routers are known through the Router Advertisement (RA) messages. After the MN determines the Ipv6 address in the new network, this address becomes the Care-of-Address. As a result, the MN sends a Binding Update message to its Home Agent which sits on its home network. When the CN wants to communicate with the MN, then it sends the data packet to the home agent, home agents accepts the packet and tunnels to MN then MN can send data packet to CN directly. MIPv6 solves the issue of IP mobility but it suffers from the handover performances such as handover latency, packet loss and signaling overhead.

HMIPv6(Hierarchical mobile Ipv6) protocol is an extension to the operation of MIPv6 and it is mainly intended to reduce the amount of signaling and latency between MN and its Home Agent, and to the CN when performing handover across number of domains.HMIPv6 is disparate to MIPv6. Where in MIPv6, the MN is required to send Binding Update to its Home Agent and CNs every time, during handover is performed. However, in HMIPv6 the handovers are handled locally within that domain depending on the MN location. When a MN enters a new domain, it needs to configure two Care-of-Addresses, the Regional Care-of-Address and the On-Link Care-of-Address. Due to the configuration of two

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new addresses, more signaling and processing are required in this protocol.

FMIPv6 (Fast handover for Mobile Ipv6) is another extension for MIPv6 comes out to minimize the handover delay and the service disruption that happens when the MN changes its point of attachment. The idea behind FMIPv6 is to quickly detect the movement of MN. However during handover the Fast Binding Update message can be lost and not processed by Previous Access Router, even when the MN have left its point of attachment. In such cases the new access router sends the Fback message to previous access router, which includes alternate IP address in case of the proposed new Care-of-Address which is not valid. After that, the New Access Router starts forwarding packets from Previous Access Router to the MN New Care-of-Address.

II. BACKGROUND

Proxy mobile IPV6 [3], [4] is a network based protocol, here the IP mobility operation does not involve [18] mobile node at all, and so all the functionalities have to be moved towards the network. PMIPv6 [1] , [15]a network based protocol, involves the handover in network and uses the Home network address within that domain.PMIPV6 provides mobility support within a localized area by adding the three logical entities to the IP network namely MAG, LMA and AAA server [8]. Mobile Access Gateway (MAG) works on the access router and it manages all the mobility related signaling of the mobile node. There are different MAGs attached to Local mobility domain. MAGs are responsible for tracking the movement of the MN. The authentication of the MN's is done by MAG. A PMIPv6-based inter-domain [12] roaming mechanism using concatenated tunnel construction from visited MAG to visited LMA and from home LMA to visited LMA when MN moves to a visited domain.The mobility related signaling is initiated by MAG itself. Local Mobility Anchor (LMA) acts like a home agent as in Mobile IPV6, in a proxy mobile Ipv6 domain. LMA stores all the routing information needed to reach each of the MNs in the corresponding local mobility domain.PMIPV6 is transparent to MN. MN is able to move within the local mobility domain without changing the IP address. When MN moves out of MAG the MAG will register MN by sending Proxy Binding Update (PBU) which contains ID of the mobile node and Proxy Care of Address (PcoA). When MN first enters into the Local mobility domain it creates an entry in the binding cache. Binding cache maintains the details of all the MN bindings in the Local mobility domain. In PMIPv6 the data is transmitted through the LMA from the MAG. After the MN got authenticated through the MAG it sends Proxy Binding Update (PBU) message to the LMA. LMA send the HN-ID (Home Network ID) to MAG. MAG sends it to the MN are transmitted, where MAG which tracks the mobility of the MN. The figure given below shows the signaling flow of PMIPv6. When a MN disconnects from MAG1 and connected to MAG2 three phase's takes place namely De-Registration phase, Authentication phase and Registration phase. The process of PMIPv6 is explained below.

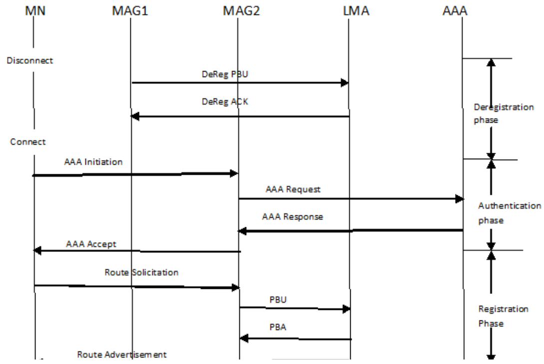

Fig.1.PMIPv6 message flow

a) *De-Registration phase*

When a MN disconnects from MAG1, then the MAG1 sends a DeReg Proxy Binding Update (PBU) message to the corresponding LMA. The LMA updates its cache and responds with a DeReg Acknowledge (ACK) message.

b) *Authentication phase*

When a MN tries to connect with MAG2 authentication is required from AAA (Authentication, Authorization and Accounting) server. The MN sends an AAA initiate message to MAG2. MAG2 sends a AAA request to AAA server.The authentication is checked with the AAA server and it responds to MAG2 whether the MN is authenticated.Once MAG2 receives the acknowledgement from the AAA server, it sends a reply message to MN by AAA Accept message

c) *Registration phase*

Here the registration starts by the MN by sending a Router solicitation message to MAG2. Now MAG2 sends a PBU message to its corresponding LMA, then LMA updates its cache and responds with PBA message. A router advertisement message is sent from the LMA to MN directly.

III. RELATED WORK

To improve the performance of the inter- PMIPv6 –domain mobility and to satisfy the Quality of Service (QoS) the following latency low inter-domain handover mechanism was used. An intermediate Global mobility anchor entity called GLMA was proposed by Ibrahim Al-Surmi et., al., to coordinate Mobile Node (MN) handover and responsible for redirecting the MN traffic across inter-PMIPv6 domains. This mechanism manages the MN handover and maintains its data session continually across inter-PMIPv6 domains. The GLMA reduces the handover latency and service disruption. A pre-inter –domain registration and reinter-domain authentication is done in advance when MN roaming across inter-PMIPv6 domains.

HANDOVER PROCEDURE

The Mobile Node attachment [2] and detachment cannot be identified precisely, but it can be predicted with some network event notifications that indicate the Link Going Down (LGD). The LGD triggers the handover situation when the Received

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Signal Strength (RSS) is not strong when the threshold signal strength indicates the current access link signal strength will not be strong enough to forward the data traffic towards the Mobile Node. When the GLMA is alerted by the event trigger, the Mobile Node's context information that includes the Mobile Node-ID and MN-Home Network Prefix is forwarded to the multiple inter-PMIPv6 domain neighbors based on the LMA's cache entry list. The context information is stored temporarily in those PMIPv6 domain neighbors. Whenever the pre-registered Mobile Node attaches to any one of those neighbor access links i.e. Mobile Access Gateway (MAG), it receives a quick Router Advertisement (Rtr Adv) message. So, the GLMA maintains the Mobile Node's data session continuously by redirecting the Mobile Node traffic towards the new neighbor's access links (MAG) in which the Mobile Node newly attached. Also, GLMA saves the ongoing data traffic during Mobile Node handover using the buffering technique with optimized functions in order to reduce the data traffic loss. To support the Mobile Node's cross-domain mobility the GLMA maintains a new list, called LMAs Cache Entry (LCE), which monitors the registration status for a group of LMAs in the PMIPv6 administration domain. Whenever any LMA associates or dissociates with this group, its status will be updated.

MESSAGE SIGNALING FLOW

1. The GLMA is alerted by the current LMA (CLMA) about the Mobile Node handover with the help of LGD trigger and sends a Forward Proxy Binding Update message

2. The pre-inter domain registration and re-inter-domain authentication is activated by the GLMA by sending the Forward Proxy Binding Acknowledgement message which comprises the Mobile Node's context information to multiple NLMA neighbors' domains. Then, set up one-way tunnels towards these neighbors' domains and start buffering the ongoing data traffic during MN handover.

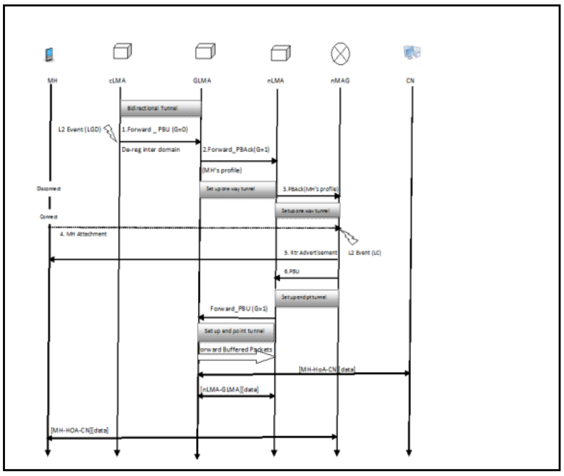

Fig.2. Message Signaling Flow

3. All neighboring nLMAs that receive the Mobile Node's context information must keep this information for a certain predefined period timeout. Afterwards, they send a Proxy Binding Acknowledgement message comprising the Mobile Node's context profile as well as set up a one-way tunnel towards their access links (i.e., nMAGs).

4. Whenever any NLMA's access link detects a Link Connects (LC) trigger, which indicates the attachment of the pre-registered Mobile Node, it will bypass the access authentication process through comparing the MN-ID and the MN-Home Network Prefix with the pre-registered Mobile Node's context profile.

5. If successfully matched, the NMAG updates the Mobile Node's record and authorizes its access by sending out a quick Router Advertisement message with the same Mobile Node-Home Network Prefix to allow this Mobile Node to re-configure its interface and resume its data session towards its CN.

6. Then, the NLMA's access link completes its domain registration by sending out a PBU message in response to the Proxy Binding Acknowledgement message (i.e., comprising the MH's profile) and sets up a reverse end-point tunnel towards its NLMA.

7. The NLMA sends the Forward Proxy Binding Update message to the GLMA in response to the Forward Proxy Binding Acknowledgement message, which is part of the proactive handover mechanism. Then, it sets up a reverse endpoint tunnel towards the GLMA. This indicating the completion of the inter-domain location update for this pre-registered Mobile Node and offering its data traffic forwarding.

8. Afterwards, the GLMA updates the Mobile Node's record in the GLMA's Binding Cache Entry (GBCE), and, henceforth, the GLMA will redirect all data traffic towards the Mobile Node through the NLMA's access link domain.

ADVANTAGES

- The GLMA coordinates the Mobile Node handover and it redirects the Mobile Node traffic across inter – PMIPv6 domains. This mechanism manages the Mobile Node handover and maintains its data session continually across inter-PMIPv6 domains.
- The handover latency and service disruption is reduced.
- A pre-inter –domain registration and reinter-domain authentication is done in advance when Mobile Node roaming across inter-PMIPv6 domains.

DISADVANTAGES

- Pre-inter registration and re-inter authentication is done so extra protocol signaling is needed. This mechanism can be used in inter domains and for heterogeneous networks, it is a challenging task.

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IV. DISTRIBUTED MOBILITY MANAGEMENT USING BUFFERING

SYSTEM DESCRIPTION

PMIPv6 is a Network based protocol, does not involve the Mobile Node modification for mobility operations. It uses a entities like Distributed Mobility Manager (DMM) , Home Access Router (HAR), Foreign Access Router (FAR) and Authentication, Accounting and Authorization (AAA) server. It performs handover between two PMIPv6 domains where the data from Correspondent Node (CN) is transferred through Distributed Mobility Manager (DMM). The Distributed Mobility Manager (DMM) act as a server between two PMIPv6 domains. Access Router (AR) act as a role of both Local Mobility Anchor (LMA) and Mobile Access Gateway (MAG) which are responsible for tracking the movements of mobile node based on the mobility related signaling and also updates the current location of the mobile node using its MN's ID and MN's Home Network Prefix (HNP). Figure.3 shows the architecture diagram of the Distributed Mobility Manager using Buffering.

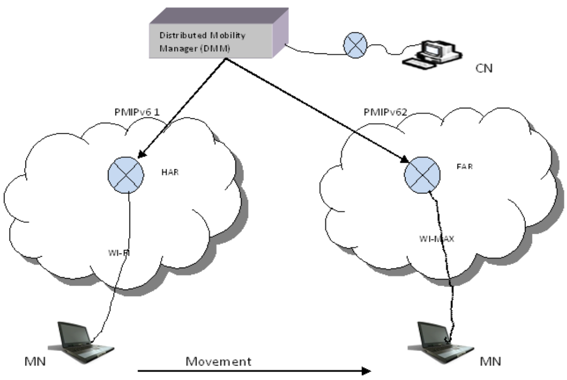

Fig.3. System Architecture

MESSAGE SIGNALING FLOW

The Figure 4 given below shows the message signaling flow of the proposed system and the algorithm is explained in step by step process

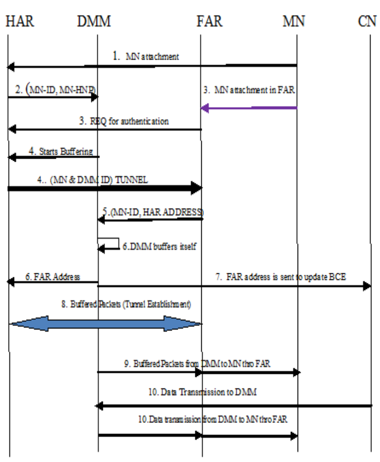

Fig.4. Message Signaling Flow

1. When MN is attached to the HAR for the first time , it sends the MN's profile to the HAR
2. The HAR allocates the MN-ID and MN-HNP and sends the MN's address to the DMM. (DMM is located in the intersection point of HAR and FAR)
3. When MN attaches to the FAR, it request for MN authentication with HAR
4. HAR knows that HO happened and it starts buffering the packets from DMM. Then it authenticates the MN by sending the MN's address and DMM address to FAR by establishing a tunnel
5. FAR locates the DMM and sends the MN-ID and the HAR address to DMM.
6. When DMM receives the request from FAR, it buffers the ongoing packets and it stops sending the packets to HAR and sends a message to HAR containing the FAR address
7. Simultaneously DMM sends the FAR address to CN to update its BCE
8. HAR compares the FAR address received from DMM with the FAR address it already has. If it is same it transmits all the buffered packets to FAR through bidirectional tunnel.
9. DMM transmits all its buffered packets to MN through FAR.
10. Then data transmission from CN travel to DMM and then to MN through FAR.

V. SIMULATION ENVIRONMENT AND PERFORMANCE EVALUATION

Network Simulator (Version 2) is known as NS2, it is a simulation tool used in studying the dynamic nature of communication networks. NS2 can be used to do simulation in wired as well as wireless networks functions and protocols. NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors. C++ and Object-Oriented Tool Command are the two key languages of NS2. The internal mechanism (i.e. a backend) of the simulation objects are defined by the C++. The OTcl sets up simulation by assembling and configuring the objects as well as scheduling discrete events (i.e. a front end). TclCL is used to link these two languages.

PERFORMANCE EVALUATION

We evaluated our proposed vertical handover scheme by comparing the parameters with the existing mechanism.

A. *Handover delay*

Figure 5 shows the handover latency results during the handover in the existing scheme and the proposed scheme.

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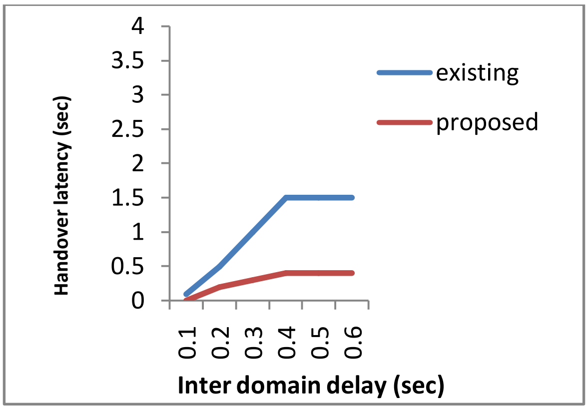

Fig.5.Performance evaluation for Handover latency

B. *Packet loss*

Figure 6 shows the packet loss simulation results during transmission in the existing scheme with no buffering and the proposed scheme with buffering.

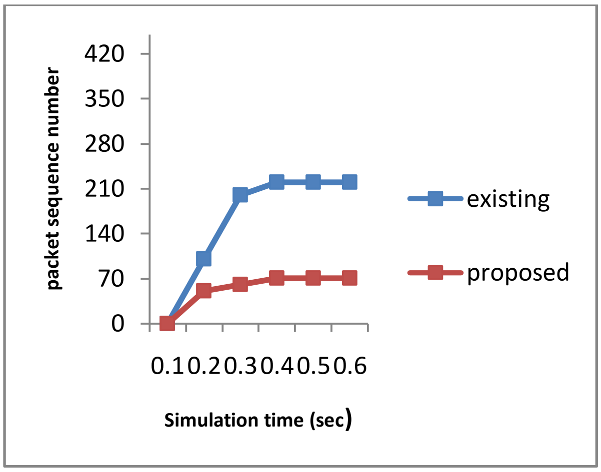

Fig.6. Comparison of packet loss

C. *Sequence of packet*

The packet disordering is one of the main problems and the Fig. 7 shows the simulation results of the packet disordering for the existing and the proposed scheme.

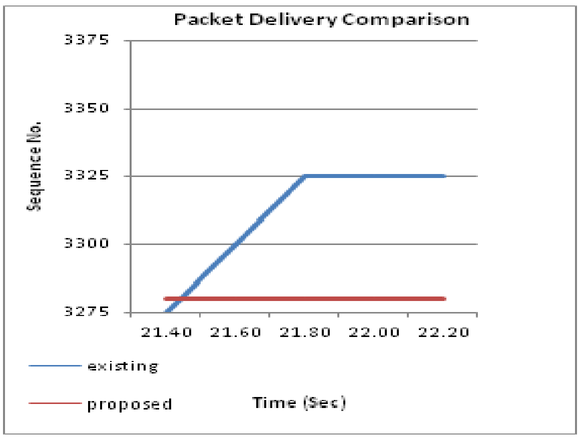

Fig.7.Comparison of Packet Delivery

VI. CONCLUSION

In network based protocols, to reduce the packet loss and handover latency various techniques were used. In our proposed work, a buffering scheme is introduced in the new entity Distributed Mobility Manager (DMM) and it delivers the packets to both previous access router and a new access router. So, that the packet loss and the handover latency were reduced than the existing mechanism. Disordering of packet sequence problem has been addressed here. The research was compared with the existing work and the performance analysis is shown.

REFERENCES

[1] S.Gundaveli, K. Leung, V. Devarapalli, K. Chowdhury, and B. Patil, "Proxy Mobile IPV6", IETF refc-5213, August (2008).

[2] Ibrahim Al-Surmi, Mohamed Othman, Nor Asila Wati , Abdul Hamid, Borhanuddin Mohd Ali, "Enhancing inter-PMIPv6-domain for superior handover performance across IP-based wireless domain networks", Springer Science, Business Media New York , 10th January 2013

[3] Dong Xu Jin · Fei Shi · Joon Sup Chin · Joo Seok Song, "Time-Efficient Handover Using Enhanced Route Optimization in Global PMIPv6" , Springer Science, Business Media New York , 2013

[4] Petro P. Ernest1, Olabisi E. Falowo1 and H. Anthony Chan, "Distributed Data Path and Mobility Function Scheme for PMIPv6 in Flattened Networks", University of Cape Town, Rondebosch 7701, South Africa. 2012

[5] Yoonchang Jang1, Seungtak Oh2, Moonseong Kim3, Hyun Jung Choe4 and Hyunseung Choo5, " Route Optimization Scheme for Global Handover in PMIPv6", International Journal of Control and Automation Vol. 6, No. 1, February, 2013.

[6] A. Bhuvaneswari, Dr. E. George Dharma Prakash Raj, "An Overview of Vertical Handoff Decision Making Algorithms, I. J. Computer Network and Information Security, 2012, 9, 55-62

[7] Chulhee Cho, Jaeyoung Choi and Jongpil Jeong, " Analytical Approach of An Extended Seamless Proxy-based andoff Scheme in IP-Based Heterogeneous Mobile Networks", International Journal of Smart Home Vol. 7, No. 4, July, 2013

[8] Ming-chin chuanga and jeng-Farn Lee, "SF-PMIPv6: A secure fast handover mechanism for proxy mobile IPv6 networks" The journal of systems and software86, no.437-448, 2013.

[9] Linoh A. Magagula, H. Anthony Chan, and Olabisi E. Falowo, "Enhancing PMIPv6 for Better Handover Performance among Heterogeneous Wireless Networks in a Micromobility Domain", EURASIP, Journal on Wireless Communications and Networking ,June 2010.

[10] Linoh A. Magagula, MIEEE , H. Anthony Chan, FIEEE , Olabisi E. Falowo, MIEEE, "PMIPv6-HC: Handover Mechanism for reducing Handover delay and Packet loss in NGWN", 978-1-4244-5637-6/10/$26.00 ©2010 IEEE

[11] Kwangsub Go, Misun Kim, Kyujin Lee, and Youngsong Mun, "QoS Guaranteed Handover Scheme for Global Roaming in Heterogeneous Proxy Mobile IPv6 Networks"

[12] Daeseon Park , Minsoo Woo / Sung-Gi Min, "PMIPv6-based Inter-Domain Handover using Efficient Buffering Scheme", ICCGI 2012 : The Seventh International Multi-Conference on Computing in the Global Information Technology

[13] Chaehwan Kim, Hyunwoo Hwang, Jung-Woo Baik, Kyung-Geun Lee, "Multicast based Proxy Mobile IPv6 for inter-domain handover", Mathematical and Computer Modelling, Elsevier, 26 August 2012

ISSN: 2278 – 7798

[14] Linoh A. Magagula, H. Anthony Chan, and Olabisi E. Falowo "PMIPv6 and MIH-enhanced PMIPv6 for Mobility Management in Heterogeneous Wireless Networks" IEEE AFRICON (2009).

[15] Kiriyama, S.,Wakikawa, R. ,Xia, J. ,Teraoka, F. ,"Context Reflector for Proxy Mobile IPv6", International Conference on Complex, Intelligent and Software Intensive Systems, 2009. CISIS '09, March 2009, PP.588 -594.

[16] Allan Borges Pontes, Diego Dos Passos Silva, José Jailton, Jr., Otavio Rodrigues, Jr., And Kelvin Lopes Dias, "Handover Management In Integrated WLAN And Mobile WiMAX Networks", Journal on Wireless communications, Vol 15, Issue 5,Oct 2008, PP. 86-95.

[17] Kheya Banerjee, Sheikh Md. Rabiul Islam, Zulkernine Ibne Tahasin, Rokon Uddin "An Efficient Handover Scheme for PMIPv6 in IEEE 802.16/WiMAX Network" International Journal of Electrical & Computer Sciences IJECS-IJENS Vol: 11, 2011.

[18] Huachun Zhou, Hongke Zhang, Yajuan Qin, "A Fast Handover Scheme of PMIPv6 and Performance Analysis ", JIT Journal of Internet Technology, Vol. 8 No. 4, PP.535-543.

[19] Anita Singhrova, Dr. Nupur Prakash , "A Review of Vertical Handoff Decision Algorithm in Heterogeneous Networks", Proc. of the 4Intl. Conf. on Mobile Technology, Applications and Systems (Mobility 2007)

[20] Proxy Mobile IPv6 Configuration Guidelines for LocalMobilityAnchorhttp://www.cisco.com/en/US/docs/ios xml/ios/mob_pmipv6/configuration/xe-3s/imo-pmipv6-lma-support.html

[21] Proxy Mobile IPv6 Support for Mobile Access Gateway Functionality http://www.cisco.com/en/ US/docs/ios-xml/ios/mob_pmipv6/configuration/xe-3s/imo-pmipv6-mag-support-xe.html

[22] Configuring the Multicast Source Discovery Protocol (MSDP)http://www.cisco.com/en/US/docs/ios/12_2/ip/ configuration/guide/1cfmsdp_ps1835_TSD_Products _Configuration_Guide_Chapter.html

[23] Network Simulator 2 (NS2) http://www.cs.virginia.edu/~cs757 /slidespdf /cs757-ns2-tutorial- exercise.pdf

[24] Teerawat Issariyakul, Ekram Hossain, "Introduction to Network Simulator NS2", 2009 Springer Science+Business Media, LLC

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