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Improved handover performance by integration of fast handover in hierarchical setup

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***Abstract* — In the infrastructure based network, mobility management is going wide importance. Currently, seamless mobility in IPv6 network is classified into HMIPv6 and FMIPv6. The HMIPv6 is used to reduce the signaling overhead and delay concerned with Binding Update in mobile IPv6. But, there is no provision for fast handover. FMIPv6 is used to reduce the handover latency by using fast handover. The proposed scheme integrates FMIPv6 in HMIPv6 to improve handover performance. With the use of NS-2 simulation, the result shows that the proposed scheme gives better handover performance than HMIPv6 and FMIPv6.**

Keywords- Handover, Handover Latency, HMIPv6, FMIpv6, TCP, UDP.

I. INTRODUCTION

Now a days, the wireless communication technology has made our lives more and more convenient. Wireless communication technology provides many kinds of wireless access ways for us, such as the wireless personal area network (WPAN), the wireless local area network (WLAN), universal mobile telecommunication system (UMTS) & so on. As this evolution of the radio system with Internet integration, the number of Internet users has drastically increased. Since, mobile Internet services are becoming more popular, new mobile Internet networks are emerging so as to overcome the weaknesses of existing mobile Internet network. These networks are developed based on IP technology with 'All-IP' trend. In IP-based new mobile Internet network, it is essential to provide efficient mobility management (MM) on IP layer as well as link (physical and MAC) layer. This kind of IP mobility management should also provide seamless handover capability to support real-time or loss-sensitive applications. Therefore, it needs to provide the IP MM protocol that satisfies the requirement for the new IP-based mobile networks. Currently, mobile Ipv4/Ipv6 protocol is used for IP mobility management. However, mobile IPv4/IPv6 is not enough to support real time or loss sensitive applications. So, IETF (Internet Engineering Task Force) proposed several solving schemes within the mobile Ipv6, such as FMIPv6 (fast handover for mobile Ipv6) and HMIPv6 (Hierarchical Mobile Ipv6). Both FMIPv6 and HMIPv6 have to enhance MIPv6 in the signaling and handover aspects.

HMIPv6 facilitates to reduce the signaling overhead and delay concerned with the binding update using a hierarchical architecture and a new entity, a mobile anchor point(MAP) is introduced for it. On the other hand, FMIPv6 exploits various L2 triggers to prepare for new CoA (Care of Address) at the new router in advance and a bidirectional tunnel is established between access routers to minimize any service disruption during the handover. It is noted that, HMIPv6 does not touch the fast handover support described in FMIPv6. This means that one still needs a certain fast handover scheme in HMIPv6 based networks. So, the new protocol has been developed to integrate FMIPv6 and HMIPv6 protocols to provide better handover performance.

II. LITERATURE REVIEW

In the past, different protocols have been designed for seamless mobility management. Richard Nelson et. al. [1], have evaluated the author evaluate the process of extending MIPv6 implementation to support Hierarchical Mobile IPv6 (HMIPv6) which attempts to reduce the delay caused by Binding Updates (BUs) during handover. Also, it highlights some of the potential techniques for further reducing handover disruption with minimal changes to the HMIPv6 standard by reducing Router Solicitation (RS) & Duplicate Address Detection (DAD) delay.

Hyon G et. al. [2], describes a normal & fast handover procedure for wireless LAN & compared them. It also focuses on the procedure of managing the layer 2 (L2: link layer) & layer 3 (L3: network layer) handovers simultaneously.

Hanane Fathi et. al. [3], focuses has been given on the network layer mobility, specifically on Mobile Internet Protocols (MIPs). Using analytical models, the authors evaluate MIPv4, MIPv6, Fast MIPv6 (FMIPv6) & Hierarchical MIPv6 (HMIPv6) & compare their performances in terms of handover delay for VOIP services.

In the above papers, many techniques are developed for reducing handover delay. The limitations of these are as under

- Whenever MN moves (within domain or from one domain to another), MIPv6 handover require the MN to signal it's HA and each CN every time the MN moves, so it introduces Signaling Overhead.
- Mobile IPv6 needs binding update to HA/CNs whenever MN moves from one subnet to another IP

subnet. If the MN is far away from HA/CN's, the time taken for a BU to reach the HA/CN's introduces Packet loss or delay until the BU is received by the HA/CN, packets are forwarded to the old CoA. So BU introduces packet loss or delay.

- In HMIPv6 and MIPv6, when MN moves from one subnet to another it performs movement detection, new CoA address configuration, verification and Binding Update procedure.
- Delay for packet delivery is increased because the packet destined to the MN is first forwarded to PAR and then to NAR.

So, the new scheme has been designed to overcome above mentioned challenges by providing following features

- The main operation for handover is accomplished by using MAP, rather than Access Routers (i.e. PAR and NAR) like in FMIPv6. For this purpose, the MN exchanges the signaling message for handover with MAP and not PAR.
- Handover is performed in advance.
- Bidirectional tunnel is establishment.
- Fast establishment of new CoA.

III. SYSTEM DESIGN

The present work is to integrate FMIPv6 effectively in HMIPv6 to design a new scheme as FHMIPv6. It is used to optimize the associated data and control flow during handover. This will have significant impact on the required handover time to signal the MAP and minimize the extra-network signaling provided by HMIPv6. The procedure of FHMIPv6 is illustrated in "Fig.1".

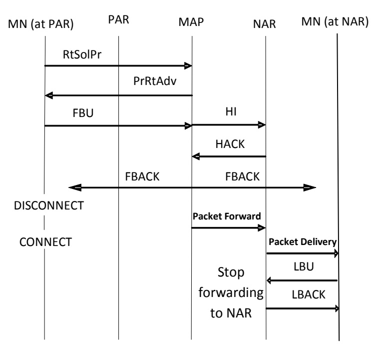

Figure 1. FHMIPv6 procedure

In the "Fig.1", it is assumed that the MAP already has the information necessary for handover support about the ARs located in the HMIpv6 domain. This information should include the link-layer address (or identifier) and network prefix of each AR. Note that the control messages depicted in "Fig.1" have identical format to those in FMIPv6[4], only the contents (the IP source and destination fields) are different and the MAP should already know the network prefix and link layer address of the associated NAR.The detailed description for the control flows are given below:

- Based on L2 handover anticipation, the MN sends RtSolPr (Router Solicitation for Proxy) message to MAP. The RtSolPr should include information about the link layer address or identifier of the concerned NAR.
- In response to the RtSolPr message, the MAP sends the PrRtAdv (Proxy Router Advertisement) message to the MN, which should contain information about NLCoA for the MN to use in the NAR region; i. e, NARs network prefix for stateless auto-configuration or NLCoA for stateful configuration.
- The MN sends Fast Binding Update (FBU) message to MAP. The FBU message contains PLCoA and IP address of the NAR.
- After receiving the FBU message from MN, the MAP will send a Handover Initiate (HI) message to the NAR so as to establish a bi-directional tunnel.
- In response to the HI message, the NAR will set up a host route entry for the MN's PLCoA.
- Then respond with a Handover Acknowledge (HACK) message. As a result, a bi-directional tunnel between MAP and NAR will be established. Over the tunnel, the data packets sent by MAP have the additional outer IP header with the following IP fields of <Source = MAP, Destination = NAR>. The NAR may cache those data packets flowing from the MAP, until it receives the RS (possibly with FNA option) message from the newly incoming MN.
- The MAP sends Fast Binding ACK (FBACK) messages toward the MN over PLCoA and NLCoA. Then, the MAP will begin to forward the data packets destined to MN to the NAR by using the established tunnel.
- The MN sends FNA messages to NAR, when it detects that it is moved in the link layer, and receives the responding RA from the NAR. Then, the NAR delivers the buffered data packets to the MN over NLCoA.
- The MN then follows the normal HMIPv6 operations by sending a Local Binding Update (LBU) to MAP, as per HMIPv6. When the MAP receives the new Local Binding Update with NLCoA from the MN, it will stop the packet forwarding to NAR and clears the tunnel established for fast handover.
- In response to LBU, the MAP sends Local Binding ACK (LBACK) to MN, and the remaining procedures will follow the HMIPv6.

IV. EXPERIMENTAL SETUP

To evaluate the performance of each handover mechanisms, the Network Simulator NS-2.31 version is used over cygwin environment. 802.11 WLAN is used as the wireless medium. The patch for FHMIPv6 was design and implemented. The simulation is tested for both An UDP and TCP session. A hierarchical address is used for all the nodes. As shown in "Fig.2", there are five domains: the wired node, the correspondent node, the home agent HA, the foreign agent FA and the mobile node.

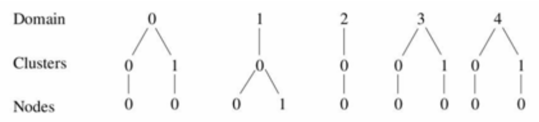

Figure 2. Hierarchical Structure

"Fig.3" shows, the network topology used for simulation. In the simulation scenario, the MN move from its previous access router (PAR) to a new access router (NAR). CN is acting as a source and MN is acting as receiver.

TABLE I. CONFIGURATION OF NODES

Link	Delay	Bandwidth
CN – N1	2ms	100Mbps
HA – N1	2ms	100Mbps
N1 – MAP	50ms	100Mbps
MAP – N2	2ms	10Mbps
MAP – N3	2ms	10Mbps
N2 – PAR	2ms	1Mbps
N3 – NAR	2ms	1Mbps

In this simulation we only consider a linear movement pattern for the mobile node, the mobile node will move linearly between the access routers from one to another at a constant speed of 1 meter/second.

TABLE II. CONFIGURATION OF SIMULATION TOPOLOGY

Simulation screen size	300m×300m
Simulation time	80s
MAC type	802.15.4
Sensor node's wireless communication radius	15m
L2 handover time	20ms
Address resolution time	100ms

At the beginning of the simulation the MN is close to HA. A few second later, the MN moves towards the area of PAR.

- At t=10s, the CN begins sending packets to the MN following the route CN -> N1 -> MAP -> N2 -> PAR -> MN.
- At t=45s, the CN begins sending to the MN following the route CN -> N1 -> MAP -> N3 -> NAR -> MN

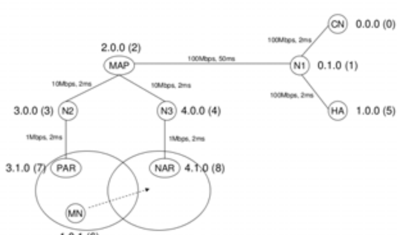

Figure 3. Network Topology

V. EXPERIMENTAL RESULTS

Table I and II shows the comparison of results obtained by implementing algorithms of new as well as existing schemes. The comparison has been done by considering the different parameters such as Packet Sent, Packet Received, Packet Dropped, Average End to End delay and Handover latency for UDP and TCP traffic which is calculated by analyzing trace file generated after running simulation of each scheme.

A. *UDP Traffic*

Here, a MN is implementing an UDP session while moving from Previous Access Router (PAR) to New Access Router (NAR). CN is acting as source, so UDP agent is attached to CN and MN is acting as receiver so NULL agent is attached to MN. As the traffic source for UDP is CBR, CN produces fixed length packets of size 1000 bytes after every 20ms.

TABLE III. UDP SIMULATION RESULTS

Protocols	#Packet Send	#Packet Received	#Packet Dropped	Average End to End delay(ms)
MIPv6	9705	8060	180	4.51181
HMIPv6	9723	7983	79	3.81262
FMIPv6	9748	8125	183	4.76528
S-FHMIPv6	9729	7932	85	3.92281
FHMIPv6	9719	7661	79	3.55440

From above results, it is observed that, the new scheme (FHMIPv6) gives comparatively less packet drops, Average End to End delay and Handover latency than existing schemes.

B. *TCP Traffic*

Here, a MN is implementing a TCP session while moving from Previous Access Router (PAR) to New Access Router (NAR). CN is acting as source so TCP agent is attached to CN and MN is acting as receiver so TCPSink agent is attached to MN. As the traffic source for TCP is FTP, CN produces fixed length packets of size 512 bytes each every 20ms.

TABLE IV. TCP SIMULATION RESULTS

Protocols	#Packet Send	#Packet Received	#Packet Dropped	Average End to End delay (ms)
MIPv6	17614	385	54	11312
HMIPv6	17653	620	51	11306
FMIPv6	17224	385	54	11118.2
S-FHMIPv6	17655	629	51	11306.5
FHMIPv6	18240	643	10	11622.1

From above results, it is observed that, the new scheme (FHMIPv6) gives drastically less packet drops, comparatively less Average End to End delay and Handover latency than existing schemes.

"Fig.4 and 5" shows number of packet transfer vs. time for existing schemes such as HMIPv6 and FMIPv6 and new scheme FHMIpv6. X-axis shows the time (second) and Y-axis shows number of packet transfer from CN to MN.

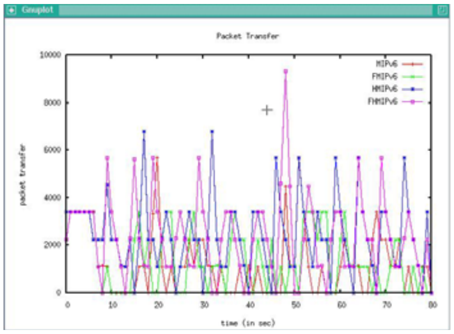

Figure 4. Packet transfer for udp traffic.

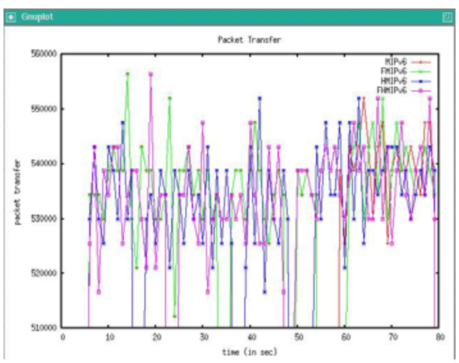

Figure 5. Packet transfer for tcp traffic.

From above graphs, it is observed that, the new scheme (FHMIPv6) shows more packet transfer as compare to existing schemes.

CONCLUSION

Network mobility support involves taking care of handover delays. The existing schemes MIPv6, FMIPv6 and HMIPv6 tend to increase the overload on MAP to improve handover performance. The present work improves handover logic for hierarchical mobile IPv6.After analyzing the results of this study, we can conclude that our newly proposed scheme reduces the packet loss, the handover latency and the MAP is free from overload. All messages used in our proposed scheme are just extensions of existing messages already defined in FMIPv6 and HMIPv6. Therefore, FHMIPv6 could be easily introduced in existing systems.

The model used in the present scheme has Base Stations separated by standard distance with a mobile node moving at constant speed along the straight line path i.e. we have considered only linear movement and not the ping pong movement. The work can be extended and experimented with ping pong movement.

REFERENCES

[1] Richard Nelson, Greg Daley Nick Moore, "Implementation of Hierarchical Mobile IPv6 for Linux," Center for Telecommunication and Information Engineering, Monash University, Melbourne, Australia. October 18, 2002.

[2] Hyon G. Kang and Chae Y. Lee, "Fast Handover Based on Mobile IPv6 for Wireless LAN," Department of Industrial Engineering, KAIST, 373-1 Kusung-dong, Taejon 305-701, Korea.

[3] Hanane Fathi, Shyam S. Chakraborty and Ramjee Prasad. "Optimization of Mobile-IPv6 Based Handovers to Support VOIP Services in Wireless Heterogeneous Networks," IEEE Transactions on Vehicular Technology, VOL.56, NO. 1, January 2007.

[4] Hesham Soliman, Claude Catelluccia, Karim EI Maiki, and Lundovic Bellier, "Hierarchical Mobile IPv6 Mobility Management", IETF RFC 4140, August 2005.

[5] Hyon G. Kang and Chae Y. Lee, "Fast Handover Based on Mobile IPv6 for Wireless LAN", Department of Industrial Engineering, KAIST, 373-1 Kusung-dong, Taejon 305-701, Korea.

[6] Li Jun Zhang, Liyan Zhang & Samuel Pierre, "Intelligent Fast Handover Scheme for Mobile IPv6 – based Wireless Local Area Networks", IJCSNS International Journal of computer science & network security, VOL. 9, NO. 8, Aug 2009.

[7] Tran Coun Hung, Le Phuc, Tran Thi To Uyen, Hae Won Jung and and Yoohwa Kang , "A Comparative Survey of Seamless Handover Mechanisms", 36th conference (Manila), Document No 118, 19-23 November 2007.

[8] R. Koodli, "Fast handovers for mobile IPv6", IETF RFC 4068, July 2005.

[9] R. Koodli, "Mobile IPv6 fast Handovers", IETF draft, draftietf-mipshop-fmipv6-rfc4068bis-03.txt, October 2007.

[10] J. Kempf, J. Wood and G. Fu, "Fast mobile IPv6 handover packet loss performance: measurements for emulated real time traffic", in Proc. IEEE WCNC 2003, New Orleans,USA, Mar. 2003, pp. 1230-1235.

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