International Journal of Modern Communication Technologies & Research (IJMCTR)
ISSN: 2321-0850, Volume-5, Issue-2, February 2017

Performance Evaluation of mobility for low power sensor nodes in the multihop communication- using cross layer design

Mr. M. D. Nikose, Dr. S. S. Salankar

Abstract— **This paper, consist with a scheme of Cross layer design path metric Algorithm which supports mobility for Internet protocol Version 6 over Wireless Personal Area Network withLow power (6LoWPAN) sensor nodes. We useda protocol for 6LoWPAN mobile sensor node, named 6LoMSN, which based on Proxy Mobile IPv6 (PMIPv6). The PMIPv6 standard supports only single-hop. We decide the movement notification of a 6LoMSN that support its mobility in multihop-based 6LoWPAN environments. Simulation results show that our proposed scheme cross layer design can minimize the jitter, energy consumption and packet Loss. Here the design and implementation of the 6LoMSN mobility based on PMIPv6 for increasing the throughputs is present. The experimental results shows that, the 6LoMSN of the proxy mobile PMIPv6-based 6LoWPAN can be expected to use maximum battery lifetime cause of less energy consumption. The 6LoMSN maintain connectivity, even though it is free to move between PANs without a mobility protocol stack.**

Index Terms—**6LoWPAN, proxy mobile IPv6, sensor node mobility, cross Layer Design.**

I. INTRODUCTION

MIP is a network layer mobility protocol specified for IPv4 [1] and IPv6 [2]. MIP enables mobile devices to keep their IP connections alive while switching network accesses. Without a mobility protocol, the IP address of the mobile device changes when it connects to a BS of another network. However, MIP provides location trackingfor determining the current location of the mobile device whenever it is out of its home domain.

The goal of this work is to obtain that supports Mobility for each 6LoWPAN mobile sensor node, named 6LoMSN using cross layer approach. To provide mobility for sensor nodes, an efficient mobility supporting protocol (CPAODV) is needed to maintain the connection link while changing the position. Such protocols are divided as host-based mobility and network-based mobility protocols.

In the host-based mobility approach, when a sensor node moves to another PAN, it requires an exchange of signaling messages with its home agent (HLR) in order to maintain the session. Thus, the host-based mobility approach is not suitable for energy constrained sensor nodes because all of the 6LoMSNs should have a mobility stack such as Mobile IPv6 (MIPv6). On the other mobility approach it is possible to support mobility for 6LoMSNs without mobility function.

Mr. M. D. Nikose, Assistant professor Department of E&TC, Sandip Institute of Technology &Research Center, Nashik India.

Dr. S. S. Salankar, Professor Department of E&TC, G.H.Raisoni College of Engineering and Technology, Higna Road Nagpur, India.

Our paper is organized as follows: In Section 2, gives briefly introduce related works on host-based mobility and network-based mobility schemes. We explain proposed scheme for PAN attachment notification in detail in section 3. Section 4 presents the results in terms of throughput, jitter, packet loss, and energy consumption of 6LoMSN mobility, based on PMIPv6 using cross layer and without cross layer design. In Section 5, provide the conclusions of our research work.

II. RELATED WORK

In this section, we introduce related works on IPv6 mobility movement management schemes of Network Topology of 6LoWPAN.

2.1 Host-Based Mobility in 6LoWPAN

MIPv6[3] supports host mobility using two IP addresses: a home Location Register (HLR) that represents the permanent address of the mobile user (MU) and a Visiting Location Register (VLR), which is a unicast routable address associated with the network that the MU is visiting. When the MU moves from a home network to a foreign network, it can make the VLR using visited network prefix which is advertised by an RA message from access router (AR). The MU sends notice of the VLR to the HA using a binding update (BU) message. The HA then sends a binding acknowledgement (BA) message to the MU. At the same time, the HA updates the binding cache entry for mapping between the HLR and VLR. Thus the VLR indicates the current location of the MU.

2.2 Network-Based Mobility in 6LoWPAN

The operation of the PMIPv6 protocol is as follows: The MAG obtains the MU profile, which includes its identifier. The MAG then sends a proxy binding update (PBU) message to the LMA to update the current point of attachment of the MU. If the LMA receives the PBU message, it updates a binding cache entry and a bidirectional tunnel between the LMA and the MAG for the MU HNP [4]. The LMA then sends a proxy binding acknowledgement (PBA) message with the MU HNP to the MAG. The MAG emulates the home interface of the MU on the access interface by sending an RA message with the MU HNP to the MU. Therefore, the MU always believes that it is located in the home network.

In this approach, PMIPv6 [5], suitable than the host-based mobility for providing mobility for 6LoWPAN, because there is no mobility-related signaling message over the wireless link.

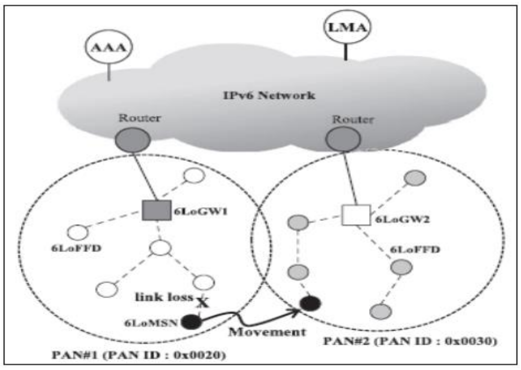

Figure 1.1: Network Topology of 6LowPAN.

The performance metrics of the network-based mobility scheme such as energy consumption, jitter, and packet loss reduced as compared to the host-based mobility scheme. In the single-hop-based PMIPv6 protocol of the network-based mobility scheme cannot be applied to the multihop-based 6LoWPAN.

III. Proposed Scheme

In this section, we present a proposed PAN attachment notification scheme for the 6LoMSNs to support mobility in the multihop communication-based 6LoWPAN environment. We explain our scheme with an example of the 6LoMSN mobility scenario, based on the network topology and address configurations as shown in Figure 1.2 below.

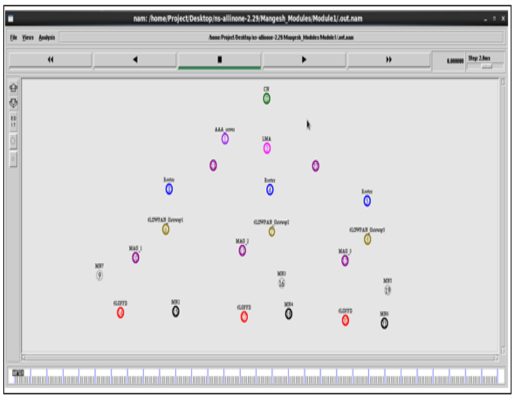

Figure 1.2: 6LoPAN mobility scenario, based on the network topology.

An IPv6 [6] network includes an LMA, two 6LoGWs, and an Authentication-Authorization-Accounting (AAA) server. The AAA server handled the 6LoMSN profile, such as its HLR and HNP. The LMA and 6LoGWs perform the PMIPv6 functions to support the 6LoMSN mobility.

The multihop communication-based 6LoWPAN networks are classified into two PANs, each having one 6LoGW with its unique PAN ID. Each 6LoGW acts as an MAG that functions as an access router; it handles the mobility related signaling for the 6LoMSN that is attached to its PAN area. The 6LoGW involves two interfaces; an egress interface, which is connected with an IPv6 router and is responsible for performing the proxy binding process on behalf of the 6LoMSN, and an ingress interface, which supports IEEE 802.15.4 and acts as a gateway for 6LoMSN. The 6LoWPANnetworks consist of 6LoWPAN full function devices, namely 6LoFFDs, which support all IEEE 802.15.4 functions. The 6LoFFDs are fixed nodes in the PAN which are capable of multihop packet communications for its associated neighbors, including the 6LoMSN. That is, the 6LoFFDs perform multihop RS and RA messages forwarding to manage the PAN attachment of the 6LoMSN. Furthermore, the 6LoFFDs have the function of sending a message periodically to provide movement detection for the 6LoMSN.

3.1 Movement Detection and Association

The primary goal of the movement detection is to detect layer-3 handover, which makes it an essential part of IP Mobility. Movement detection is more of a horizontal handover problem. In the case of vertical handovers, the configuration of networking interfaces is more or less separate from the handover decision between different access technologies. When a mobile node changes its point of attachment at layer-2, the IP layer might not have enough information whether it needs to re-configure its IP layer configuration. If there is no need to re-configure the interface, then executing the configuration procedure is unnecessary and may
also cause temporary disruption in IP connectivity. On the other hand, if there are changes at the IP level, the mobile node should re-configure its interface as soon as possible, otherwise the IP connectivity breaks. Mobile IP standards define their default mechanisms for movement detection.
In Mobile IPv4 the movement detection is based on reception of a foreign agent router advertisement with different FA-VLRs. VLR mode the movement detection is not based on Mobile IP procedures but on other information gathered from the network interface and the network. Mobile IPv6 bases its movement detection on a reception of RAs that would cause the mobile node to configure a new VLR. The movement detection may be assisted by the networking driver. The driver may deliver events to the IP layer when a layer-2 handover or a preparation for such takes place [7].The 6LoMSN can then be associated with the new PAN, as shown in Figure 1.3.

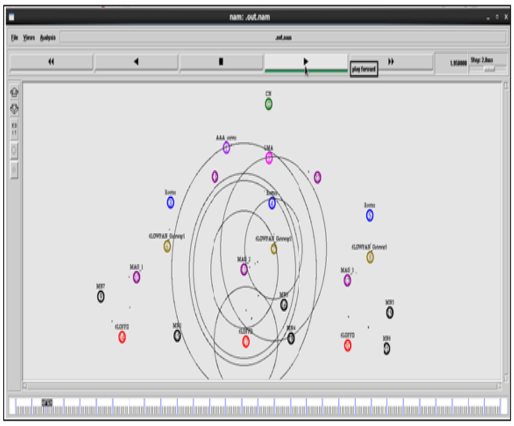

Figure 1.3: 6LoMSN mobility scenario that includes intra-PAN and inter-PAN mobility

3.2 Analytical Model

Let $P = p_{ij}$ denote the one step transition probability for the chain. The steady state probability for the chain can be found by solving the balance equations given

$$\pi P = \pi \qquad \ldots (1.1)$$
$$\sum_{i=1}^{m+n} \pi i = 1 \qquad \ldots (1.2)$$

Where vector π is the steady state probability, which constitutes the limiting matrix, S. Each row of S is comprised of the limiting vector π ,where $\pi = \pi_1 + \pi_2, \ldots . \pi_{m+n}$. Furthermore, it represents the fraction of time the process is expected to be in state si for a large number of steps, independent of the starting states. The fundamental matrix, denoted as Z, can be given by

$$Z = \big(I - (P - S)\big) - 1 \ldots (1.3)$$

Where I is an identity matrix. Let $\bar{y}_i(k)$represent the number of times the process is in state s_i the first k steps, i.e., the initial position plus k-1 steps [8]. Subsequently, for initial probability vector, the average number of time the process is in s_i, state denoted as, is given by

$$M_\pi(y_i k) = (\pi Z - S) + k\pi \qquad \ldots (1.4)$$

Now, if we choose a particular starting state (for example, state sj) for the chain, using the above equation, we then have

$$M_j((y_i k) = \left(z_{ji} - \pi_i\right) + k\pi_i \qquad \ldots (1.5)$$

We can apply the above result to find the number of binding update messages. Because we need to send a BU message when the 6LoMSN moves from one Personal Area Network to another Personal Area Network, every time the process enters into an asterisk state so every time updated BU message is generated.so we to find the process time enters into the an asterisk state within k steps.

Let the 6LoMSN starts from cell <0, 0>within the PAN. The number of binding update messages is required for the n asterisked 6LoFFDs, denoted as B, is given as,

$$B = \sum_{j=1}^{n} M_j\,[y_i\,k] \qquad \ldots (1.6)$$

Finally, the 6LoMSN needs to send B Updated BU message if it experiences a total of k transitions between 6LoFFDs. Therefore, the proportion of intra-PAN mobility is denoted as P_{intra} , expressed by$P_{intra} = (k - B)/k$. The proportion of inter-PAN mobility is denoted as Pinter, expressed by$P_{inter} = B/k$.

IV. Simulation Results

Using this network and mobility model, we perform a number of simulation experiments to evaluate the performance metrics based on mobility model for the n layer square PAN using the Objective Modular Network Tested in NS2 simulator. We implement the proposed PMIPv6-based 6LoWPAN scheme and PMIPv6-based 6LoWPAN using cross layer deign and without cross layer design.

4.1 Experimental Results

We experiment on how much the network-based mobility scheme (i.e., the proposed PMIPv6-based 6LoWPAN) can increase the lifetime of the battery in the 6LoMSN with a different number of handoffs, compared with the host-based mobility scheme (i.e., PMIPv6-based 6LoWPAN using cross layer design). The following result shows the impact of the cross layer scheme used in the path metric algorithm, with dimension of topography 1054X599 terrains for 10 nodes, simulation time is 50 seconds.

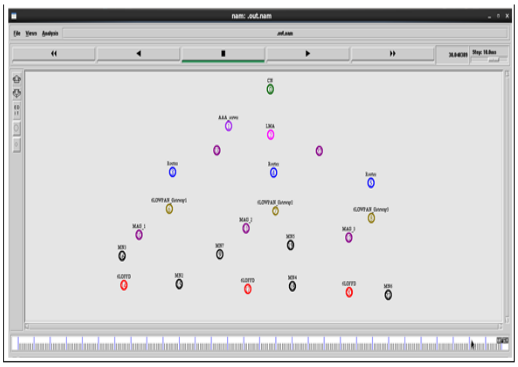

Figure 1.4: 6LoMSN mobility scenario that includes intra-PAN and inter-PAN mobility changes the position of Mobile Node after the simulation

4.1.1Energy Consumption

Mobile devices depend on their energy storage capacity. If the power consumption is high then the mobile nodes battery will be short. To reduce the energy consumption in order to avoid node failures and link break. The remaining energy in the nodes can be used as a routing metric to provide fair sharing of energy consumption in the network.

The comparative analysis of energy consumption shows that the average value without cross layer approach is **52.2099** Joule and with cross layer is **51.111425** Joule.

Thus with cross layer approach the Energy consumption is reduced.

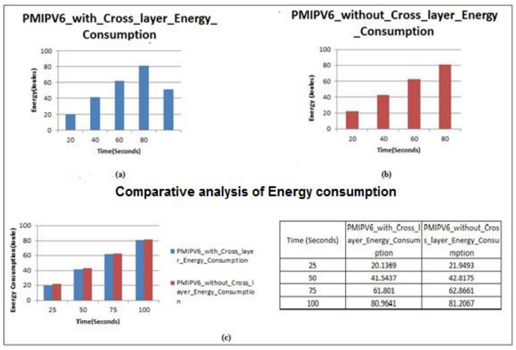

Figure1.5:(a) PMIv6_based_6LowPAN_Energy Consumption withcross layer Design.(b) PMIv6_based_6LowPAN_Energy Consumption without cross layer Design. (c) Comparative Analysis of PMIv6_based_6LowPAN_Energy Consumption with cross layer Design and without cross layer design.

4.1.2 Throughput

Throughput is the number of bits transmission per seconds from one node to another node over communication link.

The Figure 1.6 shows that CPAODV achieves higher average throughput **368.8 kbps** as compared to IEEE 802.15_4 AODVthroughput**353.76 kbps.** This is because CPAODV uses smaller carrier sensing range compared to IEEE 802.15_4 AODV, therefore large number of nodes can transmit concurrently. However, CPAODV gives increasing throughput as packet generation rate increases and saturate and remains constant after a particular point. As at low packet generation rate, less number of packets would be contending for the transmission, therefore throughput increases linearly and saturates at higher packet generation rate.

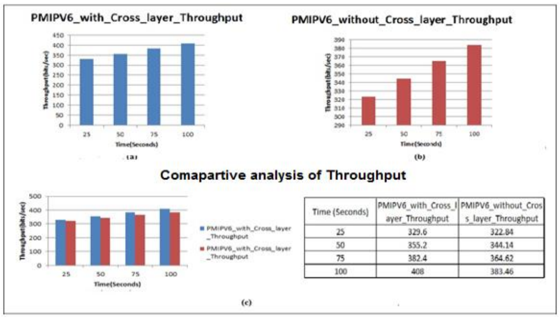

Figure1.6 :(a) PMIv6_based_6LowPAN_Throughput with cross layer Design.(b) PMIv6_based_6LowPAN_Throughput without cross layer Design. (c) Comparative Analysis of PMIv6_based_6LowPAN_Throughput with cross layer Design and without cross layer design.

4.1.3Packet Loss

Figure 1.7(a) shows the Packet Loss of for IEEE 802.15_4 AODV Routing protocol consists with PMIv6_based_6LowPAN, Figure 1.7 (b) shows the Packet Loss of for IEEE 802.15_4 AODV Routing protocol consists with PMIv6_based_6LowPAN without cross Layer design, Figure 1.7 (c) shows the comparison of the Packet Loss of IEEE 802.15_4 AODV Routing protocol consists with PMIv6_based_6LowPAN and IEEE 802.15_4 Cross Layer Path Metric AODV Routing Protocol (CPAODV) which is consists with PMIv6_based_6LowPAN.It shows that CPAODV achieves Less Packet Loss compared to IEEE 802.15_4 AODV schemes.

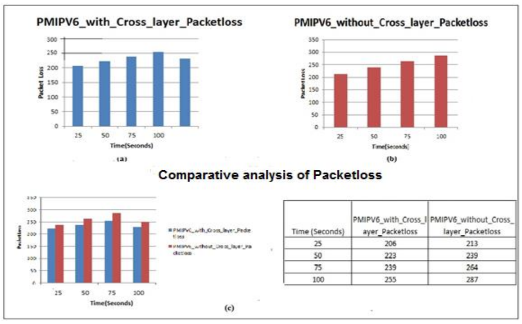

Figure 1.7: (a) PMIv6_based_6LowPAN_Time Vs Packet Loss without cross layer Design. (b) PMIv6_based_6LowPAN_Time Vs Packet Loss with cross layer Design. (c) Comparative Analysis of PMIv6_based_6LowPAN_Time Vs Packet Loss with cross layer Design and without cross layer design.

4.1.4 Jitter

Figure 1.8 (a) shows the Jitter of for IEEE 802.15_4 AODV Routing protocol consists with PMIv6_based_6LowPAN,with cross Layer design Figure 1.8 (b) shows the Jitter of for IEEE 802.15_4 AODV Routing protocol consists with PMIv6_based_6LowPAN without cross Layer design and Figure 1.8 (c) shows the comparison of the jitter of IEEE 802.15_4 AODV Routing protocol consists with PMIv6_based_6LowPANwithout cross layer design and IEEE 802.15_4 Cross Layer Path Metric AODV Routing Protocol (CPAODV) which is consists with PMIv6_based_6LowPANwith cross Layer Design.

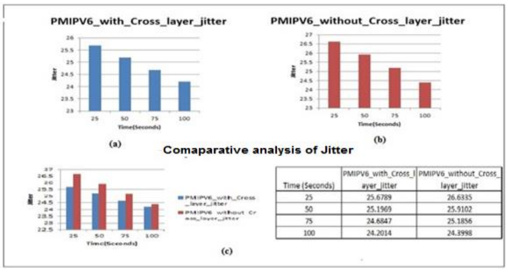

Figure 1.8: (a) PMIv6_based_6LowPAN_Time Vs Jitter with cross layer Design.(b) PMIv6_based_6LowPAN_Time Vs Jiiter without cross layer Design.(c) Comparative Analysis of PMIv6_based_6LowPAN_Time Vs. Jitter with cross layer Design and without cross layer design.

For the measurement of the actual experimental results, each test is performed for five hours and during this time the 6LoMSN performs the handoff between PAN 1 and PAN2 according to a frequency of handoffs with a low rate or high rate (every 100 or 10 seconds, respectively). Furthermore, the 6LoMSN transmits a data packet to the NN and receives a data packet from the NN such that the packet processing rate follows a Poisson distribution with a mean rate of (0.5, 1.0, 1.5, or 2.0 packets per second).

V. CONCLUSION & FUTURE SCOPE

This work consists with mobility for 6LoMSNs. We adopt the PMIPv6 protocol to provide mobility for low power sensor nodes. Accordingly, we propose an interworking mechanism between the 6LoWPAN and PMIPv6.We explain the movement identification of a sensor node to support its mobility, based on PMIPv6, as well as to detect the PAN attachment in a multihop-based 6LoWPAN environment. Our proposed scheme can minimize total energy consumption, jitter, packet Loss which increases the quality of service in wireless communication.

Also we development environment for proposed interworking mechanism between 6LoWPAN and PMIPv6 to apply to a healthcare system. From the experimental results, the 6LoMSN of the proposed PMIPv6-based 6LoWPAN scheme yield a throughput is much higher in Cross Layer Design than the PMMIPv6-based 6LoWPAN scheme. We also verify that the 6LoMSN can maintain connectivity even though they are free for movement between PANs without a mobility protocol stack. In future research efforts, evaluate our proposed scheme the performance of under various mobility models or various routing protocols.

REFERNCES

[1]. Perkins, C (Ed) (2010). IP mobility support for IPv4, revised. IETF Request for Comments:5944. (Obsoletes: 3344).

[2]. Perkins, C (Ed) (2011). Mobility support in IPv6. IETF Request for Comments: 6275. (Obsoletes: 3775).

[3] D. Johnson et al., “Mobility Support in IPv6,” IETF RFC 3775, June 2004.

[4] IETF NetLMM Working Group, http://www.ietf.org/html. charters/netlmm-charter.html, 2012.

[5] J.H. Lee, Y.H. Han, S. Gundavelli, and T.M. Chung, “A Comparative Performance Analysis on Hierarchical Mobile IPv6 and Proxy Mobile IPv6,” Telecomm. Systems, vol. 41, no. 4, pp. 279-292, May 2009.

[6]Jinho Kim, Eung Jun Cho, Choong Seon Hong “A 6LoWPAN Sensor Node Mobility Scheme Based on Proxy Mobile IPv6” IEEE Transactions On Mobile Computing, Vol. 11, No. 12, December 2012.

[7] B. Aboba. Architectural Implications of Link Indications. RFC 4907 (Informational), IETF, June 2007.

[8] J.G. Kemeny and J.L. Snell, Finite Markov Chains. Springer-Verlag, 1976.