A Survey on Mobility Management Protocols for Improving Handover Performance

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Abstract— **The wireless and mobile communication systems have enormous growth in recent years because many people use mobile devices for acquiring different services like browsing, multimedia applications and file sharing etc. Mobile IPv6 (MIPv6) is probably the most extensively known IP mobility support protocol when compared to the Mobile IPv4. But in the Mobile IPv6, there are some serious problems such as, handover latency, high overhead, packet loss problem. In this survey to analyze different extensions of the Mobile IPv6 for improving the performance. As a result, the various extensions of Mobile IPv6 such as hierarchical Mobile IPv6 (HMIPv6) and fast handover for Mobile IPv6 (FMIPv6) has primarily focus on the performance improvement in MIPv6. The requirement for modification in the mobile nodes may arise the complexity. On the other hand, the host-based mobility management protocols like MIPv6, HMIPv6, and FMIPv6 and a network based localized mobility management protocol like Proxy Mobile IPv6 does not necessitate any alteration on the mobile node while a proxy mobility agent in the network attains mobility-related signaling on behalf of the MN. Particularly, in this survey examine the different host based and network based mobility management protocols to show how to reduce the handover latency and reduce the overhead.**

Keywords— **Fast handover, MIPv6, Mobility management protocols, Handoff latency**

I. INTRODUCTION

There is enormous growth in the wireless and mobile devices because majority of the people use mobile devices to access variety of services like browsing the internet, multimedia applications, file sharing and video conferencing at anytime, anywhere. Even though, the wireless networks provides huge wireless services there are some problems like insufficient channel capacity, low computing power of mobile terminals, complex security problems. Mobile IPv6 is an Internet Engineering Task Force standard which adds the roaming capabilities of mobile nodes in IPv6 network. This standard permits mobile devices to travel from one network to another but still maintains the previous connections. Even though Mobile IPv6 is mostly targeted for mobile devices, it is uniformly pertinent for wired environments. The requirement of Mobile IPv6 is must because the mobile nodes in fixed IPv6 network cannot maintain the earlier connected link when changing location.

Mobile IPv6 utilizes care-of address as source address in distant links. Also, to preserve natural route optimization, the Correspondent node utilizes IPv6 routing header than the IP encapsulation. In Mobile Ipv6 the route optimization is an in-built feature. There is no availability in the Mobile Ipv4. In Mobile IPv6 there is no necessity of foreign agents. Neighbor Discovery and Address Auto-configuration features facilitate mobile nodes to function in any location without the services of any individual router in that position. Even though there are some benefits in the Mobile Ipv6 there are some disadvantages such as handoff latency, high signaling overhead, less packet delivery ratio.

In the following survey, examine the various mobility management protocols to reduce the handover latency. Therefore the various extensions like host-based mobility management protocols like hierarchical Mobile IPv6 (HMIPv6), fast handover for Mobile IPv6 (FMIPv6) and network based mobility management protocols like Proxy Mobile IPv6 (PMIPv6). If we compared to the hierarchical Mobile IPv6 protocol, fast handover for Mobile IPv6 (FMIPv6) the Proxy Mobile IPv6 (PMIPv6) achieves high less handover latency.

In Proxy Mobile IPv6, AAA infrastructure is used to validate the mobile nodes. But this scheme has high packet loss issue and ineffective authentication problems. The fast handover for Mobile IPv6 includes predictive (Pre-PFMIPv6) and reactive (Re-PFMIPv6) methods. Pre-PFMIPv6 may suffer from the handover failure. This is because Pre-PFMIPv6 does not take the numerous target MAGs into account resultant that in the serving MAG may decide a wrong target MAG to connect. The packet lossless PMIPv6 (PLPMIPv6) is used which utilizes a buffer mechanism to avoid packet loss during handover, but the ineffective authentication process of PL-PMIPv6 causes long handover latency. Additionally, the PL-PMIPv6 still suffers from the packet loss trouble before the bi-direction tunnel is built between the LMA and the new MAG. In the PMIPv6 there are some security troubles like Man-in-the-middle attack, message replay attack. In the man-in-the middle attack, during handover an attacker interrupts itself between the two entities. An attacker can intercept, change and drop the data packets. In the message replay attack, a malicious attacker resends the packet that affects the traffic flow.

II. PREVIOUS RESEARCH

Handover latency is one of the significant factors for the next-generation all-IP mobile networks.

Ki-Sik Kong et.al suggested network-based localized mobility management (NETLMM) protocol which is called as Proxy Mobile IPv6 [1]. The Proxy Mobile IPv6 is designed to present network-based mobility management maintainenance for the mobile nodes. The main functionalities of the proxy Mobile IPv6 are the mobile access gateway (MAG) and the local mobility anchor (LMA). By using the access router, the mobile access gateway (MAG) runs. This work analyzes the handover latency of PMIPv6 and also host-based mobility management protocols include MIPv6, HMIPv6 and FMIPv6.

Pyung-Soo Kim et.al suggested a fast handover process for Proxy Mobile IPv6 Networks [3]. This protocol does not need the mobile node to be involved in the L3 signaling needed for handover procedure. The mobility access gateway (MAG) performs the L3 signaling needed for handover procedure on behalf of the mobile node. On the other hand, the MN moves between different two MAGs in PMIPv6, the handover latency cannot be evaded.

Sheikh Md. Rabiul Islam et.al proposed an effectual handover scheme to avoid the packet loss problem in the proxy mobile IPv6 [4]. In this scheme, to consider the problem of packet transfer delay from one access point to another access point within a consider the problem of packet transfer delay from one access point to another access point within a PMIPv6 domain in the WiMAX network. When compared to the host based mobility management protocols, a network based mobility management protocol is better.

Linoh A. Magagula et.al suggested handover optimization in Heterogeneous Wireless Networks. This work observes the performance of the proxy Mobile IPv6 when used with and without MIH services. Particularly, it observes the handover delay and packet loss during the process of handover among the heterogeneous networks in the localized environments [5]. In this method, the MAG handles the entire mobility-related signaling on behalf of the mobile node.

Julien Freudiger et.al proposed the generation of mix-zones at suitable places of the vehicular node. Vehicular networks include the vehicles and the road-side units which is equipped with radios [6]. The main work is divided into three folds: Firstly, to propose a protocol to generate cryptographic mix-zones at road intersections. This solution prevents computationally-bounded eavesdroppers whereas conserving the functionality of safety messages. Secondly, to consider the location privacy accomplished by merging mix-zones into mix-networks in the vehicle nodes.

Zuriati Z Ahmad et.al proposed a cluster based proxy mobile IPv6 for IP-wireless sensor networks [8]. In this work, cluster based sensor Proxy Mobile IPv6 solves the problem like handoff latency and the route optimization problems. In this cluster based Sensor proxy Mobile IPv6, the mobility access gateways are grouped into clusters each of which is differentiated with a cluster head mobility access gateways. The cluster head mobility access gateways are basically used to diminish the load on the local mobility anchor by performing intra-cluster handoff signaling and presenting an optimized path for data communications. The main drawback of this method is there is need of load balancing and scheduling.

Chi-Hsiang Lo et.al suggested an efficient secure mechanism for mobile IPv6. Wireless networks provide ubiquitous Internet connectivity for accessing the services in the internet [9]. This work focuses on how to face these challenges in the wireless network. Firstly, a security access Gateway is used to resolve the problem of security. Secondly, robust header compression technology is used to enlarge the utilization of bandwidth. Instead of using access point, to tackle the packet header compression and de-compression in the wireless end the access gateway is used. Access gateways high computing power is capable to diminish the load in the access point.

Xiaoming Fu et.al suggested the recent localized mobility method and gives the benefits of the proxy Mobile IPv6. Mobile IPv6 is a host oriented mobility management scheme for IPv6 networks [10]. Proxy Mobile IPv6 is a network based mobility management method in which avoids both the tunneling overhead and stack updates in the host. There are three features in the Proxy Mobile IPv6. This PMIPv6 can diminish the delay by limiting the mobility management within the PMIPv6 domain. The mobile node’s home address is kept unchanged over the proxy Mobile Ipv6 domain considerably diminishes the chance that the attacker can realize the exact location of the mobile node.

III. MOBILITY MANAGEMENT PROTOCOLS

A. *Improved Bicasting Scheme*

An improved Bicasting scheme is proposed for avoiding packet loss in proxy Mobile Ipv6 [2]. The major work is to design an enhanced B-PMIPv6 which not only strives to accomplish seamless handovers by reducing handover delay and packet loss and to achieve efficient utilization of the resources. The backhaul bandwidth and the network buffer space are the resources of the network.

In the Bicasting PMIPv6 scheme uses timely link layer triggers which are used to precisely execute the Bicasting process, handoff and a predictive layer handover. The usage of timely triggers to avoid the loss of in-flight packets that results from a loss of packets just after the mobile node losses connectivity from the exceeding point of attachment access gateway. These triggers are also utilized to lesser the handover latency by transmitting the flow of packets intended to the mobile node at the Local Mobility Anchor (LMA) to the candidate point of attachment (Next Mobile Access Gateway (NMAG)) in advance by performing a layer handover proactively.

Figure 1. Shows the architecture diagram of Improved Bicasting scheme for the proxy mobile IPv6 networks.

RSS Monitor: In this figure, the received signal strength (RSS) monitor begins with monitoring the signal strength once it decays to thresholdp_{T_1}.The RSS monitor monitoring the signal and records the power level of the packet received and also the relevant time as the signal decays to p_{T_1}, p_{LGD} and p_{T_2}. This RSS monitor awares the Rollback facilitator part if there is the increase in the signal strength. Once the signal strength deteriorates to p_{T_2} the recorded tuples collected are passed to the prediction module.

Prediction module: The samples passed by the RSS monitor are used by the prediction module to predict the practicality of the decaying link. The prediction method used here is accepted from a link breakage prediction method which is used for a dynamic source routing protocol. The prediction module calculates the amount of time left before the link actually breaks which is called link viability. Knowing the link viability, we can then timely and precisely implement the start bicasting and stop bicasting events. The practicability is also used to know as to when to trigger a redirection of the flow of packets at the LMA from PMAG to NMAG. The output of the prediction module is the time at which the link down (LD) event is computed to going to be, which is when the mobile node will no larger longer profitably receive packets.

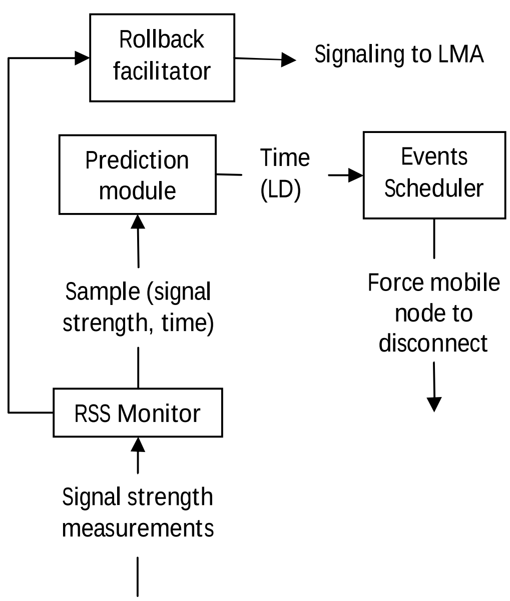

Fig 1. Architecture of IB-PMIPv6

At a particular distance d, the power received by a mobile node from a base station as per the two ray ground reflection propagation model is followed as,

$$P_{received}(d) = \frac{P_t G_t G_r h_t^2 h_r^2}{d^4 L}$$

Where P_t, G_t, h_t are the power transmitted by the access point gain and height of the access point transmitter antenna correspondingly. G_r and h_r are the gain and the height of the mobile node's receiver antenna. L is the system loss.

Event Scheduler: The event scheduler transmits messages to the LMA and the mobile node. These signaling messages teach the LMA and mobile node the time at which they have to carry out particular commands. It gives procedures to the mobile node to separate from the point of attachment with degrading signal strength. The events scheduler also transmits a signaling message to the local mobility anchor (LMA) to complete pre-registration on behalf the mobile node and setup a route to the candidate point of attachment when a handover is imminent.

B. *Hierarchical Mobile IPv6 Networks*

Hierarchical Mobile IPv6 is an improved Mobile IPv6 to diminish the indication cost by utilizing a local agent which is called Mobility anchor point. The Mobility anchor point can be positioned at any level in the hierarchical network of routers containing the access router [7]. When a mobile node enters in the MAP domain will receive router advertisements including information on one or more local mobility anchor points. The mobile node can bind its current CoA with the address on the MAP's subnet. The mobility anchor point receives all the packets on behalf of the mobile node and encapsulates and forwards them to directly on the mobile node current address.

To analyze the performance of Hierarchical Mobile IPv6 the two analytical models are used in the IP-based cellular networks. The analytical models are based on the random walk and the fluid-floe models. According to the analytical models, to formulate location update cost and packet delivery cost. After that to analyze the effects of the residence time of the cell and the user population on the location update cost and the packet delivery cost correspondingly. In addition to that, the deviation in the total cost as the session –to-mobility ratio is changed and the optimal domain size to reduce the total cost.

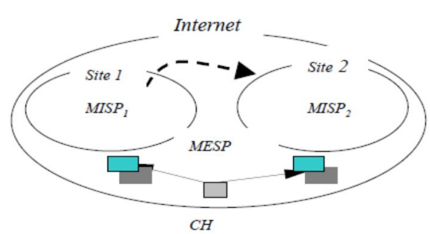

Fig 2. MISPs and MESP

This architecture is hierarchical in two points. Firstly, it divides the local mobility management from the global one. Local handoffs are handled locally and obviously to mobile's correspondent hosts. Second one is, it evidently divides the protocols managing local mobility from the protocols managing global mobility. In fact, whereas the hierarchy in the mobility management operations could be executed by the same protocol, we propose to use two different protocols. As we shown in this figure. 2 to define the methods of Mobility Internal Site Protocol, which handles mobility inside a site, and of Mobility External Site Protocol, which handles mobility among sites. The conception of site is relatively common. A site is nothing but a group of networks which belongs to the similar administrative entity, such as a company or an access provider. If any two hosts of a site must be capable to switch over the packets without the support of the Internet backbone. A site is associated to the rest of the Internet via one or numerous interconnection routers. The approach that we propose provides more plasticity to the sites that can organize the MISP the most suitable to their requirements.

C. *Fast Handover Mobile IPv6 Networks*

FMIPv6 is focused to facilitate the mobile node to quickly distinguish the mobility and to attain a prospective IP address with a new AR while being associated to a current AR. This protocol also provides the mobile node an opportunity to exploit obtainable link layer event announcement to accelerate network layer handover. Consequently, delays because of the network prefix discovery and new CoA generation are entirely eradicated during handover.

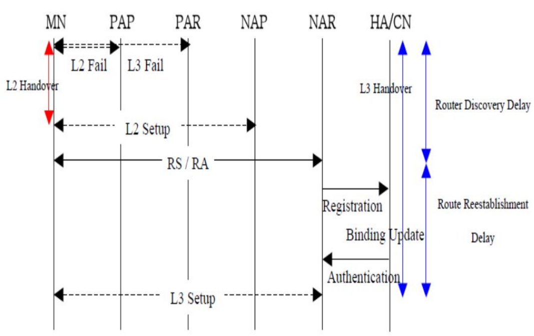

Fig 3. Fast Handover Procedure in Mobile IPv6

Fast Handover is a protocol to diminish united latency because of the Mobile IPv6 handover operation. Significant problems that have to be explained for the Fast Handover which contains how to permit the mobile node to transmit packets as soon as it detects new link, and how to distribute packets to the mobile node as soon as its presence is detected by NAR. The solution is to keep the MN's preceding CoA (PCoA) until it provides L2 connection to its NAR. This also facilitates the mobile node fast establishment of new CoA (NCoA). Fast Handover does not depend on specific L2 features for enhanced performance. Furthermore, there is no special necessity for the mobile node with respect to its standard Mobile IP operations.

The main process in the fast handover includes setting up a routing path between old and new access routers to facilitate the mobile node to transmit and receive IP packets. This tunnel organization could be triggered either by the mobile node or by network. Once the tunnel is provided, packet forwarding via the tunnel to the mobile node instigates when PAR receives Fast Binding Update (FBU) message from the mobile node. Thus, three phases are associated in the Fast Handover process: handover instigation, providing the tunnel, and forwarding data packets.

The common control channel is used to broadcast the channel state information for the secondary users. The common control channel is used particularly for managing information. The channel allocation information is broadcasted to all the neighbors. A selfish secondary user sends the false channel allocation information to the neighboring secondary users.

Framework	**Handoff latency (ms)**	**Average throughput (Kbytes/s)**
MIPv6	5487	98.78
HMIPv6	739	106.17
FMIPv6	352	105.84
PMIPv6	254	109.36

Table 1: Comparison for Handoff latency and Average throughput

IV. CONCLUSION

Mobile IPv6 is the most widely used IP protocol. In the mobility management protocols there are two types such as host-oriented mobility management protocols and the network-oriented mobility management protocols. The host based mobility management protocols includes hierarchical Mobile IPv6 and fast handover for Mobile IPv6. The network-based mobility management protocols contain proxy Mobile IPv6. The proxy Mobile IPv6 is a network based mobility management protocol which is being vigorously standardized and is starting to attract significant attention among the telecommunication and internet communities. The main intend is to reduce the packet loss and reduce the delay. The mobility management protocols are analyzed to reduce the packet loss problem. At the end of this survey, conclude that effectual mechanism is proposed to improve the handoff performance and reducing latency, packet loss and consider security issues.

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