SURVEY ON MOBILITY MANAGEMENT PROTOCOLS FOR IPv6 BASED NETWORK

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Abstract

Many mobility management protocols for IPv6 have been proposed and successfully implemented so far. In this paper, a brief survey of existing protocols for both hosed-based and network-based mobility management. The discussion of this paper includes few protocol like Mobile IPv6, Hierarchical mobile IPv6, Fast handover in MIPv6, Proxy mobile IPv6 and Fast handover for Proxy mobile IPv6. We have also include few challenges of hosed-based mobility management and define some main parameter for mobility management protocol evaluation. This discussion will help to give new work in that area.

Index Terms: Mobility Management, Mobile IPv6, Proxy mobile IPv6.

I. INTRODUCTION

With the exponential growth of the Internet as well as the increasing demand for mobile services, mobile users require the ability to access their personal files or the Web through their laptop or PDA at any time and in any location. For communication, all mobile devices must be configured with an IP address in accordance with the IP protocol and its addressing scheme. The problem occurs when a user roams away from its home network and is no longer reachable using normal IP routing [5]. The traffic demand of mobile subscribers now is not only for voice and SMS service but also for high-speed internet access service. Most of the mobile node today are equipped with multiple interface using different access technology such as Wi-Fi, WiMAX, and LTE. Therefore the most challenging issue for all the networks is IP mobility management. Mobility management protocols provide facilitate uninterrupted communication to mobile nodes without changing their IP address. Mobile IP or MIP is most useful mobility management protocol for IPv4 based networks standardized through Internet Engineering Task Force (IETF) that assists communication on the move. The mobility management mechanism in IP protocol allows location-independent routing and successful scalable mechanism for roaming users on the Internet. The features of Mobile IP let mobile nodes to change their point-of-attachment without changing their Permanent home IP address [9].

A. An overview of IP based network

Submit The Internet Protocol (IP) is the superior internetworking protocol in operation today. The logical possibility for a networking protocol for wireless data networks is IP for several reasons. First, through using an IP-based network, applications written for wired data networks can work on wireless networks. Second, to settle cost, integrated wireless and wireline networks can be built and control. Third, advances on IP technology, such as IP telephony and Quality of Service (QoS), might be directly sued to the wireless networks. This will enable wireless networks based on IP to provide voice service as well as data services, hence suing them to tap into the huge subscriber base of cellular voice customers. All mobility-related functionality must be handled at the IP (network) layer. In the access network, we utilize the internet standard, Mobile IP, as the inter-domain protocol for supporting macro-mobility.

B. Mobility Management in IP based network

Mobility management is a major research issue for future IP wireless network. In general, mobility management protocols can be managed at different OSI layers. The IP mobility protocol manages mobility management at the network layer and produce network level transparency, therefor the upper layers do not have to be disturbed, about MN mobility or the consequences of the IP address change. In addition, different IP mobility protocols have been defined as global or local mobility management that are knowing to handle the MN's mobility within the same domain or across network domains, respectively. Moreover, the IP mobility protocol can be classified into two main categories; host-based and network-based. In the host-based grouping, the MN must participate in the mobility related signaling. Whereas, in the network-based, the network entities are the only entities that are complex in the mobility related signaling. We will describe them in this paper.

C. Challenges and Issue

As Major challenges of MIPv4 are triangular routing problem, long communication route delays, extra packet end to end delivery delay and mobility signaling delay [9]. To solve many issues in MIPv4 we extend by the MIPv6. Major challenges of MIPv6 are high handover latency, high packet loss and signaling overheads. FMIPv6 was proposed to reduce handover and decrease service disruption during handover related to the MIPv6. MIPv6 is not desirable in a local domain communication due to increased signaling overhead and high handover latency. HMIPv6 handle the mobile IP registration locally using a hierarchy of MAP, alternative of the global mobile IP communication handling in the MIPv6 domain. Therefore HMIPv6 is better for local domain communication, which will decrease overall handover latency and signaling overheads on the network. Such that all the host based mobility management protocol needs an IP stack modification of MN and change its IP address in order to assist MN mobility within or across network. Consequently, it incense the MN complexity and waste air resources and some drawbacks still remain in the host based mobility protocols such as long handover latency, high packet loss and signaling overhead. Another issues in IPv6 is location management. Therefore, issues is the location registration procedure, such as the security issues due to the MN's authentication process and delay restriction associated with static and dynamic updates in the location registration. The other issues is data packet delivery procedure, such as querying delay because the type of database architecture used-centralized or decentralized as well as the delay constraint and paging delay cost [9]. To solve all this problem network based mobility management.

II. PARAMETER FOR MOBILITY MANAGEMENT PROTOCOL EVALUATION

A. Signaling Cost

For all IP network based mobility protocol, the home network needs to maintain a database, wherein MN can change its location. To inform the home network about its new location, mobile nodes use some managerial packets. These messages are called binding related packets. Signaling overhead is the cost of exchanging these managerial packets over the network to complete the location update process of mobile node with the home network. It can be measured as the product of size of the binding related packets and distance traversed by them. So, producing less signaling overhead is another desirable property of the mobility management solutions [10].

B. Handover Latency

In a network, latency also called delay is a declaration of how much time a packet takes to get from one designated point to the other. In a wireless network where mobile nodes change their location over time, the term handoff latency is defined. It is measured as the difference in time between the reception of the last packet in the old service area and the first packet in the new service area in a current session during handover. Handover period MN cannot receive or send any data packet due to the link failure. All the mobility management protocol suffer for minimizing the handover latency [10].

C. Tunneling Cost

If the MN move away from its home network a special agent that is located in the home network not only keeps track of mobile nodes location but also take care of these packets. Basically, a mechanism called tunneling is adopted by the agent to deliver the packet to actual location of the mobile node. In tunneling, the sender encapsulates the packet within another IP packet and sends it to the new location of the mobile node. In the receiver end the packet is DE capsulated from the tunneled packet and delivered to the actual recipient. So, tunneling cost is also referred as encapsulation and DE capsulation cost. It is measured in terms of bytes added to encapsulate the packet to the destination or the time required to encapsulate and DE capsulate the packets [10].

III. HOST-BASED MOBILITY PROTOCOL

Host-based mobility is category to solve the IP mobility challenge. Host-based mobility management protocol need to update IP stack modification and change IP address in order to support within or across the network. Mobile IPv6 (MIPv6), fast handover for IPv6 (FMIPv6), hierarchical mobile IPv6 (HMIPv6), and fast handover for hierarchical mobile IPv6 (F-HMIPv6) are typical host-based mobility protocols. In this section, these protocols are discussed.

A. Mobile IPV4

Mobile IP was proposed by the IETF, which generally focuses on MN mobility supports during its roaming across domains and redirects MN's packets to its ongoing domain location using typical Mobile IPv4 (MIPv4) protocol. MIPv4 allocate an MN with two different types of address: The Home Address (HoA) and the Care-of-Address (CoA). MN's home address, which is standing with its home network. Whereas, CoA address reflects the MN's address for the visited network the CoA of which changes as the MN go from one visited network to another. The MIPv4 protocol introduces new entities, which are Home Agent (HA), Foreign Agent (FA) and MN. MIPv4 supports mobility management using the following operation steps: Agent discovery, Registration and Data transfer. MN go away from its home network to a visited network, which is covered by FA (e.g., MN2), the MN start the Agent Discovery phase, which detects its movement in the new network utilize Agent Solicitation/Agent Advertisement messages towards FA. Then, the Registration phase takes place when the MN discovers its place in a foreign network and obtains a new CoA. In the last phase (i.e., Data transfer), all MN packets transfer from the MN's CN towards MN are intercepted by the MN's HA. When the HA receives any packets destined for a specific MN it will encapsulate these packets and tunnels them to the MN's CoA through the serving FA using tunnel close at the FA, which will DE capsulate these packets and forward them to the MN.

The MIPv4 support for MN's mobility, there are several limitation, such as a triangular routing problem that arises when the data packets sent from the MN's CN to the MN are routed in the HA and tunneled to the FA in order to reach the MN. This results in long communication route delays and puts a not needed burden on the networks and routers. Moreover, MIPv4 mobility routing incurs extra packet end-to-end delivery delay. Moreover, MIPv4 mobility routing incurs extra packet end-to-end delivery delay [9].

B. Mobile IPV6

MIPv6 is a standard for IPv6 global mobility support and solves many issues in MIPv4. MIPv6 allows a MN go within the Internet domain without losing current data connection directly with its CN, while in MIPv4 the CN transfer a data packet to the MN through the Home Address (HA) and FA by a longer route. To maintain ongoing connections while moving, the HA which is defined in MIPv6 uses a redirection function to deliver packets to the temporary location of MN. The HA redirects the packets destined to any mobile node which is away from its home network and acquired a temporary address in its visiting network. Mobile node always updates its location information with the home agent in order to receive packets from the HA in its current temporary location [11].

The MN is physically detect on the home link or not, packets are forwarded to the home link. If the MN is not at its home link, it's HA is responsible for tunneling packets to the MN's Care-of-address (CoA) (i.e., its real location). Since correspondent nodes try to connect to the MN's home address, hence sockets use the home address to record such connections. Therefore, it is necessary that applications see only the home address for the MN. Therefore, the IP layer is liable of for presenting the home address to applications running on the MN as a source address regardless of the MN's actual location. The IP layer hides the mobility from upper layers to maintain ongoing connections while the MN changes its address. Mobile IPv6 is only invoked when the MN is located on a FN. When an MN moves from its home to a foreign network, it first forms a CoA based on the prefix of the FN. The CoA can be formed based on stateless or state full mechanisms. However, in this paper, a stateless address auto configuration is adopted as a mechanism to form CoA through the visiting MNs. After address configuration, the MN informs it's HA of such movement by sending a binding update message. The binding update message is one of several MIPv6 messages that are encoded as options in a new header called the mobility header. The HA needs to store the information contained in the binding update message in order to forward packets to the MN's current location. Main drawback are high handover latency, high packet loss and signaling overhead [9].

C. Hierarchical MIPV6

HMIPv6 is a local mobility management protocol for MIPv6 improvements to reduce handover latency and signaling overheads that occur because the periodic change of MN's point of attachment. It adds an indirection for locating the MN independent of where the CN and HA are detect in the Internet topology. It tunnels packets to a Mobility Anchor Point (MAP), which is addressed by a regional CoA (RCoA). The MAP rotate, tunnels these packets to the MN addressed beyond a local CoA (LCoA). Thus, the MN's local handover mobility signaling only needs to be signaled to the MAP, hence, avoiding high handover latency and binding updates overheads.

The MN is currently connected to oldAR and will do a handover to the newAR. Whenever the MN like to improve the CN or HA about its new CoA, it will send them a binding update (BU) message that will travel from the MN through a MAP to the CN/HA. The acknowledgement of the BU from the CN/HA will move the same way back. If the link into the CN/HA and MAP is a long way, it means that it would take some time for the BU to move from the MAP to the CN/HA and back. Therefore, it would make sense to have a kind of temporary HA on the MAP. Hence that the MN only needs to update the MAP as long as the same MAP is located between the MN and CN/HA, then, the MN's address in this case is LCoA. Hence, the more time for sending a BU interval CN/HA and MAP is spared. Moreover, the MN can discover the MAP address from the router advertisement and will then form a RCoA address from the MAP before updating the CN/HA with this RCoA. After that, the CN/HA transfer their packets to this RCoA, then, the MAP tunnels them to the MN's LCoA. In addition, the MAP may buffer the data packets destined to the MN and send them when the MN has sent the BU message through the newAR [13].

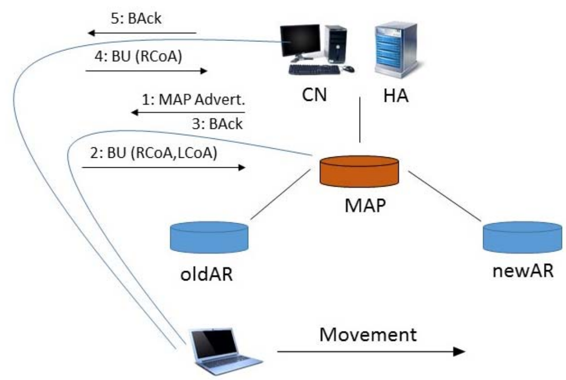

Fig 1. HMIPv6 Signaling flow

D. Fast Handover for MIPV6

Fast Handover in MIPv6 (FMIPv6) was proposed to reduce handover latency and minimize service disruption during handover related to the MIPv6. The goal of FMIPv6 is to allow a MN to configure a new CoA before it moves under the coverage of new cell or an access area. This mechanism is popularly known as make before break. The principle is to construct a new temporary address to MN and establish a new connection before the break down of the MN's ongoing connection with its old Access Router (OAR). In such a case, when the MN is attached to the new Access Router (NAR), it can continue its communications with its new already assigned address. While constructing the new CoA before the actual handover, the protocol takes help of the signal strength of the used signal and newly received signal during the movement of MN.

In general, FMIPv6 optimization is based on a reliable hand- over prediction that enables predictive configuration of the MN involved in the mobility signaling [9]. All the host-based mobility management protocols require a protocol stack modification of the MN and change its IP addresses in order to support MN mobility within or across network domains.

Consequently, it may increase the MN complexity and waste air resources [12].

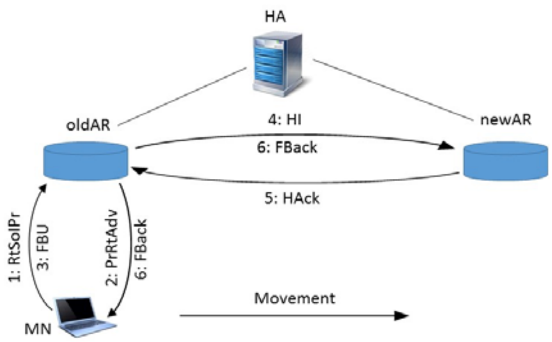

Fig 2. FMIPv6 handover signaling flow

IV. NETWORK-BASED MOBILITY PROTOCOL

Network-based mobility is second approach to solving the IP mobility challenge. It is possible to support mobility for IPv6 nodes without host participation by extending Mobile IPv6 signaling messages between a network node and a home agent. The network is responsible for managing IP mobility on behalf of the host. The mobility entities in the network are responsible for tracking the movement of the host. This specification called a network-based mobility management protocol. Proxy Mobile IPv6 (PMIPv6) and Fast Proxy Mobile IPv6 (FPMIPv6) are network-based mobility management protocols. In this section, these protocols are discussed.

A. Proxy Mobile IPv6 (PMIv6)

Proxy Mobile IPv6 protocol is intended for providing network-based IP mobility management support to a mobile node, without requiring the participation of the mobile node in any IP mobility related signaling. Hence, the proxy mobility entity performs all related signaling on behalf of the MN. Once an MN go into the PMIPv6 domain the serving network performs the MN's access authentication and assigns a unique home network prefix (HNP) to each MN using a new address model named Per-MN-Prefix model. This prefix conceptually always follows the MN wherever it transfer within a PMIPv6 domain, to ensure that the MN is always in its home network and can obtain its HoA on any access network [2].

The functional entities of PMIPv6 are local mobility anchor (LMA) and mobile access gateway (MAG). The LMA is similar to the HA in MIPv6. The mobile access gateway is the entity that performs the mobility management on behalf of a mobile node, and it resides on the access link where the mobile node is anchored. The mobile access gateway is responsible for detecting the mobile node's movements to and from the access link and for initiating binding registrations to the mobile node's local mobility anchor. The PMIPv6 signaling flow is described as follows:

Authors should consider the following points:

1) The MN initially attaches to the MAG1 in a PMIPv6 domain by present MN-ID to process an access authentication.
2) The MAG1 transfer a request message to the AAA server for the MN's access authentication.
3) The AAA server responds by sending the MN's profile (i.e., MN-ID, LMAA, address configuration mode, etc.) to MAG1 if this MN is successfully authenticated.
4) The MAG1 transfer a PBU message to the MN's LMA on behalf of the MN to update the MN's new location.
5) The LMA will reply by sending PBA message including the MN-HNP and creates BCE that binds the MN-HNP to the MAG1 address. In addition the LMA establishes a bidirectional tunnel towards the MAG1.
6) The MAG1 sets up a tunnel to the LMA and adds a default route over the tunnel to the LMA upon receiving the PBA message. It also generates a Binding Update List (BUL) that binds the MN-HNP and LMAA. In addition, MAG1 sends RtrAdv messages to the MN on the access link to a publicize MN-HNP as the hosted on-link-prefix. When the MN receives this RtrAdv message it will arrange its IP address using either a state full or stateless address configuration.
7) After successfully completing the address configuration process the MN is now able to use this address to continue the data session to/from CN [9].

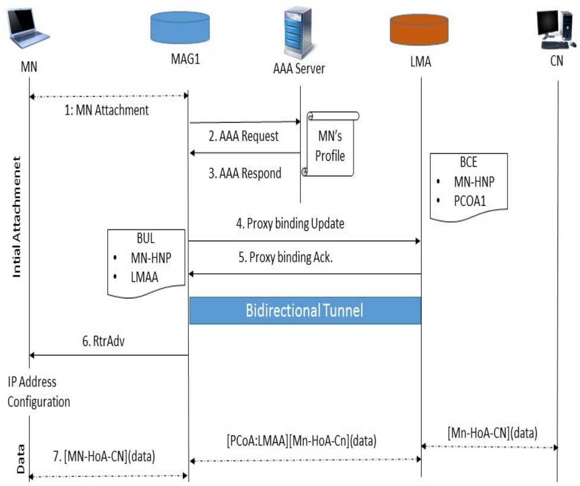

Fig 3. PMIv6 signaling flow phase

B. *Fast Proxy Mobile IPv6 (FMIPv6)*

Fast handover scheme in Proxy Mobile IPv6 called FPMIPv6, which combines Fast Mobile IPv6 operation and IEEE 802.21 link layer triggers with Proxy Mobile IPv6 protocol, and develops an analytic model for the handover performance analysis. Depending on whether layer 2 handover signaling is finished on a previous link, there are two modes of operation, that is, predictive and reactive mode. On consider the predictive mode because it shows shorter latency than the reactive one. Before the MN moves from PAP to NAP, negotiation occurs between the MN and PAP through layer 2 trigger messages as described in subsection 2.1. Link Going Down trigger from the link layer to IP layer in the MN informs the PAP that a link down event will be fired in the close future. The NAP ID information must be included. When the layer 2 handover decision is achieved, the PAP sends Link Going Down message to the PMAG. Once receiving Link Going Down message, the PMAG retrieves New MAG's (NMAGs) PCoA through [AP-ID, PCoA] tuple, and sends Handover Initiate (HI) message with the following information: the MN’s NAI identifier option, the MN's IP address, the PMAG's PCoA, the MN's Link Layer Address (LLA). The NMAG creates a Neighbor Cache entry for the MN based on the information of the HI message. To reply the HI, the NMAG sends Handover Acknowledge (HAck) message to the PMAG. Once Hack is received by the PMAG, a bidirectional tunnel is established, and the PMAG's PCoA and the NMAG's PCoA are the tunnel's two ends. When a layer 2 link is established, the NAP sends a Link Up trigger message to the NMAG. Link Up trigger from the link layer to IP layer in the MN informs the NAP that an MN completes layer 2 connection establishment with the NAP. The NMAG sends Router Advertisement (RA) with the NMAG's information which facilitates the MN to send packets. The NMAG delivers the buffered packets to the MN [3].

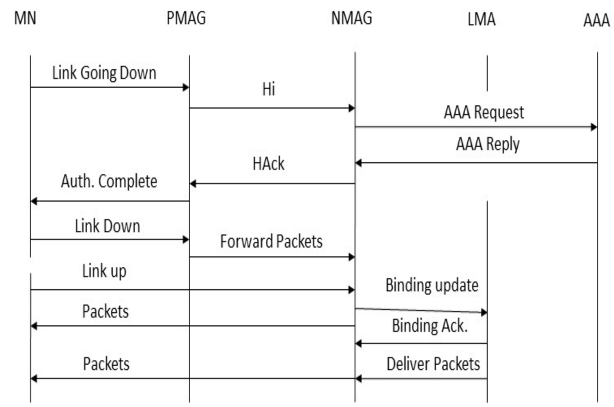

Fig 4. Predicative FMIPv6 protocol operation

C. *Proxy mobile ipv6 (pmipv6) localized routing problem statement*

The MIPv6 protocol has built-in mechanism for direct communication between an MN and CN. Mechanisms for route optimization in MIPv6 cannot be directly applied in PMIPv6. Therefor localized routing must consider functions in the network to discover whether or not a localized route is to be used and then control the setup and maintenance of localized routing states accordingly without some assistance from the MN and the CN. With localized routing, operators have the possibility of offloading traffic from LMAs and from the core network. By limiting the communication to the access nodes, the data traffic traversing the MAG - LMA path (network) can be reduced. There may be good performance for data flows between the MN and the CN in terms of delay and packet loss is reduce. Localized routing always using the default route through two communicating mobile nodes. Localized routing in a PMIPv6 network must counter unauthorized change of a routing path [1].

D. *A new strategy for signaling overhead reduction in the proxy mobile ipv6 protocol*

PMIPv6 has already been devoted to reduce the handoff latency and the packet loss ratio by pre-registering the mobile node to the new network. However, these researches have not been able to reduce the number of signals compulsory for authentication and registration processes which are frequently performed during the binding updates. Therefore, enhance PMIPv6 signaling strategy known as the I-PMIPv6 protocol is propose. The main idea of the proposed model is to minimize the redundant signaling in the authentication and registration processes of PMIPv6 and the involvement Of the Authentication, Authorization and Accounting (AAA) server in the registration process. In PMIPv6 when the MAG sends an AAA query to the AAA server; its consecutive operation is constrained by the mandatory wait of the AAA response before sending the PBU to the LMA. In the proposed I-PMIPv6, these signaling features are redesigned to achieve intended task with much reduce accumulated signaling. Thus main advantage of I-PMIPv6 protocol reduce signal of authentication and registration. But this protocol cannot work any single point of failure occur in mobility and authentication server such that information of mobility and authentication is lost [4].

E. A POINTER FORWARDING SCHEME FOR MINIMIZING SIGNALING COSTS IN PROXY MOBILE IPV6 NETWORKS

PMIPv6, the MAG suffer a high signaling cost to update the location of a MN to the remote LMA if the MN moves frequently. This incense network overhead on the LMA, wastes network resource and make longer delay time. Therefore we propose a new mobility management scheme for decreasing signaling cost using the pointer forwarding. In the pointer forwarding schema we extent the data structure. We define K and Kmax as the current pointer forwarding length and the maximum forwarding length respectively. The initial value of K is 0. The value of K is incense whenever an MN moves within the PMIPv6 domain. To reduce the signaling load of the total network however the length of the pointer forwarding chain is allowed to incense up to the maximum pointer forwarding length Kmax. We propose to extend the PUB message with an extra flag Forwarding Notification (F) taken from reserved filed. In an 'F' flag is set, it indicates that it request the receiving previous MAG (pMAG) to create a pointer forwarding by caching a new Proxy Care-of-Address (PCoA) of the new MAG (nMAG). In this case, the pMAG creates the Binding Cache Entry (BCE) and sets up its endpoint of the bi-direction tunnel to the nMAG. Thus our proposal can reduce signaling costs by registration with the neighbor MAGs instead of the remote LMA using the pointer forwarding [5].

F. ON MATHEMATICAL MODELLING OF HIERARCHICAL MOBILITY MANAGEMENT PROTOCOLS

The existing internet network identifier and host identifier consist of IP address. The host create socket using the IP address and port number of the transport layer and sets up a connection to another host using this socket address. If the host moves to another network the IP address must be change. Thus it is a disadvantage in that the exiting connection is failed and must be connect again. Therefor to solve this problem hierarchical structure protocol analyzed by the new random walk model minimize the inconvenience when each of the MN performs a binding update it shows the cost efficiency through the prediction of a fast handover structure. The efficient result of the new random walk model is camper with the fluid mobility model. The cost is analyzed according to the circumstances of each protocol using the fluid-flow model and 2D random walk model [6].

V. CONCLUSION

In this paper, we have presented comparative analysis on Host based and Network based mobility management protocol. After define the main advantage for network based mobility management. More over this paper has classify several mobility management protocol and their challenges. This survey work may help the research in this field by providing overview of Mobile IP and motivate them towards further design of Mobile IP based network.

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