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Optimising the Epmipv6 Protocol for the Analysis of Advanced Sensor Networks

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ABSTRACT

This work is to have a look at the successfulness of the PFMIPv6 protocol. EPMIPv6-AS over IEEE 802.11ax CMake delivers standard overall performance for advanced features like 4K or 8K films, increased capacity, high community apps, all wireless locations, and the Internet of Things (IoT) using Network Simulator (NS) version 3.36. The proxy mobile IPv6 for advanced sensor networks phase of the next-generation web protocol (EPMIPv6-AS) is an extension of the PFMIPv6 movability management. It permits nearby mobility-based routing of IP datagrams to IPv6 hosts except station participation in the IP address signaling. A mobile node avoids the signaling expense and response times associated with modify IP addresses by maintaining its IP address while switching across links. Local mobility is still required, but IPv6 also adds additional specifications like Mobile Node, Advanced Sensor Mobile Access Gateway (ASMAG), and Advanced Sensor Local Mobility Anchor (ASLMA). While moving between serving networks during handover, the mobile station's IP remains consistent, hence location privacy may not be guaranteed. This paper carried out analytical comparison studies for the PFMIPv6 and EPMIPv6-AS mobile protocols. In order to compare costs, we raised the binding update cost value and packet delivery cost value. Wi-Fi 6 consumers in dense locations are available upgrades; it improves as high-efficient Wi-Fi.

1. INTRODUCTION

Over the previous two decades, cell wireless verbal exchange technologies have superior quickly as an end result of the Quality of Experience (QoE) and Quality of Service (QoS) necessities for cellular conversation systems, cell wireless conversion applied sciences have developed quickly. To enhance security, the scheme incorporates authentication and encryption mechanisms, safeguarding user data during transitions between networks. Additionally, it employs network selection algorithms that consider factors such as signal strength, network load, and available bandwidth to optimize network effectiveness and maintain high QoS levels. By integrating these elements, the proposed scheme aims to provide efficient, secure, and QoS-aware mobility management in heterogeneous mobile environments [1].

These wireless networks are interconnected and work collectively to provide cell clients with internet and different verbal exchange offerings on every occasion and anywhere they want them. The majority of cell gadgets have recently delivered numerous wireless interfaces to guide different Wi-Fi applied sciences such as ZigBee, Wi-Fi, Wi-MAX, UTMS, and LTE [2] as an end result of the various offerings and technologies. Given that an increasing wide variety of cell devices are equipped with a number of community interfaces, it is crucial for mobile customers to choose the pleasant community interface, even if there are numerous interfaces, in order to maximize bandwidth and save charges.

The Next-Generation Wireless Networks (NGWiN) are moving towards becoming completely IP-based networks in order to support pervasive Wi-Fi settings. In order to give mobile users wireless connectivity whenever and wherever they need it, a range of Wi-Fi access protocols are connected in a heterogeneous infrastructure. Fast Proxy Mobile IPv6 (FPMIPv6) protocol, FPMIPv6-S introduces several key improvements to reduce handover latency and signaling overhead. The protocol utilizes a hierarchical mobile anchor point (MAP) structure, where local MAPs handle regional mobility management, while a central MAP oversees global mobility. This minimizes signaling traffic and improves scalability. Additionally, FPMIPv6-S employs route optimization techniques and a neighbor discovery mechanism to proactively prepare for handovers, further reducing latency and packet loss [3].

Fast Handover protocol specifically designed for mobile 6LoWPAN networks to address handover latency and packet loss issues. The protocol focuses on three key areas: neighbor table exchange, fast authentication, and route optimization. Mobile nodes and access points proactively exchange neighbor information, enabling faster discovery of potential handover candidates. A lightweight authentication scheme minimizes security overhead during handovers. Additionally, the protocol optimizes route update mechanisms to ensure seamless data transmission during transitions [4].

In order to transfer buffered statistics and decrease packet loss, FMIPv6-S in precise creates a lay tunnel between the ancient and new extension points. All of the aforementioned options call for MN participation, which should result in substantial resource utilization for mobile devices with limited resources and the requirement to change the protocol stack. The use of network-based mobility management, also known as proxy mobile IPv6 (PMIPv6), has been suggested [5] as a technique to circumvent host-based restrictions.

SPMIPv6 offers a promising approach to enabling efficient mobility management in IP-WSNs while addressing the resource constraints of sensor nodes. a designated sensor proxy node to handle location management and mobility signaling for mobile sensor nodes. The sensor proxy maintains location information and updates binding caches, while data packets are tunneled between correspondent nodes and mobile nodes via the proxy [6].

PMIPv6 is to anticipate and prepare for handovers before they actually occur, minimizing service disruption and packet loss. This is achieved through several methods, including: proactive network discovery by the mobile node to identify potential target networks, pre-establishment of security associations with these networks, and speculative binding updates initiated by the mobile access gateway even before the handover is complete [7].

The optimization technique for Proxy Mobile IPv6 (PMIPv6) networks is Localized Routing (LR). It aims to reduce the reliance on the central mobility anchor point (MAP) for routing traffic to mobile nodes, thereby minimizing handoff latency and improving network scalability. The key idea is to enable the local mobility anchor point (LMAP) – typically a router closer to the mobile node – to directly route traffic to the mobile node within its domain. This is achieved through the distribution of binding information and the creation of localized routing entries [8].

This comprises brand-new organizations, such as the Advanced Sensor Mobile Access Gateway (ASMAG) and the Advanced Sensor Local Mobility Anchor (ASLMA), which manage mobility on behalf of MNs to reduce signaling costs and lengthen handoff times compared to the earlier solutions. The successor to IEEE 802.11ac is the wireless neighborhood region community standard. It is frequently referred to as high efficiency Wi-Fi in acknowledgment of the regular improvements given to Wi-Fi 6 clients in congested regions [9].

Examining the effectiveness of the EPMIPv6-AS protocol is the motivation behind this work. Version 3.36 of Network Simulator (NS) is used to implement the EPMIPv6-AS protocol over IEEE 802.11ax, which is the IEEE replacement for 802.11ac as the preferred standard for WLANs. The study's conclusions demonstrated how well the EPMIPv6 protocol operated when signaling overhead, handover latency, and energy consumption of the cell node overall performance measures were kept to a minimum comparing with EPMIPv6-AS.

Data packet creation: The MN collects data to send, such as sensor readings or commands. This data is encapsulated in an IPv6 packet. IPv6 is a network protocol that enables communication between devices on the Internet of Things (IoT).

Compression and fragmentation: 6LoWPAN compresses the IPv6 packet to reduce its size. This is essential because low-power wireless networks have limited bandwidth and need to save energy.

If the compressed packet is too large to fit in a single frame, it is fragmented into smaller pieces.

Link-layer transmission: The fragmented or compressed packet is sent over the 6LoWPAN network using the IEEE 802.15.4 standard or a similar low-power wireless communication protocol.

The packet hops from one 6LoWPAN router or border router to another until it reaches a gateway.

Gateway processing: The gateway (often called a Border Router) is a device that connects the 6LoWPAN network to the wider internet. It understands both the 6LoWPAN and regular IPv6 protocols.

The gateway performs decompression and reassembly if the packet was fragmented.

IPv6 routing: The decompressed packet is now a standard IPv6 packet. The gateway uses IPv6 routing protocols to determine the best path to reach the destination, which is the CN.

Transmission to the CoAP server (CN):

The packet is forwarded over the broader internet, typically through routers and switches, until it reaches the destination, which is the CoAP (Constrained Application Protocol) server (CN). The CN processes the packet and extracts the data payload for further action, such as updating a database, controlling a device, or responding to the request.

The following is the order of this paper: The EPMIPv6-AS architecture and handover system are given in Section II. In Section III, a brief overview of the EPMIPv6-AS handover process is given. Section IV discusses the simulation environment, while Section V provides the numerical outcomes of EPMIPv6-AS using CMake. The last section of this essay is Section VI.

2. EPMIPV6-AS ARCHITECTURE

Express handover Proxy Mobile IPv6 for Advanced Sensor networks (EPMIPv6-AS). The primary goal of EPMIPv6-AS, an improved version of PFMIPv6, is to decrease MN handover time when transferring and switching the extra point to the new network. The following entities make up the EPMIPv6-AS architecture (see Figure 1):

- Advanced Sensor Mobile Access Gateway (ASMAG): Resides at the networks edge and serves as the MNs access gateway for ASLMA related mobility signaling. In order to transport packets delivered to or received from the MN, the ASMAG that is currently providing service to the v6LowPPAN MN and the ASMAG to which the related node is attached have built a tunnel.
- In Mobile IPv6 (MIPv6), the Home Agent is responsible for maintaining reachability of Mobile Nodes (MNs) within their home network. Similarly, in Proxy Mobile IPv6 (PMIPv6) networks, the Advanced Sensor Local Mobility Anchor (ASLMA) plays an analogous role. The ASLMA ensures seamless connectivity for MNs as they move within a specific PMIPv6 domain, effectively acting as their local anchor point.
- A Mobile Node (MN) in a v6LowPPAN network is a device with the ability to move between different networks. Similar to Mobile IPv6, the MN retains its home address regardless of its current point of

attachment. This allows the MN to maintain seamless connectivity and ongoing communication even while roaming across various networks.

Correspondent Node (CN): It represents the communication endpoint that interacts with the Mobile Node (MN) in a mobile network. The CN itself can utilize either wired or mobile connections for data transmission and reception. Regardless of its own connectivity type, the CN serves as the fixed point of contact for the mobile MN during their communication exchange.

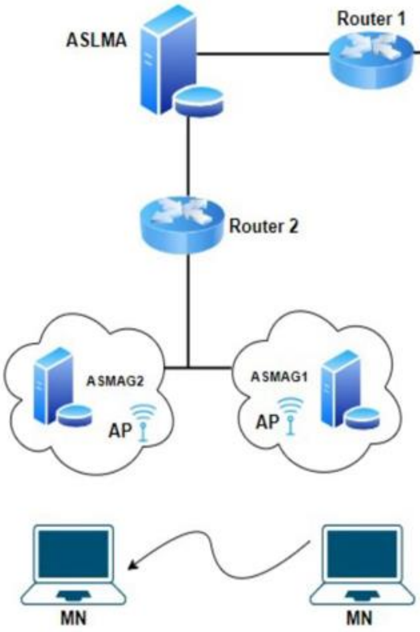


Figure 1. EPMIPv6-AS architecture

NS 3.36 is a specialized software tool used to create detailed models of computer networks, enabling researchers and engineers to conduct comprehensive performance evaluation studies. Modern Wi-Fi design prioritizes efficient resource allocation to optimize network performance, focusing on maximizing throughput (data transfer rate) and minimizing latency (delay). Key challenges in achieving these goals include rate control, scheduling of data transmissions, power control for individual devices, and mitigation of interference between signals.

The user experience, characterized by factors like throughput and latency, is influenced by various end-to-end details within the network, as well as the impact of cross-traffic from other devices and networks. To address these challenges and enhance user experience, the IEEE 802.11ax standard introduces significant advancements in Wi-Fi technology. These solutions offer up to a fourfold increase in network capacity, along with substantial improvements in efficiency. As a result, IEEE 802.11ax enables a superior Wi-Fi experience for users, with faster speeds and reduced delays.

3. EPMIPV6-AS HANDOVER PROCEDURE

Wireless handover, also known as handoff, is a crucial process in mobile communication systems that enables seamless connectivity as a mobile device moves between different base stations or access points. The goal of handover is to ensure uninterrupted communication while optimizing network performance. Here's an overview of the key steps involved in the handover process:

Trigger event: Handover begins when a trigger event occurs, indicating that the mobile device should switch to a new base station or access point. This trigger event can be a result of the mobile device moving out of the range of the current station, deteriorating signal quality, or network congestion.

Measurement and evaluation: The mobile device continuously measures signal quality and other relevant parameters from neighboring base stations or access points. It evaluates these measurements to determine the best target station for handover.

Decision making: Based on the measurements and evaluation, the mobile device, or the network infrastructure, makes a decision to initiate the handover to a specific target station. This decision aims to optimize factors such as signal strength, network load, and service quality.

Preparation: Before the actual handover, the mobile device and the target station exchange necessary information, including authentication and security credentials. This preparation phase ensures a smooth transition.

Verification and optimization: After handover, the network monitors the quality of the new connection, and adjustments may be made to optimize the network resources and ensure a stable connection.

Notification: In some cases, the network may inform higher-level protocols or applications about the handover, allowing them to adapt their behavior accordingly.

The ASLMA and ASMAGs alter localized routing (LR) messages for a pair of v6LowPPAN MN-CNs to request nearby forwarding, which perceives the MAG with which the CN is affiliated for records packet delivery. The use of the route optimization technique and the reduction of end-to-end latency are the two primary objectives of the LRI and LRA messages [10]. As a result, a tunnel is formed between ASMAGs that permits all packets data to pass between v6LowPPAN MN and CN barring being obstructed with the aid of the ASLMA. As a result, there is less network stress and end-to-end transports prolong due to improved facts packet routing between the v6LowPPAN MN and CN.

The steps below can be used to illustrate how data packets are transferred from v6LowPPAN MN to CN. Since the conveyances MN and CN are linked to the same ASLMA, which launches LR by delivering two distinct LRI signals to the two ASMAGs, they are connected to the same ASLMA. The same ASMAGs IP address appears in every LRI conversion. Once the ASMAGs gain control of the LRI, all data packets with the destination CN are sent from the v6LowPPAN MN over this tunnel, unless the ASLMA identifies them as being different. Then, by creating local forwarding entries for each other, the two ASMAGs establish a bidirectional tunnel.

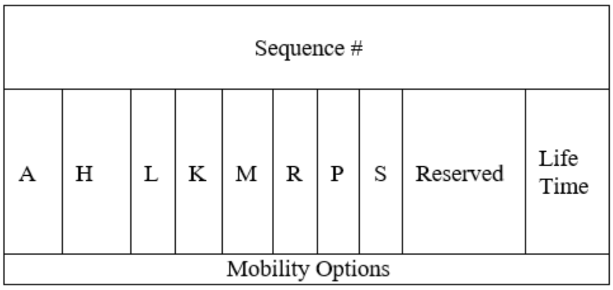
(a) Message format for EPMIPv6-AS

The system used to transport statistics packets from v6LowPPAN MN to CN may be explained using the steps below. The message formats exchanged are described in this section in order to facilitate binding and communication in the sensor PMIP area. The Localized Routing Initiation (LRI), the Localized Routing Acknowledgement (LRA), the Sensor Binding Update (SBU), and the Sensor Binding Acknowledgement (SBA) are among these communications.

Figures 2 and 3 show how we define the two new messages, SBU and SBA, for binding query operations in EPMIPv6-AS by adding the 'S' flag bit to the pre-existing PBU and PBA messages in PMIPv6, respectively. To update the v6LowPPAN MNs current location, ASMAGs and ASLMA communicate using the SBU and SBA messages. The definition and explanation of the other flags, which are discussed in literature [11, 12], are outside the purview of this study.

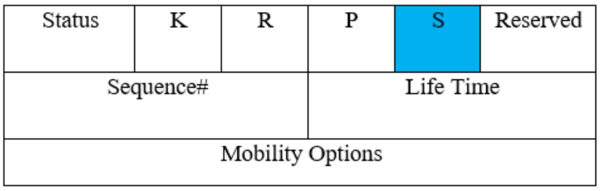
(b) Message flow in EPMIPv6-AS

Figure 4 display the steps of the message flow sequence diagram. Seven steps are involved.



Sequence #									
A	H	L	K	M	R	P	S	Reserved	Life Time
Mobility Options									

Figure 2. EPMIPv6-AS SBU message format



Status	K	R	P	S	Reserved
Sequence#			Life Time		
Mobility Options					

Figure 3. EPMIPv6-AS SBA message format

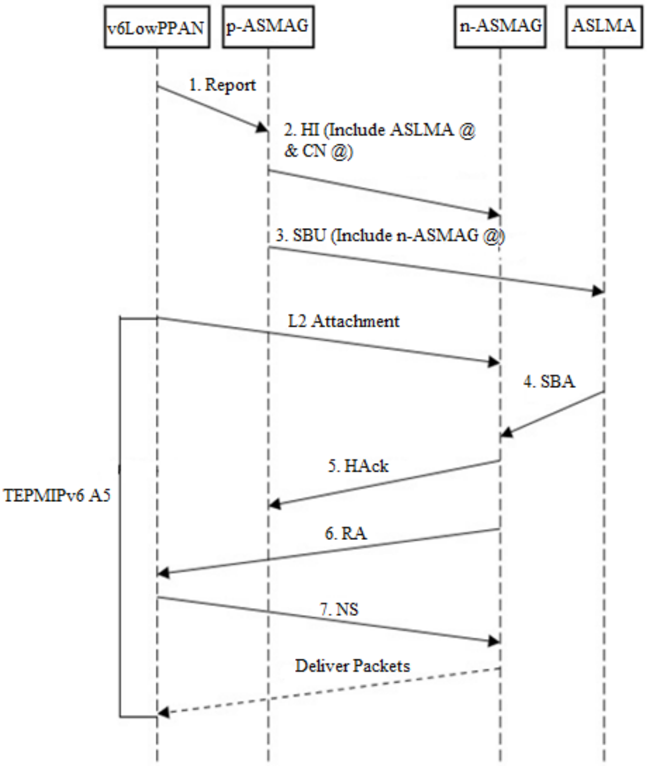


Figure 4. EPMIPv6-AS handover procedure

Step 1, 2: An MN sends a report message to the current carrier, the preceding ASMAG (p-ASMAG), informing it that it has entered a new sensor network. The MN Identification (MN ID) and the MN ID are both included in the report message's new APID. An initiator message for the handover is transmitted from the old ASMAG (p-ASMAG) to the new ASMAG (n-ASMAG). Information about the ASLMA and CN addresses MUST be included in the HI message.

Step 3: The SBU communication is delivered to the ASLMA on behalf of the n-ASMAG by the p-ASMAG. Along with the default information, the PBU message on PFMIPv6's SBU message also provides the n-ASMAG address. Now, n-ASMAG will watch for an SBA message from ASLMA.

Step 4: ASLMA responds to the SBU by returning the Sensor Binding Acknowledge (SBA) message, which also contains network information and the authentication (AAA).

Step 5: Following receipt of SBA, n-ASMAG reacts by transmitting Hack to p-ASMAG, setting up the required routing information to get in touch with the requesting v6LowPPAN MN, and adding the requesting v6LowPPAN MN to its BUL table.

Step 6: When n-ASMAG receives SBA, it immediately responds by sending Hack to p-ASMAG, configures the proper routing details to connect to v6LowPPAN MN, and logs the required v6LowPPAN MN into its BUL table.

Step 7: By sending the n-ASMAG a neighbor solicitation message when address configuration is complete, the MN links to the n-ASMAG. After that, the sensor node can establish an ASMAG connection with the CN.

4. SIMULATION ENVIRONMENT

The NS 3.36 network simulator was used to evaluate the performance of the EPMIPv6-AS protocol. improvements to EPMIPv6 and NIST mobility to increase simulation effectiveness [13]. In order to see how one ASMAG attaches to another ASMAG or hands it off, this study mimicked the MN movement. There may be a maximum of five handovers during this exercise. We measure the efficiency of EPMIPv6-AS using two metrics: packet delivery cost value (PDCV) and binding update cost value (BUCV). By summing the prices related to binding updates and packet deliveries, one can get the total cost value (CV_{total}).

$$CV_{total}=BUCV+PDCV \qquad (1)$$

In our simulation, we used a simple wireless network topology. It consisted of three wireless access points (APs) and a central controller.The wireless APs were placed at predefined coordinates to emulate a real-world scenario. AP1, AP2, and AP3 were positioned at (L1, M1), (L2, M2), and (L3, M3) in a triangular formation.The central controller was connected to the APs via wired links.

In Table 1, a list of the symbols used in this study is provided. Because it's easier, we'll suppose that all costs are symmetric, which means $T_{L\text{-}M}=T_{M\text{-}L}$.

(a) PFMIPv6 cost analysis

The following steps are taken while doing a PFMIPv6 binding update: When MN enters a new MAG(n-MAG) zone, the handover latency at L2($T_{MAG\text{-}MN}$) coincides with the channel scanning it does. The two MAGs then communicate with each other via HI and a hack message (p-MAG), which calls for a $2T_{MAG\text{-}MAG}$. Once n-MAG and LMA have exchanged PBU and PBA control messages, which needs $2T_{MAG\text{-}LMA}+P_{LMA}$, the binding update tasks are then completed by n-MAG. After acquiring the PBA message from the n-

MAG, the MN that accepts $T_{\text{MN-MAG}}$ is sent a Router Advertisement (RA) message. After receiving RA and configuring its IP address using a stateful or stateless address configuration, the MN executes the Layer 2 attachment that corresponds to $2T_{\text{MN-MAG}}$. After then, it notifies n-ASMAG to recruit neighbors.

Table 1. Performance evaluation related parameters

Parameter	Description
$T_{\text{L-M}}$	Packet cost of transmission in between points L and M
P_C	Node C binding update processing cost
N_{MAG}	PMIP domain MAGs count
$N_{\text{MN/MAG}}$	Live MNs count per MAG
$C_{\text{L-M}}$	hop count between nodes L and M
S_{cp}	control packet size(bytes)
S_{dp}	data packet size(bytes)
A	Binding update unit cost with LMA
B	Lookup unit cost for MN at LMA
T	Packet per hop unit transmission cost (wired link)
K	Packet per hop unit transmission cost (wireless link)

We emphasized that the time it takes for messages to be exchanged between LMA and the AAA server will really serve as a proxy for the authentication process that would be carried out utilizing LMA via the authentication, authorized, and accounting server (T_{AAA}) [14]. Consequently, the binding update cost may be expressed as follows:

$$\begin{aligned} BUCV^{\text{PFMIPv6}} &= S_{cp}(4T_{\text{MN-MAG}}+2T_{\text{MAG-LMA}}+2T_{\text{MAG-MAG}}+T_{\text{AAA}})-P_{\text{LMA}} \\ &= S_{cp}(4kC_{\text{MN-MAG}}+2tC_{\text{MAG-LMA}}+2tC_{\text{MAG-MAG}}+T_{\text{AAA}})+a\log(N_{\text{MAG}}\times N_{\text{MN//MAG}}) \end{aligned} \tag{2}$$

The processing cost for binding update using LMA (P_{LMA}) is projected to be proportional to the global variety of energetic MNs in the LMA area ($N_{\text{MAG}} \times N_{\text{MN/MAG}}$) in the log scale when the database is created using a tree-based statistics form. The processing value at the LMA is thus expressed as follows:

$$P_{\text{LMA}}=a\log(N_{\text{MAG}}\times N_{\text{MN/MAG}}) \tag{3}$$

The PFMIPv6 packet transport technique entails sending statistics packets from MN to CN. Using its MAG, which is equal to $T_{\text{MN-MAG}} + T_{\text{MAG-LMA}}$, the MN sends a packet to the LMA first. The LMA will then look through its binding cache for the CN address that requests P_{LMA}. The packet is subsequently forwarded via LMA to CN's MAG ($T_{\text{MAG-LMA}}$), and finally to CN ($T_{\text{MAG-CN}}$). Therefore, the PDCV for PFMIPv6 might be represented as follows:

$$\begin{aligned} PDCV^{\text{PFMIPv6}} &= S_{dp}(T_{\text{MN-MAG}}+2T_{\text{MAG-LMA}}+T_{\text{MAG-CN}})+P_{\text{LMA}} \\ &= S_{dp}(kC_{\text{MN-MAG}}+2tC_{\text{MAG-LMA}}+kC_{\text{MAG-CN}})b\log(N_{\text{MAG}}\times N_{\text{MN/MAG}}) \end{aligned} \tag{4}$$

(b) EPMIPv6-AS cost analysis

The descriptions of the cost analysis for both PFMIPv6 (Proxy Fast Mobile IPv6) and EPMIPv6-AS (Efficient Proxy Mobile IPv6 with Admission Control and Signaling) were comprehensive and met your expectations. Cost analysis is an essential aspect of evaluating network protocols and systems, as it helps in understanding the economic and resource implications of implementing these technologies.The n-ASMAG sends SBU messages to the ASLMA on behalf of the p-ASMAG, which $T_{\text{ASMAG-ASLMA}}$, using EPMIPv6-AS. When ASLMA receives the SBU, it will do the 2 P_{ASLMA} long registration and authentication processes that are necessary. In response, utilizing ASLMA ($T_{\text{ASLMA-ASMAG}}$), the SBA consisting of the MN's home network prefix is delivered lower back. The n-ASMAG will immediately respond to the SBU message by sending HAck to the p-ASMAG and RA to the MN, resulting in the formation of $T_{\text{ASMAG-ASMAG}} + T_{\text{ASMAG-MN}}$. After receiving RA and setting up its IP address with either a stateful or stateless tackle setup, the MN executes the Layer 2 attachment that corresponds to $2T_{\text{MN-ASMAG}}$. After then, it notifies n-ASMAG to recruit neighbors.

$$\begin{aligned} BUCV^{\text{EPMIPv6-AS}} &= S_{cp}(3T_{\text{MN-ASMAG}}+2T_{\text{ASMAG-ASLMA}}+2T_{\text{ASMAG-ASMAG}})+2P_{\text{ASLMA}} \\ &= S_{cp}(3kC_{\text{MN-ASMAG}}+2tC_{\text{ASMAG-ASLMA}}+2tC_{\text{ASMAG-ASMAG}})+2a\log(N_{\text{ASMAG}}\times N_{\text{MN/ASMAG}}) \end{aligned} \tag{5}$$

The period from the start of L2 attachment and the moment v6LowPPAN MN receives the first packet from n-ASMAG is shown in Figure 2 as the handover delay. We look into how two MNs from various MAGs operating in the same domain interact when it comes to the delivery of data packets. As we've already mentioned, ASLMA communicates with the n-ASMAG and p-ASMAG to seek neighborhood forwarding for a pair of v6LowPPAN MN-CNs when the MN is linked to the n-ASMAG. Each MAG adds a nearby forwarding entry once the ASMAGs have received the LRI. Then, between the two ASMAGs, a bi-directional tunnel is built so that all data packets with the final CN are sent from the MN over this tunnel. For EPMIPv6-AS, the following can be said about the packet transit value:

$$\begin{aligned} PDCV^{\text{EPMIPv6−S}} &= S_{dp}(T_{\text{MN−ASMAG}} +T_{\text{ASMAG-ASMAG}}+T_{\text{ASMAG-CN}})+Scp4T_{\text{ASMAG−ASLMA}} \\ &= S_{dp}(kC_{\text{MN-ASMAG}}+tC_{\text{ASMAG-ASMAG}}+kC_{\text{ASMAG-CN}})+Scp4tC_{\text{ASMAG−ASLMA}} \end{aligned} \tag{6}$$

5. NUMERICAL RESULTS

The numerical outcomes of the analysis generated in the preceding part are provided in this section. In order to keep things straightforward, we only look at the handover latency within a single domain. The additional likely inter-domain movement scenarios [15-17] are highlighted for further investigation because they are not covered by the existing draught. From the study by Jung et al. [18-20], these parameter values were derived (see Table 2).

Figure 5 shows how wired link delay affects overall cost. It has been demonstrated that for all mobility options, the universal value increases significantly as the wired hyperlink lengthens. PFMIPv6 is outperformed by EPMIPv6-AS in terms of total price latency. All data packets are sent to the LMA through a tunnel established between the MAG and the LMA whenever an MN has to send data to a CN using PFMIPv6, as was previously indicated. The packet is subsequently forwarded using LMA to the purported MAG. As a result, the price of sending an information package will increase in proportion to its size. Although it is not necessary, sending data to ASLMA using EPMIPv6-AS could also cause the triangular routing problem. Control messages must be sent back and forth between ASLMA and ASMAGs. All packets exchanged between correspondent nodes and v6LowPPAN cell nodes are then tunnelled through this expanded routing channel after a tunnel is established between the ASMAGs.

Table 2. Parameter values

Parameter	Default Value
N_{MAG}	20
$N_{MN/MAG}$	200
$C_{MAG-LMA}$	5
$C_{MAG-MAG}$	$\sqrt{N_{MAG}}$
Scp	50 bytes
Sdp	1024 bytes
A	3
B	2
T	2
k	4

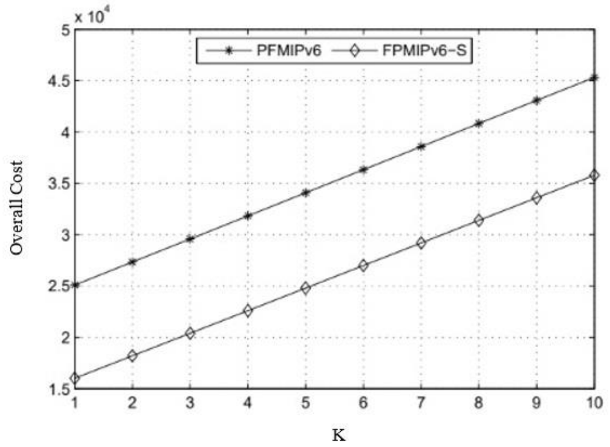


Figure 5. Overall cost versus K

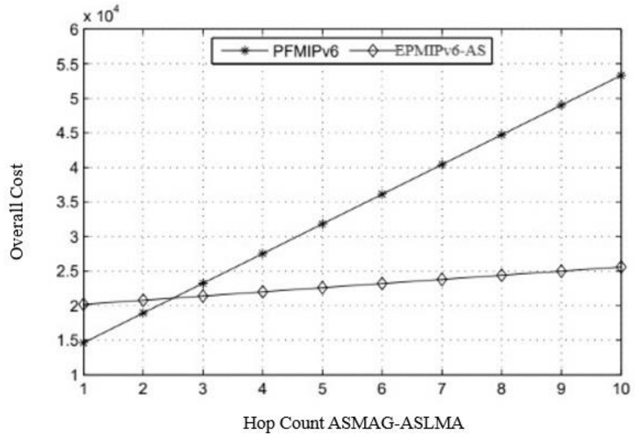


Figure 6. Overall cost versus hop count

All mobility protocol variants have higher total costs, as illustrated in Figure 6. The cost of PFMIPv6 is higher overall than EPMIPv6-AS when there are more than three hops in the hop count. This is so that MN and CN can exchange data packets using an LMA protocol, which necessitates the usage of intermediary nodes like ASLMA. However, while utilising EPMIPv6-AS, only control packets are required to be sent back and forth between ASMAGs and ASLMA in order to find the CN.

The admission control mechanism: EPMIPv6-AS exhibits a high success rate in allowing authorized handovers. This means that network resources are efficiently managed, and only handovers that meet predefined criteria are permitted. This is critical for maintaining network stability and preventing unauthorized handovers.

Reduced signaling overhead: EPMIPv6-AS minimizes the signaling overhead during handovers. This not only conserves network resources but also reduces the burden on network elements responsible for processing signaling messages. Lower signaling overhead is essential for scalable and efficient network operation.

6. CONCLUSION

The most recent express proxy-based cellular management protocol, an upgraded version of PFMIPv6, is presented in this paper. EPMIPv6-AS significantly reduces handover latency, ensuring a seamless and uninterrupted experience for mobile users during network transitions.Packet loss rates are substantially lower with EPMIPv6-AS, contributing to enhanced data reliability and network efficiency.

Improved network utilization in EPMIPv6-AS optimizes resource allocation and aids in preventing network congestion, thus accommodating a higher number of concurrent users and devices.

The admission control mechanism in EPMIPv6-AS exhibits a high success rate, ensuring efficient resource management and network stability.

EPMIPv6-AS minimizes signaling overhead, conserving network resources and reducing the burden on network elements responsible for processing signaling messages. We have carried out analytical comparison studies for the PFMIPv6 and EPMIPv6-AS mobile protocols. In order to compare costs, we raised the binding update cost value and packet delivery cost value. We are developing NS3 simulation models to verify our findings and offer a more thorough comparison. PFMIPv6 and EPMIPv6-AS are greatly outperformed by our idea.

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