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A SURVEY OF MOBILITY MANAGEMENT PROTOCOLS

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ABSTRACT

In these recent years, the number of mobile devices increases exponentially. All these Internet network mobile device services are supported by the mobility management protocols. However, data of these different types of mobility management protocols are not sufficient. Moreover, the design of network topology of these mobility management protocols are least developed. In this paper, we discover and develop the existing IPv6 mobility management protocols in On Vehicular Ad Hoc Network (VANET) and Wireless Mesh Network environment (WMN). The VANET is proposed to manage the inter network mobility management. The WMN is proposed to manage the intra network mobility management. We identify and analyze each IPv6 mobility management protocol's characteristic and performance indicator. Then, we proposed to compare and enhance the performance of each IPv6 mobility management protocols in terms of latency, throughput and packet loss ratio. Through the proposed conducted numerical results, we are able to summarized the considerations of performance for Host-based mobility management protocols and Network-based mobility management protocols both in VANET and WMN.

Keywords: host-based mobility management protocol, network-based mobility management protocol, VANET, WMN.

INTRODUCTION

Mobile wireless ecosystems facilitate more rapid growth of digital ecosystems for human lives [1-6]. These wireless ecosystems are essential for mobility management protocols. Various mobility management protocols for enabling mobility services have been introduced. The mobility support protocols are classified into two categories. First, host-based mobility management protocols such as Mobile Internet Protocol version 6 (MIPv6) [7], and its enhancement like Fast Handover Mobile Internet Protocol version 6 (FMIPv6) [8], Hierarchical Mobile Internet Protocol version 6 (HMIPv6) [9] and Fast Handover for Hierarchical Mobile Internet Protocol version 6 (FHMIPv6). Beside the host-based mobility management protocols, network-based mobility management protocols are invented to overcome the weaknesses of host-based mobility management protocols. The network-based mobility management protocols include Proxy Mobile Internet Protocol version 6 (PMIPv6) and Fast Proxy Mobile Internet Protocol version 6 (FPMIPv6). Proxy Mobile IPv6 (PMIPv6) is a network-based mobility management protocol that allows an Mobile Node to change its point of attachment without any mobility signaling processed at the MN [10]. Two types of mobility service provisioning entity are introduced in PMIPv6: mobility access gateway (MAG) and local mobility anchor (LMA). As an extension protocol to PMIPv6, Fast Proxy Mobile IPv6 (FPMIPv6) [11] has been later been developed to accelerate the handover performance by reducing handover latency and preventing packet loss. As shown in Figure-1, its represents concepts and the differences between host-based and network-based mobility management protocols. The Figure-2 shows the existing IPv6 mobility management protocols in On Vehicular Ad Hoc Network (VANET) and Wireless Mesh Network environment (WMN).

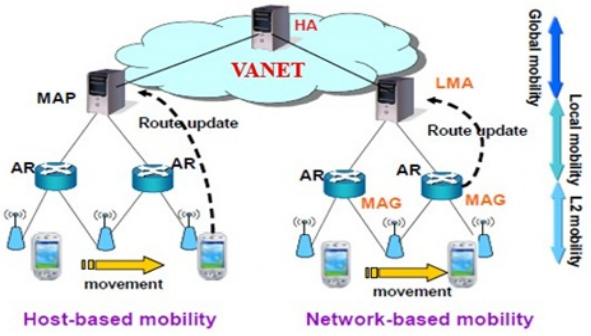

Figure-1. Host-based vs. network-based mobility management protocols.

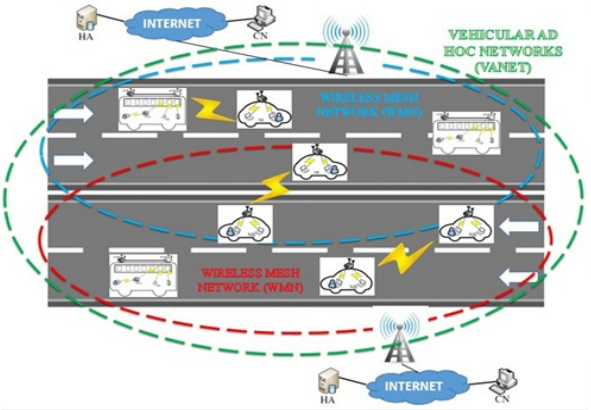

Figure-2. Existing IPv6 mobility management protocols in on vehicular ad hoc network (VANET) and wireless mesh network environment (WMN).

In this research paper, both the Host-Based Mobility Management Protocols and Network-Based Mobility Management Protocols are investigated firmly on vehicular ad hoc network (VANET) topology environment. Each mobility management protocols are developed and analysed in VANET environment which is considering the performance parameters: packet loss ratio, delay/latency and throughput. The rest of the paper is organized as follows: Related Works is discussed in section II. In section III, the Terminology is discussed. In section IV, the discussion and enhancement are discussed. Lastly, the conclusion is discussed in section V.

RELATED WORKS

Lee, *et al*., had investigated "Comparative Handover Performance Analysis of IPv6 Mobility Management Protocols". The researchers compared the host-based mobility management protocols and network-based mobility management protocols to identify the optimized routing protocol for mobile network. The host-based mobility management protocols include Mobile IPv6 and its extensions such as Fast Mobile IPv6 and Hierarchical Mobile IPv6 while network- based mobility management protocols include Proxy Mobile IPv6 (PMIPv6) and Fast Proxy Mobile IPv6 (FPMIPv6). These mobility management protocols have been standardized. The existing IPv6 mobility management protocols are developed by the IETF and have been analysed and compared in terms of handover latency, handover blocking probability, and packet loss. The conducted analysis results can be used to identify each mobility management protocol's characteristics and performance indicators. The results obtained are used to facilitate decision making in development a new mobility management protocol.

X. Perez-Costa, *et al.*, [13] had investigated "A Performance Comparison of Mobile IPv6, Hierarchical Mobile IPv6; Fast Handovers for Mobile IPv6 and their Combination". The researches had perform simulation using the (NS-2) Network Simulator version 2 software. The simulation scenario comprises four access routers and up to 50 mobile nodes. The performance matrix that researches have been taken into count are handoff latency, packet loss rate, achieved bandwidth per station and signaling load. The authors concluded that, both the FMIPv6 and the combined version FHMIPv6 were performed well during the simulation testing with low packet losses, lesser latency and also fair amount of bandwidth achieved.

J.-H. Lee, *et al.*, [14], had investigated "Cost analysis of IP Mobility Management Protocols for Consumer Mobile Devices". The analytical cost model has been developed for evaluating the performance of IPv6 mobility management protocols. The IPv6 mobility management protocols such as MIPv6, FMIPv6, HMIPv6, and PMIPv6 are analysed and compared in terms of signaling cost, packet delivery cost, tunneling cost, and total cost. PMIPv6 has been compared with the host-based mobility management protocols, but the recently developed FPMIPv6 protocol has not been considered.

Zimani Chitedze and William D. Tucker [15] had investigated "FHMIPv6-based Handover for Wireless Mesh Networks (WMNs)". The authors have compared four types of mobile routing protocol to identify the optimized routing protocol for mobile network, that are Mobile Internet Protocol version 6 (MIPv6), Fast Handover Mobile Internet Protocol version 6 (FMIPv6), Hierarchical Mobile Internet Protocol version 6 (HMIPv6) and Fast Handover for Hierarchical Internet Protocol version 6 (FHMIPv6). Network Simulator (ns-2.32) version 2.32 has been used to conduct the simulation experiment. The authors have been taken into account the performance matrix of throughput, average delay, and packet loss. The overall simulation results show that Fast Handover for Hierarchical Internet protocol version 6 (FHMIPv6) performed extremely well compared to other protocols in Wireless Mesh Networks (WMNs).

TERMINOLOGY

In this section, general terms used in this research are discussed in details. Having known these, host-based and network-based mobility management protocols are discussed in details. Then, wireless mesh network is also discussed in details in the following discussions.

Host-based mobility management protocols

Host-based mobility management protocols include Mobile Internet Protocol version 6 (MIPv6), and its enhancement such as Fast Handover Mobile Internet Protocol version 6 (FMIPv6), Hierarchical Mobile Internet Protocol version 6 (HMIPv6) and Fast Handover for Hierarchical Mobile Internet Protocol version 6 (FHMIPv6). Host-based mobility management protocols are deployable in wireless mobile communication infrastructures, communication service providers and standards development organizations. These mobility management protocols have identify that such conventional solutions for mobility service are not suitable; in particular, for telecommunication service. The reason is because mobile node (MN) is required to perform mobility functionalities at its network protocol stack inside, and thus, modifications or upgrades of the MN are needed. It obviously increases the operation expenses and complexity for the MN. The host-based mobility management protocols also cause lack of control for operators since the MN manages its own mobility support. Accordingly, a new approach to support mobility service has been required and pushed by the 3rd Generation Partnership Project to the IETF. Figure-3 represents the type of IPv6 in host-based mobility management.

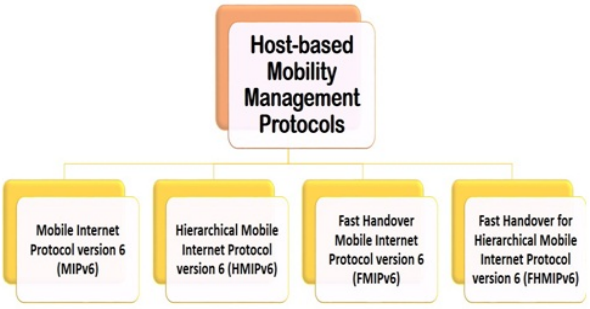

Figure-3. Types of host-based mobility management protocols.

Network-based mobility management protocols

Network-based Localized Mobility Management (NetLMM), allows conventional IP devices (for example, devices running standard protocol stacks) to roam freely across wireless stations belonging to the same local domain. This property is appealing from the operator's viewpoint because it allows service providers to enable mobility support without imposing requirements on the terminal side (for example, software and related configuration). Figure-4 represents the type of IPv6 in network-based mobility management.

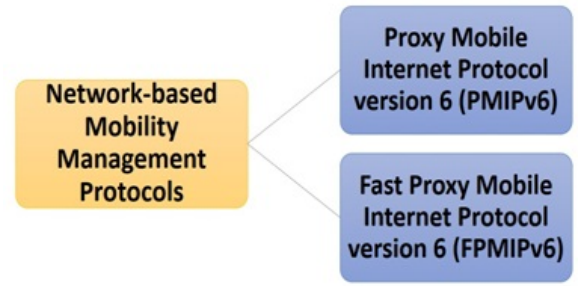

Figure-4. Types of network-based mobility management protocols.

Vehicular ad hoc network

VANET is an intelligent vehicular Ad-hoc network which uses WiMAX IEEE 802.16 and WiFi IEEE 802.11for efficient communication between vehicles with varying mobility. VANET is a type of Mobile ad hoc network (MANET) which provides communication among vehicles and vehicles and fixed equipments nearby usually these are called as roadside equipments. The key difference between MANET and VANET is as VANET as special mobility pattern and rapidly changing topology. The existing routing protocols of MANET cannot implement in VANET. VANET are widely used to support the growing number of wireless products which can be used in vehicles. VANET is a special type of mobile ad-hoc network which is divided into V2I and V2V networks. Due to various architectural differences between V2I and V2V communications, their mobility management patterns are designed differently. V2I communication is designed based on the internet mobility management protocols due to interoperability and compatibility reasons (e.g., mobile IPv6). For mobility management in V2V communication, it mainly emphasis on route discovery, maintenance and recovery.

Wireless mesh network

Wireless mesh networks are becoming the preferred way to deliver voice, video and data in outdoor environments. A wireless mesh can deliver the same network capacity, reliability and security that are once reserved for wired networks – but with the flexibility of wireless. With today's state-of-the-art solutions, municipalities, public safety agencies, port authorities, and industrial organizations can rely on mesh networks to provide essential connectivity to their workers and constituents.

A mesh is a multi-path, multi-hop wireless local area network (WLAN) and wide area network (WAN) that are ideal for outdoor deployment. With a mesh, reliable networking can be established almost anywhere without the cost and disruption of running cabling or fiber. With a powerful multiservice mesh platform, organizations can combine formerly separate voice, video and data networks onto a single network. As a result, the converged network is simpler to manage and operate, while the organization retains control over the delivery of multiple services. In addition, fewer devices are required, so the network is less expensive to purchase and maintain. A mesh is resilient and low maintenance. A modern mesh network automatically discovers the best route through the network and operates smoothly even if a mesh link goes down or a node fails. The reason is because the network is self-forming and self-healing, administration and maintenance costs are lower. In addition, a wireless mesh overcomes the line-of-sight issues that may occur when a space is crowded with buildings or industrial equipment.

Having discussed the management and mobility management over the networks, in this research, Mobile Internet Protocols (MIPv6, FHMIPv6, HMIPv6, FHMIPv6, PMIPv6 and FPMIPv6 on WMN) are investigated firmly in terms of performance matrix: delay/latency, throughput and packet loss. The Wireless Mesh Network (WMN) topology is developed by using network simulation software (NS-2).

DISCUSSION & ENHANCEMENT

In this paper, host-based mobility management protocols and network-based mobility management protocols were developed and simulated in vehicular ad hoc network (VANET) environment and Wireless Mesh Network(WMNs) environment in Network Simulator version 2 (NS-2). The characteristic and performance of each mobility management protocols in VANET and WMN were fully discovered and analysed. Table 1 shows the detail characteristics of each mobility management protocols.

Additionally, the characteristic to select the optimized mobility management protocols are also shown in Table-2. The system can select the optimized mobility

management protocols for wireless device based on those characteristics.

Table-1. Detail characteristics of mobility management protocols (VANET and WMN).

Characteristics of Mobility Management Protocols	
Host-Based Mobility Management Protocols	Network-Based Mobility Management Protocols
❖ General Model/ Macro mobility	❑ Micro/ Intra domain mobility
❖ High handoff latency	❑ Fast handoff / Low handoff latency
❖ Location-independent routing	❑ Reduction in packet loss
❖ High signaling load	❑ Reduction in mobility –related signaling
❖ Movement detection and agent discovery	❑ High transmission reliability
❖ Tunneling and routing (triangular routing)	❑ Support for Quality of Services (QoS)

Table-2. The characteristics of optimized mobility management protocols (VANET and WMN).

Characteristics of Optimized Mobility Management Protocols
➢ Fast handover / Low handover latency
➢ Seamless Handover / No Packet Loss
➢ Signaling Overhead (DB access)
➢ High Routing Efficiency / High Throughput
➢ Support Quality of Services (QoS)
➢ Fast Security (Key Exchange)
➢ Special changes

Figure-5. Characteristics of OMMP

CONCLUSIONS

In this paper, two types of mobility management protocols that are Host-based and Network-based were developed and compared in vehicular ad hoc network (VANET) and Wireless Mesh Network (WMNs) environments. The performance of Host-based Mobility Management Protocols and Network-Based Mobility Management Protocols in vehicular ad hoc network (VANET) and Wireless Mesh Network (WMNs) environment are proposed to be improved in terms of packet loss decreases, throughput increases and handover latency decreases. The improved performance of Host-based Mobility Management Protocols and Network-based Mobility Management Protocols in vehicular ad hoc network (VANET) and Wireless Mesh Network (WMNs) optimize speed Internet services to mobile devices.

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