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Mobile IPv6 Security Performance Metrics for WIMAX Roaming Environment

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Abstract*: To provide uninterrupted communication services the IETF standardized the various communication protocols. Mobile Internet Protocol is first standard protocol and responsible for secure and reliable communication, while the mobile user switches from one geographical area to another. For such a scenario, two or more devices are permissible to exchange information, while one or more devices changing the geographical location. The implementation of mobility management protocols suffers from various challenges, such as, delay to reach data packet to its destined device, load on network, long queuing delays to data packets and it results the time out error and packet loss, reduced throughput etc. To reduce these parametric factors, concept of encryption and proxy are enabled in the proposed simulation scenarios, and new measurement to these parametric values is taken. The comparative performance needs to be measured through OPNET Modeler and results show that the proposed scheme is better than the existing one.

Keywords*: Mobile Internet Protocol; WIMAX; Handover; Load; Delay; Throughput.

I. INTRODUCTION

Mobile Internet Protocol (MIP) [1] version 4 was proposed and standardized by Internet Engineering Task Force (IETF) in 2002. Later on, to overcome from limited address space problem and to serve unique IP address to future generation handheld devices, IETF proposed Mobile IP version 6 (MIPv6) [2,3]. It provides more efficient, secure and reliable communication than MIPv4 [4]. Working of MIP can be validated to operate on both wired as well as wireless networks, and can provide uninterrupted connectivity with minimum intervention and maximum throughput [5]. MIP permits users to work on location-independent routing mechanism. Permanent IP address is provided to every mobile node in a network. This IP address helps every mobile device to establish a reliable and standardized communicating state. MIP can be successfully implemented in various applications, such as Virtual Private Network (VPN) [6], Voice over IP (VoIP) [7], etc.

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MIP is designed to maintain consistent Transport Communication Protocol (TCP) [8] connection in between the communicating devices on a continuous basis. MIP facilitates the concept of tunnelling [9,10]. Tunnelling allows the set of communicating devices to find a reliable communication link between end communicating devices, i.e. the best route for data packet to travel from one mobile device and another through various networks. Tunnelling facilitates some factors of both encryption and proxy to all the datagrams or data packets that uses it in some network. When proxy is applied along tunnelling, it acts as middle-man in between the two communicating nodes in MIPv6 environment, i.e. Mobile Node (MN) [1, 9] and Correspondent Node (CN) [2, 9].

Proxy is used, in between MN and CN, to provide encrypted and encapsulated datagrams. When this proxy act is introduced in a network, no breakthrough by an individual third-party network can be performed.

Furthermore, paper can be sectioned in detail as follows: Section II underlines the handover method of communication in MIPv6 environment. Section III discusses about configuration of proposed scenario and computation of performance for different nodes in a network that facilitates communication. Section IV consists of comparative analysis of different communicating devices to measure performance metrics, such as load, delay, throughput, utilization in terms of packets/sec.; Section V, comprises conclusion.

II. HANDOVER MANAGEMENT IN MIPV6

MIP is a network layer protocol and independent of physical connection between end-to-end devices. It allows mobile nodes to stay reachable in IP environment. MIP is capable to provide services to Wi-Fi, Mobile WiMAX, Satellite link or 3G/4G network. An IP address is responsible to maintain the data session in MIPv6 environment. MIPv6 introduces two IP address to provide seamless communication. These IP addresses [1,2] are:

- Home Agent (HA) Address: A static IPv6 address within the home network.
- Care of address (CoA): An IP address that is used for uniquely identification of MN's current location in visiting network.

Consider the situation, when mobile node is visiting in network other than home network. CN sends a data packet to MN present visiting location. Firstly, the data packet is transmitted to the HA. The HA encapsulates the data packet by adding an outer header.

The header contains source address as home agent and destination address as CoA and tunnels the received data packets to the destination. MN decapsulates the received data packet to identify the original sender i.e. CN. Fig. 1 shown the packet transmission from CN to MN through HA.

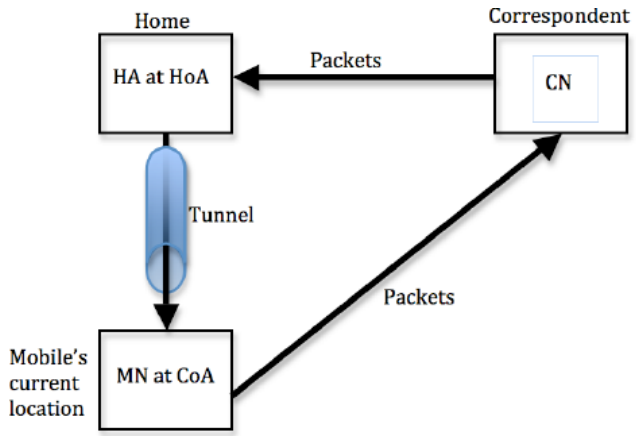

Fig. 1.Communication Process Between CN And MN

The purpose of MIPv6 is to establish a reliable communication link and constantly exchange information in between MN and CN. MIPv6 will have to study and measure performance metrics for the communication. This type of network type generally follows the process of handover. Handover management [11-16] is a method in which MN travels from its home network towards the foreign network. The concept behind such communication is to maintain the reliable communication link and provide communication without any breakage to the data exchange. The entities [1,2,9,10] that are facilitated in any MIPv6 environment can be namely:

A. Home Agent (HA)

HA is accountable to maintain a database consisting of all the permanent address for each and every MN that belongs to the home network, particularly. HA upholds a Binding Cache Entry (BCE). BCE maintains a pair of addresses i.e. Home Address (HoA) and Care-of Address (CoA). Using every MN's CoA, current location of each MN, that belongs to this particular home network.

B. Foreign Agent (HA)

FA is accountable to maintain a database consisting of information for each and every MN that visits to the visiting network. FA helps corresponding HA to efficiently justify the current location to one of the MN, belonging to a particular home network. This can be accomplished using a broadcasted CoA for that particular MN.

C. Mobile Node (MN)

MN is accountable to establish reliable two-way communication in between other nodes connected in any network. MN, in a network, can include parameter as mobility factor. MN can travel from its home network to foreign network without breakage to communication link.

D. Corresponding Node (CN)

CN is accountable mainly in exchanging and establishing reliable communication in between the CN and MN, and this can be implemented in two or more networks. CN exchanges information to MN, even when MN travels to other networks than its home network.

E. Tunneling

Tunneling helps in establishing reliable path that allows different in exchanging information between CN and MN. This concept acts virtually in any network, and is made to work whenever CN wants to exchange information to MN that has travelled to some foreign network. This task is accomplished by utilizing broadcasted CoA of that MN, respectively.

While communication is established, it has to be managed further. There exists a management scheme that manages on-going data session in between channel connected to the home network to some foreign channel; hence handover management is basically of two types in any network, such as:

- Hard Handover: Under hard handover procedure, MN is responsible to move from its home network to the visiting network. Data session is continued while MN is travelling to other networks. The two networks or channels are separated at some geographical distance and data session has to be maintained within distant networks. This introduces some intervention and data session is broken while travelling from home network to foreign network.
- Soft Handover: Under soft handover procedure, there is no or minimum intervention caused to the data session while MN is allowed to travel from its home network and towards destined foreign network. Reliable communication link is established in between the parallel channels in any network.

Fig. 2 depicts the handover management technique in two networks basically, i.e. home network (Network 1) and foreign network (Network 2). For both the handover technique's, MN is allowed to travel from its home network towards the foreign network, with a purpose to minimize the intervention caused while travelling to different network.

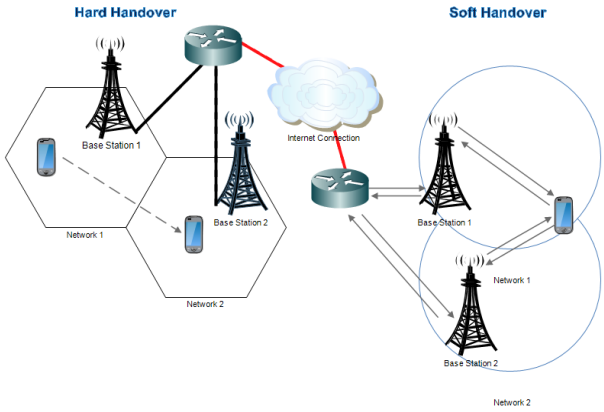

Fig. 2.Handover Management and its Types

III. SIMULATION MODEL

This section underlines the proposed simulation-based experiments under which different scenarios are made. To exhibit the simulation a number of mobile devices are taken into consideration. Performance of each communicating device is measured though specific parameters, such as delay, throughput, channel utilization, etc.

To provide seamless communication in MIPv6, the Worldwide Interoperability for Microwave Access (WIMAX) [17-21] is taken into consideration. WIMAX is one of the standard sets for all wireless communications that need to be established in any network Fig. 3 shows MIPv6 cellular networks.

WIMAX introduces a concept in with a cluster of MNs are grouped in one of the cell or home network and are allowed to move towards other networks.

A. Simple Handover in MIPv6 environment

Furthermore, in this scenario, all the MN and base stations are meant to operate onto simple MIPv6 environment.

B. Proxy Handover in MIPv6 environment

Under this scenario, all the MN and base stations are meant to operate with other communicating device with some proxy [22, 23] settings, so that reliable communication is established in between the communicating devices in any network.

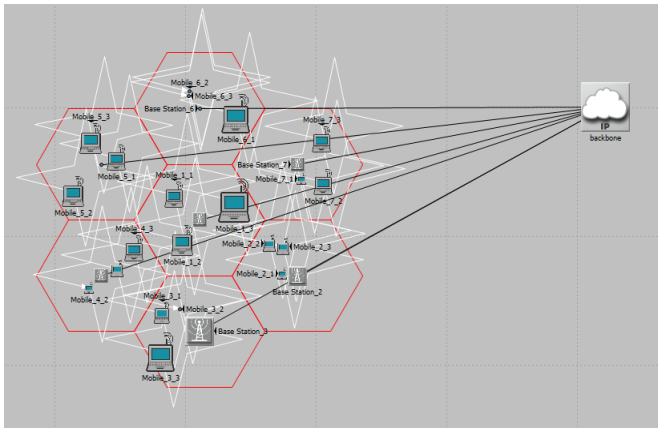

Fig. 3.An MIPv6 environment, consisting of cellular Network

To set-up both the scenarios in any network, a common configuration is made available. In our configuration consist of 29 mobile devices in each scenario, with 07 cells or network cells and 01 IP cloud [24]. Each cell consists 01 base station and 03 MN. Every MN is responsible to communicate other connected devices in a particular network, in motion.

IV. SIMULATION ANALYSIS AND RESULTS

Simulation section more concentrates on measuring the performance of all the connected devices and then compute performance factors for the proposed two scenarios in MIPv6 environment. The performance for each communicating device in such a network can be analysed in terms of delay (packets/sec), load (packets/sec) in a network, throughput (packets/sec), namely.

A. Delay

Delay [25], [26], as one of the performance metrics, can be more justified as the amount of time a device spent in transferring the data packets from a source to destined device. The delay factor should always be kept at minimum so that efficient data transmission can take place. Fig. 4 represents delay in a network onto both scenarios in terms of sec. It can be clearly seen that when proxy is applied along with the communicating base stations, delay factor has reduced up to some level.

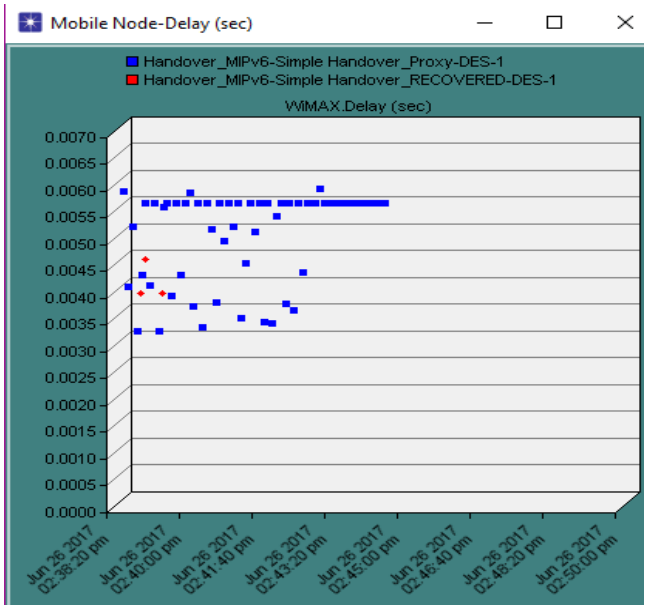

Fig. 4.Mobile Node in Cell 01: Delay in seconds

B. Load

Load [25,27,28], as one of the performance metrics, can be defined as the traffic that is flowing into the network endlessly. Unlikely, to the delay factor, load should be kept at minimum ranges, so that faster communication is done. Fig. 5 represents load in a network in terms of packets/sec.

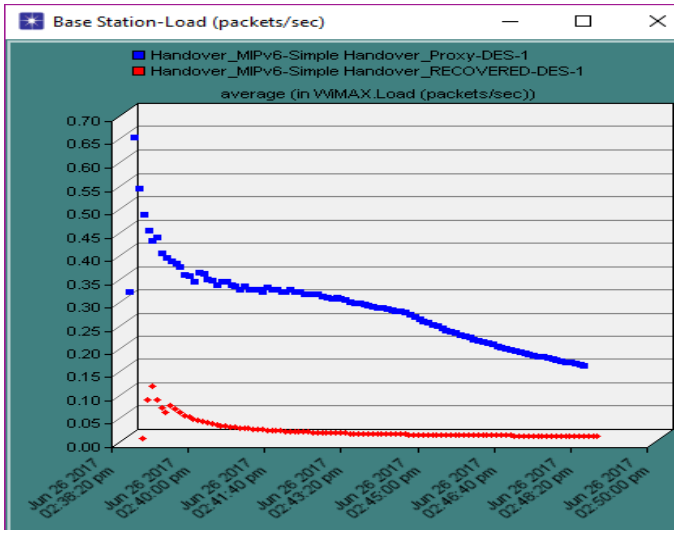

Fig. 5.Base Station in Cell 01: Load in packets/sec

The total delay that has occurred in both the scenarios at one of the base stations for cell 01. It is seen that as number of packets are increased load factor has reduced for the scenario in which proxy is made available to the base stations.

C. Throughput

Throughput [26, 29, 30], as one of another performance metrics, can be defined as rate at which, it can be said that, packet has been successfully delivered at the destined device in a network.

The rates at which successful transmissions can be attained, is formally known as throughput. Fig. 6 represents throughput in a network in terms of packets/sec.

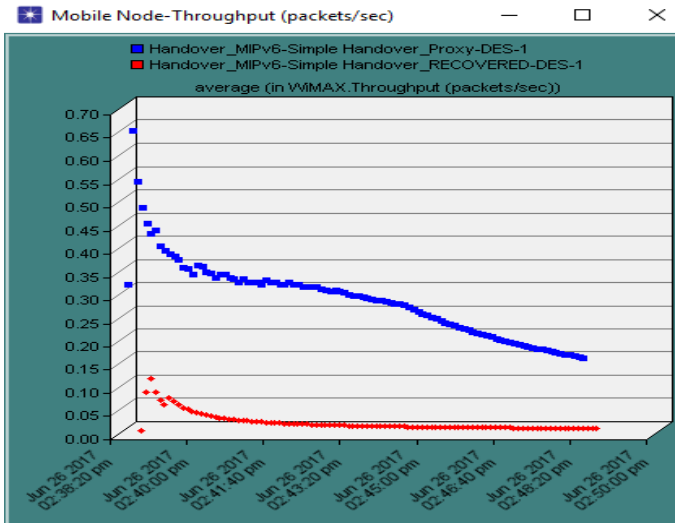

Fig. 6.Mobile Node in Cell 01: Throughput (packets/sec)

The throughput attained by proposed scenarios for one of the MN in cell 01. It can be seen that while operating with proxy communication link, higher levels to throughput has been attained.

V. CONCLUSION AND FUTURE SCOPE

MIPv6 is a technology that enables two communicating nodes, i.e. MN and CN in establishing reliable communication link and facilitates exchanging data packets while travelling from one network to another network in any of the proposed scenario. In the paper, the WiMAX is considered for communication in MIPv6 network. Two scenarios are proposed, for which different communicating devices are allowed to exchange data packets and maintain connectivity while travelling in between distant networks. For the proposed two scenarios, it is clearly justified, from simulation, that when proxy is applied with the existing network better throughput is attained, with reduced delay and load in a network.

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