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Performance Comparison Analysis of SSHMIPv6 and HMIPv6 Lost Packets using Network Simulator NS-2

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Abstract: In today's fast based technological growth the traditional networks are no longer capable of handling the increasing demands with the best Quality of Service (QoS) which depends on the type of service that network devices provide. The target of this study was to simulate different amount of transferred packets to show the performance of Smart Selection Hierarchical Mobile Internet Protocol version 6 (SSHMIPv6) with respect to lost packets. SSHMIPv6 environment has been simulated over NS-2 and used to evaluate the performance of SSHMIPv6 over HMIPv6 and to analyze the effect of adding multiple MAPs to serve each region. A decrease of 33% in lost packets was obtained by using three MAPs in SSHMIPv6 instead of one in HMIPv6. Therefore, the problem of scalability is resolved when the domain handles many MNs.

Key words: HMIPv6, SHMIPv6, MAP, queue management, scalability

INTRODUCTION

In today's fast based technological growth the traditional computer networks are no longer capable of handling the increasing demands with the best Quality of Service (QoS) (Welbourne *et al*., 2009). The QoS is an essential matter in the network performance as delay and loss rate (O'Neil, 2002) which play role in scalability. Hierarchical MIPv6 is proposed to enable scalability in which mobility management is separated into micro mobility and macro mobility (Soliman *et al*., 2005). The essential element of this structure is the Mobility Anchor Point (MAP). It is a router or a set of routers that maintain a binding with Mobile Nodes (MNs) presently visiting its domain. It is usually located at the boundaries of a network, on top of the Access Routers (AR), to receive packets for MNs attached to that network. The mobile node arriving at a MAP domain would take delivery of router advertisements that include data related to various local MAPs. The mobile node would be able to bind the current on-link CoA pertaining to it through an RCoA address that exists on the MAP's subnet as shown in Fig. 1.

The MAP, in the capacity of a local home agent, would take delivery of every packet in the name of the mobile node which it serves. It would also encapsulate as well as forward them immediately toward the mobile node's current address. In the event that the mobile node alters its current address inside a local MAP domain (LcoA), it would only be required to register the new address in the MAP.

Increasing number of mobile nodes causes several issues in the implementation of computer networks. These issues include performance of the network components and bottleneck in some network components that decreases the overall network performance such as lost packets which will be emphasized in this study. Packet loss means the total number of packets aside from the number of packets received by the receiver. Thereby the term Packet Loss is used as a measure of the overall number of packets which are not delivered to the destination (Cho and Jacquet, 2005) which affects scalability.

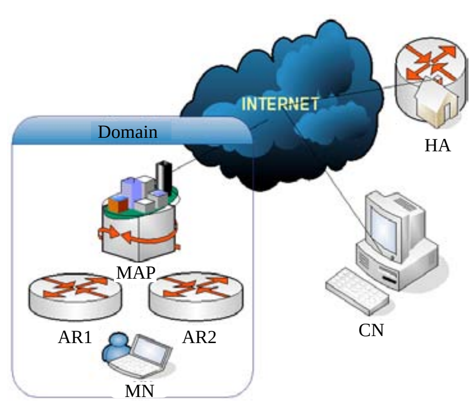

Fig. 1: Hierarchical Mobile IPv6 architecture

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Dynamic Efficient MAP Selection (DEMAPS) is proposed by Taleb *et al*. (2009) as one of the recent developments attempting to solve the issue of scalability in HMIPv6 through the introduction of the concept of dynamic selection of MAPs in cases of higher number of MNs. Nevertheless, one of the disadvantages of this proposed system is that the MAP selection is done in the MN level which can result in increased energy consumption and thus a shorter battery life of the MN.

Another MAP selection method for areas served by multiple coexisting Mobility Anchor Points (MAPs) is one that takes into account the movement direction pattern of the mobile node MN. This investigation into the best MAP selection model in terms of performance is important due the fact that it is a challenging issue for an arriving mobile node to choose the most appropriate MAP to bind. This task must be carried out by considering the issues of load balancing, binding update and packet delivery cost minimization (Baeka *et al*., 2011).

Using one MAP keeps large number of packets waiting in queue while data transmission which causes lost packets (Montavont and Noel, 2002). This study showed the performance of Smart Selection Hierarchical Mobile Internet Protocol version 6 (SSHMIPv6) with respect to lost packets.

PROPOSED SSHMIPV6

To implement SSHMIPv6, several MAPs in the domain are needed to handle many MNs. This is supported by our new proposed scheme called Smart Hierarchical Mobile IPv6 (SHMIPv6) as shown in Fig. 2.

Deployment of MAPs will work on the tunnel traffic information and the registration information at each HA to lessen and prevent traffic overload. The number of MAPs in the domain depends on the number of MNs and transferred packets in the domain. The term queue management is used to refer to buffer management as well as packet scheduling (Zhou *et al*., 2003).

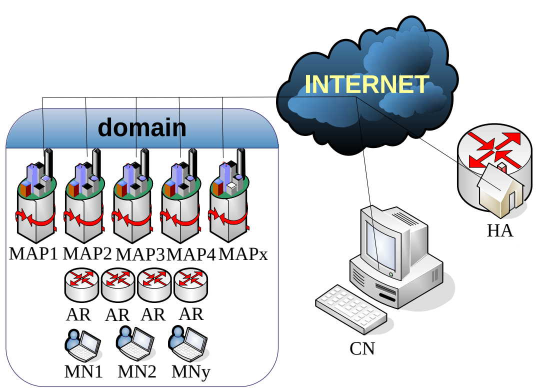

Fig. 2: Smart Selection Hierarchical Mobile IPv6 architecture

SSHMIPV6 SIMULATION USING NS-2

NS-2 is commonly used to simulate networking and communications due to the facts that it is free, open source, flexible and scalable. Although NS-2 has been a good support for Mobile Ipv4 simulation, it is still considered to be weak for Mobile IPv6. Therefore, the Mobiwan was formed in order to fulfill NS-2 by adding MIPV6 features for NS-2. To simulate Wide Ares Mobility protocol such as Mobile IPv6 and HMIPv6 Mobiwan was developed (Soldatos and Karestos, 2003).

According to the documentation of NS-2, NS-2 is a discrete event simulator targeted at networking research. NS-2 provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless (local and satellite) networks. NS-2 provides a library of network models and components that can ease the process of designing the network topology to be used in the simulation.

For instance, ready made components such as routers, mobile nodes, packets and MAPs are available and programmed to be configurable according to the specific needs of the current simulation model.

MODELING AND SIMULATION

For the purpose of our simulation the following topology was constructed to simulate the standard HMIPv6 using the following assumptions. Three MNs were introduced and configured to send packets to Correspondent Nodes (CNs) in another domain. Hence, a Mobility Anchor Point (MAP) was introduced to act as the tunnel connecting the two Access Routers (ARs) illustrated in Fig. 3. Each network component was named with a node ID starting from zero.

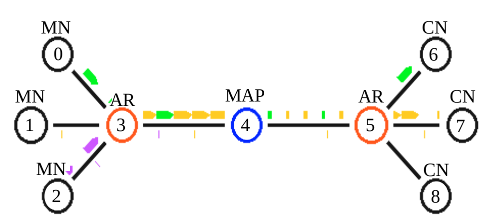

Fig. 3: Network Topology of the Simulation Carried out in NS-2

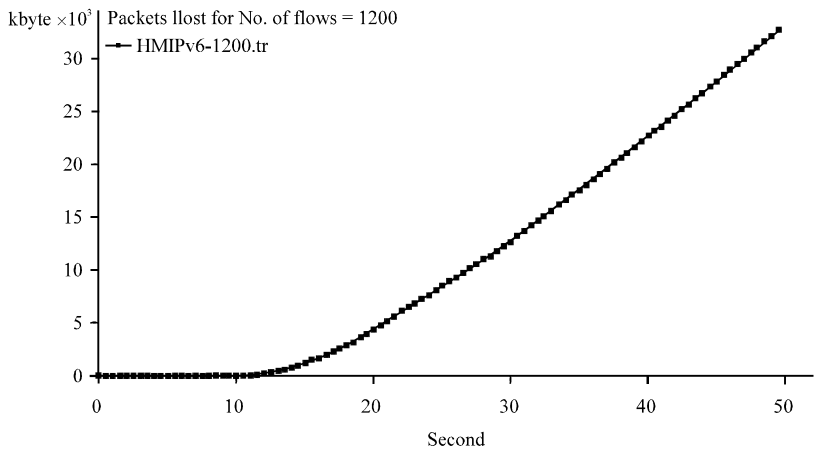

Fig. 4: No. of lost packets for Data Flow of 1200 packets under HMIPv6

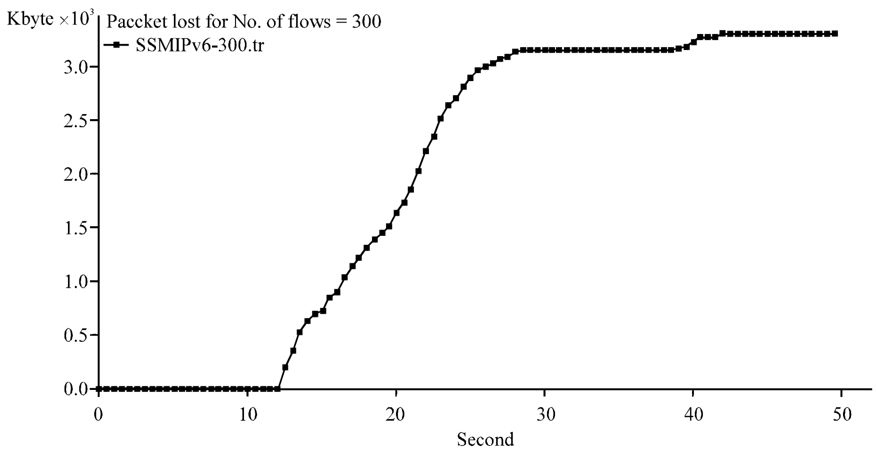

Fig. 5: No. of lost packets for Data Flow of 300 packets in the first MAP under SSHMIPv6

Finally, to compare the performances of SSHMIPv6 in contrast with that of HMIPv6, a model was constructed assuming that SSMHIPv6 through its queue management algorithm has successfully distributed the 1200 packets with a size of 1460 bytes each. These packets needs to be sent on three MAPs thus reducing the congestion occurring on the single MAP in the HMIPv6 model. It will be assumed that this distribution resulted in 300 packets being redirected to one MAP, another 400 packets to the second MAP and finally the remaining 500 packets to the third MAP. The total of 1200 packets sent is finally compared to that of the standard HMIPv6 case.

Lost packets performance: The results obtained from testing the standard HMIPv6 under a flow of 1200 packets can be seen in Fig. 4. It can be noted from the figure that HMIPv6 performs adequately in the beginning of the sending interval. However, as the sending time progresses and the number of packets queued on the MAP increase, the numbers of lost packets will increases significantly to reach a values of above 30 Kbytes of lost data.

The simulation results for the first MAP under the SSHMIPv6 model can be seen in Fig. 5 which illustrates that the data lost throughout the sending interval was merely 3.3 Kbytes. Subsequently, the second MAP which handled a data flow of 400 packets showed the results represented in Fig. 6.

It can be seen that data loss of only 8.1 Kbytes were experienced. Finally, the third MAP which was assigned with 500 packets of the data sent showed a data loss of about 12.1 Kbytes as illustrated in Fig. 7.

Figure 8 shows the comparison of results obtained from sending 1200 packets of data through Standard HMIPv6 in Contrast with sending the same amount of data through the proposed SSHMIPv6.

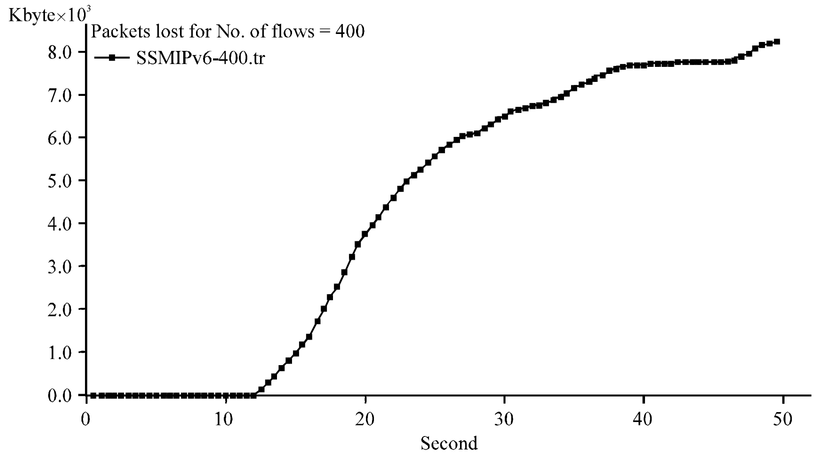

Fig. 6: No. of lost packets for Data Flow of 400 packets in the second MAP under SSHMIPv6

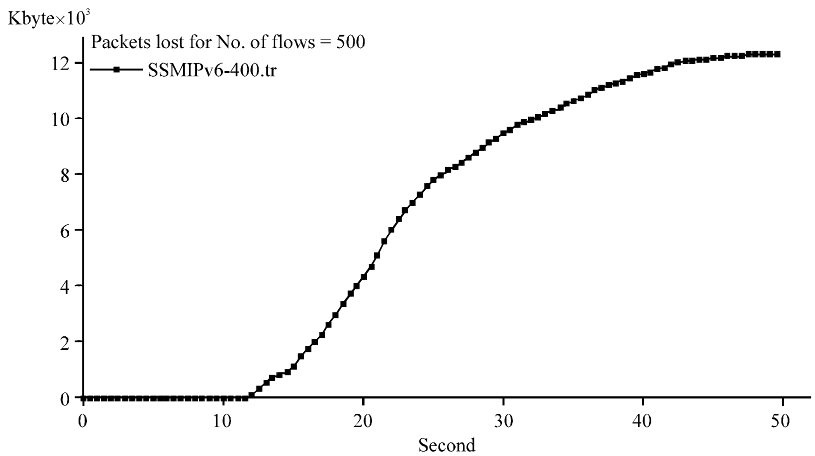

Fig. 7: No. of lost packets for Data Flow of 500 packets in the third MAP under SSHMIPv6

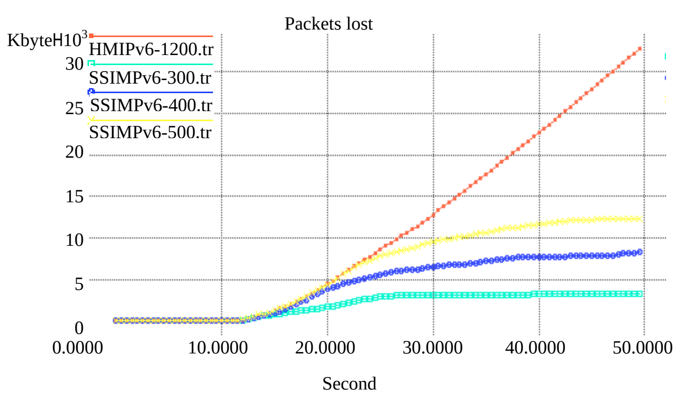

Fig. 8: Comparison between SSHMIPv6 versus HMIPv6

It can be seen that while HMIPv6 suffered from significant data loss of 35 Kbytes, the distributed nature of SSHMIPv6 though its queue management algorithm resulted in a combined data loss of 23.5 Kbytes which is significant improvement over the current standard HMIPv6 model. The improvements which could be gained through using three MAPs in SSHMIPv6 instead of one in HMIPv6 show approximately 33% decrease in lost packets.

CONCLUSION

Some of mobility management schemes for IPv6 as HMIPv6 have shown various problems which have been overcome by using SSHMIPv6 through adopting HMIPv6 protocols sharing the traffic information among several MAPs. In this system the problem of scalability is resolved when the domain handles many MNs. In this paper a study is conducted in the performance of SSHMIPv6 with respect to lost packets over NS-2 and used to evaluate the performance of SSHMIPv6 over HMIPv6 and to analyze the effect of adding multiple MAPs to serve each region.

The results show improvements which could be obtained by using three MAPs in SSHMIPv6 instead of one in HMIPv6 as it shows approximately 33% decrease in lost packets.

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