A Study on Effective Transfere Rate Over Smart Hierarchical Mobile IPv6 (SHMIPv6)

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Summary
The increase demand of the Internet applications and the mobile wireless networks uses guide to have a complete successful system for mobile wireless access to wide Internet applications. Internet Engineering Task Force (IETF) considered Mobile IPv6 to be the technology Gate for the mobile Internet which facilitates flawless communication for the wireless access networks by developing standards Mobile IP. However, MIPv6 may cause unnecessary signaling traffic and long transmission delay. Hierarchical Mobile IPv6 (HMIPv6) provides the best scalable solution for global mobility by dividing the world into domains. HMIPv6 regional registration is proposed Mobility Anchor Point (MAP) to control the visited Mobile Nodes (MNs) in the domain to reduce the number of position updates to the home network. The MAP act as the MN’s Home Agent (HA). It intercepts all the packets addressed to the MN and tunnels them to the Care of Address (CoA) of the MN in the Foreign Agent (FA) area. If the MAP handles so many MNs, lost packets will occur and then lost data rate ratio because there is only one path to all visitors to receive there packets. In this paper, we are going to introduce the basic concept of Smart Hierarchical Mobile IPv6 (SHMIPv6) that has several MAPs sharing together to handle so many MNs and to show the performance of SHMIPv6 with respect to effective transfer rate. We have used a Visual Basic 6 program to simulate HMIPv6 and SHMIPv6 over hypothetical internet.
Key words:
HMIPv6, SHMIPv6, MAP, RCoA, Data Rate

1. Introduction

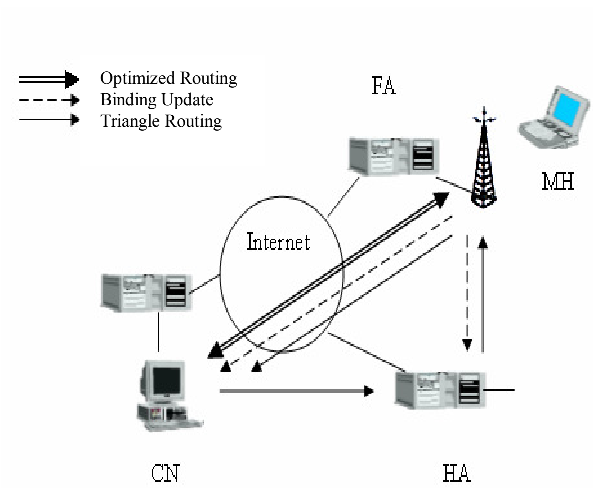
The fast deployment and growth of the Internet Protocol version 4 (IPv4) has highlighted several essential restrictions with that protocol. Internet Protocol version 6 (IPv6) [1], also called IP-NG “Next Generation”, solved these themes and offers extra improved services and functionality. It is expected that IPv6 and its applications will be applied sooner or soon after. Many internet users have portable computers that need MIPv6 to be connected while moving from one place to another. For global trading and tourism movement in the world HMIPv6 is looked-for. We proposes SHMIPv6 scheme to solve the scalability problem due to the huge number of Mobile Nodes (MNs). In this paper we are going to review the history of mobility in the internet protocol and in the last we will explain our new approach (SHMIPv6).

2. Current Systems

2.1 Mobile IPv6 overview

In Mobile IPv6 operation [3], when a MN is connected to the internet, it needs to check if it is currently connected to its home network or a foreign network. If MN detects it is under a foreign network, it will obtain a CoA at the foreign network. Then it will notify its HA about its CoA. This procedure is called Binding Update (BU). The MN also reports its CoA to the Correspondent Nodes (CNs). BU with the CN is known as Route Optimization. Route optimization [4] used to improve performance for IPv6 MN which takes place when the correspondent node knows the MN’s new CoA then it will be able to send further

Figure 1: Mobile IPv6 Architecture



Manuscript received May 5, 2007
Manuscript revised May 20, 2007

packets directly to MN's CoA, without going through the triangle route via MN's HA as shown in Figure 1.

2.2 Hierarchical MIPv6

Hierarchical MIPv6 separates mobility management into micro mobility and macro mobility. 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 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.

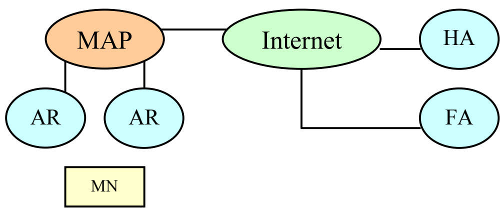


Fig (2) Hierarchical Mobile IPv6 architecture

The MAP acts as the local HA for the MN. It intercepts all packets addressed to the out-of-towners mobile node it hands out and tunnels them to the corresponding on-link Care of Address (LCoA) of the MN. If the mobile node travels to another address within a MAP domain, it only needs to register the new on-link address with the MAP since that the universal CoA does not change. If a MN travels into a new MAP Area, it needs to get a Regional Care of Address (RCoA) and an (LCoA). The mobile node then uses the new MAP's address as the RCoA, while the LCoA address can be produced as stated in [5]. Subsequent to forming these addresses, the mobile node sends an ordinary MIPv6 BU to the MAP, which will bind the mobile node's RCoA to its LCoA. Then the MAP will return a binding acknowledgement (BAck) to the mobile node indicating a successful registration. The mobile node must also register its new RCoA with its home agent by sending another BU that indicates the binding between its home address and the RCoA. Finally, it may send similar BU to its current corresponding nodes, specifying the binding between its home address and the RCoA.

3. Proposed System

3.1 SHMIPv6

Using one MAP keeps large number of packets waiting before it receives or sends them, and this causes long delay and large number of lost packets [6], hence the communication will be affected (intermittence or cut off). Furthermore, several MAPs in the domain are needed that is supported by our new proposed scheme called Smart Hierarchical Mobile IPv6 (SHMIPv6) as shown in (Fig. 3). 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.

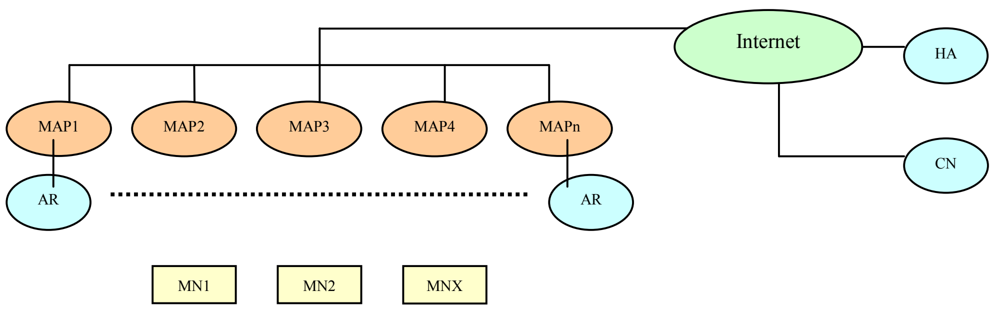


Fig (3) Smart Hierarchical Mobile IPv6 architecture

The SHMIPv6 features can be summarized as follows:

- The domain is composed of multiple Mobility Anchor Points; each MAP in the domain is attached with an Access Router (AR).
- The mechanism shares the traffic information among the MAPs in the domain to make decision of MAP reassignment.

The MAPs at the domain give the same RCoA.

3.2 Simulation Environment

For Simulation we have considered a hypothetical internet, consisting of five networks. Each network in turn is composed of 100000 nodes. Some of these are mobile nodes (1-5000). We have considered all of the networks to be identical. While simulating, we have used a hypothetical IP address format, consisting of an integer number. We have two "copies" of this internet. The first copy uses only one MAP in each region. The other copy uses more than one MAP in each region. All of the events take place in both of the two internets at the same time. We have used a logical clock and we have constructed structures for events and packets. Each event is stored with its time of occurrence. Hypothetical packets are generated in randomly on the networks while time is passing, consisting of a packet size field and time of reaction field and source and destination addresses are considered. We initialize the internet by assigning addresses to all of the nodes on the networks and setting up all of the simulation variables. The simulation clock is initialized to 0. During the simulation packets are generated each clock tick using a logarithmic equation i.e. we take the natural logarithm of the total number of mobile nodes then we multiply it by a small random number factor between 0.0 and 0.4, the generated packets are assigned size and a time stamp, and also assigned random source IP and destination IP. Then the new packets are added to the packets' queue. If the region queue is full the packet considered being lost and so it is added to the number of lost packets. This process is repeated again and again for the simulation time.

3.3 Simulation Assumptions

We have assumed the following in our simulation

- The five networks in the internet are identical.
- All MAPs are identical.
- The time it takes to process a packet is the same for all of the MAPs and for all type of packets.
- The two internets are identical in every thing including evens and packets generated. But only differs in the number of MAPs in each region.

We didn't worry about security considerations in our simulation

4. Results and Discussions

This simulation aim is to analyze the effect of adding more than one MAP to serve each region on the performance of Mobile IPv6 in terms of Effective Data Rate.

Figs. 4 and 5 show the Effective Data Rate and Lost Data Rate Ratio versus the number of MAPs at each area for various packet processing times respectively. While Fig.6 concentrate on the Lost Data Rate Ratio versus the Number of MAPs at each domain with different Number of MNs.

If we have a look toward (figure 4), we can see that if more MAPs are used, the Effective Transfer Rate will be increased. As if we take the rosy-colored line which indicates the 12ms packet-process time, we can notice that in case of HMIPv6 that uses just a MAP the Effective Data Rate is around 203 Mbps but if we increases the number of MAPs to be two, the Effective Data Rate will be got up to 407 Mbps.while if we use three MAPs at each area, that will absolutely enhance the performance of the Internet by making the Effective Data Rate more and more to reach the 610 Mbps, whereas 4 MAPs are simultaneously serving the MNs in the domain, the reasonable result will come out but it still not the most-willing result as the case of using five MAPs which gives a result tends to the Maximum Effective Transfer Rate.

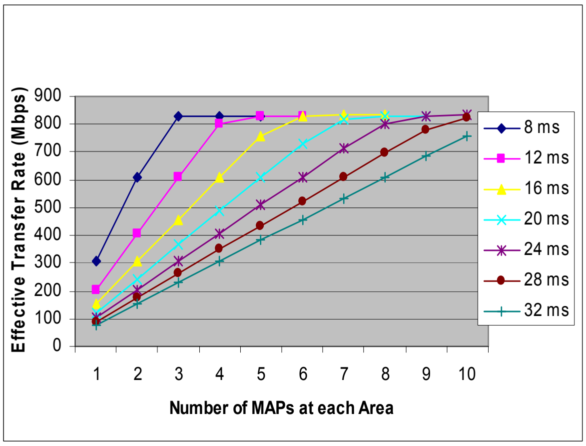


Figure 4. Effective Transfer Rate vs. number of MAPs at each area

As is known the Lost Data Rate Ratio is defined as the percentage of the lost Data Rate divided by the total Transfer Rate. So that, the Lost Data Rate Ratio will follow opposite behavior of the Effective Transfer Rate as shown in the (figure 5). It is also noticeable from the figure below the inverse relation between the number of MAPs and the Lost Data Rate Ratio. If we study a violet line (24ms packet-process time), we can see the descending order of Lost Data Rate Ratio starting from 88% at the case of using one MAP in HMIPv6 ending with only 4% at the case of 8-MAPs.

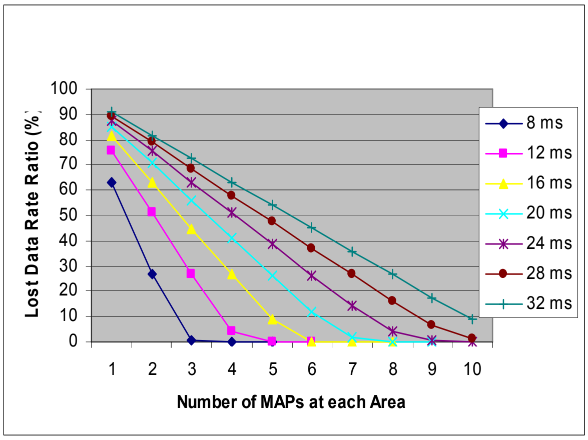


Figure 5. Lost Data Rate Ratio vs. number of MAPs at each area

The series numbers from 8ms to 32ms in the rectangle shown in the right-hand side of figs. 4 and 5 represent the time needed by the MAPs to process a packet, that indicate the maximum number of MAPs need to be used for each area. For instance the dark-blue color curve indicates that three MAPs are enough to Handle all of the MNs and process all transferred-packets if the process time for each packet is 8ms, with a perfect performance. Hence a one can exclude that more than 3-MAPs is useless and coasty.
Another case, if the AR takes longer time to process the data as in the line with the sixteen milliseconds process-time shown in the figures above, here we can notice that more than 3-MAPs is needed to get the best performance, since the packet-process time have been changed from 8ms up to 16ms. Again once we glare into the (figure 6); it is observed that we will get the same behavior and better performance for Lost Data Rate Ratio when using more MAPs for different number of MNs. And also we can notice that how the number of MNs affect the Lost Data Rate Ratio and subsequently the Effective Transfer Rate in SHMIPv6. If we take the green-colored line which indicates the 400 MN, we can conclude that in case of HMIPv6 that uses just a MAP the Lost Data Rate Ratio is around 75 %. If we increase the number of MAPs to be two, the Lost Data Rate Ratio will be slightly down to 51 %.but in case of using three MAPs at each area, the performance of the Internet gets better by making the Lost Data Rate Ratio smaller. to be 26 %, whereas if there are four MAPs running at the same time and handling the 400 MNs in the domain, the acceptable result will arise out but it still not the most-willing one as using five MAPs which gives a 0 % of Lost Data Rate Ration which means the Maximum Effective Transfer Rate. By using another angle to fig. 6, we can notice that the increase number of MN will give passive effect of performance of HMIPv6 and SHMIPv6. If three MAPs handle 1000 MNs the Lost Data Rate Ratio will be 26.8 %, while if the same number of MAPs handles just 100 MNs, the performance will be better and the Lost Data Rate Ratio is reduced to 2.6%.

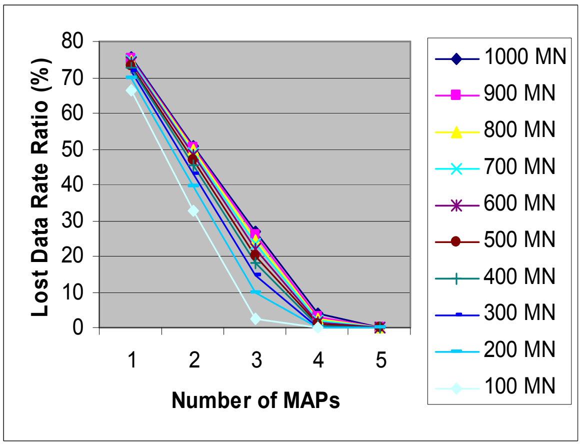


Figure 6. Lost Data Rate Ratio vs. number of MAPs at each area

5. Conclusion

As we have just mentioned, some of mobility management schemes for IPv6 (MIPv6 and HMIPv6) shown some bugs, have been overcame by using SHMIPv6 which adopting HMIPv6 protocols and their positives and handles a new management procedure by sharing the traffic information among several MAPs in the domain to make decision of MAP reassignment. Adopting such criteria had come out with desired results in the field of Effective Transfer Rate.
In this system the problem of scalability is resolved if there is many MNs in the domain, the system we have developed accommodate with any AR efficiency; however, the same result can be got by using any packet-process-time router and any number of MNs in the network.

Acknowledgments

I would like to express my sincere thanks to the Government of Malaysia for IRPA 04-02-02-0062-EA289 grant.

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