International Journal of Emerging Engineering Research and Technology
Volume 2, Issue 4, July 2014, PP 16-24
ISSN 2349-4395 (Print) & ISSN 2349-4409 (Online)

IPv6 Networks: Protocol Selection for Mobile Node

Mrs. N.S.Hunnargi
Electronics Department
DKTE'S Textile and engineering institute
Ichalkaranji, Shivaji University
Kolhapur, India
nilofar.hunnargi@gmail.com

Prof.U.A.Patil
Electronics Department
DKTE'S Textile and engineering institute
Ichalkaranji, Shivaji University
Kolhapur, India
uapatil2002@gmail.com

Abstract: *In IP version 6, Mobile IPv6 (MIPv6) is used to support mobility in IPv6 networks. Hierarchical MIPv6 (HMIPv6) is used in hierarchized network and it always cannot be better than MIPv6. These, two protocols have different application scopes. In this paper, a model is proposed to analyze the application scopes of MIPv6 and HMIPv6, through which an Optimal Choice of Mobility Management (OCMM) algorithm is designed. OCMM chooses the better mobility management scheme between MIPv6 and HMIPv6 according to users priority and requirements, deciding whether to hierarchize the network. OCMM chooses the best mobility anchor point and regional size (which are crucial when HMIPV6 is selected) suggesting how to hierarchize the network. Simulation results show the impact of key parameters on the application scopes of these two protocols as well as the optimal regional size of HMIPv6. At last, the cost is calculated and OCMM is proven better in performance than other two mobility management schemes.*

Keywords: *Mobility management, Mobile IPv6, hierarchical mobile IPv6, application scope, regional size*

1. Introduction of MIPV6

When host is mobile (wired or wireless) its mobility support in IPv6 networks is provided through Mobile IPv6 (Mipv6).MIPV6 can employed to manage macro mobility. MIPV6 enables MN to move from one subnet to another, while maintaining reach ability and all ongoing communications.

Movement of a Mobile Node (MN) is hidden from upper layers through the use of two addresses. A permanent address in its home network called its Home Address (HoA) and a temporary address in the visited network called its Care of Address (CoA). Binding between these two addresses is kept in a router called a Home Agent (HA).

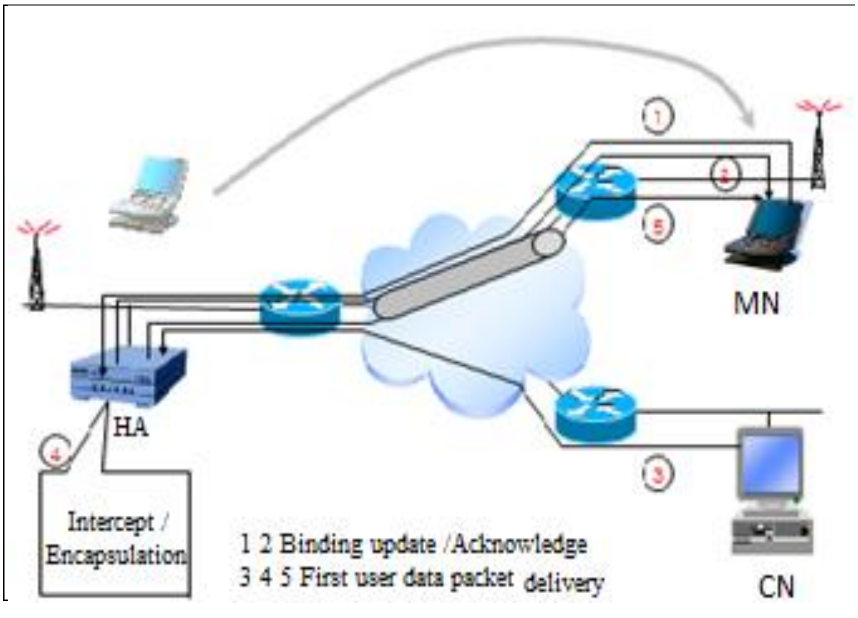


Fig1. *Operation of Mipv6*

Hence it provides a level of indirection at the network to keep the address change transparent to Upper Layer Protocols (ULPs). When MN is away from its home network packets are still sent to its HoA.HA intercepts these packets and tunnels them to the CoA.

MN can be multi homed through multiple HoAs corresponding to different access networks. MIP6 doesn't provide a mechanism to preserve connections when outage occurs between Corresponding Node (CN) with which it is communicating and HoA. MIP6 also lacks a quick mechanism to detect failures of HoA. As the basic MIPv6 protocol supports the network-layer mobility management problem but it does not attempt to solve all general problems related to the use of MNs or wireless networks. Specifically this protocol does not solve local or hierarchical forms of mobility management. Since MIPv6 only support global mobility, a hierarchical scheme that separates micro-mobility from macro-mobility is preferable.

2. INTRODUCTION OF HMIPV6

In HMIPv6 the usage of a new node, called Mobility Anchor Point (MAP) as shown in Fig.2. A MAP is essentially a local HA situated in the foreign network. It can be located at any level in a hierarchical network of routers so that it can be classified as a micro-mobility.

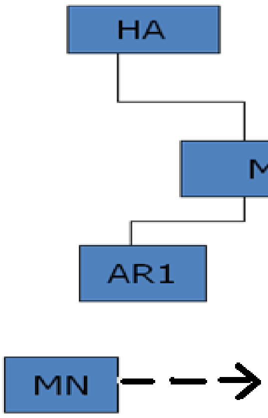


Fig2. *Operation of Hmipv6*

MN has to configure two new types' care-of-addresses (CoAs): a regional care-of-address (RCoA) and an on-link care-of-address (LCoA). The LCoA is a local address to the MN received from Access Router (AR). The RCoA is an address on the MAP's subnet, configured when an MN received a Router Advertisement (RA) message with the MAP Option during MAP Discovery. The MAP will perform the function of a "local" HA that binds the MN's RCoA to an LCoA. After the MN get new RCoA and LCoA addresses then it sends a Local Binding Update to the MAP in order to establish a binding between the RCoA and LCoA. During RA, an MN will detect whether it is still in the same MAP domain. If the MAP domain is different it needs to have two addresses from AR (LCoA and RCoA) otherwise only the LCoA will change.

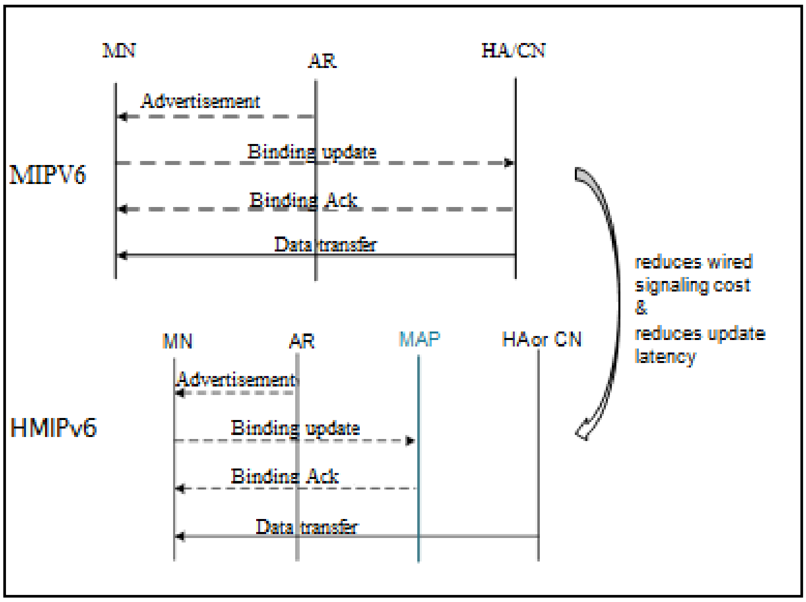


Fig3. *Comparison of MIPV6 and HMIPV6.*

Acting as a local HA, the MAP will receive all packets on behalf of the MN it is serving and will encapsulate and forward them directly to the MN's current address.If the MN changes its current address within a local MAP domain, it only needs to register the new LCoA with the MAP. Hence, only the RCoA needs to be registered with CNs and the HA. The RCoA does not change as long as the MN moves within a MAP domain. This makes the MN's mobility transparent to CNs it communicates with and better handover compared to MIPv6.

2.1. Problems with MIPV6

MIPV6 deploys a home agent (HA) in a network to bind an MN’s identifier with locator. Once the MN changes its point of attachment in a visited network, it is required to register the HA to inform its new locator. In the case that the MN moves far from the HA and performs frequent handovers within a local region, the delay for registering the HA prolongs and thus increasing handover latency.

2.2. Problems with HMIPV6

HMIPv6is proposed to enhance the performance of MIPv6 by shielding an MN’s micromobility from the CNs and HA. Let us analyze the problem. When MNs roam within the region, the handover latency using HMIPv6 is smaller than that using MIPv6.However; this profit is obtained by paying two costs. The first cost is double-registration, which means an MN needs to launch not only a regional registration to its MAP, but also a home registration to its HA when it roams across regions.

Double-registration undoubtedly increases handover latency. The second cost is long packet delivery time. Because all packets destined to MNs will be tunneled by the MAP, the packet processing delay of the MAP prolongs packet delivery delay. If the MAP is not the gateway, the packet delivery path will not be optimal, further lengthening packet delivery latency. If these two costs are greater than the profit, HMIPv6 cannot outperform MIPv6.

3. INTRODUCTION TO OCMM

Although HMIPv6 is an extension of MIPv6,it does not always outperform MIPv6. Two protocols have different application scopes. Hence, how to minimize the overall registration and packet delivery time through selecting the better alternative between them becomes an interesting problem. Furthermore, in the case that HMIPv6 turns out to be better, MAP and regional size should be well chosen to optimize network performance. In this paper, a new scheme, called the Optimal Choice of Mobility Management (OCMM) is proposed.

The “Optimal Choice” has two meanings:

1) It chooses the better alternative between MIPv6 and HMIPv6 according to the mobility and service characteristics of MNs, addressing whether to hierarchize a network;
2) It chooses the best MAP and regional size when HMIPv6 is adopted, addressing how to hierarchize a network.

To realize this purposes, a proposed model analyze the relative cost of HMIPv6 against MIPv6 in terms of average registration and packet delivery delay. To quantitatively derive the impact of regional size on the relative cost of HMIPv6 against MIPv6, a Markov model is used to analyze the mobility of MNs, where MNs can move with arbitrary direction probabilities. After proving that the value of regional size minimizing the relative cost of HMIPv6 against MIPv6 is the same as that the one minimizing the absolute cost of HMIPv6, an algorithm is proposed to choose the better alternative between MIPv6 and HMIPv6, as well as the best MAP and regional size

In the case that HMIPv6 is better. Finally, the performance of OCMM, HMIPv6, and MIPv6 are simulated under 1D and 2D mesh topologies. The results show that OCMM outperforms HMIPv6 and MIPv6 in terms of average registration and packet delivery costs.

3.1. Calculation of Relative Registration Cost (DR)

Definition (Relative Registration Cost): Relative registration cost (DR) is defined as the average registration time saved by using HMIPv6 compared with MIPv6.

Note that DR may be positive or negative. DR > 0 means the average registration delay of MIPv6 is shorter than that of HMIPv6, otherwise longer.Let m >= 1 be the number of handovers needed by an

MN to move out of a region. In other words, an MN will enter a new region at its mth handover. So the total average delay (DIT) that an MN spends for m handovers in HMIPv6 is

$$DIT = (m - 1)\ Dintra + Dinter \quad (1)$$

Where Dintra and Dinter are, respectively, the average registration delays during an intraregion handover and an interregion handover.

Without the concept of region, the total average registration delay (DAT) that an MN spends for m handovers in MIPv6 is

$$DAT = m\ .DRM \quad (2)$$

Where, DRM is the average registration delay of MIPv6 in one handover. According to Definition, the relative registration cost can be calculated by (3), where T is the average time that an MN resides in an AR. T reflects an MN's mobility rate. The smaller T is, the faster the MN moves, and vice versa.

Thus, mT represents the average time that the MN spends in an MAP region.

$$DR = [(m - 1)\ Dintra + Dinter - m\ .DRM\ ] / m.T \quad (3)$$

To compute DR, we use Dintra, Dinter, and DRM as input parameters , which can be estimated by statistical data. Only when $DR < 0$, HMIPv6 can gain the average registration revenue. To make $DR < 0$, m needs to satisfy the following inequality

$$m > (\ Dinter - Dintra) / (\ DRM - Dintra) \quad (4)$$

3.2. Calculation of Relative Packet Delivery Cost (DP)

Definition: (Relative Packet Delivery Cost). Relative packet delivery cost (DP) is defined as the average time wasted by using HMIPv6 instead of MIPv6 to forward packets.When an MAP is also a gateway of a region, the main difference between HMIPv6 and MIPv6 in terms of packet delivery is packet processing latency of MAP. As a result, the relative packet delivery cost can be formulated as,

$$DP = \alpha.\ L.\ K \quad (5)$$

In (5), α is the average packet arrival rate. $L > 0$ is a coefficient. L . K is the processing latency per packet, which is proportional to the number of different ARs managed by the MAP, i.e., K. $DP > 0$, means the average packet delivery delay of HMIPv6 is longer than that of MIPv6. This is because in HMIPv6, the packet processing delay of MAP prolongs the whole packet delivery time.

3.3. Calculation of Relative Cost

As the above sections shown, HMIPv6 outperforms MIPv6 in terms of registration in some scenarios, whereas MIPv6 outperforms HMIPv6 in terms of packet delivery in all scenarios. Thus, different performance metrics lead to different application scopes of MIPv6 and HMIPv6. To analyze their application scopes, the relative cost function is defined as follows:

Definition (Relative Cost): Relative cost (DT) formulates the overall performance of HMIPv6 against MIPv6 in terms of registration and packet delivery costs.

$$DT = n1\ .\ DR + n2.\ DP \quad (6)$$

Where $n1 > 0$ and $n2 > 0$ are the coefficients.

The reason for choosing DR and DP as the components of DT is that the former affects handover latency, while the latter affects packet delivery latency. Both DR and DP are critical to an MN's communication quality. n1 and n2 are, respectively, weights of DR and DP . They are set according to the preference of users. If a user thinks handover latency is more important than packet delivery latency, he can set $n1 > n2$, and vice versa. If a user has no preference for them, he can set $n1 = n2$.

3.4. Calculation of Optimal Regional Size (Kopt)

As described above, the value of DT largely depends on the regional size K of an MAP. If K increases, DR decreases while DP increases, and vice versa. The value of K that minimizes DT is the optimal K, denoted as Kopt. In another word,

$$Kopt = \mathrm{argmin}(DT\ .(K))$$

Through Kopt, HMIPv6 can achieve the optimal relative performance. Since Kopt can only be an integer and the relative cost is not a continuous function of K, we adopt the following method which detects the minimum DT step by step to find Kopt.

Let us first define the following functions:

$$\triangle(K) = \begin{cases} 1, & if\ D_T(K) > D_T(K-1), \\ 0, & if\ D_T(K) \leq D_T(K-1), \end{cases}$$

$$\varphi(x) = \begin{cases} 0, & if\ x \neq 0, \\ 1, & otherwise. \end{cases}$$

(7) & (8)

Equations (7) and (8) lead to the following minimization function (9)]

$$\varphi(\triangle(K)) = \begin{cases} 0, & if\ D_T(K) > D_T(K-1), \\ 1, & otherwise. \end{cases}$$

$$D_T(K) - D_T(K-1) > 0,$$

(9)

when K satisfies the condition , the computation of Kopt is completed.Therefore, the number of iterations for solving the optimal K

$$K_{opt} = \sum_{K=1}^{\infty} \varphi(\triangle(K)).$$

(10)

The operations of an MN in OCMM are shown in Algorithm 1, where M is the number of MAPs that the MN hears from the router advertisement messages. We give an example to illustrate OCMM. As shown in Fig.4 , we assume that an MN currently accesses AR1 and there are four MAPs in the domain, i.e., MAP1-MAP4. If the MN leaves its old MAP region, it needs to compute DT [i] and Kopt[i] of MAPi before it performs the home registration.

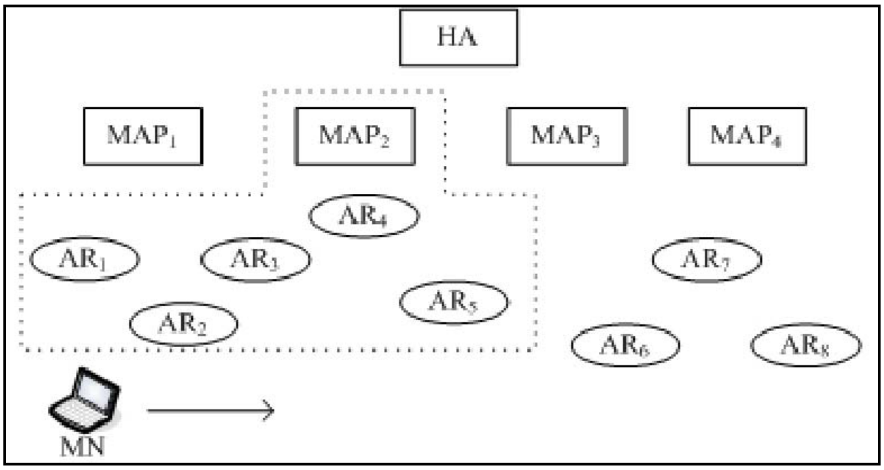


Fig4. *Example of OCMM*

We assume the results are: DT [1] = -0.005, Kopt[1]= 4,DT [2]=0.025, Kopt[2]= 5,DT [3]= 0.01, Kopt[3]= 5, DT [4]=0.015, Kopt[4]= 3. Because DT [2] is minimal and negative, the MN adopts HMIPv6 and chooses MAP2 as the regional mobility management entity. Since Kopt[2]= 5, the MN considers that the optimal regional size of MAP2 is 5. As a result, AR1-AR5 forms a region for the MN.

4. OCMM Algorithm

Algorithm1. *Operation of an MN iIn OCMM*

1: IF (MN wants to perform the home registration)

2: MN computes the Kopt[i] and DT[i] of MAP

i (Є(1, 2 ,. . .M));

3: OD = min (DT [i] |i Є (1, 2 ,. . .M));

4: OKopt = arg min (DT [i] |i Є (1, 2 ,. . .M));

5: IF OD >= 0

6: MN adopts MIPv6 as the mobility management solution;

7: ELSE //OD < 0

8: MN adopts HMIPv6 as the mobility management solution;

9: MN chooses the MAP whose sequence number is OM;

10: The chosen Map's regional size is OKopt;

11: ENDIF

12: ENDIF

To compute DT [i] and Kopt[i] of MAPi, the average dwell time T that an MN stays in an AR, and the average packet arrival rate α should be obtained beforehand. Such parameters can be periodically collected by each MN using statistical data. The period of collecting these parameters lies on experiential data.

5. SIMULATION RESULTS

In this section, a C++-based NS2 simulator is developed to observe the impact of key parameters on OCMM, and the performance of OCMM, HMIPv6, and MIPv6 in 1D and 2D mesh topologies as shown in Figs. 5a and 5b.

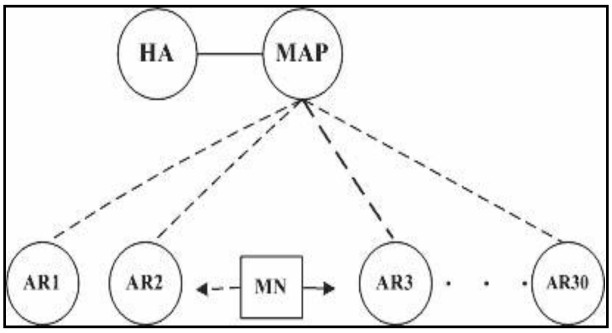


Fig5a. *1D mesh topology*

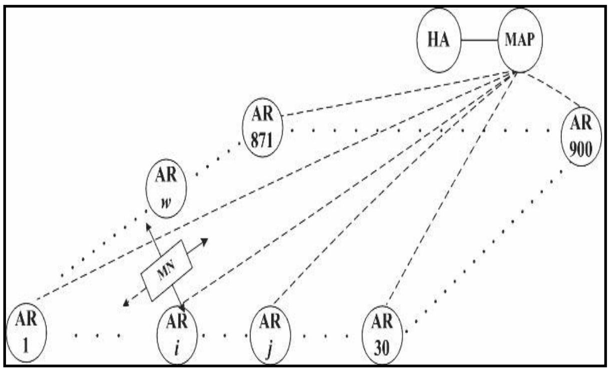


Fig5b. *2D mesh topology*

In simulation, the distance (measured by hops) between the MAP and the HA respectively, the MAP and the AR) follows a normal distribution with mean 6 (respectively, 4) and variance 0 (respectively, 0). When simulating MIPv6, the MAP acts as the gateway. The MN can move from the current AR to one of the adjacent ARs with arbitrary probabilities. The average signaling/packet delivery delay of the wired link is proportional to the distance that signals/packets travel. The unit distance wired delivery delay is μ and the wireless delivery delay is μ.η. The simulation lasted 8,000 unit times, following which the statistics are collected. In this simulation, the coefficients of n1, n2, and L are set to 1, 1, and 0.005, respectively.

DSDV is used as routing protocol which is an adaptation of classical distance vector routing protocol to ad hoc networks. In DSDV, two routing tables are maintained at each of the nodes. One of them is the routing table, which contains a complete list of addresses of all other nodes in the network. The other contains the setting time data for each destination node. It is used to determine the time for update advertisement. The routing of updates and packets between nodes is based on these tables. Along with each node's address, the routing table contains the address of next hop, route metric, destination sequence number; etc. Route updates are broadcasted periodically or scheduled as needed in the network. Routes are always selected with later sequence number. If the sequence numbers are identical, the route with smallest metric will be selected. These criteria guarantee loop-free routes.

IPV6 settings are done with MAC_802.11.cc. The IEEE 802.11 Standard is widely deployed wireless LAN protocol. This standard specifies the physical, MAC and link layer operation we utilize in our test bed. Multiple physical layer encoding schemes are defined, each with a different data rate. Part of each transmission uses the lowest most reliable data rate, which is 1 Mbps.

for nam file wired cum wireless network is formed in fig.6 (a) wireless node 9 has chosen node 6 as MAP and wireless node 13 has chosen node 8 as MAP. Later in fig.6 (b) as they move, they adopt node 8 and 6 as MAP respectively as per OCMM algorithm.

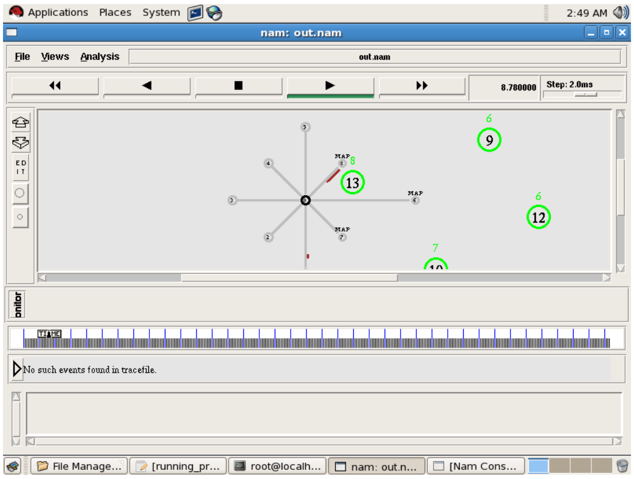


Fig6(a)

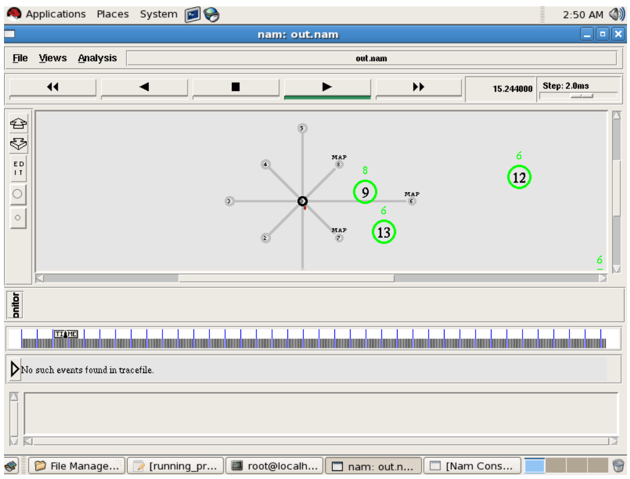


Fig6(b)

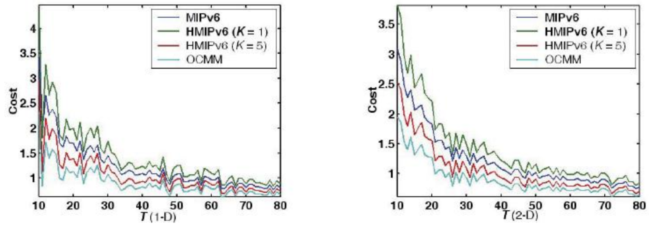
6. COMPARISON AMONG MIPV6, HMIPV6, AND OCMM

In this section, we compare the performance of MIPv6, HMIPv6, and OCMM in terms of the cost that includes the average registration and packet delivery costs. The cost of HMIPv6 (CHMIP), MIPv6 (CMIP) and OCMM (COCMM) can be calculated as follows:

$$C_{HMIPv6} = n_1 \cdot \frac{(m-1) \cdot D_{intra} + D_{inter}}{m \cdot T} + n_2 \cdot \alpha \cdot (\mu \cdot (l_{HM} + l_{MA} + \eta) + L \cdot K). \tag{11}$$

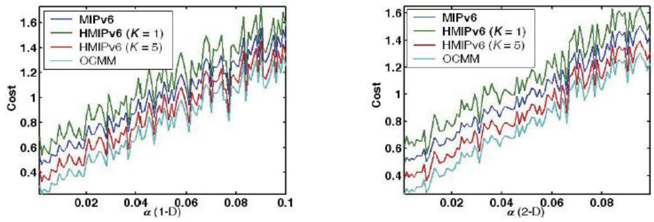
$$C_{MIP} = n_1 \cdot D_{RM}/T + n_2 \cdot \alpha \cdot (\mu \cdot l_{HA} + \eta), \tag{12}$$

$$C_{OCMM} = \begin{cases} C_{MIP}, & if\ D_T(K_{opt}) > 0, \\ C_{HMIP}(K_{opt}), & otherwise. \end{cases} \tag{13}$$



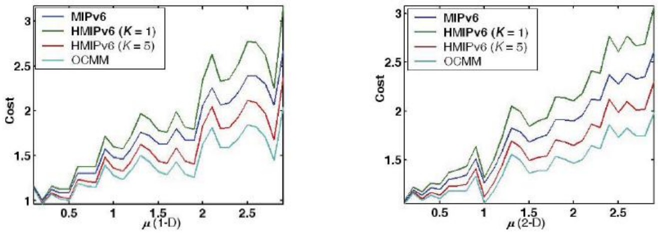
(a) (b)

Fig7. *T versus cost*



(a) (b)

Fig8. *α versus cost*



(a) (b)

Fig9. *Wired delivery delay versus cost*

7. CONCLUSION

MIPv6 and HMIPv6 are protocols for mobility management in IPv6 internet. HMIPv6 cannot be better than MIPv6 in all scenarios. The analytical model is proposed for formulating the relative registration and packet delivery costs of HMIPv6 against MIPv6 to analyze their application scopes. An algorithm called OCMM is proposed for an MN to choose the better mobility management scheme between MIPv6 and HMIPv6. For adoption of HMIPv6, OCMM decides which MAP is the best and how many ARs managed by it are optimal. Simulation results shows the impact of the average packet arrival rate, the average AR dwell time, and the unit wired/wireless delivery delay on the application scopes of MIPv6 and HMIPv6, and the optimal regional size of HMIPv6.Finally, OCMM proven better than MIPv6 and HMIPv6 in terms of the average registration and packet delivery costs.

REFERENCES

[1] IEEE Transactions on Parallel and Distributed Systems, Vol. 22, No. 10, October 2011. “Mobility in IPv6: Whether and How to Hierarchize the Network?”Shengling Wang, Yong Cui, Member, IEEE, Sajal K. Das, Senior Member, IEEE,Wei Li, and Jianping Wu, Member, IEEE

[2] D. Johnson, C. Perkins, and J. Arkko, “Mobility Support in IPv6,”RFC3775, June 2004.

[3] H. Soliman, C. Castelluccia, K. El Malki, and L. Bellier, “Hierarchical Mobile IPv6 MobilityManagement (HMIPv6),”RFC41 40, 2005.

[4] J. Cao, L. Zhang, H. Chan, and S.K. Das, “Design and Performance Evaluation of an Improved Mobile IP Protocol,” Proc. IEEE INFOCOM, pp. 319-329, Mar. 2004.

[5] J. Xie and I.F. Akyildiz, “A Novel Distributed Dynamic Location Management Scheme for Minimizing Signaling Costs in Mobile IP,” IEEE Trans. Mobile Computing, vol. 1, no. 3, pp. 163-175, Jul- Sep. 2002.

[6] W. Ma and Y. Fang, “Dynamic Hierarchical Mobility Management Strategy for Mobile IP Networks,” IEEE J. Selected Areas in Comm.,vol. 22, no. 4, pp. 664-676, May 2004.

[7] S. Das, A. Misra, P. Agrawal, and S.K. Das, “TeleMIP: Telecommunications- Enhanced Mobile IP Architecture for Fast Intra- Domain Mobility,” IEEE Personal Comm., vol. 7, no. 4, pp. 50-58,Aug. 2000.

[8] A. Misra, S. Das, A. Dutta McAuley, and S.K. Das, “IDMP-Based Fast Handovers and Paging in IP- Based 4G Mobile Networks,”IEEE Comm. Magazine, vol. 40, no. 3, pp. 138-145, Mar. 2002.

[9] Y. Watanabe and M. Yabusaki, “Mobility/Traffic Adaptive Location Management,” IEICE Trans. Comm., vol. E85-B, no. 10,pp. 2076-2082.