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Hierarchical Location Mobility Management using Mobility Management Points in IP networks

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ABSTRACT

IP mobility can be handled in different layers of the protocol. Mobile IP has been proposed to handle the mobility of Internet hosts in the network layer. Recently, a new method based on the SIGMA mobility architecture has been proposed to support mobility management with reduced packet loss and latency. The location management structure is not suitable for frequent mobile handover due to the high mobility of the user with this transport layer solution. In this paper, we propose a location management optimization method in a mobile communication network by applying hierarchical location management using MMPs(Mobility Management Points) for transport layer mobility management. Therefore, we propose an efficient hierarchical mobility management structure even between heterogeneous wireless networks using MMPs for the probability that a mobile terminal can change multiple location areas between two messages and calls. The proposed method shows reduction in location update cost and data retrieval cost using MMPs, and as opposed to mobility appearing in time intervals with the minimum cost required to reach 90% of the stabilized cost, the mobility location update search, location It was found that the message processing cost per area was reduced.

Key words: Location Management, Mobile IP, HiSIGMA, Transport Layer Mobility

1. INTRODUCTION

In mobility management for mobile communication networks, location management enables users to roam within the network, and to perform these tasks, location update and call processing procedures are required. Location updates provide a network with information about the user's location in the conditions of the location area. On the other hand, paging is responsible for delivering calls to users. In terms of signal processing cost, these two procedures show opposite behavior. And the optimization of location management in the total location management cost became a major research task[1, 2].

Many studies have been proposed to optimize the signal processing cost. Existing studies are movement-based [3], distance-based [4], and timer-based algorithms. The main parameters used to control the position update step in the algorithm are the number of movements and the distance from the initial point of movement or a specific time threshold value was used. [5] proposed a location update method applying a timer that solves the analysis optimization based on the timer as a function in traffic generation, mobility and location update conditions. [6] evaluated the performance of the cellular IP mobility tracking step, indicating the importance of appropriate selection of the timer value. In practice, mobility management of cellular IP is handled based on two states, active and inactive, in which the mobile host can work. And in the case of the inactive state, the location management method is used as a combination between the

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general structure of updating when out of the boundary of a predetermined cell set and the timer-based method.

Multiple access networks [7,8,9,13] presented a study focusing on the importance of the timer parameter, which is an optimal value that appears according to the parameter considering the user's mobility. The core of this paper is to propose a hierarchical location management method for mobility management in order to reduce the possibility that MH(Mobile Host) stores and processes LM (Location Management) information and that it can not be accessed from CN(Corresponded Node).

The suggestions are as follows. First, the hierarchical location management structure for mobility protocol is presented, and secondly, performance evaluation is performed through cost comparison between HMIPv6[5] and the proposed hierarchical mobility structure using an analysis model. However, the performance evaluation of the signal processing cost of the previous [5,6,10] for the mobility management solution is not performed. The structure of this paper is as follows. Chapter 2 presents the hierarchical location management including the existing mobility management structure and timeline. In Chapter 3, the network structure, which is a mobility model, and the arrival traffic model for evaluating the cost and performance of a mobile location are presented. In Chapters 4 and 5, the analysis model for hierarchical mobility management HiSIGMA is presented, and finally, in Chapter 5, conclusions and future development directions are presented.

2. RELATED WORK

Fig. 1 shows the basic form of location management in the transport hierarchical mobility structure in SIGMA proposed in [3]. The procedure for Fig. 1 is as follows.

① MH updates the location manager based on

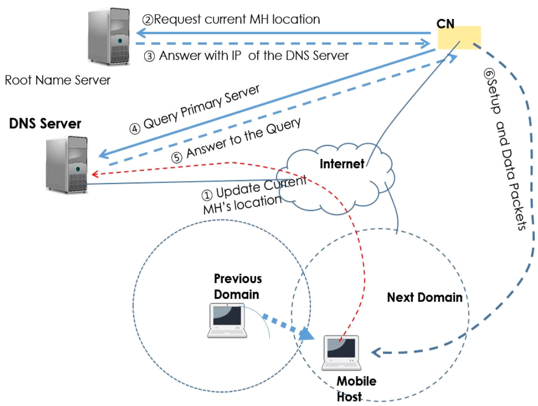

Fig. 1. Basic structure for location management in SIGMA.

the current default IP address. ② When the CN establishes a new association with the MH, the CN sends a query to the root name server with the domain name of the MH. ③ The domain name server responds to the CN as the IP address of the name server that manages the update area to which the MH belongs. ④ CN queries the domain name server for the referenced name server. ⑤ The name server responds with the MH's current default IP address. ⑥ CN initializes mobility continuity with the new default IP address of MH to establish connectivity. The location management structure used in [6,7,8] is not suitable for frequent mobility handover due to the high mobility of users.

A priority conditional state may occur between location management database updates due to the change of the attached MH point and the arrival of a connection establishment request from the CN. Moreover, the higher the round-trip processing time between MH and location management, the higher the probability that the CN will acquire information from location management to the database, which may result in the MH not being able to access the CN. Whenever the MH changes location, performing location update in mobility management can be expensive and time-consuming for processing in mobility management. In this case, there are too many messages exchanged on the network, resulting in wasted network bandwidth and unnecessary congestion. To solve this problem, the proposal of this paper proposes a hierarchical location management structure for the transport layer mobility solution in order to reduce the probability that the NH will be unconnected on the processing load for CN and mobility management.

3. PROPOSED SCHEME

In this chapter, we propose a hierarchical location management for location mobility. The structure for hierarchical location management is shown in the fig. 1. This proposal is applied as a mobility solution different from HiSGMA [3,4,8,10].

Next, an architecture called MMS(Mobility Management Server) is introduced for the proposed mobility management as shown in Fig. 2. below. The MN will update the mobility management server only when it is in the new moved location. Otherwise, the MN will update to the current location. Whenever the domain server receives a request for location information for the MH, it responds with the IP address of the registered mobility management server. The proposed method reduces the location update delay and signal cost while improving the accuracy of mobile location

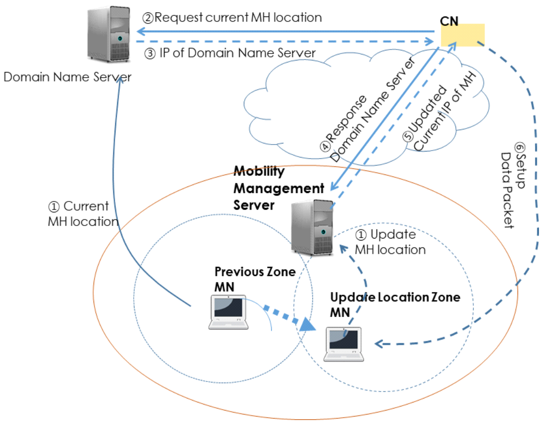

Fig. 2. Hierarchical mobility management of mobile hosts for mobility management.

management. In the figure, hierarchical location management performs the following processing steps.

In the Fig. 2, a new structure called a MMS (Mobility Management Server) is proposed. The MN(Mobile Node) only needs to update the DNS (Domain Name Server) when it enters the current MH(Mobile Host) location. Otherwise, the MH just needs to update the MMS to the current location. Whenever the initial zone server receives a locator query for the MH, it replies with the IP address of the registered MMS. The proposed structure can reduce location update delay and signal processing cost while improving the accuracy of mobility location management. In the Fig. 2, the performance processing of hierarchical mobility location management is as follows.

1) When the MH enters the new DNS range, the MH updates the current MH location with the IP address of the newly connected MMS.

2) When CN(Correspond Node) establishes a new connection with MH, CN sends a query to MH's DNS.

3) The DNS processes the response to the CN with the IP address of the MMS.

4) The CN processes the query to the MMS referenced by the DNS.

5) The MMS responds with the IP address of the current MMS where the MH is located.

6) The CN processes the query to the MMS referenced by the DNS.

7) The MMS processes the response as the current IP address of the MH.

8) CN starts with MH's current IP address in order of connection to establish connection.

The purpose of this paper is to compare the performance of the mobility protocol on the HMIPv6 and the hierarchical transport layer. It shows the contents about the improved protocol of MIPv6. The proposed HMIPv6 reduces the delay and frequency of location update due to the mobility of the MH. In HMIPv6, the operation of HA and the counterpart node is the same as in MIPv6. A new network element, MMPs(Mobility Management Points), is used to add a hierarchical structure to mobility management. The MMPs includes several subnets under the domain, which is the domain in this paper. The MMP(Mobility Management Points) is a Local Home Agent. The additional proposal of the mobility management point can limit the amount of MIPv6 message processing cost in the following areas.

When MH(Mobile Host) roams between subnets within an area surrounded by MMPs(Mobility Management Points), the mobility of local MMPs (Mobility Management Points) is generally farther than that of HA (Home Agent) with high load. Send only location updates. However, HA(Home Agent) updates only when MH(Mobile Host) moves out of the area.

4. PERFORMANCE EVALUATION

In this chapter, we present the results showing the effect of various input parameters of the total message cost in the proposed architecture. In all numerical examples, the results obtained from the previous paper [12] and this paper were compared based on the user traffic mobility model [11,13]. The purpose of this paper is to compare the performance of the mobility protocol on the HMIPv6 and the hierarchical transport layer. Therefore, this chapter presents the contents of the improved protocol of MIPv6. The proposed HMIPv6 reduces the delay and frequency of location update due to the mobility of the MH. As shown in Fig. 3, it can be seen that the messaging processing cost of both the existing HiSIGMA and the proposed HMIPv6 increases as the number of MHs increases at different dwell times in each area.

Regarding the packet forwarding cost with an analysis similar to that of [11], this proposal considers only the cost associated with tunneling in

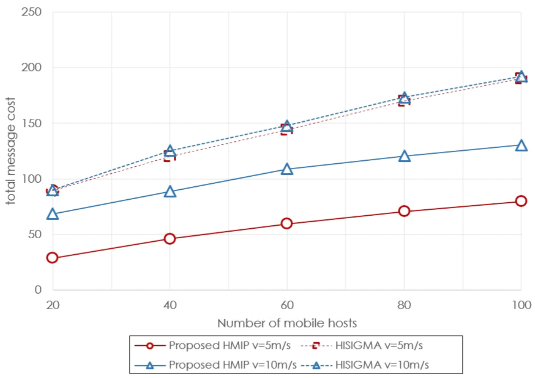

Fig. 3 Effect of number of MHs on total message cost of proposed HMIPv6 and HiSIGMA according to MH movement speed.

HA and MMP and the cost of searching the location update database. The processing cost that is sequentially generated for each packet transmitted from CN to MH is as follows.

- Encapsulation and localization in HA
- Encapsulation, non-encapsulation and location search in MMP

δ_{sh} is called the database inquiry cost by location in HA δ_{sm}, If is the database lookup cost by location in MMP μ, Assuming that is the cost per encapsulation or non-encapsulation in the HA or MMP, If is a linear constant for the location database search as defined in the following equation, the following equation (4) can be expressed.

$$\nu_{ph} = \delta_{sh} + \mu = (\nu N_{mh}) + \tau \quad (1)$$

The faster the moving speed, the shorter the time Tr stays in the subnet, so the cost of location update and binding update per second increases (Equation 1). As shown in the figure, the overall message cost of HiSIGMA is smaller than the proposed HMIPv6. The reason for this is that the cost of location update and binding update is not high when U and B have small values, and the message processing cost of the proposed HMIPv6 is higher than that of HiSIGMA due to the high packet forwarding cost. This is because U(Location Update

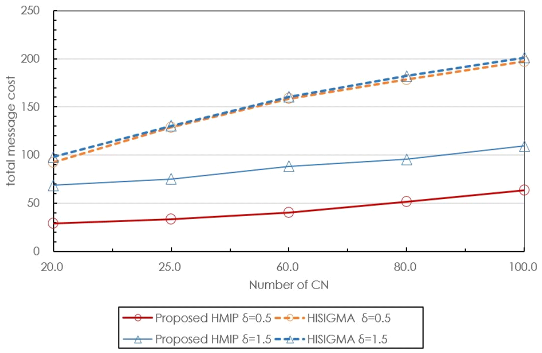

Fig. 4. Comparison of the effect of CN number and binding transport cost.

time) and B(Binding time) have small values. The message cost of the proposed HMIPv6 will be higher than that of HiSIGMA because the location update and binding update cost are not high, and the high package transmission cost.

Fig. 4 represents the fragmentation time as a delay time from the MN to the HA. MN and HA are connected wirelessly on the network. MN and HA have large delay. [11] and subnet maintenance time for performance evaluation. Assume that the total number of and MH is 80. location update cost $T_r = 60s$, the performance evaluation results for the average number of CNs connected by MH as different transmission costs are shown in Fig. 4.

These results indicate higher execution time, processor speed, and missed task deadlines by using the proposed algorithm than the existing method. However, for configurations with different speeds, the speed of processors must follow a Gaussian distribution for optimal scheduling and task assignment.

5. CONCLUSION

In this paper, we propose a hierarchical location management method for transport layer mobility processing. By comparing the message processing cost of the existing HiSIGMA and the HMIPv6 with MMP added using the message processing cost, improved results were obtained through performance evaluation. By introducing MMP, the message processing cost of HiSIGMA was greatly reduced, and it was found that the message processing cost was lowered through the improvement of the HMIPv6 mobility location update and tunneling average time.

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