http://www.icact.org/

MAIN
MESSAGE
OBJECTIVES
COMMITTEE
SESSION OVERVIEW
TUTORIAL I
PLENARY SESSION
TUTORIAL II
TECHNICAL SESSIONS
AUTHOR INDEX
REVIEWER LIST
TRANSPORTATION
FLOOR PLAN FOR ICACT2013
OTHER INFORMATION

THE 15 th INTERNATIONAL CONFERENCE ON ADVANCED COMMUNICATION TECHNOLOGY

Smart Services with Internet of Things!

Phoenix Park, Pyeongchang. Republic of Korea
Jan. 27~30, 2013

IEEE Catalog Number : CFP13561-CDR
ISSN 1738-9445
ISBN 978-89-968650-0-1

Get Adobe Reader

Organizers

Sponsors

Session 2P: Poster 2

Room : Phoenix II

Chair : Dr. Hyun-Ah KIM, Kyonggi University, Korea

02P-01 0064	Performance Analysis of WiMedia UWB System with Wireless Video Traffic
	Man-Soo Han
	Mokpo National Univ., Korea
02P-02 0209	Testing of Early Applied LTE-Advanced Technologies on Current LTE Service to overcome Real Network Problem and to increase Data Capacity
	Seung-Chul SHIN*, Young-Poong LEE*
	*Agilent Technologies, South Korea
02P-03 0375	Cluster Head Selection Scheme for Minimizing the Changes of the Cluster Members considering Mobility in Mobile Wireless Sensor Networks
	Hyunsook Kim
	Liberal Education Center, Daegu University, Korea
02P-04 0088	M2M Distance Estimation in Indoor Wireless Network
	Joonyoung Jung*, Changseok Bae*
	* Electronics and Telecommunications Research Institute, South Korea
02P-05 0415	Algebraic Space Time Code Implementation in MIMO Environment: Design Criteria and Performance
	Ines BEN HASSINE *, Ridha BOUALLEGUE *
	* National Engineering School of Tunis, Tunisia
02P-06 0081	Time-Frequency-Multiplex Preamble Design for Joint I/Q Imbalance, CFO and Channel Estimation in OFDM Systems
	Juinn-Horng Deng and Kuo-Tai Feng†
	Yuan Ze University, Taiwan
02P-07 0285	An Enhanced Method for Mitigation of Network Traffic using TCP Signalling Control
	Min Woo Kim*, Seong Gon Choi*
	*College of Electrical & Computer Engineering, Chungbuk National University
02P-08 0051	Enhanced Mobility Management Schemes in HIPbased Mobile Networks
	Sang-Il Choi, Seok Joo Koh
	Kyungpook National University, Korea
02P-09 0139	Expanding ICT Infrastructure for Rural Areas in Korea
	Hyongsoon Kim*, Eunyoung Lee**
	* National Information Society Agency, korea, **Dongduk Women's University, Korea
02P-10 0174	Key Sharing Scheme based on One Weighted Threshold Secret Sharing
	SeongMin Yoo*, PyungKoo Park**, JinSeop Shin*, JaeCheol Ryou *
	*Department of Computer Engineering, Chungnam National University **Convergence Network Research Laboratory, ETRI, Daejeon

Enhanced Mobility Management Schemes in HIP-based Mobile Networks

Sang-Il Choi, Seok Joo Koh

School of Computer Science and Engineering, Kyungpook National University, Korea

overcycos@gmail.com, sjkoh@knu.ac.kr

***Abstract*— The Host Identity Protocol (HIP) has been proposed as an identifier-locator (ID-LOC) separation scheme, in which the 128-bit Host Identity Tag (HIT) is used as an ID and the IP address of the host is used as a LOC. In HIP, the mobility control operations are performed based on a centralized Rendezvous Server (RVS) that acts as a mobility anchor for mobile nodes, in which all the HIP control messages are passed through the RVS server. However, this centralized mobility scheme has some limitation, such as the service degradation by a point of failure and the overhead of centralized anchor. In this paper, we propose the two schemes for distributed mobility management (DMM): HIP-DMM-Push and HIP-DMM-Pull. From the numerical analysis, it is shown that the proposed DMM schemes can provide better performance than the existing centralized scheme, and that the pull-based distributed control scheme (HIP-DMM-Pull) provides the best performance among the candidate mobility schemes in terms of the processing overhead at the central RVS server and the HIP connection setup delays.**

***Keywords*— HIP, Rendezvous Server, Inter-Domain, Mobile Networks, Distributed mobility control**

I. INTRODUCTION

With emergence of new types of wireless/mobile networks and wide popularity of smart phones, the number of mobile Internet users has been rapidly increasing. This mobile trend has caused a rapid growth of BGP routing table, as known as the routing scalability problem. [1].

To solve this problem the Host Identity Protocol (HIP) has been proposed in IETF [2], which splits the function of current IP address space into Host Identity (HI) and routing locator (IPv4). An HI is encoded to Host Identity Tag (HIT) and both HI and HIT are not changed. If end host wants to communication to the other, end host finds out other host's IPv4 address using HIT of other end host. In the HIP, the centralized Rendezvous Server (RVS) has the responsibility of this search process [3]. In the centralized scheme, all binding and first Initiate message (I1) are processed by a central RVS. However, the centralized scheme is vulnerable to several problems [4]. First, a single point of failure of central RVS may affect severe degradation of overall system performance and also the increased cost of network engineering. In addition, the centralized RVS has the risk of overhead by increasing of host that is stored in the RVS's HIT-IPv4 mapping table.

In this paper, we proposed two network-based distributed mobility control schemes for HIP-based Mobile Networks. The proposed distributed control schemes can be used to effectively provide the mobility support in HIP-based wireless/mobile HIP networks, compared to the existing centralized control schemes.

This paper is organized as follows. Section II describes the existing centralized schemes for HIP mobility control. In Section III, we propose the two distributed mobility control schemes. Section IV analyzes and compares the existing and proposed schemes in terms of the HIP connection setup delays, and the processing overhead at the central RVS server. Section V concludes this paper.

II. EXISTING HIP SCHEME

In existing schemes for HIP mobility control, all HIT-IPv4 mapping entries are stored at centralized RVS. Figure 1 shows the operation of existing HIP data transmission.

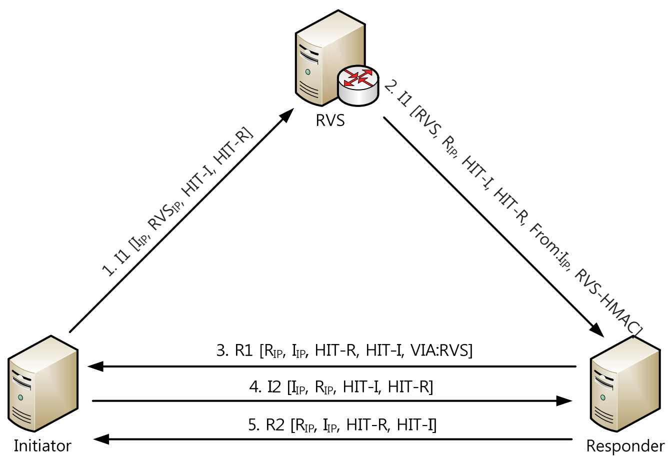

Figure 1. Existing HIP data transmission

If Initiator wants to communicate with Responder, Initiator sends the I1 message that contains the IP address of Initiator, IP address of RVS, HIT of Initiator, and HIT of Responder to centralized RVS, as described in Step 1. Next, RVS will search the HIT-IPv4 mapping table. Then, RVS will forward I1 message that adds the RVS-HMAC for authentication to Responder (Step 2). On reception of I1 message, Responder responds with a R1 message that contains the IP address of Responder, IP address of Initiator, HIT of Initiator, and VIA:RVS for authentication (Step 3). After that, Initiator and Responder exchange the I2 message and R2 message (Step 4, 5). Now, communication between Initiator and Responder is possible, because Initiator knows the IP address of Responder.

In this paper, we will focus on only the inter-domain mobility control within a HIP-based mobile network, rather than the intra-domain mobility control.

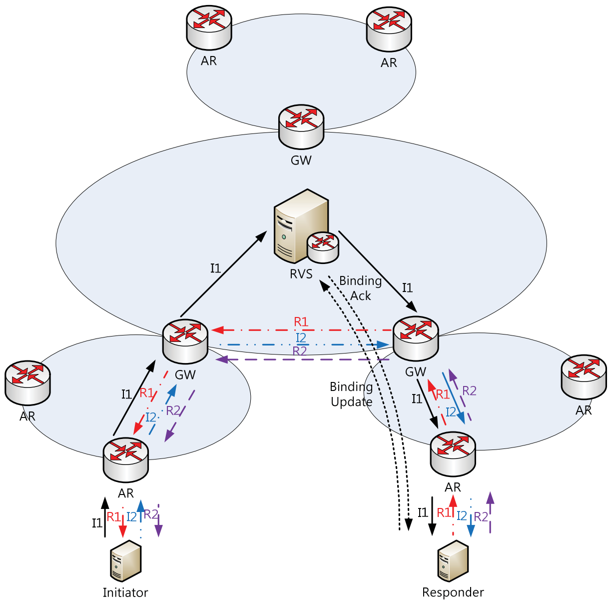

Figure 2. Existing HIP schemes

Figure 2 describe the existing HIP data transmission schemes in the inter-domain case. First, Responder sends the Binding Update message to RVS for adding the HIT-IPv4 entry of Responder. Then, RVS responds with Binding Ack message to Responder. In this state, if Initiator wants to communicate with Responder, it sends the I1 message to centralized RVS through Access Router (AR) and Gateway (GW) of Initiator. Then, centralized RVS will search the HIT-IPv4 table and forward to IP address of Responder through GW and AR of Responder. On reception of I1 message, Responder responds with R2 message to Initiator directly. After that, Initiator and Responder exchange the I2 message and R2 message through each AR and GW of Initiator and Responder.

III. Proposed Schemes

A In this section, we describe the proposed distributed mobility control schemes: HIP-DMM-Push and HIP-DMM-Pull.

A. *Overview*

In the proposed schemes, each GW has the Distributed-Rendezvous Server (D-RVS) functionality, and stores the host's information consisting of HIT and IPv4.

Each proposed scheme updates the HIT-IPv4 table in the different way. In HIP-DMM-Push, if initiator is attached to a domain, then the GW of Initiator will sends the Binding Update message that contains the HIT and IP address of Initiator to the other D-RVS by multicast. On reception of this Binding Update message, each D-RVS updates their HIT-IPv4 table and then responds with Binding Ack message. This is called the 'push' operation, which is similar to the legacy routing protocol (e. g., OSPF) mechanism. In HIP-DMM-Pull, on the other hand, each Binding Update message of Responder is completed in D-RVS of Initiator and only the D-RVS of Responder updates the entry. After that, if Initiator wants to communicate with Responder, then GW of Initiator sends the I1 message that is the first message of mapping query to other GW through multicast for HIT-IPv4 mapping entry. Then, only the GW of Responder responds with R1 message that contains IP address of Responder. From this R1 message, D-RVS of Initiator can update the Responder's information in their HIT-IPv4 table.

HIP is a centralized scheme, in which all Binding Update and Mapping Query messages are processed by centralized RVS.

HIP-DMM-Push is a distributed scheme, in which each GW performs the RVS functionality. In this scheme, Binding Update with RVS is not performed. Instead, each D-RVS will send its Binding Update message to other D-RVS by multicast, when a new Responder is attached to the network. From this process, this scheme does not need to query for HIT-IPv4 mapping to other D-RVS, because the D-RVS already knows that.

HIP-DMM-Pull is also a distributed scheme with GW acting as RVS. The Binding Update is processed at D-RVS of the host. Then, each D-RVS sends an I1 message to other D-RVS to find the IP address of host.

B. *HIP-Push*

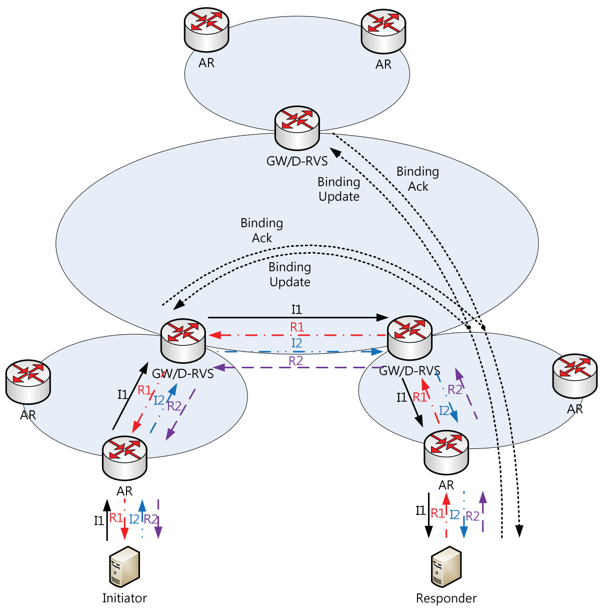

Figure 3. Distributed HIP-DMM-Push Operations

Figure 3 show the HIP-DMM-Push operations. When Responder is attached to a new domain, its HIT will be bound to its AR and GW/D-RVS. Then, GW of Responder will send (or push) the Binding Update message that contain the HIT and IP address of Responder to other GW/D-RVS by multicast. Every GW/D-RVS will update its HIT-IPv4 address, based on the Binding Update received from GW/D-RVS of Responder. When Initiator wants to communicate with Responder, the Initiator sends the I1 message to GW/D-RVS of Initiator. Then GW/D-RVS looks up the HIT-IPv4 table to find the IP address of Responder. If the IP address is found, GW/D-RVS forwards the I1 message to GW/D-RVS of Responder. Then, I1 message is forwarded to Responder. On reception of I1 message, Responder sends the R1 message to Initiator through GW/D-RVS of Responder and GW/D-RVS of Initiator. Next, Initiator sends the I2 message to Responder and receives the R2 message from Responder in the same way. Now, Initiator can send the data message to Responder directly.

C. *HIP-Pull*

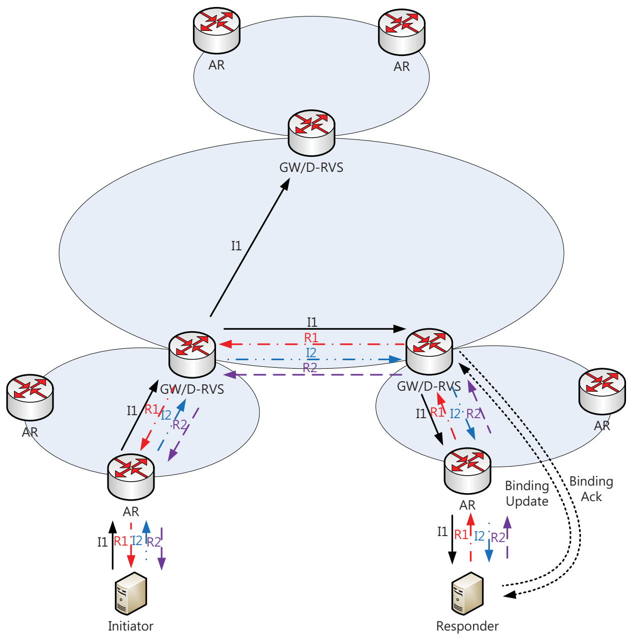

Figure 4. Distributed HIP-DMM-Pull Operations

Figure 4 shows the HIP-DMM-Pull operations. When Responder enters a domain, it is connected to AR, and the Binding Update is processed at the GW/D-RVS of Responder. Now, Initiator wants to communicate with Responder, the Initiator sends the I1 message to GW/D-RVS of Initiator. Then GW/D-RVS forwards the I1 message to other GW/D-RVS to find the IP address of Responder. Then, only the GW/D-RVS of Responder will forwards the I1 message to Responder, other GW/D-RVS will discard this message. On reception of I1 message, Responder sends the R1 message to Initiator through GW/D-RVS of Responder and GW/D-RVS of Initiator. Next, Initiator sends the I2 message to Responder and receives the R2 message from Responder in the same way. Now, Initiator can send the data message to Responder directly.

IV. Performance Analysis

A To evaluate the performance of the proposed mobility schemes, we analyze the delay of the total transmission of first data and the overhead of GW/D-RVS. We compare the total transmission delay cost and the number of HIT-IPv4 table entry of GW/D-RVS for the existing scheme (HIP) and the proposed schemes (HIP-DMM-Push, HIP-DMM-Pull).

A. *Analysis Model*

Initiator and Responder are located within the different domain (i.e., Initiator is a mobile host and Responder is a static host), as illustrated below in the Figure 5.

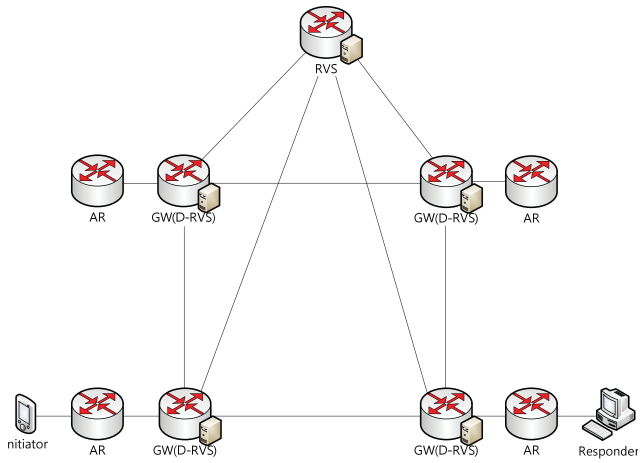

Figure 5. Network Model for numerical analysis

The binding update delay and the data delivery delay are denoted by BUD and DDD, respectively. Then the total delay (TD) is represented as TD=BUD+DDD.

B. *Cost Analysis*

We define the parameters used for the analysis in Table 1.

TABLE 1. Parameters Used for Cost Analysis

Parameter	Description
T_{setup}	Node setup and HIT encoding delay
S_b	Size of a 'b' packet
N_{GW}	Number of GW in the Network
H_{a-b}	Hop count between node a and b in the network
γ (H_{GW-GW}/H_{GW-RVS})	Ratio of H_{GW-GW} over H_{GW-RVS}
P_c	Processing cost of node c for binding update or lookup

1) HIP

If the Responder enters a network, HIT encoding process begins. We assume that this operation takes roughly T_{setup}. Then Responder sends the Binding Update message to centralized RVS through GW and AR of Responder and receives the Binding Ack message. This operation takes $2S_{control} \times \{H_{AR\text{-}GW}+H_{GW\text{-}RVS}+(H_{host\text{-}AR}/2)\}$. On reception of Binding Update message, centralized RVS updates their HIT-IPv4 table. This operation takes P_{RVS}. We assumed that the processing cost of RVS is proportional to the total number of active hosts in the domain ($N_{AR} \times N_{Host/AR}$) in the log scale by using a tree-based data structure to implement the database. Accordingly, the binding update delay of HIP can be represented as follows.

$$BUD_{HIP} = T_{setup} + 2S_{control} \times \{H_{AR\text{-}GW} + H_{GW\text{-}RVS} + (H_{host\text{-}AR} / 2)\} + \log_2(N_{host}/N_{RVS}) \quad (1)$$

In HIP, the data delivery delay for Initiator to Responder can be calculated as follows. First, Initiator sends the I1 message to centralized RVS through AR and GW of Initiator. Then, centralized RVS will look for the IP address of HIT of Responder in their HIT-IPv4 table, which takes $\log_2(N_{host}/N_{RVS})$. After that, RVS will forward the I1 message to Responder through AR and GW of Responder. This operation takes $2S_{I1} \times (H_{host\text{-}AR}+H_{AR\text{-}GW}+H_{GW\text{-}RVS})$. After that, Initiator and Responder exchange R1, I2, and R2 message through AR and GW of Initiator and Responder. Then, the first data packet will be forwarded from Initiator to Responder in the same way. This operation takes $(S_{R1}+S_{I2}+S_{R2}+S_{data}) \times (H_{host\text{-}AR}+H_{AR\text{-}GW}+H_{GW\text{-}GW}+H_{GW\text{-}AR}+H_{AR\text{-}host})$. Thus, the data delivery delay of HIP can be represented as follows.

$$DDD_{HIP} = 2S_{I1}(H_{host\text{-}AR} + H_{AR\text{-}GW} + H_{GW\text{-}RVS}) + (S_{R1} + S_{I2} + S_{R2} + S_{data}) \times (2H_{host\text{-}AR} + 2H_{AR\text{-}GW} + H_{GW\text{-}GW}) + \log_2(N_{host}/N_{RVS}) \quad (2)$$

So, we obtain the total delay of HIP as

$$TD_{HIP} = BUD_{HIP} + DDD_{HIP}$$

2) HIP-DMM-Push

If the Responder enters a network, HIT encoding process begins. We assume that this operation takes roughly T_{setup}. Then Responder sends the Binding Update message to D-RVS of Responder and D-RVS will forward the Binding Update message to other D-RVS by multicast. This operation takes $2S_{control} \times \{H_{AR\text{-}GW} + H_{GW\text{-}GW} + (H_{host\text{-}AR}/2)\}$. On reception of Binding Update message, each D-RVS updates their HIT-IPv4 table. This operation takes $\log_2(N_{host})$, since each D-RVS has all host's mapping information from fowarded Binding Updated message. Accordingly, the binding update delay of HIP-DMM-Push can be represented as follows.

$$BUD_{HIP\text{-}DMM\text{-}Push} = T_{setup} + 2S_{control} \times \{H_{AR\text{-}GW} + (H_{host\text{-}AR}/2) + H_{GW\text{-}GW}\} + \log_2(N_{host}) \quad (3)$$

In the HIP-DMM-Push, the data delivery delay for Initiator to Responder can be calculated as follows. First, Initiator sends the I1 message to D-RVS of Initiator through AR and GW of Initiator. Then, D-RVS will look for the IP address of HIT of Responder in their HIT-IPv4 table, which takes $\log_2(N_{host})$. After that, D-RVS of Initiator will forward the I1 message to Responder through GW/D-RVS and AR of Responder. On reception of I1 message, Responder sends the R1 message to Initiator directly. Then Initiator and Responder exchange the I2 and R2 message in the same way. This operation takes $(S_{I1} + S_{R1} + S_{I2} + S_{R2} + S_{data}) \times (2H_{host\text{-}AR} + 2H_{AR\text{-}GW} + H_{GW\text{-}GW})$. Thus, the data delivery delay of HIP-DMM-Push can be represented as follows.

$$DDD_{HIP\text{-}DMM\text{-}Push} = (S_{I1} + S_{R1} + S_{I2} + S_{R2} + S_{data}) \times (2H_{host\text{-}AR} + 2H_{AR\text{-}GW} + H_{GW\text{-}GW}) + \log_2(N_{host}) \quad (4)$$

So we obtain the total delay of HIP-DMM-Push as

$$TD_{HIP\text{-}DMM\text{-}Push} = BUD_{HIP\text{-}DMM\text{-}Push} + DDD_{HIP\text{-}DMM\text{-}Push}$$

3)HIP-DMM-Pull

The Binding Update operations are performed as follows. When responder enters a network, HIT encoding process starts. We assume that this operation takes roughly T_{setup}. Then Responder sends the Binding Update message to D-RVS of Responder. This operation takes $2S_{control} \times \{H_{AR\text{-}GW} + (H_{host\text{-}AR}/2)\}$. At that time, the D-RVS of Responder updates their HIT-IPv4 mapping table. This operation takes $\log_2(N_{host}/N_{D\text{-}RVS})$, since each D-RVS stored only HIT-IPv4 mapping information of host that belongs to D-RVS's domain. Accordingly, the binding update delay of HIP-DMM-Pull can be represented as follows.

$$BUD_{HIP\text{-}DMM\text{-}Pull} = T_{setup} + 2S_{control} \times \{H_{AR\text{-}GW} + (H_{host\text{-}AR}/2)\} + \log_2(N_{host}/N_{D\text{-}RVS}) \quad (5)$$

In the HIP-DMM-Pull, the data delivery delay for Initiator to Responder can be calculated as follows. First, Initiator sends the I1 message to D-RVS of Initiator through AR and GW of Initiator. Then, D-RVS of Initiator forward the I1 message to other D-RVS by multicast. This operation takes $S_{I1}(H_{host\text{-}AR} + H_{AR\text{-}GW})$. After that, each D-RVS look for the IP address of HIT of Responder in their HIT-IPv4 table, which takes $\log_2(N_{host}/N_{D\text{-}RVS})$. If D-RVS find out that entry, then it will forward the I1 message to Responder through AR of Responder, and other D-RVSs discard the I1 message. This operation takes $S_{I1}(H_{host\text{-}AR} + H_{AR\text{-}GW} + H_{GW\text{-}GW})$. On reception of I1 message, Responder sends the R1 message to Initiator directly. Then, Initiator and Responder exchange the I2, R1, and I2 message, and next, Initiator sends the data packet to Responder directly. This operation takes $(S_{R1} + S_{I2} + S_{R2} +$

S_{data}) × ($2H_{host\text{-}AR}$ + $2H_{AR\text{-}GW}$ + $H_{GW\text{-}GW}$). Thus, the data delivery delay of HIP-DMM-Pull can be reprented as follows.

$$DDD_{HIP\text{-}DMM\text{-}Pull} = S_{I1}(2H_{host\text{-}AR} + 2H_{AR\text{-}GW} + H_{GW\text{-}GW}) + (S_{R1} + S_{I2} + S_{R2} + S_{data}) \times (2H_{host\text{-}AR} + 2H_{AR\text{-}GW} + H_{GW\text{-}GW}) + \log_2(N_{host}/N_{D\text{-}RVS}) \quad (6)$$

So, we obtain

$$TD_{HIP\text{-}DMM\text{-}Pull} = BUD_{HIP\text{-}DMM\text{-}Pull} + DDD_{HIP\text{-}DMM\text{-}Pull}$$

C. Numerical Results

Based on the cost analysis given in the previous section, we now compare the numerical results. For numerical analysis, we set the parameter values, as shown in Table 2, which are partly obtained from the results given in [5].

TABLE 2. Parameter Values Used for Cost Analysis

Parameter	Default	Minimum	Maximum
T_{setup}	100		
S_{I1}, S_{R1}, S_{I2}, S_{R2}	1		
$S_{control}$, S_{data}	1		
$N_{D\text{-}RVS}$	4	1	256
N_{host}	400	100	8000
$H_{host\text{-}AR}$	1		
$H_{AR\text{-}GW}$	1		
$H_{GW\text{-}GW}$	3		
$H_{GW\text{-}RVS}$	10		
γ	0.3	0.1	1.5

Figure 6 shows the impact of hop count ratio GW-GW over GW-RVS on total transmission delay. From the figure, we can see that the distributed mobility control schemes have lower total transmission delay until the ratio is equal to 0.8 and the HIP-DMM-Pull scheme shows the lower delay than HIP-DMM-Push. When the ratio is higher than 1.2, delay of distributed mobility control schemes are higher than existing HIP scheme. However, it is not a critical weakness. In general network, average distance between centralized server and gateway is farther than the distance between two gateways. So we are focus on the value that is lower than 1. In this general situation, we are sure that two distributed mobility control schemes can show the better performance than existing HIP scheme.

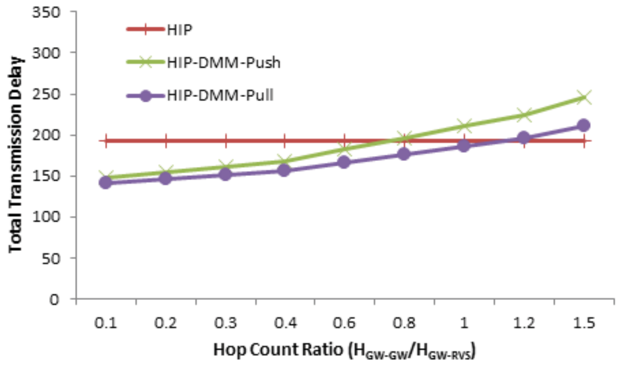

Figure 6. Impact of hop count ratio on total delay

Figure 7 and 8 show the impact of number of host and D-RVS on total transmission delay. From this figure, we can see that the two distributed mobility schemes show lower total transmission delay than existing HIP scheme. In HIP-DMM-Push, although each D-RVS has the same entry with RVS of existing HIP, there is no query operation to get the Responder's IP address. So this scheme can perform with low delay. In HIP-DMM-Pull, the I1 message's route is shorter than that of existing HIP. In addition, this scheme's HIT-IPv4 table has less entry than existing HIP scheme and HIP-DMM-Push. From these reasons, we can know that two distributed mobility control schemes shows better performance than existing scheme and the HIP-DMM-Pull has the best performance.

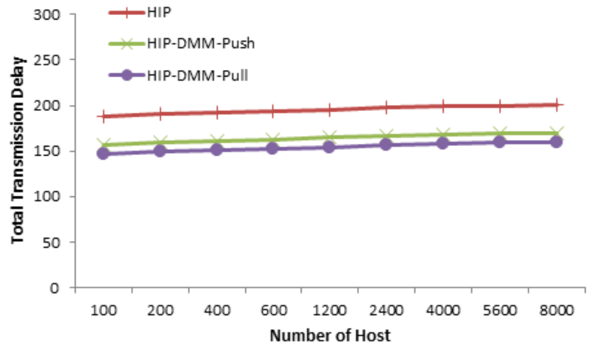

Figure 7. Impact of number of host on total delay

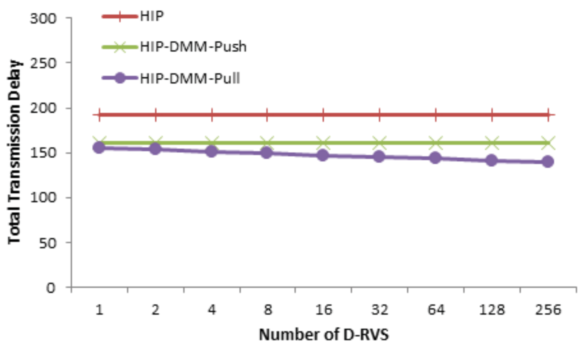

Figure 8. Impact of number of D-RVS on total delay

Figure 9 and 10 show the impact of number of host and D-RVS. In HIP-DMM-Push, HIT-IPv4 table update of D-RVS is completed at binding update operation. So, the entry number of two schemes (HIP and HIP-DMM-Push) are the same. From this reason, the existing scheme and HIP-DMM-Push show the same performance. However, in HIP-DMM-Pull, each D-RVS has the MIP-IPv4 mapping entry of hos that is located in domain of GW. Accordingly, HIP-DMM-Pull has the best performance.

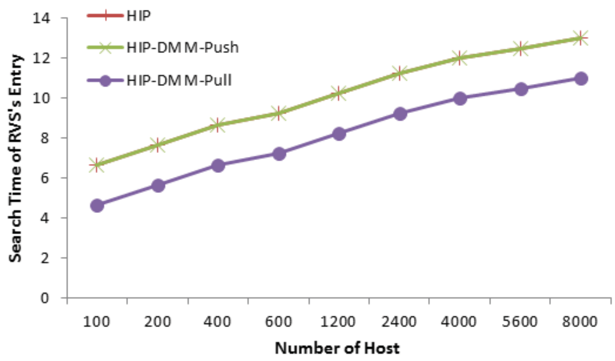

Figure 9. Impact of number of host on search time of RVS

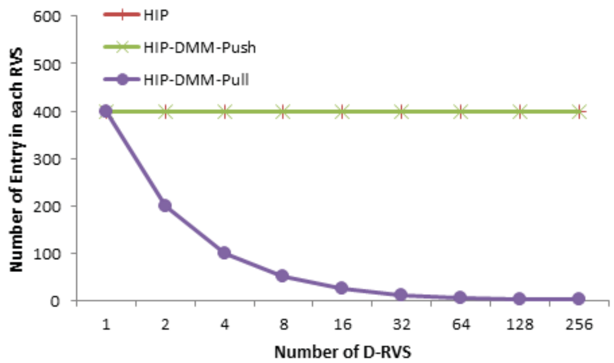

Figure 10. Impact of number of D-RVS on performance

V. Conclusions

In this paper, we propose the two schemes for distributed mobility management (DMM): HIP-DMM-Push and HIP-DMM-Pull. By numerical analysis, we compare the existing centralized RVS scheme and the two proposed distributed schemes, in terms of processing overhead at the central RVS server, and the HIP connection setup delays.

From the numerical results, we can see that the distributed mobility control scheme is better than the existing centralized RVS scheme. In particular, HIP-DMM-Pull scheme gives the best performance among all schemes. This is because HIP-DMM-Pull scheme's D-RVS has less HIT-IPv4 mapping entry than HIP-DMM-Push and Existing-HIP scheme.

Acknowledgment

This research was supported by Basic Science Research Program of NRF(2011-0026529), ITRC support program of NIPA(NIPA-H0301-12-2004), ICT Standardization program of MKE(The Ministry of Knowledge Economy), and IT R&D support program of KCA(KCA-10913-05004).

References

[1] Morgan Stanley. Internet Trends. Available: http://www.morganstanley.com/institutional/techresearch/pdfs/Internet_Trends_041210.pdf, April 2010.

[2] R. Moskowitz, et al.., Host Identity Protocol (HIP), IETF RFC 5201, April 2008.

[3] J. Laganier, et al., Host Identity Protocol (HIP) Rendezvous Extension, IETF RFC 5204, April 2008.

[4] H. Chan, Problem statement for distributed and dynamic mobility management, IETF Internet Draft, draft-chan-distributed-mobility-ps-05.txt, October 2011.

[5] Y. H. Choi and T. M. Chung, "Using Correspondent Information for Routing Optimization Scheme on Proxy Mobile IPv6" Journal of Networks, Vol 5, No. 8, pp. 984-989, August 2010.