

Mobility Support Architecture in Locator-ID Separation based Future Internet using Proxy Mobile IPv6

Seung-Joon Seok[†]

Dept. of Computer Engineering, Kyungnam University

Abstract

Of several approaches for future Internet, separating two properties of IP address into locator and identifier, is being considered as a highly likely solution. IETF's LISP (Locator ID Separation Protocol) is proposed for this architecture. In particular, the LISP model easily allows for device mobility through simple update of information at MS (Mapping Server) without a separate protocol. In recent years, some of the models supporting device mobility using such LISP attributes have emerged; however, most of them have the limitation for seamless mobility support due to the frequent MS information updates and the time required for the updates. In this paper, PMIPv6 (Proxy Mobile IPv6) model is applied for mobility support in LISP model. PMIPv6 is a method that can support mobility based on network without the help of device; thus, this we define anew the behavior of functional modules (LMA, MAG and MS) to fit this model to the LISP environment and present specifically procedures of device registration, data transfer, route optimization and handover. In addition, our approach improves the communication performance using three tunnels identified with locators between mobile node and corresponding node and using a route optimized tunnel between MN's MAG and CN's MAG. Finally, it allows for seamless mobility by designing a sophisticated handover procedure.

Key Words : LISP, Locator-ID Separation, PMIPv6, Future Internet, Mobility

1. Introduction

In order to accommodate the requirements of future Internet, which are hard to resolve using the current Internet, a new architecture has been required. Among the network architectures proposed so far for future Internet, an approach that separates two roles of IP address: routing locator (RLOC) and endpoint identifier (EID) has been focused on. It is referred to as Locator-Identifier (LID) Separation and IEEE LISP is a protocol to operate LID separation architecture. The LID separation approach discloses only endpoint identifier (EID) to host device or applications and makes routing locator (RLOC) unrelated to the operation of applications. The LID separation architecture can provide an answer to the following problems, which are hard to resolve in the current Internet.

- Multi-homing: the function to improve the performance of communication services as

communication devices use simultaneously multiple interfaces connected to several networks

- Routing scalability: the function to provide routing service effectively even when the network is expanded
- Security: the function to respond to network security issues effectively
- Mobility: the function to support effectively the transfer of devices within network and between networks without interruption of communications

The LID separation/LISP network architecture is as shown in Figure 1. Location endpoint identifier (EID) indicates location of the local router through which a device accesses to Internet; thus, it means the location

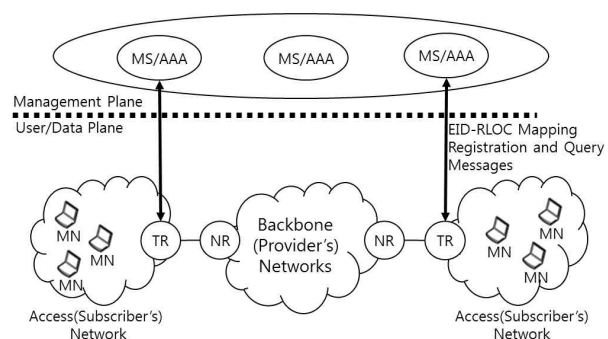


그림 1. LISP 네트워크 구조

Fig. 1. LISP Network Architecture

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게재확정일자: 2014년 2월 20일

[†] Corresponding author

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of a sub-network in which the device is. In the LISP network architecture, a management plane system should be built in order to manage the mapping information between an endpoint identifier (EID) and a routing locator (RLOC). This is a query system separately from DNS and is composed of servers, called as a mapping server (MS), saving entries which have information of RLOC for each EID, priority, load split ratio (weight), etc. The server provides the mapping information between RLOC and EID to enquirer device after receiving an enquiry. The strategy of deploying the management plane effectively still remains to be an open issue.

In the LISP scheme, the EID indicates the station itself and is fixed to the station and, however, a station device doesn't have to know its RLOC. A station asks a local router to register its EID, and the local locator generates EID-RLOC mapping information and sends it to the management plane / mapping server (MS) before communicating. Also, the locator / RLOC of the station should be changed after station movement. The ID is not, however, changed, regardless of movement.

Several network models for LID separation have been proposed; however, the LISP (locator identifier separation protocol) proposed by Cisco is currently considered as a network model for future Internet in several studies.

Figure 2 shows the data transmission in LISP. Tunnel routers (TRs), which usually operate as gateway routers between access networks and Internet, assigns its address as a RLOC for subordinate stations and register the EID-RLOC mapping information to MS in accordance with the requirement of a device. A device sends a packet, of which header has source and destination EIDs, to its local TR. Then, the TR adds a tunnel header to the original packet and transmits the tunneled packet to the corresponding TR. The tunnel header contains its and corresponding RLOCs as source and destination addresses. The TR queries the RLOC of the corresponding TR to MS using destination EID information extracted from the packet received from the sending station. Lastly, the corresponding TR transfers the packet to the destination station after removing the tunnel header from the tunneled packet.

Whenever a station moves between networks in LISP environments, the mapping of its EID and old RLOC must be changed into new one of its EID and new RLOC which indicates new access network or router. In the case of movement within current network, the mapping information doesn't have to be updated. It is required that the mapping information should maintain the latest location information all the time to support mobility effectively in LISP. In case when a station moves at high speeds, in particular, the RLOC may be frequently changed as the station. However, a certain period of time would be required to update the latest lo-

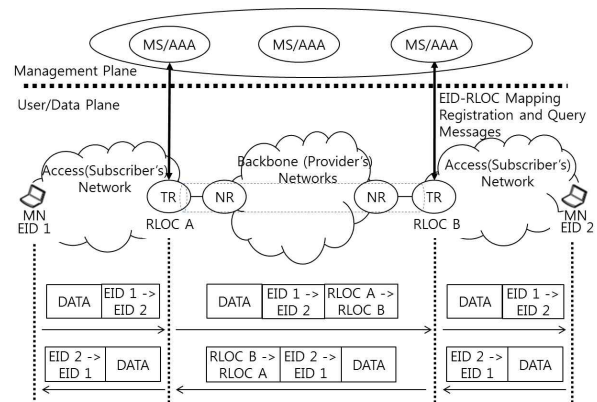


그림 2. LISP 테너링 구조

Fig. 2. LISP Tunneling Architecture

cation information in distributed mapping servers. Thus, it is believed that it would be considered as a load for the management plane when supporting high speed mobility for mobile stations.

This paper analyzes the issue of mobility support in the LID separation architecture and presents new strategy. Since the existing LISP based mobility support schemes have the performance limitation of load control for management plane, this paper aims to adopt the proxy mobile IPv6 architecture for network-driven mobility support in IPv6 network to alleviate the load of management plane in LID separation architecture.

As for the configuration of this paper, the second chapter states LISP (locator-identifier separation protocol), proxy IPv6 and mobility support schemes in the LISP network as the related studies. The third chapter proposes our strategy for mobility support in LISP future Internet. The fourth and fifth chapters verify the performance of the proposed architecture and draw conclusions.

2. Previous Works

The paper [2] proposes an approach, called as Indirect Mapping (IM), to mobility support in LISP domain. In IM, the network divided into Rendezvous Domain (RD)s and a RD is composed of one Rendezvous Point (RP) and a number of Tunnel Router (TR)s which are representative of each access network. Each time when a MN accesses to new local network, TR registers EID of MN and its own RLOC mapping information in local RP. In the case of new MN entered in RD, RP registers the EID and RP's RLOC mapping information for MN in MS. However, RP just modifies only TR's RLOC information when moving between access networks within the same RD. As a result, the mapping information of MS for MN should be changed in the case of moving to new RD. Unlike the case of the existing LISP where TR is the routing locator for

MN, RP of RD becomes the routing locator for MN to be registered in MS. The benefit of the IM is to reduce the frequent number of MS registration; Thereby, reducing the handover delay. However, it may cause data processing overhead and transfer delay as passing through the tunnel up to three times at most.

The papers [10~12] proposes LISP-DHC (distributed handover control) to implement the route optimization and fast handover functions by improving LISP protocol in order to resolve the prolonged delay problem occurred when supporting the existing LISP mobility. The access router that performs the function of TR saves both EID-RLOC information of local MN and EID-RLOC information of CN. When a MN moves to new network, the new TR requests the old TR for EID-RLOC mapping information of CN related to the MN and implements the route optimization using the mapping information of CN.

The [4] proposes a network model for mobility and routing scalability in future Internet. The proposed model is the one that combines LISP with the overlay network architecture of ALT (alternative logical topology). It is the architecture where each regional domain, in which LISP model is implemented, is connected each other through the ALT Internet backbone. This paper defines MATP (Mobility Anchor Tunnel Point) that is indicated by locator information and performs tunneling between itself and another MATP. There are two types of MATP: G-MATP and L-MATP. L-MATP is an access router and directly connected by MNs. When a MN moves to new network, new L-MATP conducts the authentication process on new MN and registers EID and locator information for the MN in the G-MATP with jurisdiction over its network to generate a tunnel with the G-MATP. G-MATP can find CN's G-MATP through looking EID up and makes a tunnel between the two G-MATPs in case of need for mobility support. Also from this measure, three tunnels at maximum would be generated between MN and CN. It would be overhead.

3. A Mobility Support Model for Locator-ID Separation Architecture

This paper applies PMIPv6 model as a measure of supporting mobility in the LID separation future Internet environment. We refer to this approach as LIDS-PMIP model. Figure 3 describes the LIDS-PMIP model merged LISP architecture and PMIPv6 model for

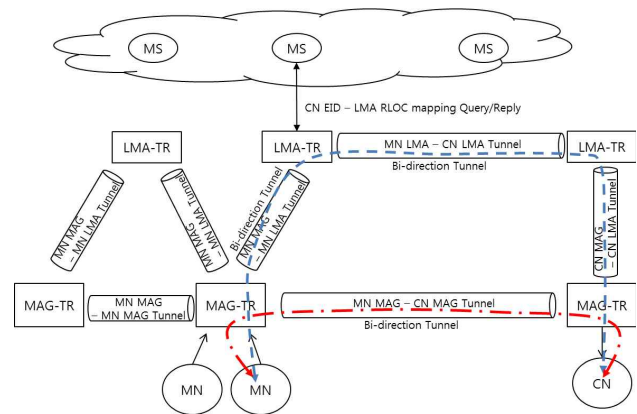


그림 3. LISP-PMIP 모델

Fig. 3. LISP-PMIP Model

supporting seamless mobility. Of these, the role of TR in LISP is separated into two devices of LMA-TR and MAG-TR which are conceptually similar to the LMA and MAG in PMIPv6 model, respectively. The functions of each device are defined in detail as follows:

- LMA-TR: It is a tunnel router(TR) of LISP protocol which puts a mapping information between mobile node(MN)'s EID (endpoint identifier) - LMA-TR's Routing Locator (RLOC) on mapping servers' list in order to distribute the home network's location of MN and which maintains a bi-directional tunnels between itself and other TRs for the data transfer of the MN. Also, LMA-TR is a home agent for a MN which maintains the RLOC information of MAG-TR for the MN's EID and bi-directional tunnels between LMA-TR and MAG-TR.
- MAG-TR: It is also both a TR and an access router in foreign network for MN. It registers the information mapping MN's EID - its' RLOC in LMA-TR in order to track the current position of MN instead of the mapping servers and sets up the bi-directional tunnel between itself and LMA-TR.
- MS/AAA(authentication & service server): It is the server that saves the mapping information between MN's EID and LMA-TR's RLOC in accordance with LISP model and responds to an enquiry. It also conducts the AAA processes when saving the mapping information for the first time.
- MN MAG - MN LMA tunnel: A bi-directional tunnel between a LMA-TR that enrolls a MN in home network and a MAG-TR where the MN is currently located. The packets are encapsulated with MAG-TR and LMA-TR RLOCs to pass through backbone Internet. This tunnel has been maintained as long as MN is inside the MAG-TR
- MN LMA - CN LMA tunnel: A bi-directional tunnel between two LMA-TRs, to which

LMA-TRs of a MN and a Corresponding Node(CN) belong. The packets are encapsulated with two LMA-TR RLOCs. This tunnel has been maintained during the communication period between the MN and the CN.

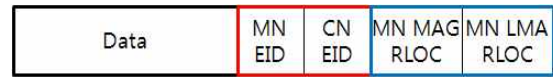
- MN MAG - CN MAG tunnel: A bi-directional tunnel between two MAG-TRs which MN and CN are currently located in, respectively. In this case, tunneling header uses two MAG RCLOs. This tunnel has been maintained before MN or CN moves to other network and during the communication period between the MN and the CN.

The proposed LIDS-PMIP model is based on LISP model. Thus, MN and CN transmit and receive packets using only EID (endpoint identifier). The data packet transmitted by MN at this time would be tunneled through the use of encapsulation header depending on the routing locator (RLOC) after arriving at MAG-TR or LMA-TR, which are TR. The three types of bi-directional tunnel are used in the model. The first is the tunnel between MAG-TR and LMA-TR, referred to as MN MAG - MN LMA tunnel; the tunnel is to transmit and receive data packets with MN's EID between LMA-TR, where the MN is registered, and MAG-TR, in which the MN is located. This tunnel has been maintained as long as the MN is inside the MAG-TR. The other one is generated and maintained for transmission and reception of data packet between the MN and the CN between LMA-TR, to which the MN belongs, and LMA-TR, to which the CN belongs. We call this tunnel as MN LMA - CN LMA tunnel. At last, LIDS-PMIP model has the tunnel between MAG-TRs. The tunnel between MAG-TRs is utilized to provide the route optimization and fast handover. The one is MN MAG - CN MAG tunnel and the other is MN MAG - MN MAG tunnel.

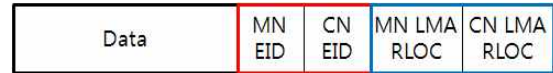
MN or CN should put the information mapping MN's EID and LMA-TR RLOC on the MS's list first before its communications. We call this operation as a MN-LMA-MS registration. Generally the LMA may be a default access router in home network for the MN. Thus, unless the MN changes its home network or the LMA-TR, the mapping information which has been registered at the MS should not change. However, the MN's location information(RLOC) may be changed whenever the MN moves to other networks. So, in LIDS-PMIP model, the MNs and CNs should its EID to local TR, regardless of LMA-TR or MAG-TR, at each time they move or periodically. Receiving the EID information, a LMA-TR registers the information mapping EID and LMA-TR's RLOC to MS. But, a MAG-TR sends the information mapping EID and MAG-TR's RLOC to the LMA-TR which the MN is belong to. This operation is referred to as



(a) Sections between MN and MAG-TR and between MAG-TR and CN



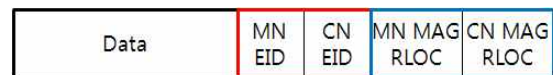
(b) Tunnel between MN MAG-TR and MN LMA-TR



(c) Tunnel between MN LMA-TR and CN LMA-TR



(d) Tunnel between CN LMA-TR and CN MAG-TR



(e) Tunnel between MN MAG-TR and CN MAG-TR

그림 4. LISP-PMIP 패킷 헤더 정보 요약

Fig. 4. LIDS-PMIP Packet Header Abstracts

MN-MAG-LMA registration or binding update.

Figure 4 describes the header architecture abstracts of data packet in the model (Figure 1). First, Figure 4(a) indicates the abstraction of packet which a MN sends to CN and this packet is n sections between MN and MAG-TR and between MAG-TR and CN. In this case, source address and destination address are MN's EID and CN's EID, respectively. Figure 4(b) is the tunnel header abstraction to be used for the transfer between MN MAG-TR and MN LMA-TR. This tunnel header uses the RLOCs of MAG-TR and LMA-TR as a source and destination addresses, respectively. Figure 4(c) is the tunnel header abstraction between MN LMA-TR and CN LMA-TR and Figure 4(d) is the tunnel header between CN LMA-TR and CN MAG-TR. At last, Figure 4(e) is the header abstraction for the tunnel directly connected between MN MAG-TR and CN MAG-TR. This is a tunnel for an optimized route.

LMA-TR and MAG-TR manages the binding cache table internally in order to maintain the tunnel information for each node or EID. Each table entry should be updated periodically in order to maintain the tunnels mentioned above. Table 1 shows the example of LMA-TR's binding cache table. The table entry is classified into two types in accordance with the type field value. First, if the type field value is LO(local),

표 1. LMA-TR의 바이딩 캐시 테이블

Table 1. Binding Cache Table of LMA-TR

Type [LO/CO]	EID [Endpoint ID]	RLOC [Routing Locator]	Seq. # [Count]	Life Time [Second]	LMA-TR [Yes/No]	Enable [Yes/No]
LO	MN's Address	MAG-TR1's Address	2	110	Yes	No
LO	MN's Address	MAG-TR2's Address	1	150	Yes	Yes
CO	CN's Address	LMA-TR's Address	1	99	Yes	Yes

표 2. MAG-TR의 바이딩 캐시 테이블

Table 2. Binding Cache Table of MAG-TR

Type [LO/CO]	EID [Endpoint ID]	RLOC [Routing Locator]	Seq. # [Count]	Life Time [Second]	LMA [Yes/No]	Enable [Yes/No]
LO	MN1's Address	LMA-TR1's Address	2	110	NO	Yes
LO	MN2's Address	LMA-TR2's Address	1	150	NO	Yes
CO	CN's Address	MAG-TR's Address	3	99	NO	Yes

then the relevant entry display the information on local MNs that are assigned at its home network with the LMA-TR as a home agent. The EID value is the address of MN and the RLOC value shows the address of MAG-TR where the MN is currently located. On the other hand, if the type field value is CO(corresponding), then the relevant entries have the information for CN nodes. In this case, the EID is the address of CN that belongs to another and remote LMA-TR and the RLOC is the address of relevant the remote LMA-TR. This LMA-TR's address can be obtained through an enquiry using CN EID's from MS. The Seq. # field of the table indicates the number of entry updates and the Life Time field is the period during which the entry validity is continued. The LMA-TR field indicates whether this table is the one of LMA-TR, and lastly, the Enable field orders whether it is possible to use the entry information.

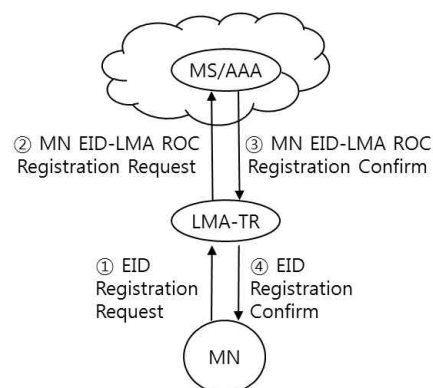
Table 2 is an example of MAG-TR's binding cache table. In the case when the Type field value is LO (local), the table entry represents the information on node located in the local network of its MAG-TR. In this case, the RLOC value is the one of LMA-TR, which MAG would enquire to MS. On the other hand, if the Type field value is CO (corresponding), the table entry is used for route optimization. So, the RLOC field has the RLOC of MAG-TR, to which CN node is currently belongs.

3.1. Registration Process

Both of LISP and PMIP models have the procedure to register the location for MN when it moves to new network. The proposed LIDS-PMIP model is also designed to perform the registration procedure which is a collage of the processes of LISP and PMIP. In short, our model requires that the mapping information between MN EID and TR's RLOC should be enrolled in MAG-TR, LMA-TR, and MS/AAA. However, the

mapping information, in particular the RLOC value, may be not same location. MS/AAA maintains the LMA-TR's location information, RLOCs, for a MN EID. LMA-TR manages the current locations of MNs which belong to itself and are now outside and the home locations of CNs which is communicating with local MNs. Finally, MAG-TR manages the home locations of MNs which is inside and the current locations of CNs corresponding to the MNs. So, MNs should enroll its EID in LMA-TR and/or MAG-TR periodically and at every movement changing networks, then the MAG-TR or LMA-TR makes the registration of the mapping information between MN's EID and RLOC.

The following Figure 5 shows the procedure for MN to register in LMA-TR and MS. First, when a new MN accesses to its home network, it sends the EID registration message to local LMA-TR through any-casting or broadcasting. After then, LMA-TR requests the MS to register the information of MN EID-to-LMA-TR's RLOC mapping. MS puts the information on the list after authentication process on the


 그림 5. MN - LMA-TR - MS 등록절차
 Fig. 5. MN - LMA-TR - MS
 Registration Procedure

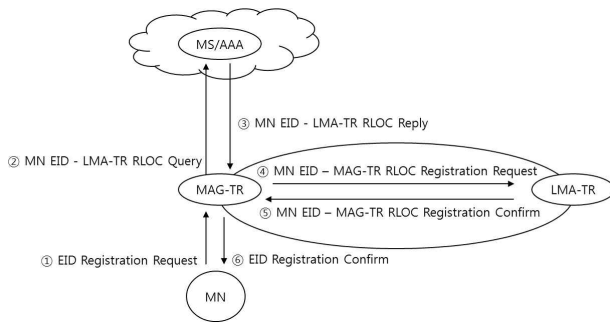


그림 6. MN - MAG-TR - LMA-TR 등록절차
Fig. 6. MN - MAG-TR - LMA-TR Registration Procedure

EID and the MN, and then responds the result to LMA-TR. Lastly, LMA-TR saves the EID's list in the internal table and a confirm message send to the MN as the response of previous registration. Hereafter, the MN refreshes the validity of the relevant entries through sending the EID update message to LAN-TR periodically.

Figure 6 depicts the registration process of MN when it access to a foreign network. First, MN sends EID registration message to local MAG-TR through any-cating with MAG-TR service address. Then, TR queries MN EID - LMA-TR RLOC mapping information to MS. After receiving the information from MS, the MAG-TR sends a binding update message to LMA-TR to update or enroll MN EID - MAG-TR RLOC mapping information and receives a confirm message as a response from LMA-TR. And finally, the MAG-TR replies to the MN's EID registration. Through such registration procedures, a bidirectional tunnel for a MN is generated between MAG-TR and LMA-TR.

Like the PMIP model, our LIDS-PMIP model also believes that the MN is below the LMA-TR (home network) although it is in foreign network. The MN would communicate with its LMA-TR regardless if it is in home network or foreign network. The MN updates its EID registration of LMA-TR periodically, and also LMA-TR advertises its information periodically. The MN located in home network directly sends the update message to LMA-TR. However, when the MN is in foreign networks, the EID update message should be translated to MN EID - LMA-TR RLOC registration update message and LMA-TR's advertisement message is transferred to MN through the tunnel between MAG-TR and LMA-TR. Also for hand-off, the procedure as above would be conducted among MN, MAG-TR, and LMA-TR.

3.2. Data Transmission Process

If CN and MN are registered in different LMAs each other, then the operation of CN transferring data to MN is as follows (Figure 7). When a MAG-TR receives the data transferred by CN to MN, it looks the routing lo-

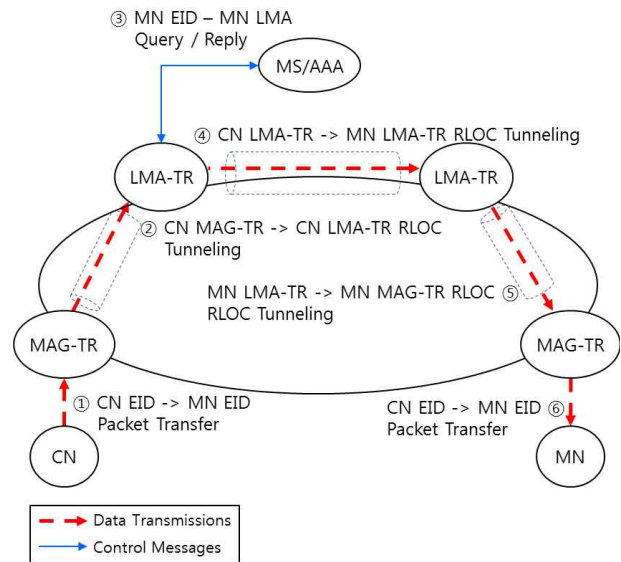


그림 7. CN-to-MN 데이터 전달절차
Fig. 7. CN-to-MN Data Transfer Process

cator (RLOC) of LMA-TR for the CN up in its local binding cache table. The MAG-TR adds the tunneling header of CN MAG-TR - CN LMA-TR tunnel and sends it to CN LMA-TR. The CN LMA-TR removes the tunnel header from the received packet and searches the RLOC of MN LMA-TR on the its binding cache table by the MN's EID. However, finding no entry for the MN, the CN LMA-TR queries MS for MN EID - LMA-TR RLOC mapping information. Since then, CN LMA-TR transfers the data to MN LMA by adding the tunneling of CN LMA-TR - MN LMA-TR tunnel. MN LMA-TR also transfers the packet to MN MAG-TR by changing the tunnel header of the packet for MN LMA-TR - MN MAG-TR tunnel. At last, MN MAG-TR transfers the original packet to the internal MN after removing the tunnel header. CN LMA-TR and/or MN LMA-TR put a new entry of CO type on their binding cache tables in case of need.

MN LMA-TR sends a route optimization message, which contains CN EID, MN EID, and MN MAG-TR's RLOC, to CN LMA-TR when receiving the first packet for new communication session between CN and MN. The CN LMA-TR relays this message to CN MAG-TR. Then, this CN MAG-TR directly sends a registration request (binding update) message to MN MAG-TR and receives a confirm message to make tunnel between these MAG-TRs. This tunnel is referred to as a route optimized tunnel (Figure 8). As a result, a CO type entry with MN EID and MN MAG-TR RLOC mapping information is added to CN MAG-TR's binding cache table and another one with CN EID and CN MAG-TR's mapping information is also added to MN MAG-TR's table.

In the case when MN and CN are registered in the same MAG-TR, the MAG-TR, which received the data

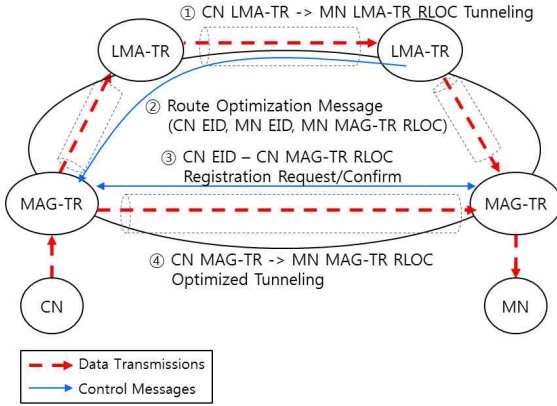


그림 8. CN MAG - to - MN MAG 사이에서 최적 터널 생성절차

Fig. 8 Generation Procedure of Optimized Tunnel between CN MAG - to - MN MAG

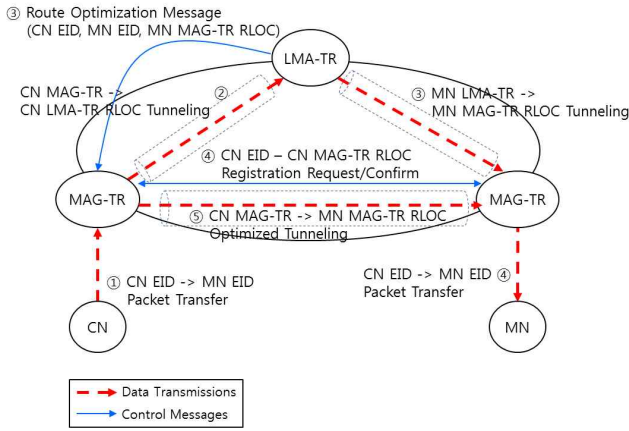


그림 9. 동일 LMA를 사용하는 경우 통신절차

Fig. 9. Communication Process When Using the Same LMA

transferred by MN, relays the packet to the internal MN directly without passing through LMA-TR. As for other cases, when MN and CN utilize the same LMA-TR even though they are registered in a different MAG-TR respectively, LMA-TR relays the original data between LMA-TR - CN MAG-TR tunnel and LMA-TR - MN MAG-TR tunnel. This case is depicted in Figure 9. After then, LMA-TR sends a route optimization message to CN MAG-TR to generate the optimal route tunnel between the two MAG-TRs.

3.3. Handover Process

In case a mobile node (MN) moves from old MAG-TR to new MAG-TR, this mobility process, referred to as handover, is as follows (Figure 10). When a MN starts moving to new MAG-TR, old MAG-TR transfers HI (handover initiation) message to new MAG-TR. HI message includes the information on MN EID, Old MAG-TR RLOC, LMA-TR RLOC, and CN MAG-TR RLOC(s). As soon as receiving the HI mes-

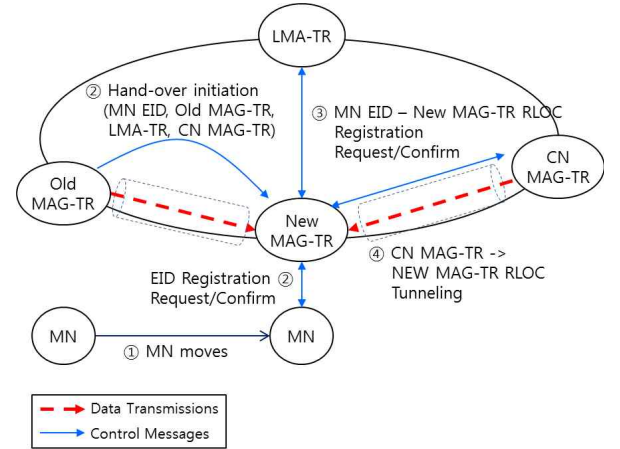


그림 10. MN의 핸드오버 절차

Fig. 10. Hand-over Process of MN

sage, new MAG-TR applies for MN EID - New MAG-TR RLOC registration to LMA-TR and at the same time it transfers the response to HI to old MAG-TR. Soon after receiving this, old MAG-TR sends MN data packets by generating the tunnel between two MAG-TRs. The packets should be stored and forward to the MN after it arrives at new MAG-TR. After a short while, the MN connects to new MAG-TR and immediately sends a MN EID registration message to new MAG-TR in accordance with the existing procedure. Just then, new MAG-TR replies to the registration of MN instead of the LMA-TR. Also, new MAG-TR replaces the previous route-optimized tunnel(s) with new tunnel(s) between new MAG-TR and CN MAG-TR(s) by transferring binding update message(s) with new MAG-TR (registration) to CN MAG-TR(s) which is announced by the HI message. So, the location information of MN is raced by LMA-TR and need not to be updated for every handover process.

4. Evaluations

This paper compares the proposed LIDS-PMIP model with others which have previously proposed to improve the mobility support of LISP model. Table 3 shows qualitative analysis results between mobility models for LISP in terms of seamless hand-over support, target locator error condition, MS registration overhead, the number of tunnels between MN and CN, route optimization support, and network driven hand-over possibility.

Our LIDS-PMIP has been designed to make a tunnel between old and new MAG-TRs to forward packets received by old MAG-TR to MN in the middle of hand-over process in order to make seamless hand-over. Let's assume that MN's hand-over operation

and new CN's query to MS are carried out simultaneously. In this case, it is possible that the new CN get old locator information for the MN. This is referred to as EID-RLOC error. In our model, the EID-RLOC mapping information of MN stored in MS(s) is fixed and not changed by hand-over. However, LISP and [10] requires that the EID-RLOC of MS(s) should be changed whenever MN moves. Some time is spent on this operation and the EID-RLOC error may happens more frequently than other methods. In [2] and [4], EID-RLOC mapping information of MS is modified only when MN moves between domains, not between neighbor networks. However, [2] and [4] make three tunnels when MN and CN are in different domains each other. In our LIDS-PMIP model, first several packets are transferred through the normal route using three tunnels and next an optimized tunnel between MN's MAG-TR and CN's MAG-TR is developed and all packets are transferred through the optimized route. Finally, the LIDS-PMIP makes as if MN is in home network always.

In conclusion, we can say that our LIDS-PMIP model has affirmative characteristics in six fields as compared to LISP model, [2], [4], and [10].

표 3. 이동성 지원 모델 비교

Table 3. Comparison of Mobility Support Models

	LISP	[2]	[4]	[10]	LIDS-PMIP
Seamless Handover	N/A	N/A	N/A	Possible	Possible
EID-RLOC Error	Frequent	infrequent	infrequent	Frequent	N/A
MS Registration Overhead	High	Low	Low	High	N/A
# of Tunnel Between MN and CN	1	2 or 3	2 or 3	1	1(≤ 3)
Route Optimization	N/A	N/A	N/A	Possible	Possible
Network Driven Hand-over	N/A	N/A	N/A	N/A	Possible

5. Conclusions

Even in the future Internet environment, the support for mobility of a device is becoming a very important issue. This paper improved Proxy Mobile IPv6 model, which is the network based mobility model among the measures to support Internet mobility that have been proposed so far, so that it can fit to the LISP model that is the future Internet environment. This is referred to as LIDS-PMIP model. On that account, we defined

anew the functions of MAG-TR, LMA-TR, MN and CN and concretely presented device registration, data transfer, route optimization and handover procedures. In this paper, to improve the transfer performance, we presented the data transfer procedures between CN and MN through three tunnels, whose endpoint are LMA-TRs for MN and CN, and through a tunnel for optimized route, which is between MAG-TRs for MN and CN. At last, this paper defined the handover process for seamless mobility support in our LIDS-PMIP model. The proposed model can significantly reduce the signaling cost and the hand-over processing delay as compared with the other LISP based measures that have been proposed for mobility support of future Internet.

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저 자 소 개



석승준(Seung-Joon Seok)

2003년 : 고려대학교 대학원 전자공학과
졸업(공학박사)

2004년~현재 : 경남대학교 컴퓨터공학과
부교수

관심분야 : 미래인터넷, 이동/무선 인터넷 프로토콜, USN, VANET

Phone : +82-55-249-2710

E-mail : sjseok@kyungnam.ac.kr