International Journal of Future Generation Communication and Networking
Vol. 9, No. 10 (2016), pp. 395-404
http://dx.doi.org/10.14257/ijfgcn.2016.9.10.33

Multi-Access Routing Switching Scheme for Smart Multimedia Transmission over Wireless Integrated Networks

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Abstract

Current mobile networking technology is continuously progressing to support the demand of today's generation of Internet users who connect about with sophisticated mobile computers and digital wireless devices. Routing protocols needs to be modified in host mobility in order that packets will be sent and delivered in its right destination. In Mobile Internet protocol, the mobile node will be able to send and receive packet from its original Home IP address to its current location regardless of the location upon connection with Internet. Through this kind of connection, packet loss is inevitable during the handover process. To solve this, numerous studies on the handover process was studied in order to minimize packet loss during the handover process. In this paper, we suggest context aware based smart distributed packet (SDP) transmission mechanism using multi-access routing switching mechanism in wireless integrated networks. We will explain and discuss the scheme that supports a distributed fast handover effectively in mobile management protocol based context-awareness. New signaling messages, smart distributed packet update messages, advanced TFRC message and reverse PBUs, are defined and utilized to hasten the handover procedure.

Keywords: *Mobility Management, Smart distributed packet update, Multi-Access network control, Reverse Binding*

1. Introduction

MIPv6 subjectively allows any IPv6 node to maintain its mobility and reachability regardless of its location within the IPv6 network. Unlike other protocols in networking, in MIPv6, the modification in Transport layers are not necessary to maintain the connection for mobile nodes. Instead, modifications are done in the Internet Layer using MIPV6 messages, its options and processes that will ensure that the packets are delivered properly to its mobile node's location regardless of its location. [1].

With Mobile IPv6, Fast Mobile IPv6 evolved as a development of MIPv6. It is designed to enhance the MIPv6 in the signaling and handover aspects. The MIPv6 enables in reducing the signaling overhead and delay concerning with the location update. The mobile node sends a local Binding Updates (BU) to the local MAP, instead of the Home Agent (HA) and Correspondent Nodes (CN). In Fast MIPv6, it uses bi-directional tunnels between ARs and makes various L2 triggers to support a faster handover and continuously minimizing service interruption during the handover process.

In this paper we proposed a robust multimedia packet transfer mechanism using context aware based smart distributed packet (SDP) transmission scheme which suggested multi-access routing switching mechanism in wireless integrated networks.

The rest of these papers are as follows: Section 2 explains related works; In Section 3 we illustrate and discusses the proposed smart distributed packet transmission mechanism;

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ISSN: 2233-7857 IJFGCN

comparison and performance analysis is explained in Section 4; and concluding in Section 5.

2. Related Works and Problems

2.1 Standard Mobile IPv6

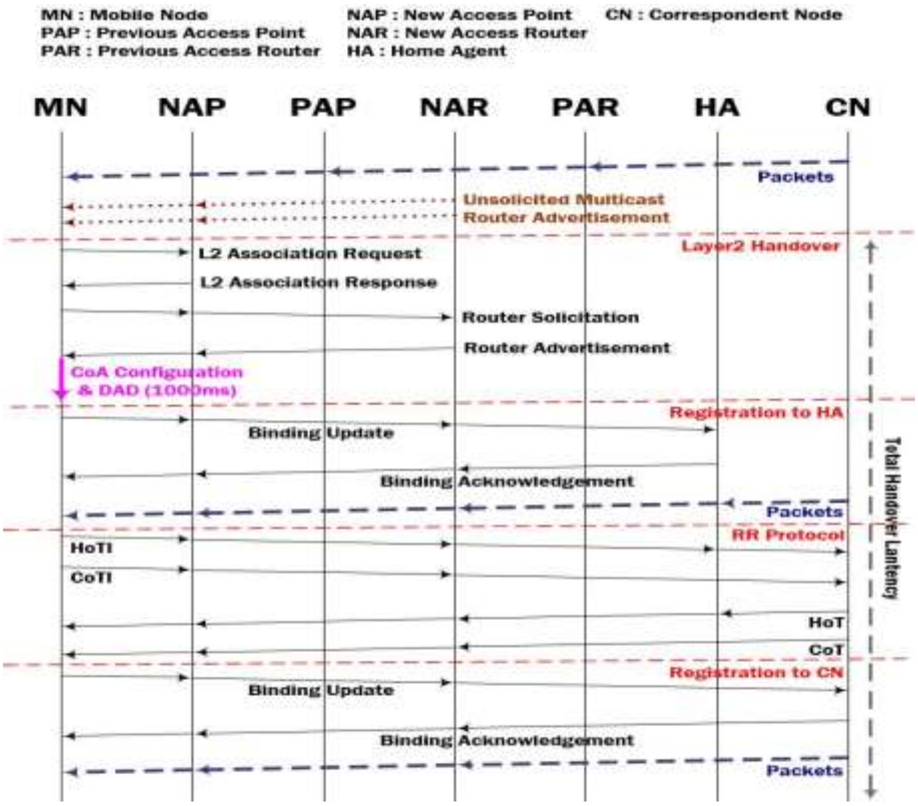

Figure 1. Standard Mobile IPv6 Handover Procedure

Mobile IPv6 (MIPv6) [4] is a host based mobility management protocol that supports global mobility of MN. MN uses a permanent HoA and a temporary CoA in MIPv6 protocol. When MN enters in a foreign domain the MN should obtain the CoA from router advertisement message. After the configuration of new CoA, Duplicate Address Detection (DAD) procedure is performed. Then, MN registers CoA to HA through binding update (BU) message. When MN moves away from the home network, the HA works as a stationary proxy.

The HA intercepts packets destined to the HoA of MN and forwards these packet by tunnelling to the CoA of MN. For efficient transmission of packets the Mobile IPv6 has a route optimization scheme. In this scheme the MN sends its new CoA to CN by BU message. After receiving this BU message the CN sends packets to MN directly. However packets from CN are delivered to MN via HA until the CN receives the new CoA of MN. Figure 1 shows handover procedure of mobile IPv6.

The MIPv6 handover procedure consists of movement detection, new CoA configuration, and location update. These procedures will cause long handover latency, which is not acceptable for real time multimedia application. In order to improve the handover latency, the various extensions of MIPv6 such as fast handover for Mobile IPv6 (FMIPv6) [5] and hierarchical MIPv6 (HMIPv6) [6] has been proposed.

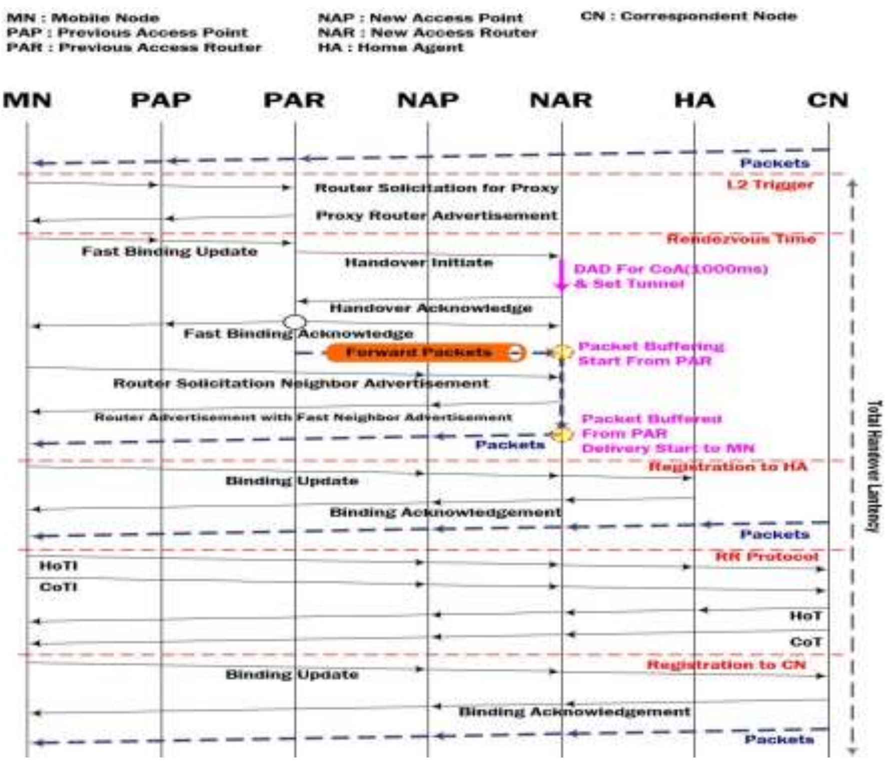

Figure 2. Standard Fast Handover for Mobile IPv6 Handover Procedure

Though a lot of enhanced MIPv6 schemes have been reported over the past year the MIPv6 has not deployed widely in practice because of heavy specification which has to be implemented at small mobile node for support MIPv6.

2.2 Fast Handover for Mobile IPv6 (FMIPv6)

The event where the Mobile Node receives a positive confirmation from a potential NCoA on the present subnet is termed as predictive mode. While, an event, where the MN checks the distinctiveness of an NCoA after that the MN is attached to the present subnet is termed as Reactive Mode. Even though the MN does an early verification on the present subnet, it could be a reactive event for FMIPv6, until such the verification from the current will be received by the MN. Figure 2 shows handover procedure of FMIPv6.

In cases where during the confirmation process and the NCoA is rejected, the NCoA will be configured by the MN solely after movement was detected and the handover latency will be longer. Cases like this, a unique NCoA will be suggested by the NAR, but how to do it has no exact method. Handover latency will greatly be reduced by having the predictive mode more often rather than the reactive mode. Because of this, the positive confirmation on the NCoA will always be a success and it should be done promptly. Nevertheless, an appropriate method on confirmation should be given and must be provided.

3. Context-Aware based Multi-Access Network Control Scheme for Smart Distributed Multimedia Packet Transmission

The main goal of the proposed scheme is to incorporate the smart distributed packet (SDP) transmission mechanism to fast handover for to overcome such ineffectiveness by defining the signaling messages between NAR and MN. We also added Return Routability (RR) and a buffer from PAR to CN, HA to NAR and NAR to CN, in order to periodically store the data. Also, smart distributed packet (SDP) transmission mechanism using multi-access network control in IP-based fast mobile networks would be supported seamless packet transmission during handover. Our proposed scheme use fast look-up CoA algorithm [8] to support reliable fast multimedia transmission. Also, SDP protocol suggest new signal messages between PAR and HA and between NAR and CN which can decrease data packet transmission traffic load.

3.1. Handover Procedure for Fast Mobility Management with Smart Distributed Packet (SDP) Transmission Mechanism and Optimized TFRC scheme.

The Smart Distributed Packet Transmission Mechanism over Fast Mobility Management consists of the following messages which show in figure 3. Our proposed SDP scheme would be processed during L2 Handover which can neglect proposed new signaling messages handover latency such as PFC, FIR, OTI.

(1) The PAP can receive L2 HO signaling message which included trigger messages (AP-ID, CoAs) from APs when MN passes by access points periodically.

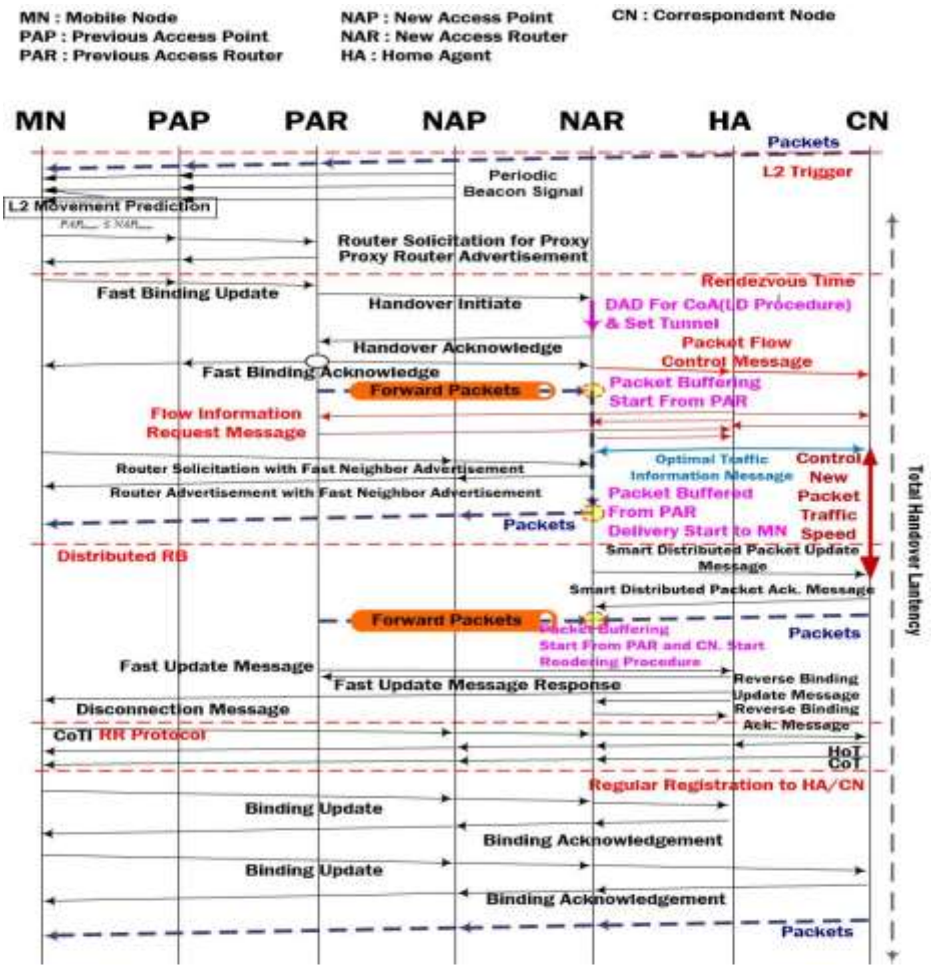

Figure 3. Smart Distributed Packet Transmission Mechanism over Fast Mobility Management Protocol

(2) When MN aware L2 trigger, the mobile node (MN) sends a L2 Router Solicitation for Proxy (RtSolPr) to find out about neighboring ARs. That is, from receiving periodic beacon signal message, MN can aware L2 movement prediction which can prepare L2 handover before MN moving to foreign networks.

(3) After sending L2 Trigger message to PAR, the MN receives a L2 Proxy Router Advertisement (PrRtAdv) containing one or more [AP-ID, AR-Info] tuples.

(4) As soon as receiving L2 Proxy Router Advertisement (PrRtAdv), MN sends a Fast Binding Update (FBU) which include address confirmation information (duplicate address detection) about Look up (LD) procedure for NAR to the Previous Access Router (PAR).

(5) To set up the tunnel between PAR and NAR, the PAR sends a Handover Initiate (HI) message to the New Access Router (NAR), LD for Care of Address (CoA) within (3.36 μsec and 5.28 μsec for best and worst case) [11].

(6) After finishing address confirmation procure (Duplicate Address Detection), the NAR sends a Handover Acknowledge (HAck) message to the PAR.

(7) PAR sends a Fast Binding Acknowledgement message to the MN on the new link. The FBAck is also optionally sent on the previous link if the FBU was sent from there.

(8) As soon as receiving FBAck, NAR send advanced TFRC scheme called "Packet Flow Control (PFC)" message to HA and CN that will be support control of packet transmission speed based on network BW traffic load. This message can support seamless service during tunneled packet transmission between PAR and NAR.

(9) PAR starts packet forwarding message to NAR, and then the packet buffering start. As soon as receiving PFC message from NAR, HA send Flow Information Request (FIR) Messages to neighbor's all routers to collect BW, traffic information, packet flow sequence, etc. By using this message, HA can know all routers current traffic status which can decide transmission packet speed. After receiving traffic information of all routers, HA send optimal traffic information message (OTI) which can include recommended packet speed for tunneled packet to NAR and CN at the same time. As soon as receiving OTI message CN start to control new packet streaming traffic speed by rating OTI's information such as optimal packet recommend speed, BW, traffic information.

(10) MN sends a router solicitation with Fast Neighbor Advertisement (FNA) to NAR.

(11) After the NAR received the outer solicitation with Fast Neighbor Advertisement (FNA), it sends an outer Advertisement FNA to MN.

(12) NAR sends a tunneled Packet to MN by comparing OTI message.

(13) NAR sends a Smart Distributed Packet (SDP) Update Message to the CN. SDP message include NAR's current final status which can include distributed neighbors all traffic information.

(14) CN received the Smart Distributed Packet (SDP) and sends a Smart Distributed Packet Update Message Acknowledgement which can support reliable packet speed information and traffic BW information about new packet to the NAR.

(15) NAR starts packet buffering which came from CN and PAR. At this time, NAR start packet reordering control procedure which can prevent re-sending date. This procedure will improve total network traffic load by minimizing re-ordering packets.

(16) PAR sends a Fast Update message to HA. (Total packet numbers, BW, Traffic Information)

(17) After HA received the Fast Update message, it sends a Fast Update message response to PAR.

(18) Also, HA sends a Disconnection message to PAR. (This message include PAR disconnection order message which can improve network usage)

(19) HA sends a Reverse Packet Binding Update to NAR.

(20) After NAR received the Reverse Packet Binding Update, it replies a Reverse Packet binding Acknowledgement to HA.

(21) MN sends a home test init (HoTI) and a care-of test init (CoTI) messages to CN.

(22) CN sends a home test (HoT) and a care-of test (CoT) messages to MN.

(23) MN sends a Binding Update to HA.

(24) After HA received the Binding Update, it sends a Binding Acknowledgement to MN.

(24) After MN received the Binding Acknowledgement, it sends a Binding Update to CN which can support route optimization scheme. However, CN have to check packet number and traffic conditions in order to avoid packet disorder problems in MN. If disorder problem would be happen in MN, TCP performance will degrade half of current performance condition.

3.2. Movement Detection

The main purpose on movement detection is to determine L3 handovers. Figure 3 shows NUE or Neighbor Unreachability Detection to determine routers that are no longer reachable, as well as the MN should determine a new link from a new router. Movement detection only happens if the MN sends packets. With the router advertisements from other routers, no handover will take place since there is no indication from the link layer and no handover will take place.

3.3. Fast Neighbor Discovery.

In the proposed FMIPv6 Neighbor Discovery, the protocol is embedded with a built in timer. This is to restrict immediate responses to RS. This is to prevent a long duration of synchronization of multiple nodes that transmits simultaneously at the same time. A reverse binding mechanism was also added in Binding Update (BU) Packet Flow Control (PFC), Flow Information Request (FIR), and smart distributed packet (SDP) messages.

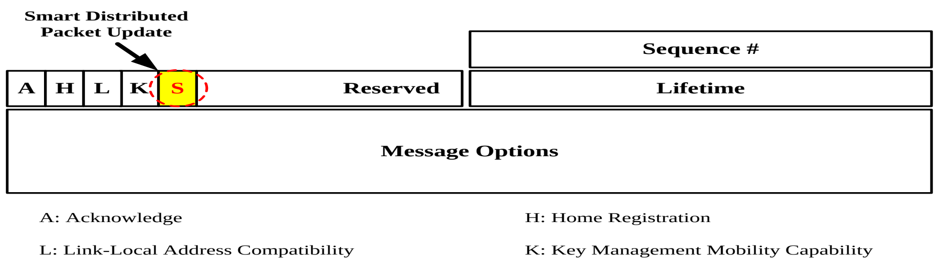

Figure 4. Smart Distributed Packet Update Message

3.4. Smart Distributed Packet Update Message.

Smart distributed packet (SDP) transmission mechanism which based multi-access network control scheme adds a flag to BU message, used existing FMIPv6, for exchanging created key. Figure 4 show proposed SDPU message format.

After the NAR sends a Fast Neighbor Advertisement (FNA) to MN, the NAR send a new smart distributed packet update message (SDPU) to CN. If S flag is set to 1 it indicates SDPU should be done. S and A flag must be set to distinguish SDPU to CN or HN. By using this message CN can disconnect flow data path between CN and PAR which can reduce network traffic load and signaling load.

4. Performance Analysis and Comparison

In this section we will show and explain the performance of the robust fast handover scheme using smart distributed packet (SDP) transmission mechanism which based multi-access network control scheme applied in fast handover for MIPv6. We will also show the latency handover simulation results of each scheme using the proposed mechanism.

Each simulation used an assumed data in order to get the performance of each scheme and compare it to normal scheme. We assigned a parameter with corresponding description and value for each symbol, tCoA = 1000 ms and tLU = 3.36 μsec and 5.28 μsec with their corresponding description. For each scheme, we measured the handover latency as the internal between the last packet in the previous access router and the first packet in the next access router.

Table 1. Performance Analysis Parameters

Parameter	Description	Value (ms)
t_a	MN⇔AP	20ms
t_b	AP⇔AR	40ms
t_c	AR⇔AR	60ms
t_d	AR⇔HA	80ms
t_e	AR⇔CN	100ms
t_{CoA}	Form CoA	1000ms
t_{LU}	Form CoA using LU	3.36μs (Best Case) 5.28 μs (Worst Case)

Below are the total latency handover formula and the assigned parameters of FMIPv6 using smart distributed packet (SDP) transmission mechanism which based multi-access network control scheme. We based our formula on the timing of each schemes.

Fast handover for MIPV6 (1)

= tL2 + tMD + tCoA + tREG_HA + tREG_CN
= (2ta +2tb) + (4ta +4tb +3tc) + tCoA + (2ta +2tb +2td) + (2ta +2tb +2te)
= 10ta +10tb +3tc+ tCoA+2td+2te
= 10(ta +tb) + 3tc+2(td+te) + tCoA

SDP (2)

= tL2 + tMD + tCoA + tSDP + tRR (Optialnal)+ tREG_HA + tREG_CN
= (2ta +2tb) + (4ta +4tb +3tc+td +te) + tLU +(2te +2td +2td) + (2ta +2tb +2td) + (2ta +2tb +2te)
= 10ta +10tb+3tc+7td +5te+ tLU
= 10(ta +tb)+ 3tc+7td +5te+ tLU

Where: tL2, tMD, tCoA, tSDP, tREG_CN, tREG_HA as described above. tL2 is composed of association request and response time, tMD is movement detection time, tCoA is duplicate address detection with processing time of 1000 ms, tSDP is SDP, Fast update, reverse binding update exchange time, tREG_CN is registration time to corresponding node, tREG_HA is registration time to home agent.

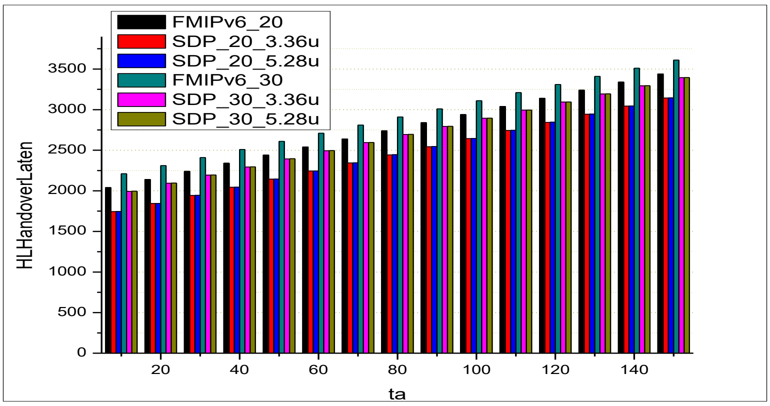

Figure 5. Handover Latency Comparison at time ta

The Figure 5 shows the comparison of performance analysis between the FMIPv6 and the proposed FMIPv6 using smart distributed packet (SDP) transmission mechanism which based multi-access network control scheme. As we analyzed the performance of our proposed scheme we proved that proposed FMIPv6 using SDP transmits the message faster and efficient compared to the standard FMIPv6. Also we argue that SDP would be better than standard mobility management protocols in a mobile computing system where some possibility of traffic flow conflict exists.

5. Conclusion

This paper has described smart multimedia packet transmission mechanism using multi-access network control in IP-based fast mobile networks. Also, we would be explained fast handover scheme using reverse binding mechanism effectively. The proposed smart distributed packet (SDP) transmission mechanism which based multi-access network control scheme supports a fast handover seamlessly in FMIPv6 by optimizing the associated data and signaling flows during handover. New signaling messages, smart distributed packet update messages, disconnection message, fast packet binding update and reverse packet binding update are defined and utilized to hasten the handover procedure. It is also noted that the Reverse PBU and PBA are the alternates of the original PBU and PBU of FMIPv6. That is, the proposed scheme incorporates the main part of FMIPv6 procedure in the fast handover procedure, and thus any subsequent FMIPv6 procedure may be not necessary.

Acknowledgments

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and future planning (2015R1A2A2A03002851).

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