SDN 기반의 Inter PMIPv6 도메인 핸드오버

Syed Muhammad Raza, 염상길, 김동수, 추현승
성균관대학교 정보통신대학
{s.moh.raza, sanggil12, dskim61, choo}@skku.edu

SDN based Inter Proxy Mobile IPv6 Domain Handover

Syed Muhammad Raza, Sanggil Yeom, Dongsoo Kim, and Hyunseung Choo
College of Information and Communication Engineering, Sungkyunkwan University

Abstract

Proxy Mobile IPv6 (PMIPv6) is a network based IP mobility management protocol. PMIPv6 make sure that the IP address of the mobile node remains the same as long as the mobile node roams with in the PMIPv6 domain. A mobile node roams with in a PMIPv6 domain. PMIPv6 protocol doesn't provide the mobility support once the mobile node moves from one PMIPv6 domain to another PMIPv6 domain. This paper proposes a Software Defined Networking (SDN) based PMIPv6 scheme which provides the mobility support for inter PMIPv6 domain movement of mobile node. In the proposed architecture each PMIPv6 domain has a SDN controller and SDN controllers from different domains communicate with each other to share the mobility information.

1. Introduction

Today people use media enriched and highly interactive applications on the go, which requires mobility management for seamless connectivity. Proxy Mobile IPv6 (PMIPv6) [1] has been introduced for IP mobility management. In last few years different aspects of PMIPv6 have been vigorously researched upon [2][3][4]. Unfortunately, IP mobility management provided by the PMIPv6 is limited to the PMIPv6 domain. The PMIPv6 domain can be defined as a network where the mobility management of a Mobile Node (MN) is handled using the PMIPv6 protocol. The PMIPv6 domain includes Local Mobility Anchors (LMAs) and Mobile Access Gateways (MAGs) between which security associations can be set up and authorization for sending Proxy Binding Updates on behalf of the MN can be ensured.

When a MN attaches to a MAG in the PMIPv6 domain the MAG communicates with the AAA server to authenticate the MN. The AAA server authenticates the MN and provides the address of the LMA for that MN. The LMA is an anchor mobility router for the MN. Therefore in other words we can say that MN is in a PMIPv6 domain as long as the MAG is able to retrieve the address of the LMA from the AAA server for the corresponding MN. This shows that different networks can be considered as the part of the same PMIPv6 domain as long as their AAA servers somehow shares the same information. And the PMIPv6 domain becomes different as soon as the AAA server of some network doesn't have the information of the mobile node.

This paper proposes a inter PMIPv6 domain (ID-PMIPv6) mobility scheme based on Software Defined Networking (SDN). The architecture presented in this paper is extension of already presented OF-PMIPv6 architecture for reduced handover latency [2]. Similar to OF-PMIPv6, an OpenFlow controller is present in each ID-PMIPv6 domain and performs the control signaling with the LMA on behalf of OpenFlow enabled MAGs (OMAGs) present in that ID-PMIPv6 domain. The controller in each ID-PMIPv6 domain also communicates with the controller in the other ID-PMIPv6 domain to exchange information prior to MN inter ID-PMIPv6 domain handover. The communication between the controllers is based on TCP and uses the BGP model.

2. Background

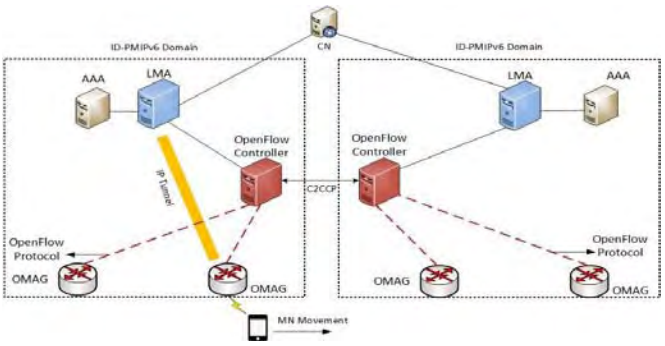
Proxy Mobile IPv6 (PMIPv6) [1] is a network based IP mobility management protocol, which handles all the mobility related signaling without involving the MN. In PMIPv6, All data communication between MN and corresponding node (CN) moves through LMA. When the MN first enters in PMIPv6 domain it needs to register itself with the LMA.

SDN is a concept which separates the control plane of the network elements from the data plane, and centralizes it in central controller. Openflow (OF) [5] has emerged as the first implementation of SDN. Researchers have opted OF to implement SDN concept in different domains of networks, e.g. wireless sensor networks, mesh networks, data centers etc. OF network architecture consists of OF-enabled network devices (switch/router/access point) and an OF controller (OFC). Data plane in the OF switch is responsible for packet forwarding whereas control plane of the OF switch takes care of communication between OF switch and OFC over a secure TCP connection. The main objective is to make control functions more centralize rather than distributed. OFC performs all the control logic and manages all the forwarding elements using OF protocol.

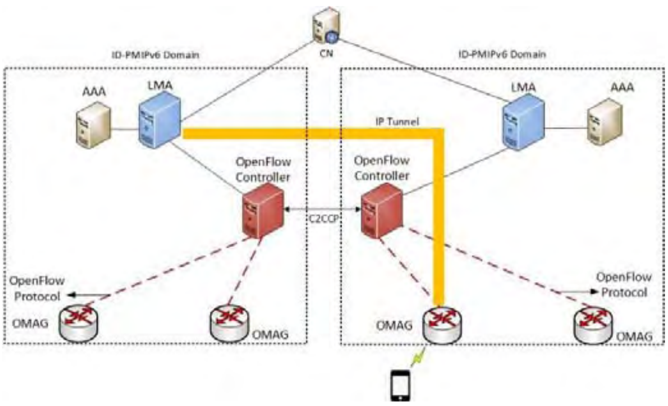
OF-PMIPv6 [2] separates the control signaling path from the data communication path as originally described in the PMIPv6. Logically, the OF controller in OF-PMIPv6 virtualizes multiple OMAGs as one MAG and performs the control signaling with the LMA on behalf of multiple OMAGs, Communication between OMAGs and the OF controller is over the OF protocol. As control signaling has been offloaded from OMAGs therefore they are only responsible for establishing layer 2 connection with the MN. In OF-PMIPv6 architecture OMAGs are assumed to be connected to the OF controller trough a backbone network. LMA and AAA server resides in the home network of the mobile node. OF controller communicates with LMA and AAA through layer 3 messages.

3. Proposed ID-PMIPv6 Scheme

The proposed ID-PMIPv6 scheme provides the inter PMIPv6 domain IP mobility. The OF controller in the ID-PMIPv6 domains manages the MN information and performs the mobility signaling with the LMA on behalf of the OMAG. It is assumed that OF controller in each ID-PMIPv6 domain maintains a database for the location of the OMAGs. Initially when the OF controller in the ID-PMIPv6 domain is activated, it communicates with the OF controllers in the other ID-PMIPv6 domain using the proposed controller to controller communication protocol (C2CCP) and establishes a connection. Once the connection is established with the OF controller in the other ID-PMIPv6 domain, the two controllers exchange their databases regarding the location of OMAGs in their domain. Figure 1 shows the proposed ID-PMIPv6 architecture and the inter PMIPv6 handover of the MN.



(a) ID-PMIPv6 Architecture



(b) Inter ID-PMIPv6 Handover

Figure 1: Architecture of ID-PMIPv6 domains and inter ID-PMIPv6 domains handover

When the MN is about to move to the other ID-PMIPv6 domain the OF controller in the current ID-PMIPv6 domain detects that MN is about to exit its domain and checks its database for the next possible OMAG in the other ID-PMIPv6 domain. On finalizing the best possible candidate OMAG in other ID-PMIPv6 domain, the OF controller communicates with the OF controller in the other ID-PMIPv6 domain and provides it the MN ID, home network prefix of the MN and the address of the corresponding LMA. Therefore when the MN attaches to the OMAG in the new ID-PMIPv6 domain the OF controller provides MN the home network prefix received from the OF controller in the previous ID-PMIPv6 domain and also sends the proxy binding update message to the corresponding LMA of the MN. On receiving the proxy binding update message from the OF controller in the new PMIPv6 domain the LMA establishes the IP tunnel with the OMAG in the new ID-PMIPv6 domain. Mobility management of the MN within the new domain is responsibility of the controller in that domain. Figure 2 shows the control signaling for the inter domain handover between two PMIPv6 domains.

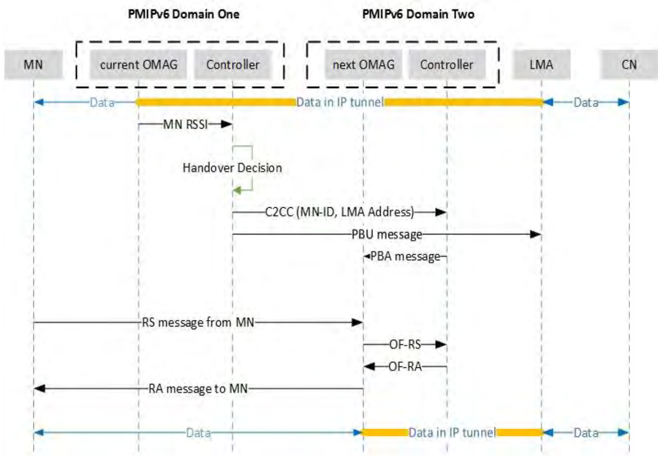


Figure 2: Handover signaling for inter ID-PMIPv6 domain handover

Acknowledgment

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