엔터프라이즈 무선네트워크에서 SDN 기반 이동성 연구

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SDN Based Mobility in Enterprise Wireless Network

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Abstract

Seamless mobility is one of the most crucial feature of telecommunication industry. Researches are going on in full swing to deal with this feature in most efficient manner. Software Defined Networking (SDN) is seen as the next generation paradigm which can facilitate seamless mobility across heterogeneous networks by segregating the control plane and data plane functionalities, and logically centralizing the control plane. In this paper, we propose a simplified Layer 2 handover mechanism for enterprise wireless networks, based on SDN framework. We present a network assisted L2 handover method using the IEEE 802.21 Media Independent Handover (MIH) protocol and SDN concepts, to achieve seamless mobility across heterogeneous networks.

1. Introduction

A successful enterprise needs excellent connectivity and communication backbone. Usually, an enterprise network engages relatively fewer communication protocols and incurs less overhead due to a fundamental notion of trusted environment. Once device authenticates and registers itself with the enterprise network then generally, it does not need to undergo authentication and authorization every time at every step. Most likely, an enterprise network would at least support cellular and wireless local area network (WLAN) [3]. Wireless LAN is considered to be more cost effective communication channel than Cellular network because the latter technology uses expensive licensed spectrum unlike the former which works on unlicensed spectrum of 2.4 GHz or 5 GHz frequencies.

It is highly desirable for the devices to have session continuity during roaming even when they move across different WiFi Access Points (APs) or to register on to the cellular network dynamically in Non-WiFi zone. Session continuity is accomplished by supporting Layer 2 (L2) and Layer 3 (L3) Mobility. L3 Mobility is also known as IP Mobility where the IP address assigned to a device interface should remain unchanged during roaming. L2 Mobility deals with the connectivity intricacies with respect to the MAC address. In case of cellular network, the L2 mobility is well taken care of under the guidance of 3GPP standards. Although 3GPP Release 8 [1] and Release 10[2] standardized the method of communication between 3GPP and non-3GPP access networks, there is no widely adopted real time systems currently.

3GPP proposed Access Network Discovery and Service Function (ANDSF) protocol [2] to communicate and connect with non-3GPP access networks like Wireless LAN or WIMAX (802.16). IEEE standard 802.21 [4] Media Independent Handover (MIH) is another such protocol which deals with the mobility across heterogeneous network. While ANDSF is capable of providing mechanisms to connect between Cellular to WiFi network or vice versa, it does not provide any guideline to connect between different WiFi APs. MIH supports mobility in all three scenarios i.e. Cellular to WiFi or vice versa and between different WiFi APs. Although, MIH is a good candidate protocol for network assisted mobility and handover, the MIH Function (MIHF) has to be implemented in each intermediate equipment to understand and parse the MIH messages. It makes the process lengthy and results in exchange of more messages. We propose a central network entity which will interact with the devices, resulting in relatively fewer message exchanges to achieve the handover. This central entity will manage all the control plane functionality. Software Defined Networking (SDN) [5, 6] is just appropriate paradigm to realize our proposed framework.

In this paper, we present a simplified architecture and flow sequence of messages to facilitate L2 handover and provide a trigger point where L3 mobility can be taken care of by the device using existing protocols like Proxy Mobile IPv6 (PMIPV6)[7]. Our approach includes an MIHF Agent /Service, running on top of SDN Controller. It would interact with a very basic database server similar to MIH Information Server (MIIS). We assumed that Authentication is taken care of when the device enters and registers itself to the enterprise network.

The paper is structured as follows: Section 2 discusses the background and motivation, Section 3 presents the proposed architecture and handover scheme Section 4 concludes the paper.

2. Background

Researches on integrating the SDN to MIH is in progress. [8] proposes enhancements in the SDN mechanisms in an SDN-MIH integrated environment. MIH is the only major IEEE standard which governs the mobility across heterogeneous networks. One of the limitation of using MIH is that the MIHF has to be supported in all the intermediate nodes to understand the MIH messages. The acceptance of MIH is not wide spread currently. Secondly, MIH is a bit heavy protocol to implement which may result in higher development cycle. We tried to over these two limitations in our enterprise network environment.

SDN [5] is one of the most promising concept towards next generation networking. OpenFlow [6] is most widespread protocol used to realize the SDN concepts. We are trying to combine the 802.11 MIH protocol (lighter version) and SDN – OpenFlow constructs to provide network assisted handover. The APs in our environment are normal APs with a simple modification that all control packets/frames will be sent to the Controller.

3. Proposed Handover Scheme

The proposed architecture assumes MIHF functionality support in the mobile node (MN) as well as in the Age nt/Service running on SDN Controller. The MN supports Multi-RAT (Radio Access Technology). Figure 1 shows a part of the enterprise network comprises of OpenFlo w enabled switches, t-he SDN Controller, WiFi Access Points (APs), OpenBTS[9] provided Base Stations (BS) and basic Information Server to store information which can help the MN for taking handover decision.O-ur ai m is to facilitate MN in performing L2 handover (HO).

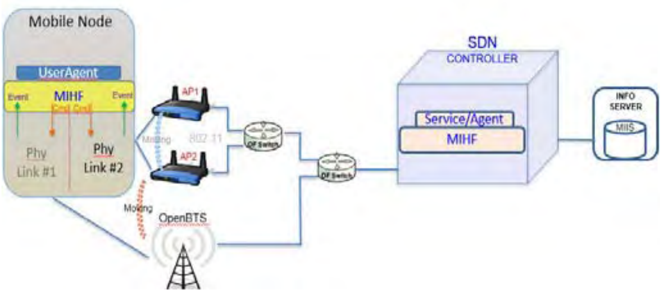

Figure 1: MIH enabled SDN based simple enterprise network, depicting basic mobility scenario.

The MN keeps performing signal strength measurement periodically. Let's assume that the MN is connected to an AP and is moving away from it and approaching towards an OpenBTS BS. The complete message flow sequence is shown in Figure 2. The MN sends a Candidate_Query_Request to Controller in which it will share the list of radios which it sensed. Controller will check with MIIS SVR about the latest status of those radios (APs, BSs). It can be a simple database query and response. Based on this response, Controller will prioritize those radios and send it back to MN via Candidate_Query_Response. MN will take the HO decision by following the Controller's s uggestion or can even override it. Once decided, MN will sen d MN_HO_COMMIT_REQ to the Controller mentioning it's destination BS info. Controller will internally update the BS to prepare for the resources meanwhile, MN will request i ts lower layer to bring up the cellular interface. The lower L-ayer of Mobile will send the notification once the physical ra dio link is up. Then the MN will initiate the L3 mobility by using the existing protocols, for example Proxy Mobile IPv 6 (PMIPv6). At the end of this L3 Mobility confirmation, the Controller will updated the MN's location into the databas e through Update_Request.

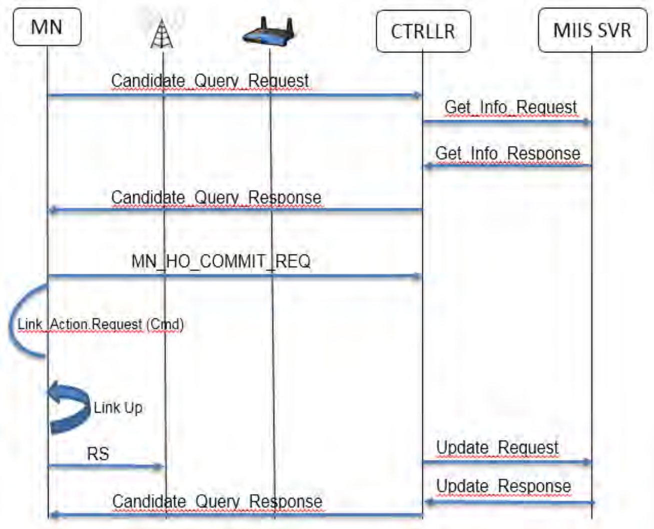

Figure 2: Message Flow sequence for L2 handover. L3 hando ver would start from RS (Router Solicitation) message.

4. Conclusion

The proposed mechanism uses basic MIH messages and the Controller in SDN enabled enterprise network assists the MN in performing the handover. As the Controller has the knowledge of entire network topology, it provides the list of candidate radios to the MN for HO. The L3 mobility can also be simplified in this kind of environment.

Acknowledgment

This research was supported in part by PRCP (NRF-2010-0020210), (B0190-15-2013, Development of Access Technology Agnostic Next-Generation Networking Technology for Wired-Wireless Converged Networks), respectively.

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