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Control and Data Plane Separation Architecture for supporting Multicast Listeners over Distributed Mobility Management

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ABSTRACT
Distributed mobility management (DMM) is currently being researched and standardized in academia and standardization development organizations for the purpose of overcoming the major issues of existing centralized mobility management. The most recent DMM protocols are being redesigned with regard to the control and data plane separation concept. However, at present, there is no solution for supporting IP multicast listeners in such new DMM environments. In this paper, we review ongoing academic research works, standardization activities and propose an IP multicast mobility design for the DMM environment using the control and data plane concept.

Index Terms: Control and data plane separation, Distributed mobility management, IP multicast, PMIPv6, SDN

I. INTRODUCTION

Centralized mobility management (CMM) protocols exhibit certain major issues, such as a single point of failure, non-optimal routing, and scalability [1], which result from the nature of current hierarchical mobile network architecture. Therefore, distributed mobility management (DMM) is currently being studied and standardized in both academia and standardization development organizations (SDOs) in order to overcome these issues. In academia, the most commonly proposed DMM protocols are based on the traditional Proxy Mobile IPv6 (PMIPv6) [2] [3] and the software-defined networking (SDN) concept [4] [5].

IP multicast is used to provide efficient live streaming content distribution over IP-based networks. IP multicast mobility (MULMOB) management protocols offer subscribers seamless handover and the ability to keep receiving subscribed multicast traffic with low latency. Thus far, some base solutions have been standardized by the Internet Engineering Task Force (IETF) for the CMM environment [6] [7] but not yet the DMM environment. In terms of DMM, several multicast mobility schemes [8-11] have been proposed in academia.

Currently, control and data plane separation is considered as a key factor in designing 5G networks. With this concept, control plane functions can be deployed as software on a cloud platform to facilitate the elastic scaling of control functions as signaling traffic increases. Furthermore, the data plane functions can be deployed on the high speed and simplified hardware networking devices, optimized for packet-forwarding tasks. Separation of the data and control planes also enables the efficient use of a common data plane and eases service provisioning by using the management and orchestration (MANO) framework of network function virtualization (NFV). This concept is not limited to SDN, with all functions placed on a centralized controller, but involves the separation of the control and data planes in both the horizontal and vertical axes. Control and data plane functions are designed as deployable and modular components. In the IETF DMM working group [12], this concept is being used to redesign the DMM protocols. Four major working items are currently being discussed, namely the mobility anchor function [13], forwarding policy configuration (FPC) [14], deployment models [15], and on-demand mobility [16].

However, to the best of our knowledge, the current IETF works are restricted to unicast traffic, and multicast mobility management is still lacking in such control and data plane separation environments. Apart from our previous work, an initial idea [17] was introduced; however, this study did not include detailed architecture of the integration and protocol operation. In this paper, we review state-of-the-art research works and current standardization activities in the DMM working group and present architecture to support DMM for multicast traffic. In addition, we provide a solution for integrating our newly defined multicast mobility architecture into the current unicast DMM, including detailed protocol operation.

The remainder of this paper is organized as follows. Section II presents state-of-the-art and ongoing standardization of DMM and multicast mobility. Our control-data plane separation architecture for multicast mobility and protocol operations are introduced in section III. Section IV discusses our qualitative evaluation, and a discussion and conclusion are provided in Section V.