A Study of Flow Mobility Management Architecture for Multimedia Contents over Software Defined Networks

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Abstract. The Internet usage is continuously becoming more and more popular in an unprecedented rate that results into a more complex distribution of multimedia contents over the heterogeneous wireless networks. The standardization and optimization of several mobility management protocols were limited and suffering from numerous drawbacks such as routability issues, higher handover latency, signaling overheads and other mobility related issues. To address these issues, this paper deals with the analysis of a flow mobility management architecture for a balanced distribution of multimedia contents over software defined networks (SDN). The SDN has been an effective alternative for the mobility management as well as on the delivery of multimedia contents over the heterogeneous wireless networks.

Keywords: SDN, flow mobility, heterogeneous wireless networks.

1 Introduction

A well balanced load distribution among network entities is essentially important for an efficient delivery of multimedia contents across the heterogeneous wireless networks. The widespread growth of the Internet popularity has brought an increasing demand in the distribution and delivery of multimedia contents as the telecommunication enabling technologies were also evolving. The number of mobile users continuous to grow as mobile devices such as smartphones, PDAs, tablets, and notebooks becomes more available and Internet accessibility becomes easier. According to the visual networking index (VNI) forecast in the year 2016, the multimedia traffic across the Internet is projected to be tripled after 5 years [1]. In this regard, traffic congestion can be expected to hinder the real-time multimedia contents delivery to the mobile Internet users. In addition, the heterogeneity of wireless access network technologies provides complexity on balancing the traffic load among the network elements.

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In order to address these issues, several mobility management protocols have been standardized and optimized to effectively manage the mobility of mobile devices and the flow distribution of multimedia contents. However, the standard mobile internet protocol version 6 (MIPv6) suffers from routability issues, higher handover latency, signaling overheads, reliability, etc. The incompatibility of different wireless access networks could cause significant addition of message signaling exchanges in order to work cooperatively, thus, resulting to a much higher latency. The optimizations of the standard MIPv6 employ hierarchical configurations that consider a centralized mobility management to support the handovers of mobile devices between heterogeneous wireless access networks. In this setup, multimedia contents will be traversing a central anchor point which can be susceptible for a single point of failure. It can also lead to suboptimal routing issues, low scalability, and other mobility related concerns [2]. Thus, a need for a reliable flow mobility management is essentially important to support the increasing demand of real-time multimedia contents across the heterogeneous wireless networks.

This paper deals the analysis of the flow mobility management on the distribution of multimedia contents over software defined networks. The SDN architecture is currently transforms the traditional network infrastructures into a standard that could meet the requirements of today’s businesses, enterprises, telecommunication carriers, and end users. The main advantage of SDN based mobility management support is that the control plane is decoupled from its data plane. That is, the centralized control is relegated to an entity called SDN controller that orchestrates the management of network resources. The multimedia contents will no longer traverse the central mobility anchor and will be directed by the SDN controller as to its destination. The routing of multimedia contents will be determined by the SDN controller and will be based on the current condition of certain paths.

The rest of this paper is organized as follows: Section 2 discusses the architecture for flow mobility management of multimedia contents over software defined networks; Section 3 provides the discussions on the operations of the proposed architecture; and the concluding remarks in Section 4.

2 The Flow Mobility Management Architecture

The Software Defined Networking (SDN) is an emerging mobility management paradigm transforming the traditional network architectures into a more dynamic and programmable infrastructure that can meet the requirements of today’s demands. It is fronted by the Open Networking Foundation (ONF) that provides programmable network devices and a centralized control over network entities [5, 6]. The control plane is separated from its data plane, thus, making the network intelligence being logically centralized. The forwarding and delivery of multimedia contents will be carried out by the network elements in the data plane while being directed by the SDN controller that resides on the control plane. The SDN controller decides the routing path for the delivery of multimedia packets considering the current condition of the traffic among the governed network elements.
Table 1. The SDN Architectural Planes.

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<tr>
<th>Planes</th>
<th>Description</th>
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<tr>
<td>Application Plane</td>
<td>Communicates their network requirements to the SDN controller(s) through Application-Controller plane interfaces (ACPIs), e.g., business applications</td>
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<tr>
<td>Control Plane</td>
<td>It is comprised of SDN controllers that are responsible for orchestrating the control on a set of resources for one or more network elements. It provides services to the application plane while controlling the operations of the network elements on the data plane.</td>
</tr>
<tr>
<td>Data Plane</td>
<td>It is comprised of a set of network elements that are directly controlled by SDN controllers through Control-Data Plane Interfaces (CDPIs).</td>
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The SDN provides the network systems with an exceptional programmability, automation, and network control management which can result to an efficient and optimized flow mobility management for the delivery of multimedia contents in heterogeneous wireless networks.

Fig. 1. Mobile Node Attaches to NE₁ and Receives Multimedia Contents from CN while Considering the Current Traffic among Different Network Elements

3 Discussions

As shown in Fig. 1, the network element 1 (NE₁) detects the attachment of the mobile node (MN) into one of its links, it acquires the MN’s home address (HoA) and assigns a temporary care-of address (CoA) to the MN. The assigned CoA contains the prefix of the NE₁. The NE₁ then sends a binding update (BU) message to the SDN Controller containing the MN’s HoA and CoA. The SDN controller stores the bindings into its flow table that contains all the mappings of the network elements under its control. It then sends a binding acknowledgement message to NE₁ indicating that MN currently binds its HoA to the prefix associated with NE₁.

Whenever the correspondent node wanted to communicate with MN, it sends out the multimedia packets with the MN’s HoA as its destination address. As NE₄ receives the packets, it sends out an address query to the SDN controller and
downloads the optimized routing datapath. The SDN controller looks up to its flow table and provide the NE4 with the correct destination where the MN’s HoA is currently attached. Network conditions will be computed by the SDN controller, learning which next hops are optimized before forwarding the routing datapath to the inquiring NE4. The NE4 rewrites the destination address of the next hop and delivers the multimedia packets via the designated routing datapath. Whenever, the multimedia packets reach NE1, the destination address will again be rewritten from the MN’s CoA to its HoA.

If MN moves to another network element, let’s say NE2, the same procedure will be followed, that is, NE2 sends a binding update to the SDN controller. The handover becomes programmable and a centralized control is provided for an efficient delivery of multimedia contents. The consideration of the current network conditions by the SDN controller aims to utilize the best possible route in terms of efficiency and handover performance.

4 Conclusion

This paper analyzed an alternative flow mobility management solution for overflowing multimedia contents in the Internet. The SDN has been utilized in order to provide an efficient and dynamic delivery of multimedia contents over heterogeneous wireless networks. The network resources orchestration has been provided with a centralized control and the multimedia traffic load were distributed among network entities considering its current network condition. Thus, flow mobility management becomes balanced and real-time delivery of multimedia services is provided.

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