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Flow Distribution Management Architecture for Multimedia Contents over Heterogeneous Mobile Networks

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Abstract. As the magnitude of Internet usage is rapidly increasing, the distribution of multimedia contents over heterogeneous mobile networks becomes more and more complicated. This motivated the standardization of mobility management protocols starting with Mobile Internet Protocol version 6 (MIPv6). However, the mobility management for MIPv6 is limited to in terms of longer handover latency, routability issues, signaling overheads, etc. propagation of Cloud computing to assist the multimedia contents distribution In this regard, this paper deals with the integration of the network-based mobility management capability of Proxy Mobile Internet Protocol version 6 (PMIPv6) for the flow distribution of multimedia contents over heterogeneous IP-based mobile networks.

Keywords: PMIPv6, flow mobility, Heterogeneous networks.

1 Introduction

The reproduction and distribution of multimedia contents over heterogeneous mobile networks has become more and more complex as the magnitude of Internet usage is vastly increasing. Along with this widespread Internet growth, the number of connected mobile devices such as smartphones, PDAs, and laptops is continuously swelling. In this regard, mobility management protocols have been standardized in order to address the unceasing issues in terms of the flow distribution of multimedia contents. Some current issues that have a direct impact on the flow distribution of multimedia contents can include: high handover latency, caused by a number of message signaling between the mobile devices and the content providers in order to establish dialog sessions; routability issues, the standard MIPv6 protocol [1, 5] faces a number of routability problems; signaling overheads; security; etc. In addition, the heterogeneity among mobile devices and multifaceted access networks could also influence the flow distribution of multimedia contents.

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This paper deals the flow mobility management on the distributing multimedia contents across heterogeneous multiple access mobile networks. The architecture for the flow distribution of multimedia contents will be presented in order to address or somehow limit the identified issues with regards to flow mobility issues. The multi-connectivity for mobile devices could provide dynamic allocation of addresses from one access network to the other for workload balancing which is provided by the PMIPv6. PMIPv6 [2] introduces a local mobility anchor (LMA) to act as the central controller for mobile devices and mobile access gateways (MAGs) that is responsible for providing access points to the mobile devices. Multiple MAGs are allowed in PMIPv6 domain which provides the mobile device with multi-connectivity. The mobile device is capable of switching from one MAG to the other depending on the optimum handover latency with the LMA's approval.

The rest of this paper is organized as follows: Section 2 discusses the architecture for flow distribution management of multimedia contents across heterogeneous mobile networks; Section 3 provides the discussions of the operations of the proposed architecture; and the concluding remarks in Section 4.

2 The Flow Distribution Management Architecture

The PMIPv6 allows a network-based mobility management that introduces two functional entities in the form of the Local Mobility Anchor (LMA) and the Mobile Access Gateway (MAG) [2, 3, 4]:

- The Mobile Access Gateway (MAG) provides the MN with access points in order to establish its connection. Multiple MAGs with different access networks are allowed within the PMIPv6 domain.
- The Local Mobility Anchor (LMA) acts as the central controller that maintains the collection of routes for mobile nodes that are attached within the PMIPv6 domain. The LMA intercepts the packets of multimedia contents and tunneled to the corresponding MAG the MN is currently connected.

The MN that wishes to access a specific multimedia content can establish its connectivity to the available MAGs within the PMIPv6 domain. That is, with the varying traffic and connectivity issues among the available MAGs on a heterogeneous environment, the MN is capable of making multi-connections depending on the optimum handover latency. As the LMA gathers traffic information on the collection of possible routes, the MN can switch between multiple MAGs as shown in Fig. 1.

The multimedia content provider to which is represented by the correspondent node (CN) delivers the multimedia contents to the MN through the LMA which acts as the central controller for all MAGs available on the PMIPv6 domain to where MNs make their attachments. The LMA will be responsible for sending signaling to every MAG in order to classify and determine specific traffic information among the possible routes, and thus determines to which MAG to bind the home network prefix (HNP). In this regard, the LMA can decide to start the flow handover for delivering the multimedia content IP packets to a particular MN. The LMA classifies the traffic based on the acquired route conditions as to traffic congestions, route bandwidth, etc.

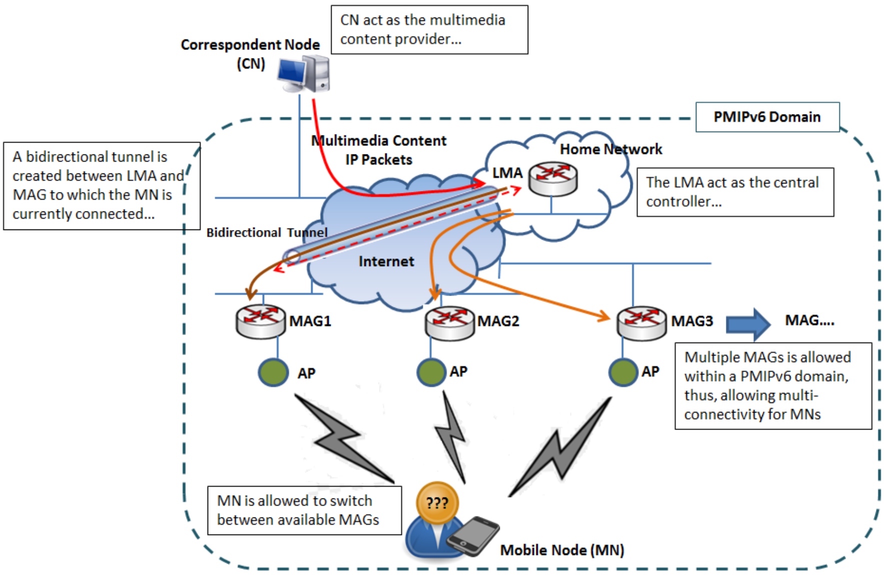

Fig. 1. Mobile Node Chooses Connection Considering the Handover Latency based on the Current Traffic among Heterogeneous Networks

3 Discussions

The MN is assumed to be currently connected to MAG1 as indicated in Fig. 1. Since MNs are allowed for multi-connectivity, The MN can switch to MAG2, MAG3, etc. depending on the acquired traffic information and conditions. The standard handover procedure for the MN in PMIPv6 to establish connection as well as re-establish connections are followed for the attachment and detachments of mobile nodes [2, 3]. The multimedia contents that are requested by a mobile user from the CN will be intercepted by the LMA, then the LMA forwards the multimedia content packets to MAG1 wherein the HNP currently binds through the bidirectional tunnel created upon attachment procedure. The received multimedia content packets by MAG1 will be de-capsulated and forwarded directly to the MN through the specific access link it is connected.

To facilitate the multi-connection, the LMA sends a multicast flow control signaling to available MAGs that the MN can possibly establish its connection within the PMIPv6 domain. The purpose of this flow control signaling is to classify traffic information for all possible routes to deliver the multimedia content IP packets. It aims to identify the current route condition for the available MAGs such as traffic information, number of currently connected nodes, bandwidth, etc. The MAGs that have received the flow control signaling replies with an acknowledgement and the handover latency for every possible route will be identified. The MAG that has the lowest or optimal handover latency will be chosen by the LMA to bind the HNP of MN.

The basis for switching from the current MAG to another will be the computed total handover latency. The MAG that has the lowest handover latency will be selected, that is, the MN detaches its connection from its current MAG, and establishes a new connection to the MAG with the lowest handover latency. The bidirectional tunnel will be transferred to whichever MAG it is currently connected. This aims to utilize the best possible route in terms of efficiency and handover performance.

4 Conclusion

This paper has presented an efficient architecture for the flow distribution management of multimedia contents over heterogeneous mobile networks. The capability of PMIPv6 that allows mobile nodes to have multi-connectivity provides a seamless flow distribution of multimedia contents among multiple MAGs within the PMIPv6 domain. Thus, the mobile device can be distributed on the best case scenario depending on the connection with the shortest handover latency.

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