An Optimized Bicasting Scheme for Proxy Mobile IPv6

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Abstract- Current research in mobility management depicts that the trend in mobility management is moving towards offering mobile users seamless connectivity across different access technologies. This entails minimizing packet loss and handover delay without compromising utilization of the limited wireless network resources. Bicasting Proxy Mobile IPv6 (B-PMIPv6) is one of the solutions proposed to achieve the desired mobility management objectives. B-PMIPv6 deals with packet loss by sending duplicate packets to both the current mobile access gateway (MAG) and the target mobile access gateway, thus offering a seamless IP handover. However, some of the current bicasting solutions for PMIPv6 start the bicasting process too early and stop too late, thus putting a strain on limited network resources, such as network buffers and backhaul bandwidth. In this work, we propose a bicasting solution to determine optimal times to start and stop bicasting while utilizing the backhaul bandwidth efficiently and avoiding buffer overflows that result from too early and too late bicasting. The description of the proposed bicasting scheme is presented in this paper.

Index Terms-Proxy Mobile IPv6, bicasting, scalability

I. INTRODUCTION

Over the years, mobility management schemes have been proposed and some have been implemented. There have also been extensions to the proposed schemes to lower handover delay and packet loss as a mobile node changes its point of attachment. These schemes have been applied to manage mobility in legacy and current network architectures. It has however been noted that the mobile data traffic volumes are growing very fast and are expected to grow even faster in the future due to the introduction of new bandwidth hungry and innovative services based on the Internet Protocol (IP), as well as new broadband access technologies, such as Long Term Evolution (LTE). To optimize the handling of the mobile node’s data traffic, as it changes points of attachment, mobility management schemes have to incorporate effective utilization of network resources, for instance, backhaul bandwidth and buffer space.

The fundamental foundation of PMIPv6 is based on MIPv6. It extends MIPv6 signaling and reuses many of its concepts, such as the Home Agent (HA) [1]. PMIPv6 has gained a lot of popularity and has already been adopted by the WiMAX forum [2] and has been recommended in 3GPP standards, such as the Evolved Packet Core (EPC) [3]. Due to this, many researchers have put their efforts in proposing extensions to PMIPv6 in order to minimize packet loss and handover delay. Bicasting is one of the proposed extensions, mainly for reduction of packet loss.

However, the proposed bicasting extensions to PMIPv6 suffer from timing problems; for instance, bicasting could start too early and/or stop too late. Hence, this may result into increased backhaul bandwidth and buffer requirements. Therefore, there is a need to develop bicasting schemes that start and stop the bicasting process at optimal times while ensuring efficient use of network resources. In this paper, we present an optimized bicasting solution for PMIPv6.

This paper is organized as follows. Section II presents related work. Section III outlines motivation for the proposed study. Section IV describes the proposed solution, and Section V concludes the paper.

II. RELATED WORK

Bicasting extensions to PMIPv6 allow sending duplicate packets to both the current MAG and the target MAG. For instance, in [4] and [5], packets are bicast to both the previous MAG (PMAG) and the new MAG (NMAG) as soon as another binding about NMAG is created at the Local Mobility Anchor (LMA). Thus, the trigger to start bicasting is a successful creation of a bidirectional tunnel between the LMA and the NMAG. When the MN successfully attaches to NMAG, bicasting stops. The bicasting process in [4] and [5] is too long, resulting in inefficient resource utilization. To solve this, a partial bicasting extension to PMIPv6 has been proposed.

In [6], partial bicasting has been proposed, where PMAG is released as soon as NMAG obtains a proxy binding acknowledgement (PBA) message from the LMA. The major improvement in [6] is that NMAG doesn’t wait for the MN to connect to it for it to trigger the stop bicast signal; hence, PMAG is relieved much earlier, thus shortening the bicasting period. However, as shown in figure 1, the scheme in [6] may introduce unnecessary traffic flow disruption. One way to address this, as illustrated in figure 2, is to start and stop bicasting close enough to the media independent handovers (MIH) event, LINK_DOWN.

![Figure 1–An Example of Partial Bicasting PMIPv6.](image-url)
The partial bicasting scheme, whose operation is shown in figure 1, uses a buffer on NMAG when bicasting stops. Thus, it may suffer packet losses due to buffer overflows on the NMAG when the number of mobile nodes than need to be handed over to NMAG increases.

Consequently, the buffer space utilization will be reduced on the NMAG. Our scheme will monitor the Received Signal Strength Indication and perform time estimation on the viability of the current link. The bicasting process will then be scheduled just before the current link’s signal strength drops below the receive signal strength threshold. The optimal time margins by which bicasting will start and stop ahead of the MIH LINK_DOWN will be determined during simulations so as tune the performance of the proposed scheme.

V. CONCLUSION AND FUTURE WORK
This paper has presented the proposed scheme in an attempt to solve the problems posed by the already proposed bicasting based schemes for Proxy Mobile IPv6. It has additionally motivated the need for the work. The future work that has to be performed is that of continually refining the proposed scheme. Thereafter the proposed solution shall be simulated on the network simulator (ns-2) and performance evaluation will be carried out with respect to the following metrics: packet loss, bandwidth utilization and buffer utilization.

REFERENCES

Lebajoa Mphatsi received his Bachelor of Engineering in Computer Systems & Networks degree in 2009 from The National University of Lesotho and is presently studying towards his Master of Science (Electrical) degree at the University of Cape Town. His research interests include Mobility Management.