International Journal of Multimedia and Ubiquitous Engineering
Vol.11, No.9 (2016), pp.203-210
http://dx.doi.org/10.14257/ijmue.2016.11.9.21

Parametric Comparison of Multicast Support for Network Mobility Management: A Qualitative Analysis

Azana Hafizah Mohd Aman[1], Aisha-Hassan A. Hashim [1], Azween Abdullah [2], Huda Adibah Mohd Ramli [1] and Shayla Islam[1]

[1]Kulliyyah of Engineering, International Islamic University Malaysia, Jln Gombak 53100, Kuala Lumpur, Malaysia
[2]SOCIT, Taylor's University, Jalan Taylors, Subang Jaya 47500, Selangor, Malaysia

Abstract

Proxy Mobile IPv6 (PMIPv6) was initially introduced to assist unicast network-based mobility. In recent years, new approaches have been introduced to provide multicast support in PMIPv6. IP multicast is an imperative mechanism for internet video provision. As the usage of internet data traffic remains to develop rapidly, there is a need to optimize and improve the performance of multicast service. Issues such as large overhead, high packet loss rate, single point of failure, service disruption time, handover latency, and non-route optimization needs to be tackled efficiently. To provide multicast services in PMIPv6, route optimization, global mobility, load balancing and context transfer approaches have been introduced. The foremost aim of this paper is to study and analyze these methods via qualitative analysis. This is to focus the advantages and the limitations of the current approaches.

Keywords*: Multicast, Mobility, Mobile Multicast, PMIPv6*

1. Introduction

Multicast Mobility Working Group (MULTIMOB WG) offers guidance to support multicast in Network Mobility (NEMO) environment. The group works on extensions of PMIPv6 to improve its capability to handle multicast efficiently [1]. This includes several proposals such as base solution schemes, dedicated schemes and direct routing schemes [2]. These schemes require communications to go through Local Mobility Anchor (LMA), Mobile Access Gateways (MAG), dedicated server as well as native multicasting infrastructure, respectively. The MAGs and the LMAs are the network entities which are defined in PMIPv6 protocol [1].

The key objective of this paper is to study these multicast support schemes through qualitative analysis. The outcomes of the existing schemes are analyzed intensely in which a comprehensive assessment is presented. The parameters reflected in this analysis are handover latency, packet loss, throughput, as well as delay respectively.

The paper is prepared as follows: Section 2 provides current challenges of PMIPv6 mobility and multicast support mechanisms. Section 3 highlights details of the selected approaches. Section 4 describes the qualitative analysis of the selected scenarios. Lastly, the conclusion is detailed in Section 5.

2. Current Challenges of Mobile Multicast

In real-time application scenarios (*i.e*. voice or video over IP, multimedia conference, games or collaborative environments), multicast is the most efficient transmission approach [3]. Mobile multicast face challenges in providing sufficient handover latency, packet loss rate, service recovery time and total signaling cost [3]. The fast growths in

ISSN: 1975-0080 IJMUE

real-time and delay-sensitive applications make these challenges a crucial topic to be considered. Mobile multicast challenges are divided into four major issues, which are receiver movement, source movement, deployment issues and the reconstruction of multicast delivery tree [4]. When mobile multicast subscriber moves into another subnet, it has to reconstruct Multicast Listener Discovery (MLD) states in the new location [4]. Approach of transferring the MLD state between old location and new location affects the performance of multicast services [4]. Thus, supporting seamless mobility in mobile multicast is still an on-going research area.

3. Basic Overview of Multicast Solutions in PMIPv6 Environment

Currently there are few multicast PMIPv6 solutions. This section highlights four multicast PMIPv6 solutions which are route optimization, global mobility, load balancing and context transfer [2, 5-8].

In route optimization solution in the PMIPv6 domain, an effective handover for multicast subscribers is introduced. This is to support an optimum delivery path for multicast data by reducing handover delay as well as packet loss rate. The proposed protocol joins the multicast group in advance as shown in Figure 1. Thus, provide a shorter service disruption period as there is no multicast tree join delay as well as a binding update delay. It also decreases the amount of lost packets via sending and buffering at the destination (*i.e.* new MAG) during a handover. The suggested solution outperform existing base solution multicast scheme for PMIPv6 concerning end-to-end delay, session disruption time, and the amount of lost packets at the time of handoff.

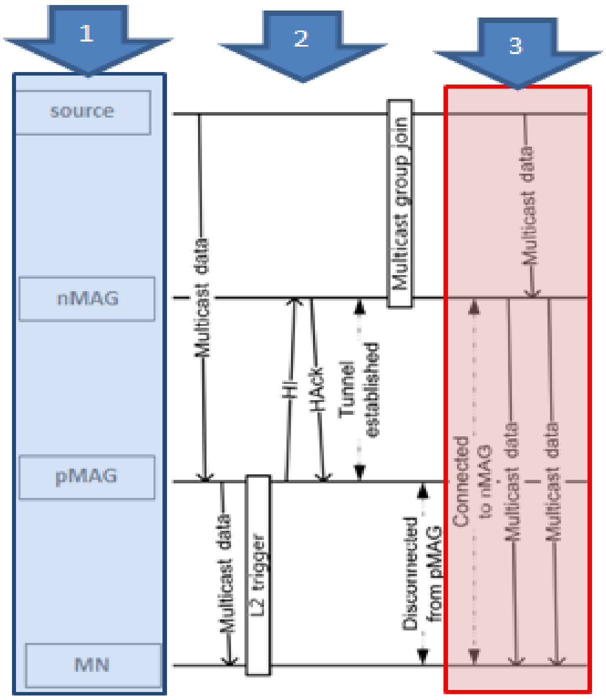

Figure 1. Signaling Call Flow for Route Optimization Solution for PMIPv6 Multicast

The context transfer solution illustrates an addition of the Context Transfer Protocol (CXTP) [8]. This is to provide continuous handover for PMIPv6 multicast. When a multicast mobile node disconnects from the existing MAG and connects to a new MAG, the node is capable to get the multicast data uninterruptedly via the new link (*i.e.* new MAG) once the node completed handover except any MLD signaling. This process provides multicast session stability and evades extra packet loss as well as session disturbance. The CXTP is triggered, in either a predictive scheme or reactive scheme. Based on Multicast Listener Discovery, the multicast router identifies that one or more mobile node is heeding to a specific multicast address and source at particular interface.

As for global mobility solution, the aims is to provide inter domain (global) multicast mobility since the existing PMIPv6 based multicasting which are base solution schemes, dedicated schemes and direct routing schemes could not preserve the global mobility straightly among changed PMIPv6 domains. The existing multicast PMIPv6 is mainly considered for local (intra) mobility in particular PMIPv6 domain. The existing PMIPv6 based multicasting origins the interruption of services since it does not reveal the problems of packet loss at the time of binding and group joining technique [9-11]. Therefore, it recommended a global mobility scheme which provides the continuous multicasting service in PMIPv6 environments. The proposed scheme maintenance the global mobility by adding extra signaling messages between LMAs called Session Mobility Anchor (SMA) as shown in Figure 2. Likewise, it attains smaller latency due to accomplish fast binding as well as group joining process.

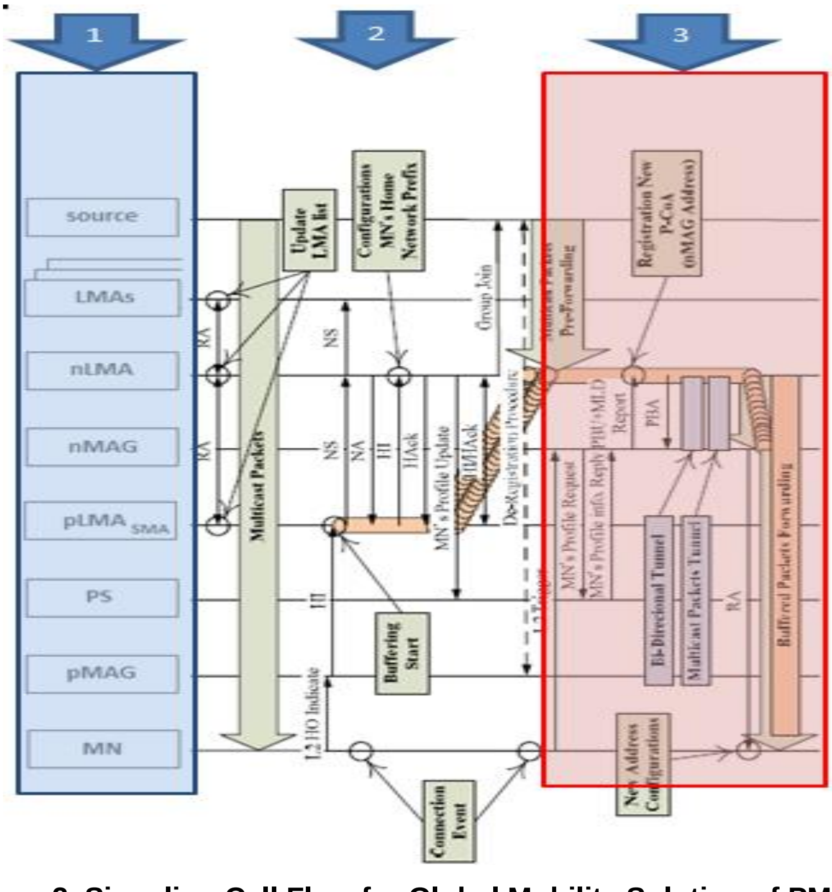

Figure 2. Signaling Call Flow for Global Mobility Solution of PMIPv6 Multicast

In load balancing solution, the aim is to tackle multicast traffic issue at the LMAs. The LMA is liable for retaining the mobile node's accessibility state. This is also responsible for sending the data traffic from and to the present position of the MN in PMIPv6. As mobile multicast traffic promptly growing, it is simple to create a blockage as well as a single point of failure at the LMA. Consequently, load balancing solution among LMAs is a promising way out for these matters. The solution supports to better allocate the load between the LMAs while significantly decreasing the multicast facility interruption. The solution balances the multicast load among LMAs by using Load Balancing Controller (LBC) as shown in Figure 3.

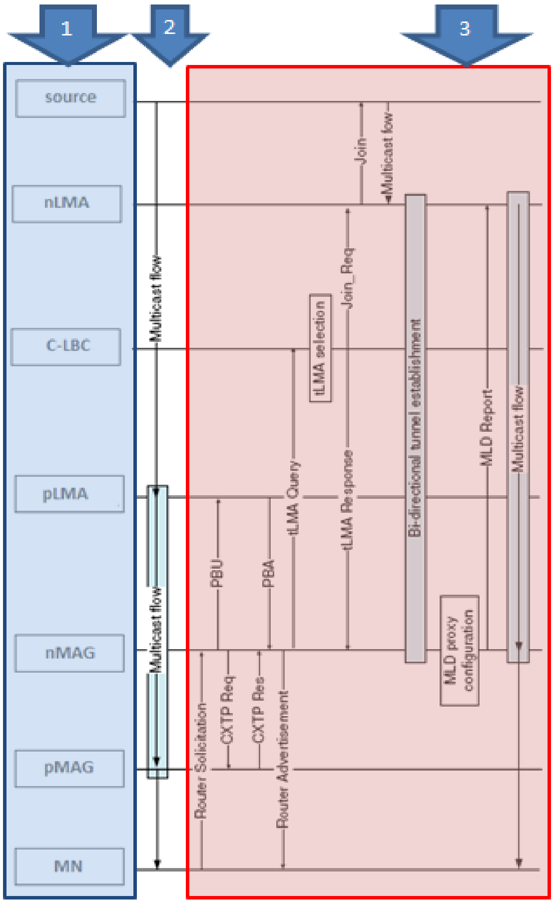

Figure 3. Signaling Call Flow for Load Balancing Solution of PMIPv6 Multicast

4. Qualitative Analysis and Discussions

The PMIPv6 multicast is still an ongoing concept to study as the PMIPv6 main concerns is on the unicast mobility support and little considers the multicast mobility. This conveys the objective of this paper which is to examine the recent solutions for multicast PMIPv6. Besides enabling multicast, these solutions try to address the service disruption, packet loss and handover performance issues related to PMIPv6 multicast environment.

The route optimization solution focused on the implementation of multicast support on the MAGs. The solution enable multicast in intra-domain for PMIPv6 environment. Figure 1 depicts the signaling call flow for the route optimization solution.

The context transfer solution focused on the implementation of multicast support on the MAGs. The solution enable multicast in intra-domain for PMIPv6 environment. The solutions enhanced the MAGs by adding Context Transfer Protocol (CXTP) to the MAGs. Figure 4 illustrates the signaling call flow for the CXTP implementation.

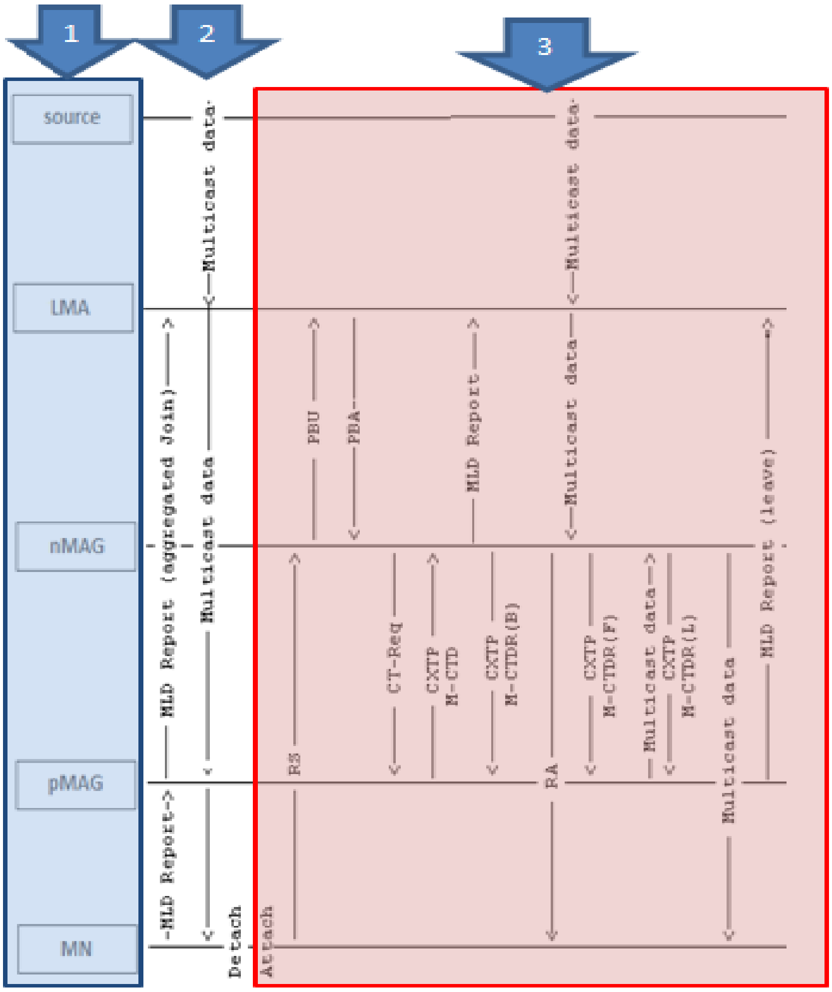

Figure 4. Signaling Call Flow for Context Transfer Solution of PMIPv6 Multicast

The global mobility solution focused on the implementation of multicast support on the LMAs (as Figure 2 describes the signaling call flow for the global mobility solution). The solution enable multicast in inter-domain PMIPv6 environment. The solutions enhanced the LMA by adding new function named Session Mobility Anchor (SMA) to the LMAs.

The load balancing solution focused on the implementation of multicast support on the LMAs as Figure 3 indicates the signaling call flow for the load balancing solution. The solution enable multicast in inter-domain PMIPv6 environment. The multicast traffic is equally distributed among the LMAs using proactive and reactive method. The solutions enhanced the LMAs by adding Load Balancing Controller (LBC) to the LMAs.

Table 1 summarize the number of network entity, number of signals involved before the handover of mobile node and number of signals involved after the handover.

Table 1. Summary of Signaling Call Flow for the Solutions

Solution / Criteria	Route Optimization (Figure 1)	Context Transfer (Figure 2)	Global Mobility (Figure 3)	Load Balancing (Figure 4)
1 Network Entity	4 entities	5 entities	8 entities	7 entities
2 Signals before handover	8 signals	6 signals	15 signals	2 signals
3 Signals after handover	4 signals	16 signals	8 signals	14 signals

Table 2 compares the parameter and criteria of the four solutions. By using either route optimization, load balancing or context transfer solution, the delivery of multicast data is optimized. All the four solutions help to minimize service disruption period and packet loss rate [12-20]. Only route optimization, global mobility and context transfer solution considers the handover performance. Route optimization and context transfer solution solves the issues of intra domain mobile multicast, while the global mobility and load balancing solution solves the issues for inter domain mobile multicast. All the solutions enabled and enhanced the multicast data in PMIPv6 using additional function.

Table 2. Parameter and Criteria Comparison of the Four Solutions

Multicast Solutions / Criteria	Route Optimization	Global Mobility	Load Balancing	Context Transfer
Optimal Path	Yes	No	Yes	Yes
Service Disruption Period Consideration	Yes	Yes	Yes	Yes
Packet Loss Rate Consideration	Yes	Yes	Yes	Yes
Handover Consideration	Yes	Yes	No	Yes
Inter/Intra Domain	Intra Domain	Inter Domain	Inter Domain	Intra Domain
MAG/LMA Based	MAG	LMA	LMA	MAG
Additional Function	Yes	Yes	Yes	Yes

5. Conclusion

This qualitative analysis is not about deciding or determining the best model or criteria, every multicast model has its own parameters and requirements. However it is hoped that, based on this analysis, we could elucidate new ways to analyze, evaluate and enhance mobile multicast in PMIPv6. Through this study, we will be able to know the approach and able to minimize the establishment of new service and maximize the application continuation in seamless way. Hence, maximize the performance, the availability and reliability of mobile multicast in network-based environment. On a further view, combination of these solutions is another option to solve multicast issues for intra and inter domain of the PMIPv6 multicast.

References

[1] S. Gundavelli, E. Leung, K. Devarapalli, V. K. Chowdhury and B. Patil, "Proxy Mobile IPv6 (PMIPv6) RFC 5213", **(2008)**.
[2] D. Kim, W. S. Lim and Y. J. Suh, "Multicast Extension To Proxy Mobile IPv6 for Mobile Multicast Services", Journal of Computing Science and Engineering, vol. 5, no. 4, **(2011)**, pp. 316-323.
[3] C. J. Bernardos, M. Calderon and I. Soto, "PMIPv6 and Network Mobility Problem Statement Internet-Draft", **(2012)**.
[4] T. C. Schmidt and M. Waehlisch, "Multicast Mobility in MIPv6: Problem Statement and Brief Survey Internet Draft", **(2007)**.
[5] H. G. Kim, J. M. Kim and H. S. Kim, "A Global Mobility Scheme for Seamless Multicasting in Proxy Mobile IPv6 Networks", Kwangwoon University Industry-Academic Collaboration Foundation, **(2012)**.
[6] T. T. Nguyen and C. Bonnet, "Considerations of IP Multicast for Load Balancing in Proxy Mobile IPv6", Networks Department of Mobile Communications EURECOM, **(2014)**.
[7] T. T. Nguyen and C. Bonnet, "Performance Optimization of Multicast Content Delivery in a Mobile Environment based on PMIPv6", Department of Mobile Communications EURECOM, **(2014)**.
[8] D. V. Hugo and H. Asaeda, "Context Transfer Protocol Extension for Multicast draft-vonhugo-multimob-cxtp-extension-03", **(2013)**.
[9] R. Vida and L. Costa, "Multicast Listener Discovery Version 2 (MLDv2) for IPv6 RFC 3810 Internet Research Task Force IRTF", **(2004)**.
[10] J. Loughney, M. Nakhjiri, C. Perkins and R. Koodli, "Context Transfer Protocol RFC4067", **(2005)**.
[11] A. Patel, K. Leung, M. Khalil, H. Akhtar and K. Chowdhury, "Mobile Node Identifier Option for Mobile IPv6 (MIPv6) RFC 4283", **(2005)**.
[12] R. Koodli, "Mobile IPv6 Fast Handovers (FMIPv6) RFC 5268", **(2008)**.
[13] T. Schmidt, M. Waehlisch and S. Krishnan, "Base Deployment for Multicast Listener Support in Proxy Mobile IPv6 (PMIPv6) Domains RFC 6224", **(2011)**.
[14] J. C. Zuniga, L. M. Contreras, C. J. Bernardos, S. Jeon and Y. Kim, "Multicast Mobility Routing Optimizations for Proxy Mobile draft-ietf-multimob-pmipv6-ropt-03IPv6", **(2013)**.
[15] T. Schmidt, S. Gao, H. Zhang and M. Waehlisch, "Mobile Multicast Sender Support in Proxy Mobile IPv6 (PMIPv6) Domains draft-ietf-multimob-pmipv6-source-01", **(2012)**.
[16] A. Petrescu, M. Boc and C. Janneteau, "Network Mobility with Proxy Mobile IPv6 Internet-Draft", **(2012)**.
[17] Z. Ma, K. Wang and F. Zhang, "Network-based Inter-domain handover Support for Proxy Mobile IPv6 Internet-Draft", **(2012)**.
[18] J. Liu, W. Luo and W. Yan, "Routes Optimization for PMIPv6 Multicast Internet-Draft", **(2012)**.
[19] T. C. Schmidt, M. Waehlisch and G. Fairhurst, "Multicast Mobility in MIPv6: Problem Statement & Brief Survey RFC 5757", **(2010)**.
[20] J. Liu, W. Luo and W. Yan, "Routes Optimization for PMIPv6 Multicast Internet-Draft", **(2012)**.

