Network Working Group Seil Jeon
Internet-Draft Younghan Kim
Intended status: Standards Track Soongsil University, Korea
Expires: January 11, 2012 July 11, 2011

PMIPv6 Multicasting Support using Native Infrastructure
draft-sijeon-multimob-direct-routing-pmip6-01.txt

Status of this Memo

Abstract

To support IP multicasting in PMIPv6 domain, [RFC6424] has been determined as a base solution. This solution requires all the LMA to forward multicast packets to MAG via PMIPv6 tunnel. This approach creates a tunnel convergence problem. To resolve the issue, the current MULTIMOB WG charter is trying to draw a solution about how to separate multicasting routing from a mobility anchor. To address the issue, we propose the local routing approach that makes the direct connection between MAG and multicast router. The advantages of the proposed local routing solution are compared with the base solution and dedicated LMA approach. In addition, we present the applicability of local routing solution depending on several constraints.

Table of Contents

1. Introduction

PMIPv6 is a network-based IP mobility protocol that requires no host stack involvements; it provides enhanced mobility performance compared to host-based approaches like MIPv6, FMIPv6. However, current PMIPv6 specification does not explicitly address the method of multicasting communications [RFC5213].

To support multicasting in PMIPv6 domain, the base solution proposes deployment option [RFC6424], which places multicast routing on LMA. MAG receives a multicast stream from LMA by using PMIPv6 tunnel. It is simply derived from PMIPv6 specification and requires no modification to PMIPv6 components and MNs. However, the base solution introduces a tunnel convergence issue in case a MAG receives the same multicast packets from more than one LMA. This causes severe network bandwidth. To avoid a tunnel convergence problem, the current MULTIMOB WG charter is trying to d a solution on how to separate multicasting routing from the mobility anchor. As potential techniques, two kinds of approaches have been presented: a dedicated mobility anchor and local routing.

The concept of dedicated LMA is to assign dedicated multicasting LMA to each MAG. This approach resolves tunnel convergence issues but introduces tunnel avalanche problem because M-LMA needs to replicate data streams to all MAGs. It imposes a heavy burden on the M-LMA to process and forward tunnel packets. Additionally, it makes severe packet tunneling overhead.

In this draft, we propose a local routing solution that a MAG receives multicast packets directly from MR without any tunnel. This solution can completely solve tunnel-related performance issues by placing MLD proxy on a MAG and allowing multicast connectivity between the MAG and MR. With the description of local routing operation, we present the comparisons of a few of candidate solutions in terms of performance. In addition, we also check the applicability of local routing depending on several constraints.

2. Terminology and Functional Components

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC2119.

- Mobile Node (MN)
- Previous Mobile Access Gateway (P-MAG) - The MAG that manages mobility related signaling for a MN before handover.
- New Mobile Access Gateway (N-MAG) - The MAG that manages mobility related signaling for the MN after handover
- Multicast Router (MR)
- MLD Proxy (M-Proxy)

3. Local Routing Solution

3.1. Architecture

```
                             Multicast Tree
                                    :
                                    :         || - PMIPv6 Tunnel
         +----------+          +----------+    |  - Multicast Data Path
         |   LMA    |          |    MR    |
         +----------+          +----------+
              ||\\                  /|
              ||  \\              /  |
              ||    \\          /    |
              ||      \\      /      |
              ||        \\/          |
              ||        / \\         |
              ||      /     \\       |
              ||    /         \\     |
         +----------+        +----------+
         |  P-MAG   |        |  N-MAG   |
         |(M-Proxy) |        |(M-Proxy) |
         +----------+        +----------+
              :                   :
          +------+             +------+
          |  MN  |   ----->    |  MN  |
          +------+             +------+
```

Figure 1. Direct routing solution for PMIPv6 Multicasting

Figure 1 shows the proposed local routing architecture using native multicasting infrastructure [I-D.deng-multimob-pmip6-requirement]. To forward IGMP/MLD signaling and multicast packets, a MLD proxy function defined in [RFC4605], SHOULD be placed on a MAG. This solution is much simpler than the base solution and easy to deploy because multicasting functions are totally separated from mobility anchor by using a native multicasting infrastructure.

3.2. Handover Procedure

```
                                                              Multicast
           MN         P-MAG       N-MAG        LMA      MR      Tree
            |           |           |           |        |        |
            |           |           |           |        |        |
            |<----------|<-- Multicast Data--------------|<-------|
            |           |       .   |           |        |        |
            |           |       .   |           |        |        |
            |           |       .   |           |        |        |
      Link->|       Handover        |           |        |        |
    Disconnected    Detection       |           |        |        |
            |           |           |           |        |        |
            |           |           |           |        |        |
            |           |    MN Attachment      |        |        |
            |           |           |           |        |        |
            |           |           |           |        |        |
            |------ Rtr. Sol. ----->|           |        |        |
            |           |           |           |        |        |
            |<----- MLD Query ------|           |        |        |
            |           |           |           |        |        |
            |------ MLD Report ---->|           |        |        |
            |           |           |    Aggregated      |        |
            |           |           |--- MLD Report ---->|        |
            |           |           |           |        |        |
            |           |           |           |        |        |
            |<----------------------|<-- Multicast Data--|<-------|
            |           |           |           |        |        |
            |           |           |           |        |        |
            |           |           |   Proxy   |        |        |
            |           |           |--Binding->|        |        |
            |           |           |   Update  |        |        |
            |           |           |           |        |        |
            |           |           |   Proxy   |        |        |
            |           |           |<-Binding--|        |        |
            |           |           |   Ack.    |        |        |
            |           |           |           |        |        |
```

Figure 2. Handover procedure in direct routing architecture

Figure 2 shows the handover operation in local routing architecture. When an MN hands off to the N-MAG from the P-MAG, the N-MAG detects the newly arrived MN and transmits an MLD query message to the MN. After receiving the MLD query message, the MN sends an MLD report message that includes the multicast group information. The N-MAG then sends an aggregated MLD report message to the MR. When the N-MAG receives the multicast packets from the MR, it then simply forwards them without tunnel encapsulation. The N-MAG updates the MN’s location information to the LMA by exchanging PBU/PBA signaling messages.

4. Comparison with Base Solution, Dedicated LMA, and Local Routing

In this section, we compare the direct routing with the base solution [RFC6424] and dedicated LMA [I-D.zuniga-multimob-smspmip] in terms of performance, ease of deployment, and other factors.

4.1. Tunnel Convergence

In the base solution, the MR function is combined with LMA. Thus, all the packets are delivered to MNs through PMIPv6 tunnel between MAG and LMA, which raises the tunnel convergence problem. because a MAG may receive the same multicast packets from several LMAs. Dedicated LMA and the proposed direct routing have different approaches; however, they can avoid the tunnel convergence issue.

4.2. Complexity in LMA

In the tunnel-based approaches, a LMA needs to deal with MLD signaling, join/leave procedure, and tunnel packet processing (i.e., encapsulating/decapsulating and tunnel packet lookup) as well as the role of mobility anchor. When using a dedicated entity, these complexities can be reduced but cannot be avoided completely. On the other hand, the direct routing is absolutely not affected by these complexities.

4.3. Packet Overhead

Using native multicasting infrastructure, local routing does not make tunneling overhead for multicast data delivery while tunnel-based approaches require 40 bytes of IP tunnel header per packet. According as packet arrival rate increases, the overhead becomes much severe.

4.4. Another Advantage

When we consider that MNs move to non-PMIPv6 domains from PMIPv6 domains as described in [I-D.von-hugo-multimob-future-work], the direct routing approach can provide a compatible method because it does not depend on PMIPv6 tunnel for multicasting operation.

5. Applicability in Visited Network

If a multicast listener is in visited network, the local routing can be applied on the condition that there are a multicast peering entities, e.g., content delivery network (CDN), inter-domain multicast routing like BGMP [RFC3913] or MBGP [RFC4765] in visited network. At that time, the multicast channel used in home network MAY be different in visited network therefore, the listener MAY need to wait a time for joining the channel informed from visited network but this latency can be reduced through handover optimization technique with multicast context transfer.

In particular, the source in which the multicast listener is interested and the receiver are in same visited network, the local routing is used efficiently than tunnel-based multicast transmission technique using home subscription because local routing provides much optimized routing path for delivering multicast data transmission regardless of the number of channels and receivers.

6. Message Formats

This section describes source and destination address of MLD signaling messages. The interface A-B means that an interface on node A, which is connected to node B.

6.1. MLD Query

Interface	Source Address	Destination Address
MR-MAG	MR link local	[RFC2710], [RFC3810]
MAG-MN	MAG link local	[RFC2710], [RFC3810]

6.2. MLD Report

Interface	Source Address	Destination Address
MN-MAG	MN link local	[RFC2710], [RFC3810]
MAG-MR	MAG link local	[RFC2710], [RFC3810]

6.3. Multicast Packets

Interface	Source Address	Destination Address
MR-MAG	Streaming Source Addr.	Multicast Group Addr.
MAG-MN	Streaming Source Addr.	Multicast Group Addr.

7. IANA Considerations

TBD.

8. Security Considerations

This document does not discuss any special security concerns in detail. The protocol of this document is built on the assumption that all participating nodes are trusted each other as well as there is no adversary who modifies/injects false messages to corrupt the procedures.

9. References

9.1. Normative References

[RFC2710] S. Deering, W. Fenner, B. Harberman, "Multicast Listener Discovery (MLD) for IPV6", IETF RFC 2710, October 1999.

[RFC3810] R. Vida, and L. Costa, "Multicast Listener Discovery Version(MLDv2) for IPv6", IETF RFC 3810, June 2004.

[RFC5213] S. Gundavelli, K. Leung, V. Devarapalli, K. Chowdhury, and B. Patil, "Proxy Mobile IPv6", IETF RFC 5213, August 2008.

[RFC4605] B. Fenner, H. He, B. Haberman, and H. Sandick, "Internet Group Management Protocol (IGMP) / Multicast Listener Discovery (MLD)-Based Multicast Forwarding ("IGMP/MLD Proxying")", IETF RFC 4605, August 2006.

[RFC6424] T. Schmidt, M. Waehlisch, and S. Krishnan, "Base Deployment for Multicast Listener Support in PMIPv6 Domains", IETF RFC 6424, April 2011.

9.2. Informative References

[RFC3913] D. Thaler, "Border Gateway Multicast Protocol (BGMP): Protocol Specification," IETF RFC 3913, September 2004.

[RFC4765] T. Bates, R. Chandra, D. Katz, and Y. Rekhter, "Multiprotocol Extensions for BGP-4," IETF RFC 4765, January 2007.

[I-D.deng-multimob-pmip6-requirement]
H. Deng, T. Schmidt, P. Seite, and P. Yang, "Multicast Support Requirements for Proxy Mobile IPv6", draft-deng-multimob-pmip6-requirement-02.txt (work in progress), July 2009.

[I-D.zuniga-multimob-smspmip]
J. C. Zuniga, A. Rahman, L. M. Contreras, C. J. Bernardos, and I. Soto, "Support Multicast Services Using Proxy Mobil IPv6," draft-zuniga-multimob-smspmip-05.txt (work in progress), March 2011.

[I-D.von-hugo-multimob-future-work]
D. von Hugo, H. Asaeda, B. Sarikaya, and P. Seite, "Evaluation of further issues on Multicast Mobility: Potential future work for WG MultiMob", draft-von-hugo-multimob-future-work-02.txt (work in progress), Juney 2010.

Authors' Addresses

Seil Jeon
Soongsil University
4F Hyungnam Engineering Bldg. 424, Sangdo-Dong,
Dongjak-Gu, Seoul 156-743 Korea
Phone: +82-2-820-0841
E-mail: sijeon@dcn.ssu.ac.kr

Younghan Kim
Soongsil University
11F Hyungnam Engineering Bldg. 1107, Sangdo-Dong,
Dongjak-Gu, Seoul 156-743 Korea
Phone: +82-2-820-0904
E-mail: yhkim@dcn.ssu.ac.kr