Distributed Mobility Management
Internet Draft
Intended status: Informational
Expires: April 2017

Kyoungjae Sun
Truong-Xuan Do
Younghan Kim
Soongsil University, Korea

October 31, 2016

Multicast mobility deployment scenarios over distributed mobility management
draft-kjsun-dmm-deployment-scenarios-multicast-dmm-04.txt

Status of this Memo

This Internet-Draft will expire on April 30, 2017.

Copyright Notice

Abstract

This document presents deployment scenarios for supporting IP multicast over distributed mobility management (DMM) architecture, which considers the separation of the control and the data planes. This document describes three main use cases of IP multicast deployments over DMM depending on the placement of control and data plane functional entities.

Table of Contents

1. Introduction 2
2. Functional Decomposition.................................... 3
3. Terminology 3
4. Use Cases Analysis 4
   4.1. Use Case 1 5
   4.2. Use Case 2 6
5. Forwarding Policy Configuration for Multicast 8
6. Security Considerations..................................... 9
7. IANA Considerations 9
8. References 9
   8.1. Normative References................................... 9
   8.2. Informative References................................. 9
9. Acknowledgments 9

1. Introduction

Distributed mobility management is a new paradigm to solve current problems of centralized mobility management, such as a single point of failure, non-optimal routing [RFC7333].

IP multicast is an efficient content distribution mechanism which is designed with the IP mobility to bring new user experience and reduce bandwidth cost. In the [RFC7333], one requirement for DMM is to enable multicast solutions to avoid the inefficiency in the multicast traffic delivery.

Existing solutions for supporting multicast in DMM are bi-directional tunnel [TUNNEL] and direct routing [ROUTING]. These solutions focus on the placement of MLD proxy and multicast router functions into the Mobility Access Router.

The current architecture of the DMM is being changed to employ the concept of data and control plane separation. The data plane nodes are configured by the control nodes via Forwarding Policy Configuration protocol, as defined in [I-D.ietf-dmm-fpc-cpdp]. The several deployment scenarios were presented in [I-D.wt-dmm-deployment-model].

However, there is no work until now, mentioning about multicast support in such new DMM architectures. Therefore, this document presents possible deployment scenarios, which support multicast listener in the DMM architectures based on the concept of the data and control planes separation.

2. Functional Decomposition

Two options for deploying the multicast over conventional distributed mobility management (i.e. without the control and data plane separation) are MLD Proxy and Multicast router [RFC3810] [RFC4605]. This section decomposes functions of MLD Proxy and Multicast router that are required to deliver the multicast traffic with the respect to the concept of data and control planes separation. Below table is represented about functional description for supporting multicast.

Function	Description	C/D Plane
Run multicast routing protocol	Used to join/leave the multicast tree infrastructure to receive the multicast data	C-Plane
MLD membership report	Used to notify about the multicast group membership on the directly attached link	C-Plane
MLD Querier	Used to discover multicast listeners on the directly attached link	C-Plane
Membership database	Used to maintain the merger of multicast subscriptions	C-Plane
Multicast forwarding	Used to forward multicast packets based on the multicast subscriptions over each link	D-Plane

Figure 1: Functional descriptions for supporting multicast

3. Terminology

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 RFC-2119 [RFC2119].

This document uses the terminology defined in [RFC4605] and [RFC3810]. Also, new entities are defined relying on the concept of data and control planes separation and the functional decomposition. Terminologies are similarly named as DMM functions defined in [wt-dmm-deployment-model].

- CMA (Control plane Multicast Anchor): CMA consists of the control plane functions of the multicast router (Multicast Anchor). CMA is responsible for joining the multicast tree.
- DMA (Data plane Multicast Anchor): DMA is the topological anchor point for multicast channels, subscribed by the MN. DMA provides packet treatment functions, such as packet forwarding, packet encapsulation. The DMA can be configured by the CMA via Forwarding Policy Configuration (FPC) protocol
- CMN (Control plane Multicast Node): CMN is responsible for control plane functions of MLD-Proxy (multicast node) as described in the previous section.
- DMN (Data plane Multicast Node): DMN is located at the first-hop router where the MN is attached. The DMN has the protocol interface with the CMN for configuration.

4. Use Cases Analysis

Following defined terminologies, we adjust these entities into current centralized approaches which support multicast in centralized mobility architecture. Current multicast support approaches in centralized mobility architecture are defined in [RFC6224] and [RFC7028]. Since both approaches are based on PMIPv6, we use DMM entities which are mapped with PMIPv6 entities. Following table identifies the potential mapping of DMM function defined in [I-D.wt-dmm-deployment-model].

FUNCTION	PMIPv6	MIPv6	IPsec	3GPP	Broadband
Home-CPA	LMA-CPA	HA-CPA	IKE-CPA	PGW-CPA	BNG-CPA
Home-DPA	LMA-DPA	HA-DPA	IKE-DPA	PGW-DPA	BNG-DPA
Access-CPN	MAG-CPN	-	-	SGW-CPN	RG-CPN
Access-DPN	MAG-DPN	-	-	SGW-DPN	RG-DPN

Figure 2: Mapping of DMM functions

For supporting multicast, several entities are already defined in IETF and 3GPP. Following table idientifies the potential mapping of multicast functions with our defined terminologies.

FUNCTIONS	3GPP	IETF
CMA	BMSC-CPA	Multicast Router-CPA
DMA	BMSC-DPA	Multicast Router-DPA
CPN	MBMS-GW-CPN	Multicast Proxy-CPN
DPN	MBMS-GW-DPN	Multicast Proxy-DPN

Figure 3: Mapping of Multicast functions

4.1. Use Case 1

First use case is based on [RFC 6224], which LMA has a role of both unicast and multicast anchor in PMIPv6 domain. In that approaches, LMA transposes any MLD message from a MAG into the multicast routing infrastructure and creates appropriate multicast forwarding states at its tunnel interface between LMA-to-MAG. Additionally, LMA acts as a MLD Querier. MAG acts as MLD proxy which forwards multicast traffic and initiates related signaling down to the appropriate MN. In this approach, most importantly, mobility entities are tightly coupled with multicast support functions. In other words, there is no additional entities to support multicast besides adding more functions into their PMIPv6 entities.

Considering DMM deployment scenario with separation of control and data plane, two possible deployment models are existed. First model is that separated control and user plane model presented in Figure 4. In this model, the control plane function of multicast anchor is handled by the CMA and where as the data plane function is handled by DMA. The control plane function of the MLD proxy is handled by CMN and where as the data plane function is handled by DMN. Between control plane nodes, CMA and CMN, multicast related signaling messages are used to manage multicast group and make upstream/downstream interfaces to appropriate nodes. After a mobile node wants to join specific multicast channel and all related signaling messages are exchanged between control plane functions, control plane functions interact with their corresponding data plane nodes for the multicast traffic forwarding state management.

```
                              =====================
                            ==                     ===
                           = Multicast Infrastructure =
                             =========================
                                        |
          +=================+  FPC  +=================+
          | CMA + Home-CPA |-------| DMA + Home-DPA |
          +=================+       +=================+
                 |                         |
                 |   MLD/IGMP              | UP {Tunnel/Route}
                 |                         |
         +===================+ FPC +===================+
         | CMN + Access-CPN |-----| DMN + Access-DPN |
         +===================+     +===================+
```

Figure 4: Separated control and user plane model with
multicast supports

Another possible deployment model is that centralized control plane model presented in Figure 5. In this model, the control plane functions of multicast anchor and MLD proxy are combined into a combined control function of DMM. There is no signaling messages between multicast anchor and MLD proxy. Between the control plane and the data plane nodes, FPC protocol defined [I-D.ietf-dmm-fpc-cpdp] can be used to managing forwarding states of multicast traffic.

```
                                =====================
                              ==                     ===
                             = Multicast Infrastructure =
                              ========================
                                          |
        +=================+  FPC  +=================+
        | CMA + Home-CPA |-------| DMA + Home-DPA |
        |                 |       +=================+
        |                 |               |
        |                 |               | UP {Tunnel/Route}
        |                 |               |
        |                 |  FPC  +==================+
        |CMN + Access-CPN|-------| DMN + Access-DPN|
        +=================+       +==================+
```

Figure 5: Centralized control plane model with multicast supports

4.2. Use Case 2

In [RFC 7028], it separates multicast function into PMIPv6 entities. Following that document, two approaches are proposed;

Multicast Tree Mobility Anchor (MTMA) solution and Direct routing solution. In the MTMA solution, the MTMA is dedicated to multicast traffic and used to get access to remote multicast content. That is, the MTMA acts as multicast router or MLD proxy. When MN attach to this architecture and receive both unicast and multicast traffic, since the MAG connects to both unicast anchor (e.g. LMA) and multicast anchor (e.g. MTMA), MN can simultaneously receive both unicast and multicast traffic from same MAG. For that, the MAG should support MLD proxy function in [RFC4605] and maintain its upstream/downstream interfaces to appropriate nodes. For multicast traffic, a multicast tunnel is established between MAG and MTMA.

Considering DMM deployment scenario with separation of control and data plane, MTMA approach can be described as Figure 6. In this figure, all multicast functions are deployed separately from unicast DMM function except access data plane function. In the access data plane, it maintains two forwarding states; unicast traffic forwarding states and multicast forwarding states. Unicast forwarding states are anchored by Home-DPA and multicast forwarding states are anchored by DMA. The control plane functions of DMM can be centralized and also the control functions of multicast can be centralized.

```
                           =====================
                         ==                      ===
+=================+     = Multicast Infrastructure =
| Unicast Traffic |       ========================
+=================+              |             .
                |                |              .
                |                |              . MLD/IGMP
+======+     +======+            |              .
| Home |_FPC_| Home |          +=====+        +=====+
| -CPA |     | -DPA |          | DMA |---FPC--| CMA |
+======+     +======+          +=====+        +=====+
    |           ||               ||              |
    |PMIP/      || UP            || UP           | MLD/IGMP
    |GTP        ||{Tunnel/route} ||{Tunnel/route}|
+======+     +======================+         +=====+
|Access|_FPC_|  Access-DPN + DMN    |____FPC__| CMN |
| -CPN |     |                      |         +======+
+======+     +======================+
```

Figure 6: MTMA solution model with separated control
          and data plane

Direct routing solution in [RFC7028] allows the MAG to directly connect to a multicast router. In this case, there is no multicast anchor and the MAG acts as the MLD proxy. For multicast traffic, the upstream interface of the MLD proxy instance has been configured pointing to a multicast router internal to the PMIPv6 domain. The MAG does not manage multicast group information. It just maintain upstream/downstream interface and performs MLD proxy operations defined in [RFC4605].

Considering DMM deployment scenario with separation of control and data plane, direct routing approach can be described as Figure 7. In this figure, the multicast anchor function and the multicast access function are combined into single control/data plane nodes. In the access data plane node, it maintains both unicast and multicast forwarding states and interfaces to the appropriate nodes. Similar with the MTMA solution, the control plane functions of DMM or the control functions of multicast can be centralized.

```
                            =====================
                          ==                     ===
+ =================+       = Multicast Infrastructure =
| Unicast Traffic |         =========================
+==================+                     |
               |                         |
               |                         |
+======+     +======+                    |
| Home |_FPC_| Home |              +===========+
| -CPA |     | -DPA |              | Legacy MR |
+======+     +======+              +===========+
    |             ||                 ||         .
    |PMIP/        || UP              || UP       . MLD/IGMP
    |GTP          || {Tunnel/Route} ||           .
+========+     +==========================+        +===========+
| Access |_FPC_|        Access-DPN        |___FPC__| CMA + CMN |
|  -CPN  |     |          DMA+DMN         |        +===========+
+========+     +==========================+
```

Figure 7: Direct routing solution model with separated control
          and data plane

5. Forwarding Policy Configuration for Multicast

For communicating between DMM control plane and data plane function, Forwarding Policy Configuration (FPC) protocol is proposed in [I-D.ietf-dmm-fpc-cpdp]. FPC protocol enables the configuration of any data plane node and type by the abstraction of configuration details and the use of common configuration semantics. In recent document gives detail protocol attributes and operation parameters. Considering multicast support, we need to make sure that the current FPC protocol is resolved to create a forwarding rules for multicast traffic. For example, we can add identifier which represent multicast source address or add attribute for specific multicast group.

6. Security Considerations

T.B.D

7. IANA Considerations

T.B.D

8. References

8.1. Normative References

[RFC2119] S. Bradner, "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC7333] H. Chan, D. Liu, P. Seite, H. Yokota, and J. Korhonen, "Requirements for Distributed Mobility Management", IETF RFC 7333, Aug. 2014.

[RFC3810] R. Vida, and L. Costa, "Multicast Listener Discovery Version 2 (MLDv2) for IPv6", IETF RFC 3810, June 2004.

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

8.2. Informative References

[TUNNEL] S. Figueiredo, S. Jeon, and R. L. Aguiar, "IP Multicast Use Cases and Analysis over Distributed mobility Management",draft-sfigueiredo-multimob-use-case-dmm-03 (expired April 2013).

[ROUTING] Y. Kim, T-X. Do, and Y. Kim, "Direct Routing for Mobile Multicasting in Distributed Mobility Management Domain", Proc. INTERNET 2013 pp. 1-3.

[I-D.ietf-dmm-fpc-cpdp] M. Liebsch, S. Matsushima, S. Bundavelli, D. Moses, "Protocol for Forwarding Policy Configuration (FPC)", draft-ietf-dmm-fpc-cpdp-03 (work in progress), March 2016.

[I-D.wt-dmm-deployment-model] S. Gundavelli, "DMM Depolyment Models and Architectural Considerations", draft-wt-dmm-deployment -models-00 (work in progress), April 2016.

[RFC6224] Schmidt, T., Waehlisch, M., Krishnan, S., "Base Deployment

for Multicast Listener Support in Proxy Mobile IPv6
(PMIPv6) Domains", RFC 6224, April 2011.

9. Acknowledgments

Authors' Addresses

Kyoungjae Sun
Soongsil University
369, Sangdo-ro, Dongjak-gu
Seoul 156-743, Korea

Email: gomjae@ssu.ac.kr

Truong-Xuan Do
Soongsil University
369, Sangdo-ro, Dongjak-gu
Seoul 156-743, Korea

Email: xuan@dcn.ssu.ac.kr

Younghan Kim
Soongsil University
369, Sangdo-ro, Dongjak-gu
Seoul 156-743, Korea

Email: younghak@dcn.ssu.ac.kr