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Multicast Anchoring in DMM
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Status of this Memo

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Abstract

In this draft, we define multicast support functions in a Distributed Mobility Management (DMM) environment. Based on the decomposed mobility management functions in [RFC7429], each defined multicast support function can be located and operated with DMM functions.

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1. Introduction

Based on [RFC7333], a multicast solution in Distributed Mobility Management (DMM) should be considered early in the process of designing protocol and deployment models. Multicast support in DMM should avoid inefficient methods, such as non-optimal forwarding or tunnel convergence.

To support IP multicasting, we need several functions: a multicast routing protocol, membership management, etc. When we consider multicast support in DMM, we should determine how efficiently these functions can be operated with the mobility management functions in DMM. Possible use cases are already described in [Use Case for Multicast DMM]. However, since current DMM research considers control/data separation and functional decomposition, we need to define multicast support functions following decomposed DMM anchor functions and operate with them.

In this draft, we define multicast mobility management functions that enable us to deploy the DMM functions defined in [RFC7429]. We define multicast mobility management functions in a similar way because it is easier to deploy multicast mobility management functions with DMM functions.

2. Conventions and 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 [RFC5213], [RFC3810], and [RFC4601]. New entities are defined by relying on the DMM functions specified in [RFC7429]:

1. Anchoring Function (AF) is an allocation to a mobile node of an IP address (e.g. Home Address (HoA))) or prefix (e.g. Home Network Prefix (HNP)), topologically anchored by the advertising node.

2. Internetwork Location Management (LM) function manages and keeps track of the internetwork location of an Mobile Node (MN). The location information may be a binding of the advertised IP address/prefix (e.g. HoA or HNP) to the MN's IP routing address, or it may be a binding of a node that can forward packets destined for the MN.

3. Forwarding Management (FM) function intercepts and forwards a packet to/from the IP address/prefix assigned to the MN based on the internetwork location information, either to the destination or to some other network element that knows how to forward the packets to their destinations.

3. Multicast Support Functions in DMM

In this chapter, we define functions to support multicasting in DMM environment. The multicast support of previous mobility management schemes (e.g., MIP and PMIP) deployed multicast router or MLD proxy functions into their mobility entities (e.g., HA, LMA, and MAG). According to the decomposition of previous mobility management functions and considering the separation of the control and data planes, a multicast support function also could be decompose into several functions.

3.1. Multicast Anchoring Function (Multicast AF)

The multicast AF is defined as the anchoring point for multicast subscribers in DMM domain. It means that all multicast traffic

from/to the DMM domain should be forwarded through the multicast AF.

Even if the multicast AF is anchor point for multicast traffic, it does not mean that it is anchor point for unicast traffic. In other words, this function could be deployed separately with the DMM AF (e.g. MTMA solution in [RFC7028]), or combined with the DMM AF (e.g. LMA in [RFC6224]). The multicast AF function provides connectivity to the multicast infrastructure out of the DMM domain. With the multicast AF, the network entity may be part of multicast tree. That is, multicast AFs have a Tree Information Base (TIB). It could be act role of MLD proxy function which generate MLD membership report or user-defined subset in the its upstream interface. In addition, the multicast AF acts as MLD Querier of other MLD proxy instances located in DMM.

To support multicast listeners, the multicast AF collects MLD report messages from mobile nodes or other entities (e.g. MLD proxy defined in [RFC4605]). To provide an appropriate multicast subscription, the multicast AF should join/prune multicast channels based on MLD reports from the mobile nodes. To support the multicast sender, this function forwards the source information of the sender to the Rendezvous Point (RP) in multicast infrastructure.

The multicast AF could be separated into control-plane function and data-plane function. In that case, the multicast AF Control Plane (multicast AF-CP) is responsible of managing multicast tree information and sharing source information through multicast infrastructure. In other words, the multicast AF-CP acts as MLD Querier for the DMM domain and MLD proxy for the multicast infrastructure. For that, the multicast AF-CP maintains multicast forwarding states at its corresponding downstream interface and aggregated multicast membership states at its upstream interface. The multicast Data Plane (multicast AF-DP) is responsible of anchoring multicast data packets destined to the appropriate subscribers in the DMM domain. It should forward multicast traffic according to the multicast forwarding rules configured by the multicast AF-CP.

3.2. Multicast Group Management Function (Multicast GM)

The multicast GM function is partially acts as MLD proxy which manages multicast subscriber information. According to [RFC4605], the MDL proxy devices maintain the membership database, which considers merging all subscriptions on the downstream interface. The membership database is presented a set of membership records, multicast addresses, filter modes and source lists. The multicast GM can maintain this database to support maintaining multicast subscribers and multicast sources. For that, the multicast AF function should create/delete/update membership database in the multicast GM when the mobile node join or leave multicast channel.

Especially the multicast GM support mobility management easily by requesting/updating subscriber information to this function. To track location of mobile node, the multicast GM can deployed with the location management function for DMM or can be extended flow entry table in that. Using this function, all multicast subscribers using the same multicast channel can be managed logically into the same records wherever they attach to so that it can avoid tunnel convergence problem. For example, even though two different nodes subscribing same multicast channel from different access router are moving to the same access node, the multicast GM can support to use only one upstream interface to the same multicast source address by updating its database and signaling with access node. Additionally the multicast GM function can support optimal multicast routing which sender and receiver are connected in the DMM domain. According group database in the multicast GM and location information of mobile nodes, in case that both sender and subscriber are located in DMM domain, the multicast AF can forward multicast packets directly to the access node where receiver is located in.

3.3. Multicast Forwarding Management Function (Multicast FM)

The multicast FM function manages forwarding states that is used to forward packets from a source to a multicast group. Forwarding states could be managed together or separately with unicast forwarding states handled by the DMM FM function. In the former case, the multicast FM function should be located at the same entity where the DMM FM function is deployed (e.g. MAG function in [RFC7028] and [RFC6224]). Basically the multicast FM function maintains forwarding rules for routing from/to multicast infrastructure and multicast subscribers, and additionally it can be used specific forwarding mechanism such as PMIP or GRE tunneling between multicast FM entities to support mobility.

The multicast FM function can be split into the control and data plane. The multicast FM control plane (FM-CP) performs multicast routing mechanism, makes forwarding rules for multicast traffic and commands to the multicast FM data plane (FM-DP). For communication between control and data plane, [dmm-fpc-cpdp] can be a method for configuring forwarding policies. Rule of forwarding multicast traffic can be considered in various way; a set of forwarding rules of multicast subscribers or a single rule for each multicast channel.

4. Considering multicast functions into current approaches

In this section, we consider how multicast functions can be merged with DMM functional deployment model. In this section, based on DMM

functional deployment model in [sijeon-dmm-deployment-models], we make use cases which combine or separate multicast functions as we defined in previous section.

4.1. Distributed AM, LM, and FM : All-in-One

In this model, all of DMM anchor functions (AF, FM, LM) are combined into one physical entity and such physical entities are distributed at the edge of network. This model is presented in [seite-dmm-dma] and [bernardos-dmm-pmip] To support multicast, the multicast anchor functions may be deployed together in mobility router. Optionally, in case of central LM usage, the multicast GM entity also may be centralized. On the other hand, one or more multicast entity also may be deployed independently as described in Figure 1. For example, in case of deploying the multicast AF functions separately, signaling messages for supporting mobility are required between All-in-One DMM entity and the multicast AF. In this example, DMM entity which includes the multicast FM function can perform as multicast proxy.

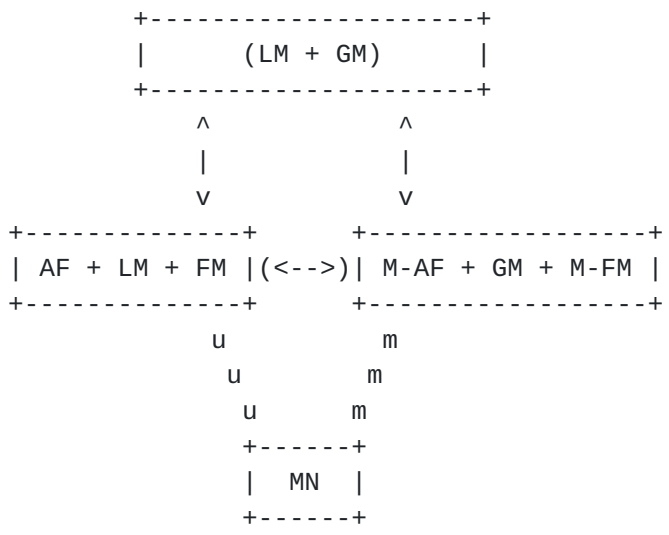

Figure 1: Multicast anchor for distributed AM, LM, and FM

4.2. Distributed AF-DP, LM and FM with centralized AF-CP

This model separates AF function into control and data plane. AF-DP is distributed with LM and FM while AF-CP is centralized in a single entity. In this model, centralized AF-CP can determine AF-DP based on policy or network condition. As presented in [RFC7389], specific routing protocol, such as GTP or GRE, can be used to forward MN's traffic between AF-DPs.
To support multicast in this model, the multicast AF-CP may be co-located where DMM AF-CP is placed. The multicast AF-DP may deploy together with DMM AF-DP or separately. In the latter case, like as Multimedia Broadcast Multicast Service (MBMS) gateway in [3GPP TS 36.440], specific AF-DP gateway can be used. Centralized

AF-CP which includes multicast AF-CP can determine the multicast AF-DP for forwarding multicast traffic of MN. Figure 2 is described one options for adopting this model.

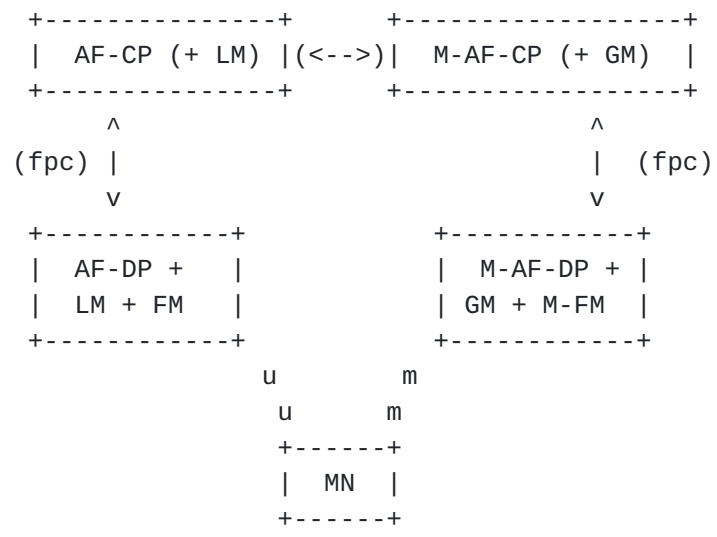

Figure 2: Multicast anchor for distributed AF-DP, LM and FM with centralized AF-CP

4.3. Distributed AF-DP and FM-DP with centralized AF-CP, LM, and FM-CP

This model considers separation of FM-CP and FM-DP with separation of AF-CP and AF-DP. In this model, forwarding path between AF-DP can be provided more flexible. [matsushima-stateless-uplane-vepc] is one example of this model. To support multicast in this model, multicast FM-CP, AF-CP and GM may be implemented in centralized control plane of DMM. In this case, signaling messages between control and data plane can be used by extending messages which could be used in normal DMM. For example, [dmm-fpc-cpdp] can be extended to make rule for multicast traffic by defining group forwarding rules. Figure 3 is described for this model.

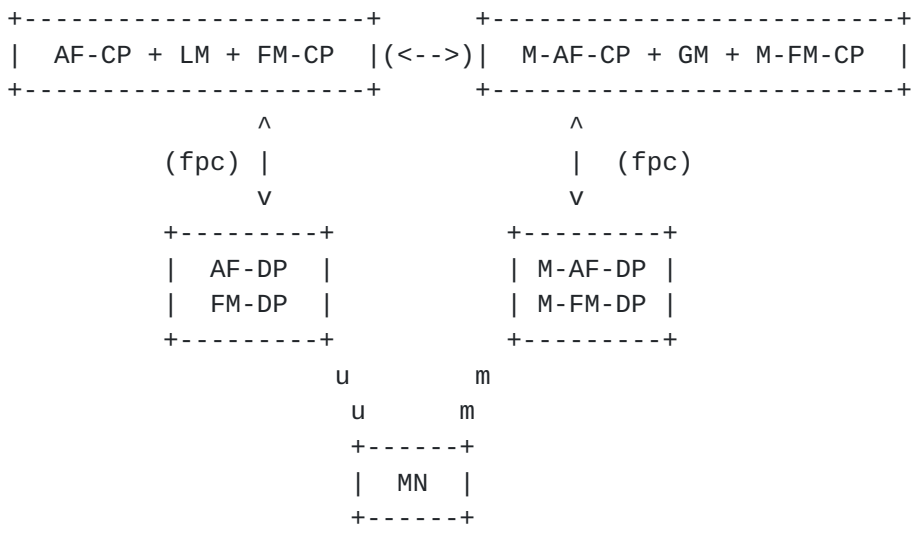

Figure 3: Multicast anchor for distributed AF-DP and FM-DP
with centralized AF-CP, LM, and FM-CP

5. Security Considerations

TBD

6. IANA Considerations

TBD

7. References

7.1. Normative References

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8. Acknowledgments

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