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H. Deng
China Mobile
T. Schmidt
HAW Hamburg
P. Seite
France Telecom
P. Yang
Hitachi

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Multicast Support Requirements for Proxy Mobile IPv6
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Abstract

This document summarizes requirements for multicast listener support in Proxy Mobile IPv6 (PMIPv6) scenarios. In correspondance to PMIPv6, multicast mobility management requirements do not request any active participation of the mobile node.

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1. Introduction

Many of the current mobile network architectures as well as link layer technologies provide an independent multicast/broadcast support for dedicated group communication services, e.g., based on specific wireless channels. Typically, applications like Internet IPTV, that require voluminous content streams to be distributed to potentially large numbers of receivers, may take benefit of this transport mode. At the same time, with the development of mobile Internet protocols, the need emerged for a seamlessly available multicast solution that makes efficient use of the multipoint transmission technologies deployed by operators [MMCASTv6-PS].

As an example, mobile IPTV channels, which combine Audio/Video programs with interactive data for supplementary information (using bi-directional wireless broadband links), and with potential large audience, may take particular advantage of any multicast/ broadcast mobile support at access networks for downlink distribution of A/V streams.

Among IP mobility management protocols, Proxy Mobile IPv6 (PMIPv6) [RFC5213] has been designed to bring IP mobility making the mobile nodes unaware of network layer changes. Functional entities in the PMIPv6 infrastructure are the Local Mobility Anchor (LMA) and the Mobile Access Gateway (MAG). The local mobility anchor is responsible for maintaining the mobile node's reachability state and is the topological anchor point for the mobile node's home network prefix(es). The mobile access gateway performs mobility management operations on behalf of the mobile node. Basically, the mobile access gateway is responsible for detecting the mobile node's movements, to and from the access link, and for initiating binding registrations (i.e. location updates) to the mobile node's local mobility anchor.

The current PMIPv6 specification lacks dedicated support of group communication. To facilitate design of a multicast support in future solutions, this document gathers requirements for multicast listener support. In correspondance to PMIPv6, multicast mobility management requirements should not request any active participation of the mobile multicast recipient.

2. Scenarios of Multicast Support for PMIPv6

According to [RFC5213], two basic routing scenarios exist in PMIPv6: the tunneling mode and local routing. The tunneling mode as displayed in Figure 1 uses IPv6-in-IPv6 encapsulation [RFC2473] (IPv6-in-IPv4 in [PMIPv6v4]) to transfer data between LMA and MAG. Thus two entities are facing an avalanche problem (cf. [MMCASTv6-PS]), the LMA in feeding multicast streams to the MAGs, and the MAG in distributing multicast on air to the mobile nodes.

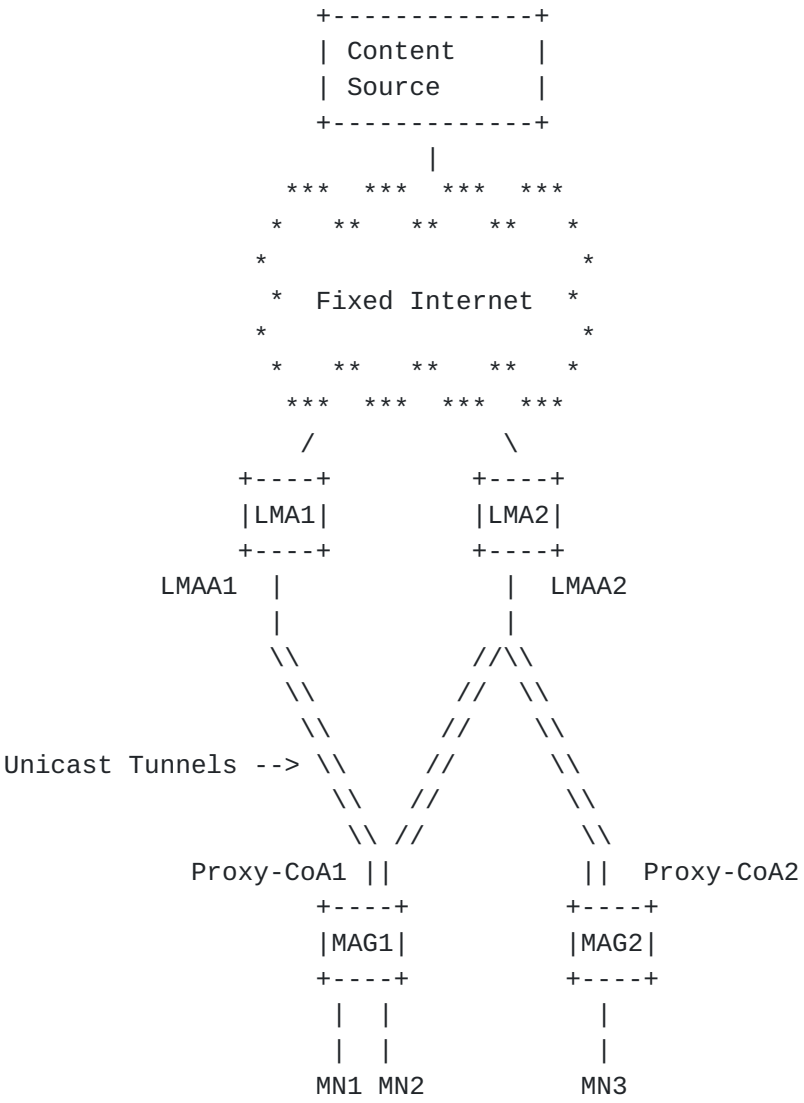

Figure 1: Multicast Scenario in PMIPv6 Tunneling Mode

The local routing option has been designed to support direct node to node communication within a PMIPv6 domain. Assuming a locally available content source, the local routing mode may give rise to the scenario visualized in Figure 2. Local routing will resolve tunnel

convergence issues at the LMA but not the avalanche problem point to the MAG.

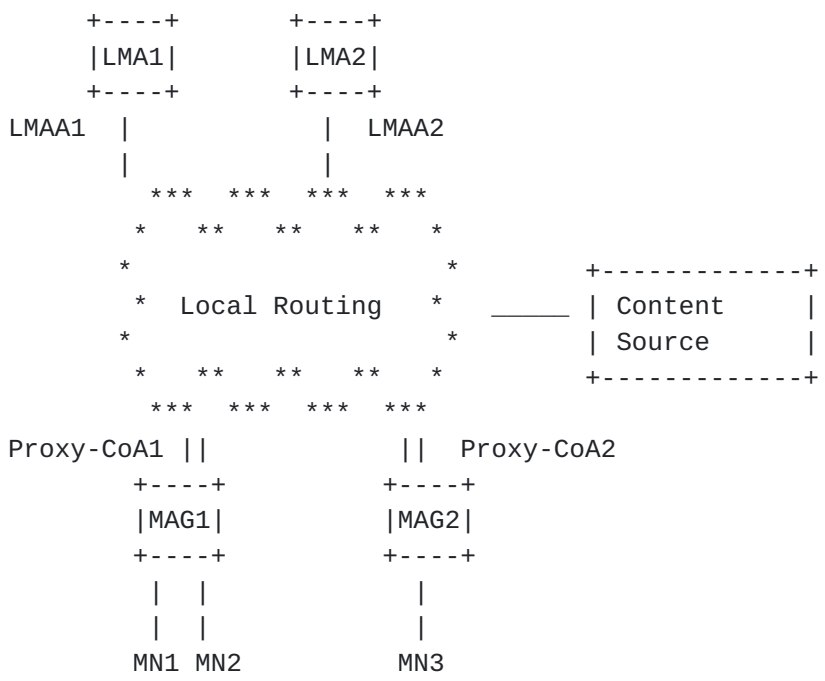

Figure 2: Multicast Scenario for PMIPv6 Local Routing

PMIP multicast support must clearly address above issues but should also bring good user experience of multicast mobility. In addition, it is expected that the solution shall inherit from the basics of PMIP scenarios; in particular mobility management should not require to add specific functions to the IPv6 node. In these perspectives, following sections summarize protocol and architecture requirements for multicast support in Proxy Mobile IPv6.

3. Requirements for multicast support in PMIPv6

This section summarizes the requirements for mobile multicast protocol extensions of PMIPv6.

3.1. Basic functional requirements

R1 - PMIPv6 multicast mobility management MUST transparently support the reception of Any Source Multicast (ASM) and Source Specific Multicast (SSM) channels.

R2 - The mobile node is responsible for initially subscribing to the multicast group(s).

R3 - The mobile node MAY remain agnostic of the multicast mobility management when roaming. In particular, the node MUST not be required to re-subscribe to multicast group(s) after handoff.

R4 - Multicast packet distribution within a PMIPv6 domain MUST not cause MTU-size conflicts on the network layer. In particular, path MTU discovery MUST NOT be required for multicast transmission.

R5 - PMIPv6 multicast mobility management MUST comply with multicast scoping rules and restrictions.

R6 - PMIPv6 multicast mobility management MUST equally cover IPv6/ IPv4 only and dual stack nodes.

R7 - A multicast solution SHALL be compatible with the existing PMIPv6 network architecture and protocol structure such as multihoming and vertical handover.

3.2. Multicast performance requirements

R8 - PMIPv6 transmission SHOULD realize native multicast forwarding, and where applicable conserve network resources and utilize link layer multipoint distribution to avoid data redundancy.

R9 - The solution SHALL minimize multicast forwarding delays to provide seamless and fast handovers for real-time services. After a handoff, multicast data SHOULD continue to reach the mobile listener at a latency similar to unicast communication.

R10 - The PMIPv6 multicast mobility management SHOULD avoid to cause packet loss in addition to unicast handoff.

R11 - Multicast mobility SHOULD minimize transport costs on the forwarding link, as well as any additional overhead on the multicast

delivery path.

R12 - Routing convergence MUST be ensured, even when the MN moves rapidly and performs handovers at a high frequency.

R13 - The protocol MUST be robust against irregular moves of the MN (e.g. ping-pong mobility) and MUST not compromise (unicast) network performance.

4. Architecture requirements

In addition to protocol requirements as listed in the preceeding section, mobile multicast support for listeners MAY lead to requirement on the PMIPv6 architectural entities. These potential issues are sketched in the following sub-sections:

4.1. LMA Requirements for multicast support in PMIPv6

Multicast Bandwidth Control: LMA should be able to control the total bandwidth of a user port that can be used for multicast service, thereby monitoring the fraction of the total bandwidth consumed by multicast. This requirement may lead to support a range of different service classes with various QoS requirements.

Multicast session control: AAA functions resident at the LMA, in particular admission control and accounting, SHOULD be preserved and applicable under multicast services.

4.2. MAG Requirements for multicast support in PMIPv6

It is foreseeable that the MAG has to act as a multicast designated router. Hence support of MLDv2 [RFC3810] is required at the MAG.

Further MAG-specific requirements can be identified:

Connection Admission Control (CAC): it is required that Connection Admission Control based on available resources is supported at the MAG.

Network Attachment Control: the attachment control should be supported by a multicast control function and multicast replication function.

5. Security Considerations

Multicast security is one of the most crucial issues in mobile multicast service such that it is required to provide security capabilities to protect mobile multicast multicast network from any malicious attempts caused by multicast security holes such as denial of service attacks.

- The multicast service in PMIPv6 should not degrade the security protection of the basic PMIPv6 AAA mechanism.

- Multicast system architecture is required to provide an admission control mechanism to regulate any multicast events.

- Multicast system architecture is required to be independent of adjacent domains such that it shall not affect the adjacent multicast domain without permission.

- Multicast system architecture is required to provide a mechanism to check integrity of multicast sources prior to service delivery such that it prevents unauthorized source to distribute multicast content.

6. IANA Considerations

This document makes no requests to IANA.

7. Contributors

This document is a result of discussions in the multicast support for PMIPv6 design team. The members of the design team that are listed below are authors that have contributed to this document:

Pierrick Seite

pierrick.seite@orange-ftgroup.com

Peny Yang

pyang@hitachi.cn

Von-Hugo, Dirk

Dirk.Hugo@t-systems.com

Hitoshi Asaeda

asaeda@sfc.wide.ad.jp

Thomas C. Schmidt

schmidt@informatik.haw-hamburg.de

Suresh Krishnan

suresh.krishnan@ericsson.com

John Zhao

john.zhao@huawei.com

Matthias Waehlisch

mw@link-lab.net

Hui Deng

denghui@chinamobile.com

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Authors' Addresses

Hui Deng (Editor)
China Mobile
53A,Xibianmennei Ave.,
Xuanwu District,
Beijing 100053
China

Email: denghui02@gmail.com

Thomas C. Schmidt (Editor)
HAW Hamburg
Dept. Informatik
Berliner Tor 7
Hamburg, D-20099
Germany

Email: Schmidt@informatik.haw-hamburg.de

Pierrick Seite (Editor)
France Telecom
4, rue du Clos Courtel
BP 91226
Cesson-Sevigne, 35512
France

Email: pierrick.seite@orange-ftgroup.com

Peng Yang (Editor)
Hitachi
301, North Wing, Tower C Raycom Infotech Park
2 kexueyuan Nanlu
Haidian District
Beijing, 100080
P.R. China

Phone: +861082862918(ext.)328
Email: pyang@hitachi.cn

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