NETEXT Working Group
Internet-Draft
Intended status: Informational
Expires: September 13, 2012

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March 12, 2012

PMIPv6 and Network Mobility Problem Statement
draft-bernardos-netext-pmipv6-nemo-ps-02

Abstract

The NETLMM WG standardized Proxy Mobile IPv6 (PMIPv6). PMIPv6 enables mobile devices to connect to a PMIPv6 domain and roam across gateways without changing the IP address.

Current PMIPv6 specification does only support the movement of hosts within the localized mobility domain. A mobile network (commonly referred to as a NEMO, NEtwork that MOves) can also benefit from the network-based localized mobility support provided by PMIPv6 [I-D.ietf-netext-pd-pmip], but with some limitations. This I-D describes what can be done with current standardized protocols, and describes the problem statement of fully supporting network mobility in Proxy Mobile IPv6.

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1. Introduction and Motivation

Proxy Mobile IPv6 (PMIPv6), specified in [RFC5213], provides network-based mobility management to hosts connecting to a PMIPv6 domain. PMIPv6 introduces two new functional entities, the Local Mobility Anchor (LMA) and the Mobility Access Gateway (MAG). The MAG is the first layer three hop detecting Mobile Node (MN) attachment and providing IP connectivity. The LMA is the entity assigning one or more Home Network Prefixes (HNPs) to the MN and is the topological anchor for all traffic from/to the MN.

The network-based localized mobility support provided by PMIPv6 was designed for hosts, so a mobile host can freely roam within the PMIPv6 domain, without changing its IP address. An interesting scenario -- which is not supported by current standards (as we will explain later in this document) -- is the following: let's consider a scenario in which users move around a large area (e.g., an airport, an exhibition site, a fairground or even a metropolitan area covered by different public transportation systems). In these areas, attachment points to the Internet might be available both in fixed locations (such as coffee shops, airport terminals or train stations) or in mobile platforms, such as vehicles (e.g., buses that move between pavilions at a fair or a train that moves from one terminal to another at an airport). Users demand the ability to keep their ongoing communications while changing their point of attachment to the network as they move around (e.g., when a user leaves a coffee shop and gets on a bus).

While PMIPv6 [RFC5213] is the solution specified to provide network-based localized mobility support (which nicely fits the requirements related to providing Internet access in a large area, such as in the use cases described above), and the NEMO Basic Support Protocol [RFC3963] is the solution to provide transparent network mobility support to a set of nodes moving together (which nicely fits the requirements related to providing Internet access to users in mobile platforms, such in the use cases described above), these two solutions cannot fully cope -- neither working standalone nor in a combined fashion -- with the kind of use case introduced above. We need therefore a solution -- which may be for example based on extending NEMO mechanisms, extending PMIPv6 or both -- to address this scenario. We next explain with a bit more detail the problem statement of combining PMIPv6 with network mobility support and explain why current IETF standards are not able to fully tackle this problem.

2. Conventions and Terminology

Readers are expected to be familiar with all the terms defined in [RFC5213], [RFC3753] and [RFC4885]. In addition, the following terms are used in the context of this problem statement:

MR/MAG

We use this term to refer to the router providing connectivity to a set of nodes moving together. We do not use the term Mobile Router (MR) to avoid confusion with its well accepted meaning in the context of the NEMO Basic Support protocol (i.e. we do not assume nor prevent the MR/MAG to implement the MR functionality specified in [RFC3963]). Analogously, since the nodes attached to the MR/MAG are expected to obtain network-based localized mobility support, it might be tempting to refer to this entity as a MAG, but an RFC 5213-compliant MAG cannot move (i.e. change its point of attachment within the PMIPv6 domain).

Network Mobility

Within the scope of this document, we refer to network mobility as the capacity of a set of nodes -- attached to an MR/MAG -- to move together _within_ the PMIPv6 domain (similarly as done in [I-D.ietf-netext-pd-pmip]). We do not consider the case of mobile networks that may roam across PMIPv6 domains (i.e. global mobility). Although this scenario might be also interesting, current PMIPv6 does not support inter-domain mobility, thus we limit the scope of the problem statement to the same of PMIPv6.

3. PMIPv6 and Network Mobility Problem Statement

Figure 1 shows an example of the use case scenario described in Section 1. Let's consider a very simple PMIPv6 domain composed of one LMA and two MAGs: MAG 1 and MAG 2. There are three MNs: MN 1, MN 2 and MN 3. Additionally, there is also an MR/MAG: MER/MAG 1. The goal is to enable any MN to freely roam within the PMIPv6 domain, without changing its IP address -- and without requiring any mobility support nor involvement from the MN -- even if the MN moves between the mobile network and the fixed access network (i.e. the MN changes its point of attachment from the MR/MAG 1 to the MAG 1 or MAG 2).

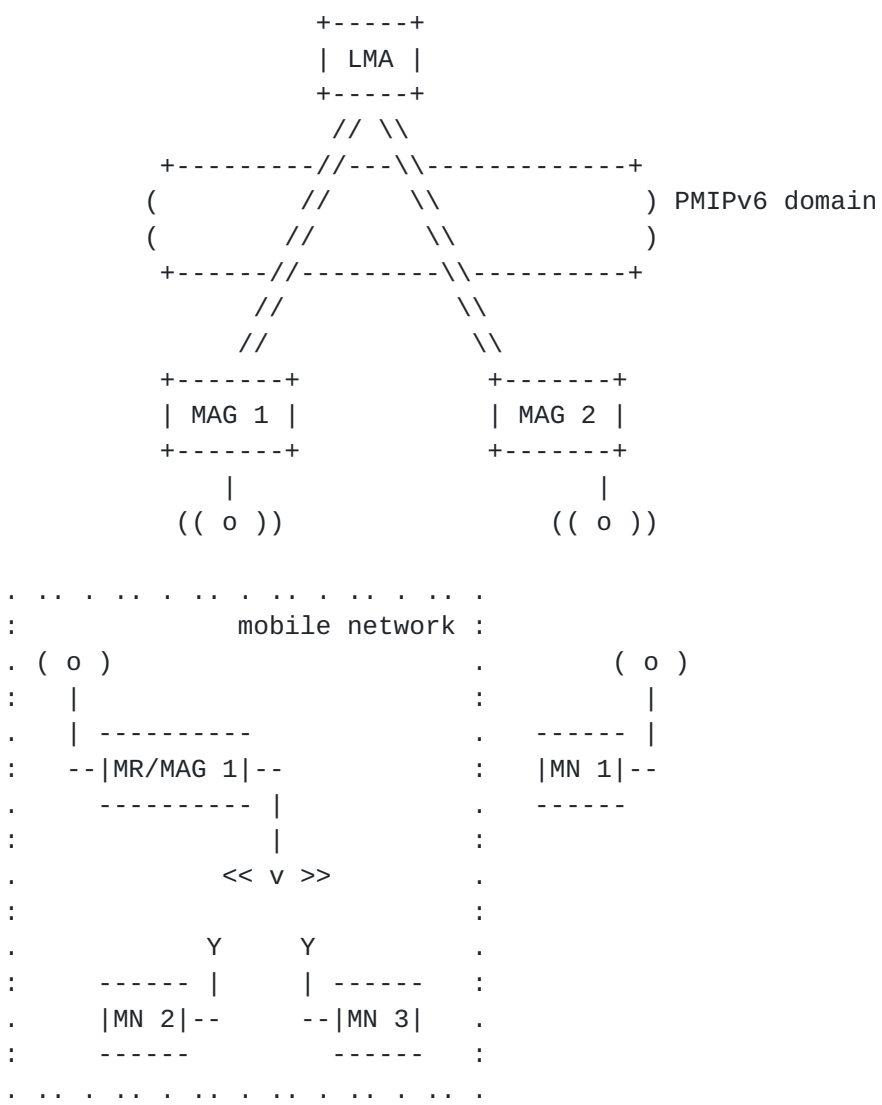

Figure 1: PMIPv6 and network mobility scenario

3.1. Applicability of existing standards

This section briefly analyzes how the use of current standards fails to fully support the scenario described in this problem statement:

1. PMIPv6 only. By using PMIPv6 only, a single host (i.e. an MN) would be able to freely roam between fixed points of attachment (MAG 1 and MAG 2 in Figure 1). By enabling bridging on an MR/MAG attaching to a fixed MAG, some very limited kind of network mobility support could be achieved (if the Per-MN-Prefix model [RFC5213] is used). [I-D.ietf-netext-pd-pmip] specifies extensions to Proxy Mobile IPv6 to support network mobility. However, none of these approaches do support a mobile node leaving the mobile network and attaching to another MAG (or MR/

MAG) without changing IP address of the mobile node.

2. NEMO Basic Support (NEMO B.S.) only. In this case, MAG 1 and MAG 2 in the example of Figure 1 would only play the role of plain IPv6 Access Routers. If NEMO B.S is enabled on the MR/MAG (and a Home Agent is deployed in the network), a set of nodes would be able to freely roam within the domain . However, an MN would not be able to move between the mobile network and the fixed access network (because the addresses that nodes may use while connected to the MR/MAG would belong to the Mobile Network Prefix -- MNP -- of the network, which is different from the prefixes provided by the LMA within the PMIPv6 domain). Additionally, this scenario requires the deployment of a NEMO B.S. Home Agent (for example at the location where the LMA is placed in Figure 1) and involves the NEMO B.S. signaling every time the MR/MAG moves.

3. NEMO B.S. + PMIPv6: by enabling NEMO B.S. on the MR/MAG and deploying PMIPv6 in the domain, we would achieve the same level of functionality as the previous case, but saving the NEMO signaling required every time the MR/MAG moves, since its Care-of Address (CoA) would not change while it is roaming within the domain (the address the MR/MAG uses as CoA is anchored at the LMA and does not change despite of the MR/MAG movements, thanks to the PMIPv6 support). In this scenario, NEMO B.S. HA and the PMIPv6 LMA could be collocated.

The previous compilation of potential approaches does not consider the use of Mobile IPv6 [RFC6275] on the MNs, since this would not meet the fundamental feature of network-based localized mobility solutions (such as PMIPv6): not to involve the MN on the signaling nor on the management of its own mobility.

As shown, with existing standards, there is no way of achieving the level of functionality required in our scenario. It is therefore required to work on new solutions/extensions to existing protocols (either to the NEMO B.S., to PMIPv6 or to both when working in a combined way).

4. IANA Considerations

This document makes no request of IANA.

5. Security Considerations

Security considerations regarding the MR/MAG would be needed. It might be safe to assume that the MR/MAG has the same level of trust/

security that the MAGs of the network, but this may depend on the particular solution.

6. Acknowledgments

The work of Carlos J. Bernardos has also been partially supported by the European Community's Seventh Framework Programme (FP7-ICT-2009-5) under grant agreement n. 258053 (MEDIEVAL project). The research of Carlos J. Bernardos and Maria Calderon has also been partially supported by the Ministry of Science and Innovation of Spain under the QUARTET project (TIN2009-13992-C02-01).

7. References

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