

Network Working Group

Internet Draft

Intended status: Informational

Expires: December 2009

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June 23, 2009

Problem Statement of IPv4 Support for PMIPv6 Localized Routing
draft-wu-netext-pmipv6-ipv4-ro-ps-01.txt

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Abstract

[ID-PMIPv6-R0-PS] describes the problem space of localized routing which allows end-to-end user traffic forwarding between MN and CN directly without involving Local Mobility Anchor (LMA) in a single Proxy Mobile IPv6 [\[RFC5213\]](#) domain. However, localized routing with IPv4 support which allows IPv4 transport between MAG and LMA and/or IPv4 enabled user traffic between MN and CN is not considered. This document details the scenarios and problem statement for localized routing with IPv4 support.

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1. Introduction

In Proxy Mobile IPv6 [[RFC5213](#)], Local Mobility Anchor (LMA) is responsible for forwarding the user traffic from the correspondent node to the current location of registered mobile nodes. To reduce latency and backhaul load, optimized routing path without involving LMA in path is expected. [[ID-PMIPv6-R0-PS](#)] has outlined some possible problems during setting up an optimized routing path between MN and CN which requires that MN and CN are connected to same PMIP domain. However, the scenarios and problems for the IPv4 support of PMIPv6 localized routing [[ID-PMIPv6-IPv4](#)] are not specified.

As [[ID-PMIPv6-IPv4](#)] described, PMIPv6 with IPv4 support contains two basic features: IPv4 transport support and IPv4 HoA support. This document details these scenarios and describes its relevant problems during setting up an optimized routing path. In these IPv4 support localized routing scenarios, it allows a MN and a CN subscription belong to different operators.

2. Conventions used in this document

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](#)].

This document uses the terminology of [[RFC5213](#)]. The following terms are used in the context of this problem statement:

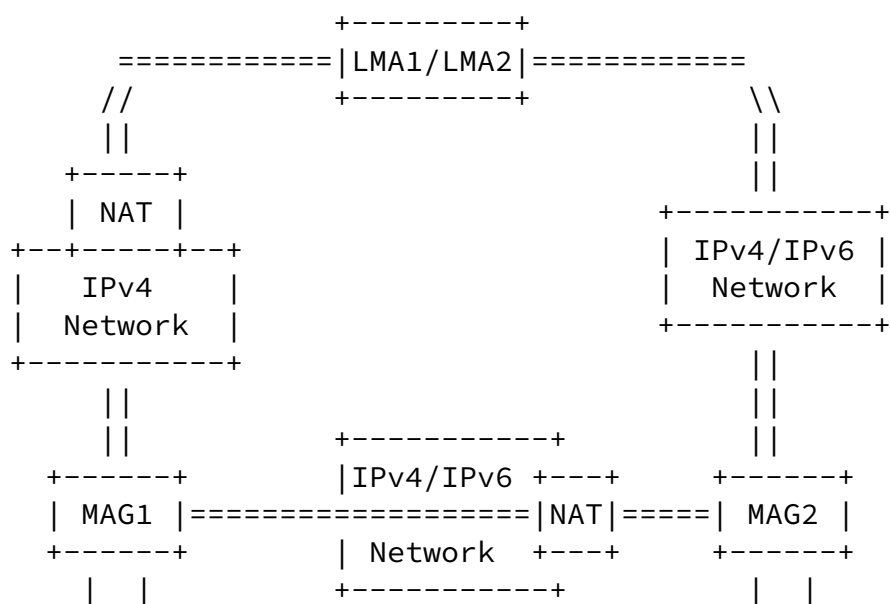
- o Routing Optimization (R0): referred as the functionality that makes end-to-end user traffic between the MN and the CN go through an optimized routing path in the same PMIPv6 domain.
- o Routing Optimization Path (ROP): the direct MAG-to-MAG path for a user traffic between the MAG the MN is attached to and the MAG the CN is attached to.

- o Routing Optimization States (ROS): referred as RO information that is generally stored in the corresponding LMA(s) and MAG(s). Such information includes RO policies and tunnel ID of ROP, etc.
- o Routing Optimization Control (ROC): the ROP setting up and the ROS management done by the PMIPv6 network entities participating to the RO.

3. Scenarios and Problem Statement

Fig.1 shows a generic IPv4 support architecture. In this architecture, the end-to-end user traffic routing is allowed between MN and CN (CN1, CN2 or CN3). To make the description simple, we have the following general assumptions to this architecture.

- LMA1 and LMA2 which MN and CN are respectively anchored to may be the same LMA or different LMA in the same PMIPv6 domain.
- With IPv4 user traffic support, MN and CN both are IPv4-only enabled nodes or dual stack nodes.
- With IPv4 transport support, we assume IPv4 network is deployed between LMA1 and MAG1. However, the transport network between LMA2 and MAG2, MAG1 and MAG2 is not limited to IPv4 network.



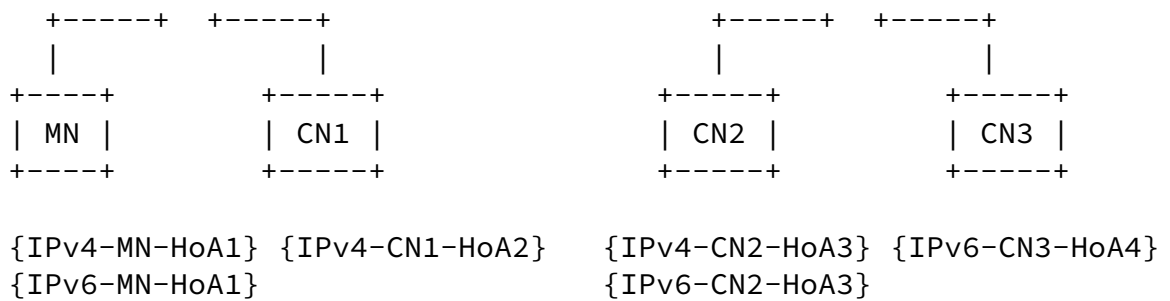


Fig.1 IPv4 support architecture

Based on the assumption mentioned above, we have the following three use cases on IPv4 support for PMIPv6 localized routing.

Case 1: Both MN and CN attached MAGs are using IPv4 transport

In this case, the PMIPv6 signaling between MAGs and LMAs for MN and CN is carried over IPv4 network. The end-to-end user traffic between MN and CN can be IPv4 or IPv6 application. With IPv4 transport support, the NAT may exist between MAG1 and MAG2 or between the LMA1 and LMA2.

Case 2: MN and CN attached MAGs are using IPv4 transport and IPv6 transport respectively

In this case, the PMIPv6 signaling between MAG1 and LMA1 for MN is carried over IPv4 network while the PMIPv6 signaling between MAG2 and LMA2 for CN is carried over IPv6 network. The end-to-end user traffic between MN and CN can be IPv4 or IPv6 application. With the IPv4 transport support, the NAT may exist between MAG1 and MAG2 or between the LMA1 and LMA2.

Case 3: Both MN and CN are IPv4 enabled nodes

In this case, MN is using IPv4 address to communicate with CN through the direct path between the MN and CN's MAGs located in the same PMIPv6 domain. The end-to-end user traffic between MN and CN belongs to the IPv4 application. Furthermore, MN and CN may be attached to the same or different MAGs. MN and CN attached MAGs communicate with the LMAs using IPv6 transport.

Case 4: Roaming user MN and non-roaming user CN subscription belong

to different Operators

In this case, Roaming user MN moves to the visited network owned by the operator using IPv4 transport where no-roaming CN is located. MN and CN are under the same PMIPv6 domain. However, MN and CN subscription belong to the different operators.

Case 5: Both MN and CN are "roaming" and using visited network LMAs
In this case, both MN and CN moves to the same visited network owned by the operator using IPv4 transport. MN and CN are roaming users and both using visited network LMAs. However MN and CN subscription belong to the different operators.

On the basis of the above use cases, we have several problems of IPv4 Support for PMIPv6 localized routing to be considered below.

- o P1: NAT Detection

For IPv4 transport support, when the IPv4 network is deployed between both MAG(s) in an optimized routing path, NAT [[RFC3022](#)] device may be located. In general, [ID-DSMIPv6] for detecting the on-path NAT device may be applicable for ROP setup. However, if there existing NAT between the MAGs associated with the MN and CN and the MAG is not aware of it, the NAT may automatically drop the user traffic between the MN and CN and prevent setting up localized routing path.

- o P2: Encapsulation Mode Negotiation

There may be some situations where MN communicates with CN using the direct path between the MAGs to which both MN and CN attached and such MAGs support different tunnel encapsulation or transport (e.g., IPv4 over IPv6 transport, IPv6 over IPv4 transport, IPv6 over IPv4 UDP). In such cases, there may be various encapsulation modes existed between MAG1 and MAG2 for choice. Therefore, it is expected to negotiate and determine the appropriate encapsulation mode for end-to-end user traffic routing between MN and CN during ROC processing.

- o P3: IPv4 address space overlapping

There may be some situations where mobile nodes from different

operators may be assigned the same IPv4 HoA from overlapping private address space. In PMIPv6 domain, the MAG and the LMA can distinguish each mobile node flow based on the GRE key encapsulated within the tunneled packet [[ID-PMIP-GREKEY](#)], even though two mobile nodes are assigned the same IPv4 HoA. However, when the traffic destined for the CNs with same HoA does not pass through the tunnel between the MAG and the LMA and go directly to the path between the MAGs associated with MN and CN, the MAG attached by the CN can not identify the right CN based on the overlapped IPv4 HoA in the destination field of the incoming packet, therefore can not forward the user traffic to the right CN.

- o P4: IP Protocol Version Transition

There may be some situations where the IPv4 network is deployed between both MAG(s) in an optimized routing path and the IPv6 network is deployed between the MAG and the LMA, in such cases, once the local routing is allowed between both MAG(s) and the traffic from the MN or CN does not pass through the LMA and is sent directly to the corresponding MAG, the dual stack MAG needs to transit from the IPv6 transport version to the IPv4 transport version ,e.g., change the destination address of the packet from IPv6-Proxy-CoA to IPv4-Proxy-CoA. This change should be considered during ROC processing.

- o P5: ROS Maintaining

For IPv4 support, the ROS should include the additional source/destination IPv4 address or the transport IPv4 address (e.g. IPv4-Proxy-CoA), etc. Further more, RO policy (e.g. whether per-MN based RO is enabled or disabled) may be downloaded from AAA as an attribute of ROS and maintained locally in the ROS.

[4. Security Considerations](#)

The scenarios and problems specified in this document can use the security association between the LMA and the MAG to create security association between MAGs associated with the MN and CN in the communication.

[5. References](#)

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6. Acknowledgments

Many thanks to NetExt members for their comments.

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