

Mext Working Group  
Internet-Draft  
Intended status: Informational  
Expires: September 4, 2009

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March 3, 2009

Problem Statement for Route Optimization in dual stack environments  
draft-oulai-mext-dsmip-v4ro-ps-00.txt

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Internet-Draft

Problem Statement for DSMIPv6 R0

March 2009

## Abstract

Dual Stack MIPv6 (DSMIP) is a MIPv6 extension to support IPv4 mobility for mobile hosts. While route optimization is well defined for IPv6 traffic, this features is not defined for IPv4. This document looks at the different scenarios where IPv4 route optimization is desirable and highlights some problems.

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## 1. Introduction

Dual Stack MIPv6 (DSMIP) is a MIPv6 extension to support IPv4 traffic for mobile nodes [[I-D.ietf-mext-nemo-v4traversal](#)]. DSMIP introduces two new address options: the IPv4 Home Address option and the IPv4 CareOf Address option. With those options, a mobile node (MN) can send and receive v4 traffic although all the mobility signaling is MIPv6 based. Therefore, there is no need to have a MIPv4 stack on the mobile node.

Route optimisation (R0) is a process that allows an MN to communicate directly with a correspondent node (CN) without transiting by the home agent. There are several benefits for R0 such as shorter path delay, reduced bandwidth consumption and reduced load on the HA. MIPv6 R0 is done using the return routability procedure (RRP). RRP's main goal is to assure the CN that the MN is reachable through the home address (HoA) and the care-of address (CoA) and to configure security keys for the binding. This mechanism does not consider IPv4 addresses. However, it is anticipated that IPv4 and IPv6 will coexist for a long time and lots of work is being done for IPv4-IPv6 coexistence. Therefore, having R0 enabled will enhance DSMIP as a strong alternative for IPv4-IPv6 coexistence.

This document briefly describes current MIPv6 R0 process and scenarios where IPv4 R0 would be desirable. Then specific problems related to IPv4 R0 and use cases are discussed.

## 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](#)].

### 3. Terminology

All the general mobility-related terms used in this document are to be interpreted as defined in the Mobile IPv6 [[RFC3775](#)] and DSMIP [[I-D.ietf-mext-nemo-v4traversal](#)] base specifications.

#### [4.](#) MIPv6 Route Optimization

MIPv6 defines a route optimisation procedure where an MN can send a binding update (BU) directly to the CN in order to use a direct path [[RFC3775](#)]. Before sending the BU, the MN has to perform the RRP in order to prove to the CN that it owns both the HoA and the CoA. To perform RRP, the MN sends a HoTI message to the CN through the HA. The source address of the HoTI is the HoA. Simultaneously, the MN sends a CoTI message to the CN with its CoA as a source address. The CN responds to these two messages and includes a Home keygen Token in the HoT message and a CareOf keygen token in the CoT message. If the MN received those two messages then it is reachable via the HoA and CoA. Next step for the MN is to combine both tokens to get a binding management key (Kbm), which is used to authenticate the BU. The CN will then be able to verify that the Kbm was formed using both

tokens.

Some optimizations have been proposed for R0. [[RFC4449](#)] proposed to precompute several binding management keys to speed up the binding update process but this requires the MN and the CN to be in the same administrative domain. [[RFC4866](#)] introduced an enhanced fast R0 process, which requires cryptographically generated addresses.

## [5.](#) The Problem

The DSMIPv6 specification allows a dual stack mobile node to communicate with a correspondent node under two fundamental scenarios: a) using IPv4, by assigning an IPv4 home address to the mobile node and b) while the mobile node is located in an IPv4-only foreign link. In both scenarios the mobile node may be located in an IPv4 network that assigns private addresses and is therefore

separated by a NAT from the rest of the Internet. In DSMIPv6, the mobile node can communicate with a correspondent node in the above scenarios by routing traffic through the home agent, which manages mobility for the IPv4 and IPv6 home addresses by binding them to either an IPv4 or an IPv6 care-of address. However, DSMIPv6 does not allow mobile nodes and correspondent nodes to optimise communication between them and bypassing the home agent.

Route optimisation cannot be achieved using the current DSMIPv6 specification. Route optimisation is not achievable when the mobile node is communicating to an IPv4-only correspondent node. However, if the correspondent node is IPv6-enabled, route optimisation can be achieved by extending DSMIPv6 and the current RRP in MIPv6.

Hence, the problem discussed in this draft is the lack of route optimisation support in DSMIPv6. The following section discusses the scenarios that illustrate this problem. A solution for the route optimisation problem for dual stack nodes should address the scenarios in the following section.

In this section we present different scenarios that need to be addressed in order to provide a complete route optimisation solution for dual stack mobile nodes. In all scenarios we assume that both the mobile node and correspondent node are dual stacked with both stacks enabled.

The scenarios in this section discuss the options for encapsulating the application payload between the mobile and correspondent nodes. The capability of the access network will essentially force the need for tunnelling or allow the communication without the use of tunnelling.

#### [6.1.](#) Mobile and correspondent nodes communicate using IPv4

In this scenario, the mobile and correspondent node's traffic used IPv4 only. This might be due to the fact that either node is located in an IPv4-only environment, or because their applications can only use IPv4 addresses. In this scenario, the mobile node needs to optimise the route for the IPv4 communication using Mobile IPv6 signalling. Essentially, the mobile node needs to optimise the route for its IPv4 home address. This scenario assumes that the correspondent node's IPv6 stack is enabled, even if it is not assigned a global IPv6 address.

It should be noted that in this scenario the mobile node can be located behind a NAT. However, it is assumed that the correspondent node is reachable with a public IPv4 address. Also, note that this scenario is somewhat orthogonal to the access network's capability. That is, the access networks may provide IPv4-only, IPv6-only or dual stack access. In all cases, the nodes encapsulate the application payload in IPv4; although, the access capability would require a solution to tunnel such traffic according to the IP version supported by the access network.

#### [6.2.](#) Mobile and correspondent nodes communicate using IPv6

Unlike the scenario above, in this scenario, the mobile and correspondent nodes communicate using IPv6. Hence, the mobile node is using its IPv6 home address and needs to optimise the route using MIPv6 signalling.

Note that this scenario is again orthogonal to the access capability, which will affect how the IPv6 traffic will be routed (or tunnelled) between the mobile node and correspondent node. That is, if both access networks support IPv6, traffic will be routed natively and standard MIPv6 will be used to optimise the route. However, if

either access network supports IPv4 only, then the solution will need to overcome this issue through tunnelling.

## 7. Security Considerations

This document does not introduce any security vulnerabilities. Solutions for the problems presented in this document need to endure that they are as secure as the current RRP in [[RFC3775](#)].

## 8. Normative References

[I-D.ietf-mext-nemo-v4traversal]

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