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Route Optimization for Mobile Network by Using Bi-directional
Between Home Agent and Top Level Mobile Router

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Abstract

This document shows how to route optimization by using bi-directional tunnel between home agent and top level mobile router. A packet will be transmitted directly from the home link of the mobile node to top level mobile router of the correspondent node through this tunnel.

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 [RFC-2119](#).

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[1.](#) Introduction

The basic support of mobile network (NEMO) enables mobile network nodes and correspondent nodes to communicate through bi-directional tunnels. However, using MIPv6 for mobile network will introduce a problem of dog-leg routing. In order to communicate from foreign networks with mobile nodes, packets are usually transmitted via the home link of the mobile node. Dog-leg routing may cause a transmission latency, this subsequently causes the difficulty for a real time service and the delay in binding update. This document specifies how we can optimize the routing in NEMO [\[2\]](#)-[\[4\]](#).

[2.](#) Overview

A possible solution to routing optimization is to make tunnels between top level mobile router of NEMO and home agent of each mobile router. When a mobile node detects an access to a foreign network, a mobile router does binding update to home agent. At this time, mobile

----- : original packet
+====+ : tunneling between HA of MR3 and MR3
+///// : tunneling between HA of MR3 and TLMR
+####+ : tunneling between TLMR and MR3
+***** : tunneling between TLMR and MR2

Figure 2. all tunneling model of R0 solution

3. Mobile Router extension : mobile router of mobile subnetwork

Mobile router MUST relay extended router advertisement message of TLMR that has been transmitted from its parent mobile router to its child mobile router. If a mobile router receives an extended router advertisement message of TLMR, it MUST notify the TLMR's address to its own home agent to set up a direct tunnel between the home agent

and TLMR. The mobile router registers its address and the address of its parent router to TLMR to set up a tunnel between TLMR and mobile router.

When a mobile router receives a packet from its children nodes, if the packet's destination address is TLMR, then the mobile router does encapsulation to make the destination address to be TLMR, not its home agent. This makes a direct communication between mobile router and TLMR. Therefore, this packet doesn't have to pass the home agent of the parent mobile router.

4. Mobile Router extension : Top level mobile router

If the mobile router doesn't receive an extended router advertisement with TLMR option, it becomes a TLMR. The TLMR MUST advertise that it is TLMR by an extended router advertisement message with TLMR option (see [Section 6.1](#)). When a mobile router receives this message, it requests a registration to TLMR by sending registration request message. This message includes its address and the address of the access router(parent router). When the TLMR receives a registration request message, if it accepts the registration, it determines the path to mobile router from the addresses in this message.

Based on this routing information, TLMR decides how to encapsulate the packet to the mobile router or a home agent of a mobile router.

5. Home agent extension for Mobile Router

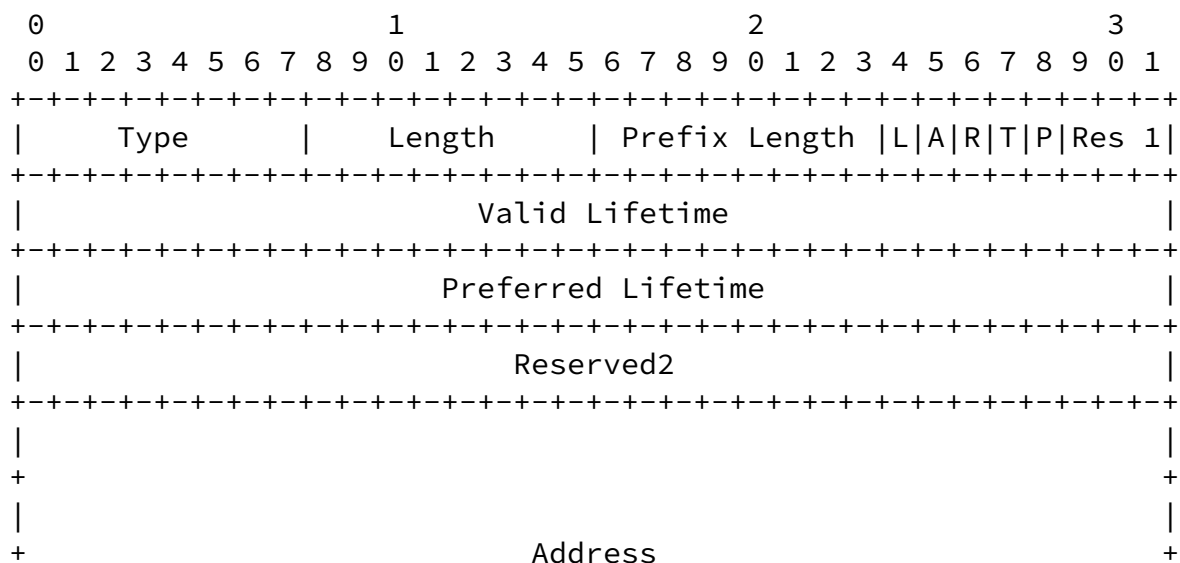
The home agent of mobile router SHOULD bind the CoA of the mobile router and address of TLMR of the mobile router from new binding update message which has the TLMR address option. The home agent SHOULD add TLMR field to its own binding table. This field is used for encapsulating a packet to TLMR. When a home agent receives a packet to the mobile router, it SHOULD encapsulate the packet to send to the CoA of the mobile router. But, for a route optimization, the home agent SHOULD perform one more encapsulation to have its destination address is TLMR. Similarly, when a home agent receives a packet from TLMR, it can find an original packet encapsulated by a mobile router through decapsulating the packet encapsulated by TLMR

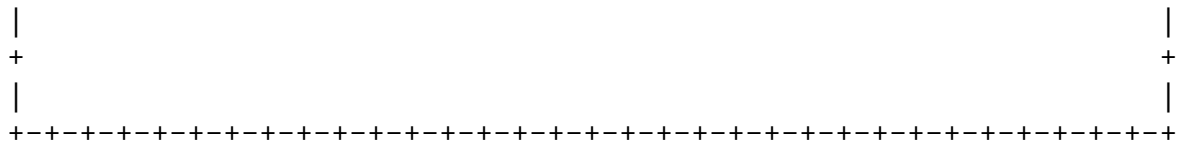
6. New RA message and mobility option

This approach needs some new message formats or options such as router advertisement message, registration request message to TLMR, and binding request message to home agent with TLMR address for route optimization [5]-[8].

6.1 RA message with TLMR option

The router advertisement messages with TLMR option is needed by a mobile router to create a bi-directional tunnel between TLMR and the home agent of mobile router.





Field:

T 1-bit TLMR flag. When set, it indicates that the message contains the address of the TLMR

P 1-bit parent mobile router flag. When set, it indicates that this message contains the CoA of the parent mobile router. The CoA of the parent mobile router is used for tunneling between TLMR and the parent mobile router.

T flag and P flag SHOULD not be set at the same time.

Address This address is an address of the TLMR or parent mobile router.

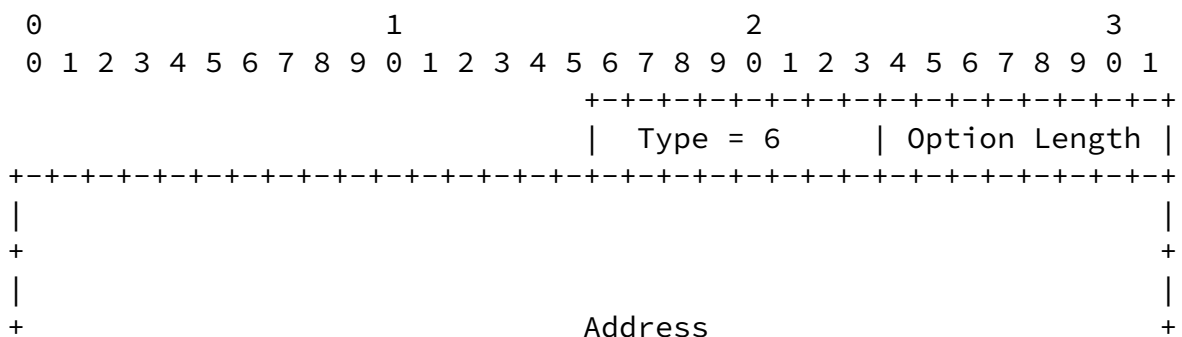
Figure 3. Modified Prefix Information Option Format for R0

When T flag is set, it indicates that this message includes the address of the TLMR. This option is used by a mobile router to send binding update to home agent and registration message to TLMR.

6.2 New mobility option

A modified binding update message is used when a mobile router registers to TLMR and updates its binding to home agent. The TLMR

determines the path to the mobile router from the address in this message.



home agent.

When TLMR receives a registration request message from a mobile router, it makes a tunneling table to mobile router from this message. The tunneling table is composed of mobile router and its access router. When the home agent receives this binding update message, it creates a bi-directional tunnel between the home agent and TLMR, which will be used for direct communication without dog-leg routing.

[7.3](#) Delivery of Data Packets

[7.3.1](#) CN transmit to MN (or Fixed Node in MR)

A correspondent node sends a packet to a node in mobile router, and this packet goes to the home network of mobile router. The home agent intercepts this packet, and encapsulates it to send to a mobile router. In order to communicate with a mobile router directly, the home agent encapsulates again to send the packet to TLMR. When TLMR receives this packet, it decapsulates the packet. TLMR finds the destination address to determine the path to the mobile router by using the tunneling table. In order to send to a mobile router, TLMR does encapsulation for each mobile routers that are between TLMR and destination mobile router. In this way, TLMR sends a packet to a mobile router. When a mobile router receives a packet, it first decapsulates the packet encapsulated by TLMR, and it does one more decapsulation encapsulated by its home agent. This packet will be sent to the destination node.

[7.3.2](#) MN (or Fixed Node in MR) transmits to CN

When a node in mobile network sends a packet to CN, this packet is encapsulated by a mobile router to be sent to the home agent of mobile router. The mobile router encapsulates the packet again to directly communicate with TLMR. This packet goes to the parent mobile router, the parent mobile router does encapsulation again for direct communication with TLMR. Likewise, this packet is encapsulated by each mobile router located between TLMR and mobile router. When this packet arrives on TLMR, TLMR decapsulates all the encapsulation headers made by intermediate mobile routers except for the encapsulation made by the end-point mobile router. And then, TLMR encapsulates the packet to send to the home agent of mobile router.

When the mobile router receives this packet, it decapsulates the packet encapsulated by the TLMR and end-point mobile router. The packet decapsulated by home agent is the original packet that has been sent to the correspondent node.

Security Considerations

The route optimization in this document does not add any other security problems to the NEMO or Mobile IPv6.

References

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Route Optimization for Mobile Network

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