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The Global HAHA Operation at the Interop Tokyo 2008
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Abstract

   This document describes the protocol design consideration of the
   correspondent router for the NEMO Basic Support Protocol.

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1. Introduction

The Global HAHA protocol [ID-HAHA] has been discussed for long time
in MIP6, NEMO and now MEXT working group. We have published several
documents [ID-HAHA] [ID-HAHAPROTO] and presented several time in IETF
meetings. We implemented a protocol for the global HAHA and tested
it in the real networks. Some results can be found in [PAPER-
CONEXT].

We have tested a Global HAHA protocol at the Interop Tokyo 2008
[INTEROP-TOKYO]. The Interop is a global event of the networking
products and services. There are more than 300 exhibitors and about
150,000 visitors in this year. In the Interop Tokyo, the Network
Operation Center (NOC) team builds an experimental advanced network
called "ShowNet" as a backbone of the event. The experimental
network was connected to several peering points (Internet Exchange
Point) by more than 120G bps links in this year. Our global HAHA
experimentation was served as a part of "ShowNet".

As additional information, the WIDE project [WIDE] is operating the
global HAHA testbed with IIJ and other network operators. The three
home agents are configured in Tokyo, Los Angeles, and Seoul. We have
a dedicated autonomous system number (AS4690) for this
experimentation and operates the huge block of prefix (/35) as a home
prefix.

2. **Operational Configuration**

   In the Interop Tokyo 2008, we setup two home agents in the ShowNet.
   Figure 1 is the overview of ShowNet. More detail topology can be
   found in [INTEROP-TOKYO]. In the event, we used 6 halls for the
   exhibits and one conference hall for the tutorial and technical
   sessions. In ShowNet, two NOCs (operational center) were located in
   both Hall2 and Hall4. We configured the home agents in both NOCs.

   For IP anycast routing, the upper router of the home agent advertise
   the routes of the home prefix by OSPF with equal cost. The home
   agents did not advertise the route by themselves. If a mobile node
   attaches to the networks in the hall 1 to 3, it associates with the
   home agent in the Hall-2 (HA1 in Figure 1). Otherwise, the mobile
   node registers to the home agent in the Hall-4 (HA2).

```
                     Internet
     Server Segement      ||             Segement
       in Hall-1-3        ||           in Hall-4-6
           |              ||                |
           |--------- BackBone  ----------|
      HA1 ---+         /          \          +--- HA2
           |        /              \         |
                   |                |
                   |                |
               Segments         Segments
            in Hall-1-3     in Conference-Hall
```
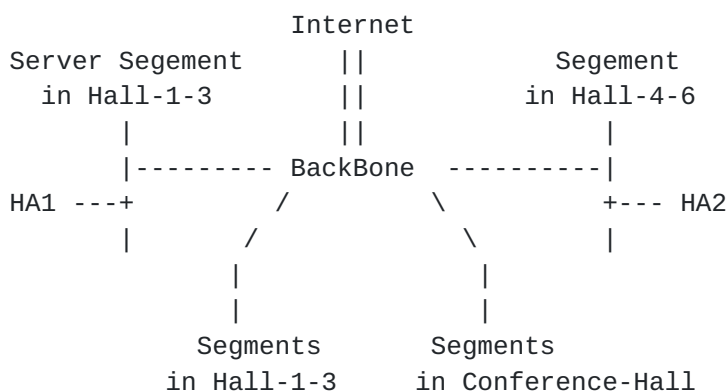
              Figure 1: SHOWNET Overview and HAs Location

   Implementation informations:

   For the home agents, we uses the NetBSD current version (20080128).
   The global HAHA is implemented on top of the SHISA package [SHISA].

   For the mobile nodes, we prepare two different operating systems.
   One is NetBSD current (20080128) with the SHISA package. Another is
   Ubuntu LINUX and MIPL package. The SHISA and MIPL packages were
   modified to support the Home Agent Switch message [RFC-5142]. We
   setup 6 NetBSD machines (ThinkPAD) and also distributed the virtual
   machine image for the Ubuntu mobile node to the experimentation
   participants. The mobile nodes for this experimentation was not open
   to the public users due to security reason, because the mobile node
   was grant for the permission to access the ShowNet.

3. **Global HAHA Protocol**

   We describe a global HAHA protocol implementing on NetBSD SHISA
   package in this section. This protocol is defined as an extension to
   the Home Agent Reliability protocol. Figure 2 shows the protocol
   sequence of the Global HAHA. Some new terms are introduced to
   explain the protocol as follows:

   Global Home Agent Set

      The set of home agents serving the same home prefix. The home
      agents can be located in different locations.

   HAHA link

      For the global HAHA, each home agent maintain a link to other home
      agents. The link can be IP-in-IP tunnel, some L2 technology like
      L2TP or even direct dedicated link. If the HAHA link is a
      dedicated fiber link, the global HAHA can be easily operated
      without any complexity or protocol extensions described in this
      section.

   Primary Home Agent

      The home agent which a mobile node is currently registering. This
      primary home agent must be the closest home agent of the mobile
      node. The primary home agent is defined per a mobile node.

   Initial Binding Registration (1-2 in Figure 2)

   As Mobile IPv6 [RFC-3775] and the NEMO Basic Support protocol [RFC-
   3963], the mobile node attempts the binding registration to its home
   agent. In the global HAHA, the binding update is routed to the
   closest home agent of the mobile node by IP anycast routing. The
   home prefix is advertised from different location by anycast
   technology. As soon as the primary home agent (HA1) creates a
   binding cache for the mobile node, it sends a Binding Notification
   message to the other home agents (HA2) in the same global home agent
   set.

   HA2 creates a host route to the mobile node with the next hop set to
   the HAHA link of HA1 and HA2. For a mobile router, it can be the
   network route to the mobile network prefix of the mobile router.
   With that route, when HA2 receives the traffic meant to the mobile
   node, it can forward the traffic to the HA1 over the HAHA link. The
   route must be maintained with the lifetime and should be available
   while the binding is active on the HA1. How to maintain the host

route is out of scope in this document. In our implementation, we
use the same lifetime of the binding cache entry at HA1. Therefore,
whenever HA1 receives a binding update from the mobile node for
extending the binding lifetime , it also sends another Binding
Notification message to the HA2. There might be scalable issue for
this periodic update approach, but we can fix this. For example, the
route on HA2 is activated until the HA1 sends a new signaling
indicating the route deletion (on-demand management).

```
 MN          HA1          HA2          CN
  |           |            |           |
  |----> (Primary)    |           |    1. Binding Registration (HA1)
  |           |-------->|           |    2. Binding Notification
  |<=======|<=======|<--------|    3. From CN to MN
  |=======>|------------------>|    4. From MN to CN
  |           |            |           |
  :           :            :           :    MN MOVEMENT
  |           |            |           |
  |----------------+|           |    5. Binding Registration
  |           |<======+|           |
  |<--------|            |           |    6. Home Agent Switch
  |--------------> (Primary)    |    7. Binding Re-registration
  |           |<--------|           |    8. Binding Notification
  |<================|<--------|    9. From CN to MN
  |================>|-------->|  10. From MN to CN
  |           |            |           |
```
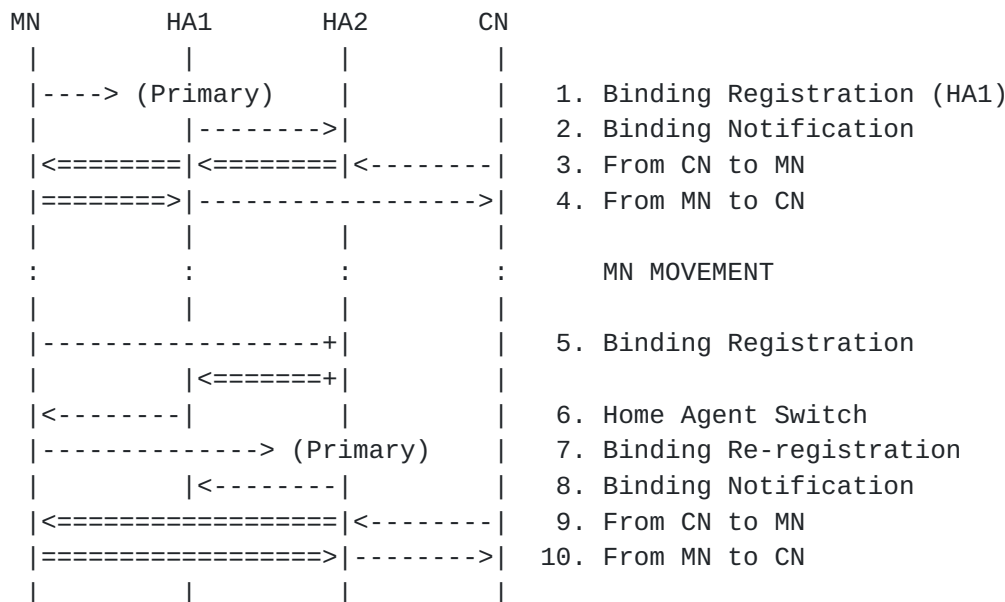
Figure 2: Overview of Global HAHA

Binding Update after Movement (5-8 in Figure 2)

After the mobile node changes its point of attachment, it sends a
Binding Update to renew its binding as [RFC-3775]. In this case, if
the closest home agent is changed to HA2, the Binding Update is
arrived at the HA2 according to the IP anycast routing. The primary
home agent of the mobile node is changed from HA1 to HA2. However,
the destination address of the Binding Update is still the address of
the HA1 because the mobile node is unaware of the primary home agent
change. Therefore, the HA2 forwards the Binding Update to the HA1
over the HAHA link. The HA1, then, detects that the primary home
agent is now changed to the HA2 because the Binding Update is
forwarded from the HA2. It first processes the Binding Update and
returns a Binding Acknowledgment to the mobile node. In parallel, it
triggers a Home Agent Switch message [RFC-5142] to the mobile node.
In the Home Agent switch message, the address of the HA2 is stored in

the Home Agent Address field.

When the mobile node receives the Home Agent Switch message from the
HA1, it processes it according to [RFC-5142] and switches its home
agent to the HA2. The mobile node sends another Binding Update to
the HA2. After receiving the Binding Update, the HA2 creates the
binding cache and sends a Binding Notification message to the other
Home Agents (i.e. HA1) in the global home agent set. The HA1
removes the binding cache entry of the mobile node and creates the
route for the mobile node with the next hop set to the HA2 over the
HAHA link.

Figure 3 shows the new message named "Binding Notification message".
This message is used for the active home agent to notify the mobile
node registration to the other home agents in the global home agent
set.

Routing Packets (3-4, 9-10 in Figure 2)

The packets originated by the mobile node are always routed through
the primary home agent as shown in Figure 2. They are tunneled to
the primary home agent to which the mobile node is currently
registering and, then, routed directly to the CN. The primary home
agent does not have the state of the correspondent node and cannot
forward the packets to the closest home agent of the correspondent
node.

On the other hand, the packets originated by the correspondent node
are routed to the closest home agent by IP anycast routing. If the
home agent is not the active home agent of the mobile node
(destination), the home agent looks up the routing table and routes
them to the active home agent of the mobile node over the HAHA link.
Then, the active home agent routes the packets to the mobile node
over the bi-directional tunnel.

Mobile Node/Router Requirements

For mobile nodes and mobile routers, no modification specific to the
global HAHA is required. In addition to [RFC-3775] and [RFC-3963],
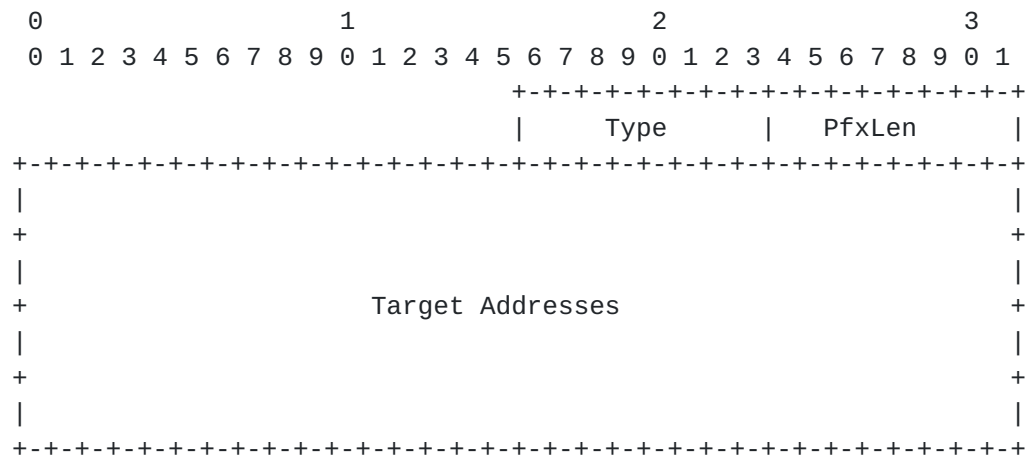the Home Agent Switch message is required. It is already
standardized as [RFC-5142].

```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
                                    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                                    |     Type      |    PfxLen     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    +                                                               +
    |                                                               |
    +                      Target Addresses                         +
    |                                                               |
    +                                                               +
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 3: Binding Notification Message

Type

   8-bit unsigned integer.

PfxLen

   The length of the Prefix. If the message is for a home address,
   the prefix length is set to 128.

Target Address

   This field is set to either Home Address or Mobile Network Prefix

4. Experimentation Result

   During the five days event, the global HAHA was successfully
   operated. We had about 30 mobile nodes registering to our home
   agents. For the network setting, we needed special consideration on
   the configurations of IP anycast routing. When we setup the IP
   anycast for the home prefix, the upper routers of both home agents
   advertise the home prefix with equal OSPF cost. If a router receives
   two different routing updates for the same prefix with the equal
   cost, it often operates the equal-cost multipath routing. This is a
   natural behavior of most of routers today when multiple routes for a
   same prefix with an equal cost are received. In our experimentation,
   if the router switches the nexthop for the home prefix in the round-
   robin fashion, the mobile node sometime switched the active home
   agent per binding update. In order to avoid the equal-cost multipath
   routing, we set the static route to these routers who is receiving
   the equal cost routes by OSPF. The equal-cost multipath routing is
   discussed in [RFC-2991].

   The IP anycast must be carefully configured for the global HAHA
   specially when multiple home agents are distributed in the same
   autonomous system due to the equal-cost multipath routing. The IP
   anycast routing of the global HAHA is not effected to other parts of
   networks. The influence to the networks is only limited to the home
   network (i.e. Mobile IPv6 or NEMO operations).

5. IANA considerations

   This document does not require any IANA action.

6. Security Considerations

   Security vulnerability is not introduced in this specification.

Appendix A. References

A.1. Normative References

A.2. Informative References

   [RFC-3775] Johnson, D., Perkins, C., and J. Arkko, "Mobility Support
   in IPv6", RFC 3775, June 2004.

   [RFC-3963] Devarapalli, V., Wakikawa, R., Petrescu, A., and P.
   Thubert, "Network Mobility (NEMO) Basic Support Protocol", RFC 3963,
   January 2005.

   [RFC-3753] Manner, J. and M. Kojo, "Mobility Related Terminology",
   RFC 3753, June 2004.

   [RFC-2991] D. Thaler and C. Hopps, "Multipath Issues in Unicast and
   Multicast Next-Hop Selection", RFC 2991, November 2000.

   [RFC-4885] Ernst, T. and H. Lach, "Network Mobility Support
   Terminology", RFC 4885, July 2007.

   [RFC-4888] C. Ng, et. al, "Network Mobility Route Optimization
   Problem Statement", RFC 4888, July 2007.

   [RFC-4889] C. Ng, et. al, "Network Mobility Route Optimization
   Solution Space Analysis", RFC 4889, July 2007.

   [ID-HAHA] Thubert, P., Wakikawa, R., and V. Devarapalli, "Global HA
   to HA protocol", draft-thubert-mext-global-haha-00.txt (Work in
   Progress), March 2008

   [ID-HAHAPROTO] Wakikawa, R., Thubert, P., and V. Devarapalli, "Inter
   Home Agents Protocol Specification",
   draft-wakikawa-mip6-nemo-haha-spec-01 (work in progress), March 2006.

   [ID-AEROREQ] W. Eddy, et. al,"NEMO Route Optimization Requirements
   for Operational Use in Aeronautics and Space Exploration Mobile
   Networks", draft-ietf-mext-aero-reqs-02.txt, May 2008.

   [ID-AUTOREQ] R. Baldessari, et. al, "Automotive Industry Requirements
   for NEMO Route Optimization",

      draft-ietf-mext-nemo-ro-automotive-req-00.txt, February 2008.

      [PAPER-CONEXT] Ryuji wakikawa, Guillaume Valadon, Jun Murai.,
      "Migrating Home Agents towards Internet-Scale Mobility Deployments",
      ACM 2nd CoNEXT Conference on Future Networking Technologies, Lisbon,
      Portugal. 4-7 December 2006

      [INTEROP-TOKYO] http://www.interop.jp/ (2008, July)

      [WIDE] http://www.wide.ad.jp/ (2008, July)

      [SHISA] http://sourceforge.net/projects/shisa/ (2008, July)

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