Internet Engineering Task Force   X. Liu
Internet-Draft   B. Yan
Intended status: Informational   CNIC / Chinese Academy of Sciences
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                                                           March 3, 2014

Experience from Double Translation and Encapsulation (MAP) Testing
draft-liu-softwire-experience-map-02

Abstract

   This document discusses the experiences of using Mapping of Address
   and Port (MAP).

   Network setup and testing results using MAP-Translation (MAP-T), MAP-
   Encapsulation (MAP-E) and mixed MAP-T/MAP-E are described in this
   document.

   Relationships among native IPv6, single translation, double
   translation, and encapsulation are also discussed.

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1. Introduction

In recent years, many researchers focus on the IPv6-only network.

Users or applications in IPv6-only environment may meet with
difficulties when visiting IPv4 resources, e.g. big data visiting or
migration.

From May 2012, CNIC (Computer Network Information Center) in Chinese
Academy of Sciences performed a series of experiments on the
comparison with native IPv6 and single translation using NAT64/DNS64
[RFC6144][RFC6145][RFC6146].

Although many applications work correctly, there are problems that
single translation cannot solve, these problems are also mentioned in
IETF's IPv6-only experiences [RFC6586] and [I-D.draft-hazeyama-
widecamp-ipv6-only-experience]:

Several OSes and devices do not work in IPv6-only network; access difficulties happen when IPv4 address literal is embedded in the application; ALG problem, e.g. FTP; etc.

Double translation or encapsulation can solve the problems we have when single translation is used.

This document presents our experience from the network experiment using double translation and encapsulation named Mapping of Address and Port (MAP). Common applications are tested in MAP-T, MAP-E, and mixed MAP-T/MAP-E modes.

We refer to the IETF's MAP-T testing results [I-D.draft-cordeiro-softwire-experience-mapt], we add some applications test with Chinese applications, and try to clarify new issues on the relationships among native IPv6, single translation, double translation, and encapsulation in the environment.

Subjectively, we didn't find significant differences when using applications in MAP-T, and MAP-E mode. MAP-T can support IPv6-only server.

2. Technology and Terminology

In this document, the following terms are used.

"MAP-T" refers to MAP double stateless translation based solution for providing IPv4 hosts connectivity to and across an IPv6 domain, as defined by [I-D.draft-ietf-softwire-map-t].

"MAP-E" refers to MAP Encapsulation based solution with an automatic tunneling mechanism for providing IPv4 connectivity service to end users over service provider's IPv6 network, as defined by [I-D.draft-ietf-softwire-map].

3. Network and Experiment Setup

3.1. Network Topology

```
                                   ------
                                  | Host |
                                  |   3  |
                                   ------
                                     |IPv6
      ----------            +--------+
     /   CSTNET   \ IPv4 ------ IPv6|   IPv6  |IPv6 ------ IPv4 ------
    | IPv4 Network |----|  MAP  |----|   only  |----|  MAP  |----| Host |
     \  (Net 1)  /      | Core |    | Router |    | CPE  |    |   1  |
      ----------         ------      +--------+     ------       ------
                                     |           |
                                     |IPv6       |IPv4    ------
                                     |           |-------| Host |
                                   ----------            |   2  |
                                  /   CSTNET   \           ------
                                 | IPv6 Network |
                                  \  (Net 2)  /
                                   ----------
```
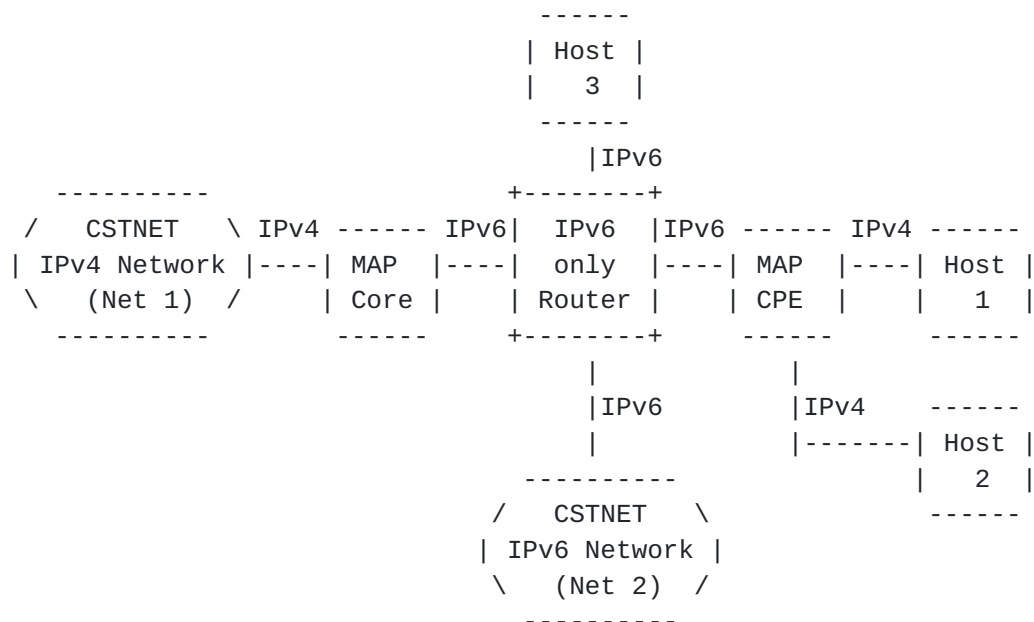
                         Network Topology

                             Figure 1

   The MAP core and MAP CPE support both MAP-T and MAP-E modes, running
   Fedora 11 and MAP-T 2.2c and MAP-E 2.2c software developed by CERNET
   (http://mapt.ivi2.org:8039/mapt.html).

   We use three host machines in the experiment, Host 1 and Host 2 are
   IPv4-only PC with Windows 7 and Linux Ubuntu 12.04, Host 3 is
   IPv6-only PC with Windows 7.

   Net 1 is an IPv4 network with public valid IPv4 address, Net 2 is an
   IPv6 network with public valid IPv6 address. Both Net 1 and Net 2
   are supported by CSTNET.

   The configuration of MAP-T/MAP-E core, MAP-T/MAP-E CPE is shown in
   Appendix part. DHCP function is not used in this experiment.

3.2. Test Content

   We tested difference applications in different OS:Windows 7 and Linux
   Ubuntu 12.04.

```
+------------------+-------------+-------------------------------+
| content          | categories  | applications                  |
+------------------+-------------+-------------------------------+
| Normal           | Browser     | Internet Explorer, Mozilla    |
| Applications     |             | Firefox, Google Chrome, Safari|
|                  | On-line     | Flash, Java applets           |
|                  | games       |                               |
| Client/Server    | Web         | IPv4/IPv6 website: Google.com,|
| Applications     |             | Yahoo.com;                    |
|                  |             | IPv4 website: Baidu.com,      |
|                  |             | Yahoo.com.cn                  |
|                  | e-mail      | Gmail, Yahoo mail, Hotmail    |
|                  | video stream| Address-based indexing:       |
|                  |             | youku.com, ku6.com            |
|                  |             | Domain name-based indexing:   |
|                  |             | Sina video                    |
| Peer to Peer     | File        | BitTorrent                    |
| Applications     | distribution|                               |
|                  | VOIP        | Skype, Voipcheap              |
|                  | IPTV        | PPTV                          |
|                  | Instant     | Client Messaging: MSN         |
|                  | Messaging   | Messenger, QQ, Skype          |
|                  |             | Web Messaging: Renren, Weibo  |
| Security         | Antivirus   | 360, AVG                      |
+------------------+-------------+-------------------------------+
```

Table 1: Test Content

Besides the applications tested in [draft-cordeiro-softwire-experience-mapt], we add applications with Chinese characteristics, like Baidu.com, Yahoo.com.cn (IPv4 website); video stream series; PPTV (IPTV), QQ (Instant Messaging), 360 (Antivirus).

In Web test, we separate IPv4/IPv6 website and IPv4 website for checking whether A or AAAA record is received.

In video-stream test, we separate Address-based indexing and Domain name-based indexing. Since in former single translation (NAT64) test, only Domain name-based indexing video-stream works well, problem occurs when visiting video-stream with IPv4 address literals indexing.

Security test, like Firewall, IPSEC, VPN are not tested in this experiment.

Applications with IPv4 address literals, like HTTP, SSH, VNC are not tested in this experiment.

4. **General Experiences**

   For MAP-T and MAP-E test, subjectively we didn't find significant
   differences compared to native IPv4 environment using Windows 7 and
   Ubuntu 12.04:

   in Internet Applications (Normal) test, the browsers and online game
   works correctly;

   in Internet Applications (C/S) test, we visited the website, e-mail,
   video stream without problems, only IPv4 resources are visited;

   in Internet Applications (P2P) test, we also had good experience with
   file distribution, VOIP, IPTV, and instant messaging;

   in security application, the antivirus software works correctly and
   can be updated.

   For mixed MAP-T/MAP-E test, since the forwarding mode is only
   required in the IPv4 to IPv6 direction, and it can be automatically
   identified by checking the value of the next header in IPv6 packets
   in the IPv6 to IPv4 direction. In the test, we first set MAP core
   with MAP-T mode and CPE with MAP-E mode; then set MAP core with MAP-E
   mode and CPE with MAP-T mode. The applications also work correctly.

5. **Discussion of relationships among native IPv6, single translation,
    double translation and encapsulation**

   For the new users, we suggest to build IPv6-only network and the
   transition of IPv4 to IPv6 includes four types: native IPv6, single
   translation, double translation, encapsulation.

   In this scenario, the host first tries to visit server in native mode
   (IPv6 to IPv6);

   If the host and server are in different environment, the host tries
   single translation (IPv6 to IPv4);

   If there are access difficulties using single translation (ALG,
   IPv4-only application, etc), the host tries double translation (IPv6
   to IPv4 to IPv6);

   For some applications (IPSec), if double translation doesn't work,
   the host uses encapsulation (IPv4 over IPv6).

   The topology shown in Figure 1 concludes the four steps:

The process Host 1/Host 2 - CPE - IPv6 Router - core - IPv4 Internet
is for double translation and encapsulation;

The process Host 3 - IPv6 Router - IPv6 Network is for native IPv6;

The process Host 1/Host 2 - CPE - IPv6 Router - IPv6 Network is for
single translation.

6. Acknowledgements

We would like to thank Guoliang Han from CERNET/Tsinghua University,
and Dujuan Gu, Shuangjian Yan from CNIC/Chinese Academy of Sciences
on this experiment.

7. IANA Considerations

This document has no IANA implications.

8. Security Considerations

This document has no security implications.

9. References

9.1. Normative References

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          mapt-02 (work in progress), September 2013.

   [I-D.hazeyama-widecamp-ipv6-only-experience]
             Hazeyama, H., Hiromi, R., Ishihara, T., and O. Nakamura,
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             progress), October 2012.

   [I-D.xli-softwire-map-testing]
             Li, X., Bao, C., Han, G., and W. Dec, "MAP
             Interoperability Testing Results", draft-xli-softwire-map-
             testing-03 (work in progress), January 2014.

   [RFC6586] Arkko, J. and A. Keranen, "Experiences from an IPv6-Only
             Network", RFC 6586, April 2012.

Appendix A. Configuration Files

A.1. MAP-T Core Configuration

```
#!/bin/sh

# configure system profile
echo 1 > /proc/sys/net/ipv4/ip_forward
echo 1 > /proc/sys/net/ipv6/conf/all/forwarding
echo 0 > /proc/sys/net/ipv6/conf/eth1/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth0/autoconf

# configure eth0 -- IPv4 interface
/sbin/ifdown eth0
/sbin/ip link set eth0 up
/sbin/ip addr add 159.226.15.173/30 dev eth0
/sbin/ip route add default via 159.226.15.129 dev eth0

control start
utils/ivictl -r -p 159.226.15.174/32 -P 2001:cc0:2003:fff0::/60
-R 16 -M 1 -T
utils/ivictl -r -d -P 2001:cc0:2003:ffff::/64 -T
utils/ivictl -s -i eth0 -I eth1

service iptables stop
service ip6tables stop
```

A.2. MAP-E Core Configuration

```
#!/bin/sh

# configure system profile
echo 1 > /proc/sys/net/ipv4/ip_forward
echo 1 > /proc/sys/net/ipv6/conf/all/forwarding
echo 0 > /proc/sys/net/ipv6/conf/eth1/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth0/autoconf

# configure eth0 -- IPv4 interface
/sbin/ifdown eth0
/sbin/ip link set eth0 up
/sbin/ip addr add 159.226.15.173/30 dev eth0
/sbin/ip route add default via 159.226.15.129 dev eth0

control start
utils/ivictl -r -p 159.226.15.174/32 -P 2001:cc0:2003:fff0::/60
-R 16 -M 1 -E
utils/ivictl -r -d -P 2001:cc0:2003:ffff::1/128 -E

utils/ivictl -s -i eth0 -I eth1

service iptables stop
service ip6tables stop
```

A.3. **MAP-T CPE Configuration**

```
#!/bin/sh

# configure system profile
echo 1 > /proc/sys/net/ipv4/ip_forward
echo 1 > /proc/sys/net/ipv6/conf/all/forwarding
echo 0 > /proc/sys/net/ipv6/conf/eth0.2/autoconf
echo 0 > /proc/sys/net/ipv6/conf/br-lan/autoconf

# configure eth1 -- IPv4 interface
ifconfig br-lan 192.168.1.1/24

./control start

utils/ivictl -r -d -P 2001:cc0:2003:ffff::/64
utils/ivictl -s -i br-lan -I eth0.2 -H -N -a 192.168.1.0/24
-A 159.226.15.174/32 -P 2001:cc0:2003:fff0::/60
-R 16 -M 1 -o 0 -c 1440 -T

#service iptables stop
#service ip6tables stop
```

[A.4](#). **MAP-E CPE Configuration**

```
#!/bin/sh

# configure system profile
echo 1 > /proc/sys/net/ipv4/ip_forward
echo 1 > /proc/sys/net/ipv6/conf/all/forwarding
echo 0 > /proc/sys/net/ipv6/conf/eth0.2/autoconf
echo 0 > /proc/sys/net/ipv6/conf/br-lan/autoconf

# configure eth1 -- IPv4 interface
ifconfig br-lan 192.168.1.1/24

./control start

# encapsulate mode 1: /128 address is configured directly
utils/ivictl -r -d -P 2001:cc0:2003:ffff::1/128
utils/ivictl -s -i br-lan -I eth0.2 -H -N -a 192.168.1.0/24
-A 159.226.15.174/32 -P 2001:cc0:2003:fff0::/60
-R 16 -M 1 -o 0 -c 1400 -E

#service iptables stop
#service ip6tables stop
```

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