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# Experience with Testing of Mapping of Address and Port Using Translation (MAP-T)

## Abstract

This document describes the testing result of a network utilizing a Mapping of Address and Port using Translation (MAP-T) double translation solution; it provides an overview of user applications’ behavior with a shared IPv4 address.

The MAP-T software is from CERNET Center and the test environment is on the NIC.br network with real and virtualized machines.

## Status of This Memo

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# 1. Introduction

This testing is based on most common applications utilized by home users. The main purpose is to check if those applications work correctly on a network using MAP-T [RFC7599]. MAP-T is based on [RFC6791].

Based on testing, we know which applications could be used on a network with MAP-T and the impact on a typical Internet user in Brazil. The classification as a working application is based on user experience, not on network measurements.

# 2. Testbed Overview

## 2.1. Network Topology

```
        -------                    +--------+
      / NIC.br  \ IPv4 ------- IPv6|  IPv6  |IPv6 ------- IPv4 ------
     |   IPv4    |----| MAP-T |----|  only  |----| MAP-T |----| Host |
      \ Network /     | Core  |    | Router |  | | CPE 1 |    |   1  |
        -------        -------     +--------+  |  -------      ------
                                       |       |
                                       |IPv6   |  ------- IPv4 ------
                                       |       |-| MAP-T |----| Host |
                                    -------      | CPE n |    |   n  |
                                  / NIC.br  \     -------      ------
                                 |   IPv6    |
                                  \ Network /
                                    -------
```

Figure 1: Network Topology Used in the Tests

The MAP-T Core and MAP-T Customer Premises Equipment (CPE) are virtualized Linux machines running Fedora 11 and MAP-T 1.1 software developed by CERNET (https://github.com/cernet/MAP).

The host machine is, in fact, three virtualized machines: one with Linux Kubuntu 12.04, one with Windows 7, and one with Windows XP. The host machine is replaced in the topology to test each operating system (OS).

The IPv6 router is a Linux machine with static routes to match the MAP-T network topology routes.

The NIC.br IPv4 Network is an IPv4 network with public IPv4 addresses. It is connected to the global IPv4 Internet.

The NIC.br IPv6 Network is an IPv6 network with global unicast IPv6 addresses. It is connected to the global IPv6 Internet.

The host may have both IPv4 and IPv6 addresses, but to guarantee that the translation was being tested, the host received only an IPv4 address; the IPv4 packet must be translated to pass on the IPv6-only network. If the host is assigned an IPv6 address, this address should have a preference as specified in [RFC6555], and the translation might not be tested in some cases where the application or the content provider is available on IPv6.

### 2.2. Configuration Files

#### 2.2.1. MAP-T Core

Configuration summary:

- ipv6-prefix=2001:db8:6:d600::/56
- ipv4-prefix=198.51.100.248/29
- interface-ipv6-only=2001:db8:6:e000::2/64
- interface-ipv4-wan=192.0.2.171/27

Configuration file:

```
#!/bin/sh

./control stop

# 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/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth1/autoconf

# configure eth0 -- IPv6 interface
ifconfig eth0 down
ifconfig eth0 up
ifconfig eth0 inet6 add 2001:db8:6:e000::2/64
ip -6 route add 2001:db8:6:d600::/56 via 2001:db8:6:e000::1 dev eth0
route -A inet6 add default gw 2001:db8:6:e000::1

# configure eth1 -- IPv4 interface
ifconfig eth1 down
ifconfig eth1 up
ifconfig eth1 192.0.2.171/27
ip route add default via 192.0.2.161 dev eth1

./control start
./utils/ivictl -r -p 198.51.100.248/29 -P 2001:db8:6:d600::/56 -R 16
-M 2
./utils/ivictl -r -d -P 2001:db8:6:d6ff::/64
./utils/ivictl -s -i eth1 -I eth0

service iptables stop
service ip6tables stop
```

### 2.2.2. IPv6-Only Router

Configuration summary:

- interface-ipv6-to-mapt-core=2001:db8:6:e000::1/64
- interface-ipv6-to-mapt-cpe1=2001:db8:6:e001::1/64
- interface-ipv6-to-gateway=2001:db8:0:6160::ed19/64

Configuration file:

```
#!/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/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth1/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth2/autoconf

# configure eth0 -- IPv6 interface to core
ifconfig eth0 down
ifconfig eth0 up
ifconfig eth0 inet6 add 2001:db8:6:e000::1/64

# configure eth1 -- IPv6 interface to cpe
ifconfig eth1 down
ifconfig eth1 up
ifconfig eth1 inet6 add 2001:db8:6:e001::1/64

# configure eth2 -- IPv6 interface gateway
ifconfig eth2 down
ifconfig eth2 up
ifconfig eth2 inet6 add 2001:db8:0:6160::ed19/64

ip -6 route add 2001:db8:6:d640::/64 via 2001:db8:6:e001::2 dev eth1
ip -6 route add 2001:db8:6:d6ff::/64 via 2001:db8:6:e000::2 dev eth0

ip -6 route add 2001:db8:6:e000::/64 dev eth0
ip -6 route add 2001:db8:6:e001::/64 dev eth1

ip -6 route add ::/0 via 2001:db8:0:6160::1ab6 dev eth2

service iptables stop
service ip6tables stop
```

### 2.2.3. MAP-T CPE 1

Configuration summary:

- ipv6-prefix=2001:db8:6:d600::/56

- ipv4-prefix=198.51.100.248/29

- interface-ipv6-only=2001:db8:6:e001::2/64

- interface-ipv4-lan=198.51.100.249/29

Configuration file:

```
#!/bin/sh

./control stop

# 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/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth1/autoconf

# configure eth0 -- IPv6 interface
ip -6 link set eth0 down
ip -6 link set eth0 up
ip -6 addr add 2001:db8:6:e001::2/64 dev eth0
ip -6 route add default via 2001:db8:6:e001::1 dev eth0

# configure eth1 -- IPv4 interface
ip link set eth1 down
ip link set eth1 up
ip addr add 198.51.100.249/29 dev eth1

./control start
./utils/ivictl -r -d -P 2001:db8:6:d6ff::/64
./utils/ivictl -s -i eth1 -I eth0 -H -a 198.51.100.250/29
-P 2001:db8:6:d600::/56 -R 16 -M 2 -o 0 -c 1440

service iptables stop
service ip6tables stop
```

#### 2.2.4. Host 1

The host could be Linux, Windows 7, or Windows XP, so there isn’t a script for each of them. The following must be configured manually:

- ipv4-address=198.51.100.250/29
- ipv4-gateway=198.51.100.249
- ipv4-DNS=8.8.8.8
- IPv6 is disabled

The communication using IPv6 from/to the host to/from the Internet has no limitation and is not impacted by the translation mechanism. IPv6 is disabled to guarantee that the translation is being used.

## 3. Operating Systems Used in This Test

### 3.1. Linux

| | |
|---|---|
| OS | Linux |
| Details | Ubuntu 12.04 LTS Kernel 3.2.0-23 |
| Architecture | 32 bits |

### 3.2. Windows 7

| | |
|---|---|
| OS | Windows 7 |
| Details | Windows 7 Ultimate |
| Architecture | 64 bits |

### 3.3. Windows XP

| | |
|---|---|
| OS | Windows XP |
| Details | Windows XP Professional Service Pack 3 |
| Architecture | 32 bits |

## 4. Application Testing Summary

The table below contains the summary of the testing results. The details of each test are included in Appendix A.

| Category | Application | Result |
|---|---|---|
| Browser | Google Chrome | Passed |
| Browser | Mozilla Firefox | Passed |
| Browser | Internet Explorer | Passed |
| Browser | Safari | Passed |
| Browser | Lynx (text browser) | Passed |
| Web browsing | www.google.com | Passed |
| Web browsing | www.msn.com | Passed |
| Web dynamic content | Flash Player | Passed |
| Web dynamic content | Silverlight | Passed |
| Web dynamic content | Java applets | Passed |
| Web dynamic content | HTML5 websites | Passed |
| Video-stream website | www.youtube.com | Passed |
| Video-stream website | www.dailymotion.com | Passed |
| Video-stream website | www.zappiens.br | Passed |
| Social-networking website | www.facebook.com | Passed |
| Social-networking website | www.twitter.com | Passed |
| Webmail | www.gmail.com | Passed |
| Webmail | www.hotmail.com | Passed |
| Real-time Internet text messaging (chat) website | Chat rooms of UOL content provider | Passed |
| Image-hosting site | www.flickr.com | Passed |
| Communication protocol | Skype | Passed |
| Communication protocol | Google Talk | Passed |
| Communication protocol | Jabber (XMPP) | Passed |
| Communication protocol | MSN Messenger | Passed |
| Communication protocol | IRC | Passed |
| Torrent client | Vuze | Partially Passed |
| Torrent client | uTorrent | Partially Passed |

| | | |
|---|---|---|
| Torrent client | Ktorrent | Partially Passed |
| Remote access and file transfer software | ssh | Passed |
| Remote access and file transfer software | ftp | Failed |
| Remote access and file transfer software | FileZilla ftp | Passed |
| Remote access and file transfer software | wget | Passed |
| Antivirus update | Avira | Passed |
| Antivirus update | AVG | Passed |
| Antivirus update | Avast | Passed |
| Media player updates and video streaming | VLC | Passed |
| Media player updates and video streaming | RealPlayer | Passed |
| Media player updates and video streaming | Windows Media Player | Passed |
| Network testing tool | ping outbound | Passed |
| Network testing tool | ping inbound | Failed |
| Network testing tool | traceroute | Failed |
| Network testing tool | tracert | Failed |

## 5. Effect Analysis

### 5.1. User Experience

User experience can only be evaluated subjectively: there is no quantitative rule to define if the user experience is acceptable. Network delay, streaming experience, and download time are similar to a network without MAP-T using IPv4 addresses and a NAT44 on the CPE.

The user experience was reported to be very good. Almost all the software and websites worked correctly, the exceptions were the network traceroute and command-line FTP.

The traceroute is only capable of reaching the MAP-T CPE and receiving a return message that the destination net is unreachable.

The command-line FTP, using active mode, is capable of connecting to the host with or without authentication, creating, deleting, and navigating folders, but it is not capable of listing folder contents or sending/receiving files. The differences between active and passive mode are explained in [RFC959].

The BitTorrent applications can’t seed or share files, since there aren’t incoming connections to the host, it may cause some difficulties and low downloading speeds.

## 5.2. Testing Summary

The working applications had no need of a special configuration to function. The user experience was reported to be very good. Almost all the software and websites worked correctly, the exceptions were the network traceroute and command-line FTP.

The command-line FTP doesn’t work correctly because active mode requires incoming connections to specific ports without having an outbound connection on those ports. When the test was run on FTP passive mode on Linux, the FTP worked correctly. When the test was run on FTP passive mode on Windows 7 and Windows XP, the FTP didn’t work correctly. When using FileZilla FTP in passive mode, FTP worked on all tested operating systems.

The network traceroute doesn’t work in inbound or outbound directions because there is no continuity of the IPv4 network, as it is interrupted by an IPv6-only network. The tool is not capable of detecting the hosts in this IPv6-only network and because of that the traceroute doesn’t succeed.

The testing was run with the version 1.1 of the MAP-T software developed by CERNET. In this version, the MAP-T CPE uses a NAT44, so it is not possible to receive incoming connections even on the ports assigned to the host by the address plus port division. Because of that, it is not possible to configure a server on the host. We provided this feedback to the CERNET team and they developed a new version of the software (2.2c) that is capable of receiving incoming connections on specific ports in each CPE.

## 6. Future Testing Considerations

Future tests should consider testing Mapping of Address and Port with Encapsulation (MAP-E) [RFC7597] as well (currently supported in the new version of CERNET’s MAP software). Other operating systems (Mac OS, Android, IOS, etc.), devices (mobile phones, tablets, video games, etc.), and programs (mail and instant messaging clients and servers) could be tested, too. Another consideration is the port sharing ratio and if it affects performance and functionalities. The results of the testing made in MAP Interoperability Testing Results [MAP-TESTING] are also relevant for future tests. Impact on other protocols, like DNS and DNSSEC, could also be verified.

## 7. Security Considerations

There are no new security considerations pertaining to this document.

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# Appendix A.  Application Testing Details

## A.1.  Browsers

### A.1.1.  Google Chrome

| | |
|---|---|
| Test Item | Browser |
| Sub-Item | Google Chrome |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 20.0.1132 (Linux), 21.0.1180 (Windows 7, Windows XP) |
| Test Objective | Check the browsing experience with Chrome browser behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input a content provider address.<br>2. After loading the page, load one of the latest news pages that has not been accessed yet.<br>3. Check whether contents can be accessed and displayed. |
| Expected Result | Browser can open and display content correctly. |
| Actual Result | Passed |
| Remarks | |

### A.1.2. Mozilla Firefox

| | |
|---|---|
| Test Item | Browser |
| Sub-Item | Mozilla Firefox |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 13.0.1 (Linux), 14.0.1 (Windows 7, Windows XP) |
| Test Objective | Check the browsing experience with Firefox browser behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input a content provider address.<br>2. After loading the page, load one of the latest news pages that has not been accessed yet.<br>3. Check whether contents can be accessed and displayed. |
| Expected Result | Browser can open and display content correctly. |
| Actual Result | Passed |
| Remarks | |

### A.1.3. Internet Explorer

| | |
|---|---|
| Test Item | Browser |
| Sub-Item | Internet Explorer |
| Test OS | Windows 7, Windows XP |
| Software Version | 8.0.7600 (Windows 7), 8.0.6001 (Windows XP) |
| Test Objective | Check the browsing experience with Internet Explorer behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input a content provider address.<br>2. After loading the page, load one of the lastest news pages that has not been accessed yet.<br>3. Check whether contents can be accessed and displayed. |
| Expected Result | Browser can open and display content correctly. |
| Actual Result | Passed |
| Remarks | |

### A.1.4. Safari

| | |
|---|---|
| Test Item | Browser |
| Sub-Item | Safari |
| Test OS | Windows 7, Windows XP |
| Software Version | 5.1.7 (Windows 7, Windows XP) |
| Test Objective | Check the browsing experience with Safari browser behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input a content provider address.<br>2. After loading the page, load one of the latest news pages that has not been accessed yet.<br>3. Check whether contents can be accessed and displayed. |
| Expected Result | Browser can open and display content correctly. |
| Actual Result | Passed |
| Remarks | |

### A.1.5. Lynx (Text Browser)

| | |
|---|---|
| Test Item | Browser |
| Sub-Item | Lynx (text browser) |
| Test OS | Linux |
| Software Version | 2.8.8 (Linux) |
| Test Objective | Check the browsing experience with Lynx browser behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser, input a webmail address and perform the login.<br>2. After loading the page, verify the directories of the account and check for stored emails.<br>3. Check whether the webmail content is accessed and displayed. |
| Expected Result | Browser can open and display content correctly. |
| Actual Result | Passed |
| Remarks | |

### A.2. Web Browsing

#### A.2.1. www.google.com

| | |
|---|---|
| Test Item | Web browsing |
| Sub-Item | www.google.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether we can access the services of Google, including the search mechanism, behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Google search engine address.<br>2. After loading the page, perform a new search.<br>3. Check whether the website addresses Google outputs match the search results.<br>4. Access the Google Maps service.<br>5. After loading the page, switch to satellite view.<br>6. Perform a known street address search.<br>7. Check whether the satellite images of the street are displayed. |
| Expected Result | The search engine recognizes requests from user. The Maps service displays the satellite images of the appointed localization. |
| Actual Result | Passed |
| Remarks | |

### A.2.2. www.msn.com

| | |
|---|---|
| Test Item | Web browsing |
| Sub-Item | www.msn.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether the various content provided by the MSN website can be accessed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the MSN website address.<br>2. After loading the page, load one of the latest news pages that has not been accessed yet.<br>3. Check whether contents can be accessed and displayed. |
| Expected Result | MSN content can be opened and displayed correctly. |
| Actual Result | Passed |
| Remarks | |

### A.3. Web Dynamic Content

#### A.3.1. Flash Player

| | |
|---|---|
| Test Item | Web dynamic content |
| Sub-Item | Flash Player |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 13.3.31.109 (Linux), 11.3.31.227 (Windows 7), 11.3.300 (Windows XP) |
| Test Objective | Check whether Flash content (videos, mainly) can be downloaded and displayed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Adobe website address.<br>2. Download and install the version of Adobe Flash Player better suited to the system in use.<br>3. Refresh or reopen the browser and input the YouTube address.<br>3. After loading the page, load one of the last videos posted, not displayed yet.<br>4. Check whether the video is loaded and displayed in the Flash version of YouTube player. |
| Expected Result | Video played in Flash can be displayed correctly. |
| Actual Result | Passed |
| Remarks | Example used: http://www.flashexample.com/ |

### A.3.2. Silverlight

| | |
|---|---|
| Test Item | Web dynamic content |
| Sub-Item | Silverlight |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Moonlight 3.99.0.3 (Linux), 5.1.10411 (Windows 7, Windows XP) |
| Test Objective | Check whether Silverlight content can be downloaded and displayed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Microsoft website address.<br>2. Download and install the version of Microsoft Silverlight better suited to the system in use.<br>3. Refresh or reopen the browser, input the Google address, search for a ’Silverlight Example’ and open the link of a result (examples can be found in the References).<br>4. After loading the page with and example, check whether the plugin is working properly. |
| Expected Result | Silverlight applet executes correctly. |
| Actual Result | Passed |
| Remarks | Linux must use Moonlight as alternative to Silverlight as it is not available for Linux.<br>The Moonlight plugin for Linux has problems refreshing the images of applets. Images are only refreshed when the user comes back to the display of the tab running Moonlight.<br>Example used: http://flashenabled.wordpress.com/2007/07/09/from-a-to-z-50-silverlight-applications/ |

### A.3.3. Java Applets

| | |
|---|---|
| Test Item | Web dynamic content |
| Sub-Item | Java applets |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 1.6.0_24 open jdk (Linux), jdk 7.0.5 (Windows 7, Windows XP) |
| Test Objective | Check whether Java applications can be downloaded and executed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Java website address.<br>2. Download and install the version of Java better better suited to the system in use.<br>3. Refresh or reopen the browser, input the Google address, search for a 'Java Example' and open the link of a result (examples can be found in the References).<br>4. After loading the page with and example, check whether the plugin is working properly. |
| Expected Result | Java applet executes correctly. |
| Actual Result | Passed |
| Remarks | Example used:<br>http://profs.etsmtl.ca/mmcguffin/learn/java/ |

### A.3.4. HTML5 Websites

| | |
|---|---|
| Test Item | Web dynamic content |
| Sub-Item | HTML5 websites |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether the contents of HTML5 websites can be downloaded and displayed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Google address.<br>2. Search for a 'HTML5 Example' and open the link of a result (examples can be found in the References).<br>3. After loading one page with video content, load a video.<br>4. Check whether the video is displayed properly. |
| Expected Result | HTML5 website content can be downloaded and displayed without errors. |
| Actual Result | Passed |
| Remarks | Example used: http://101besthtml5sites.com/ |

## A.4. Video-Stream Websites

### A.4.1. www.youtube.com

| | |
|---|---|
| Test Item | Video-stream website |
| Sub-Item | www.youtube.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether videos and contents of the YouTube streaming video website can be downloaded and displayed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the YouTube address.<br>2. After loading the page, load one of the last videos posted.<br>3. Check whether the video is loaded and displayed. |
| Expected Result | YouTube video can be downloaded and displayed correctly. |
| Actual Result | Passed |
| Remarks | |

### A.4.2. www.dailymotion.com

| | |
|---|---|
| Test Item | Video-stream website |
| Sub-Item | www.dailymotion.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether videos and contents of the Dailymotion streaming video website can be downloaded and displayed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Dailymotion address.<br>2. After loading the page, load one of the last videos posted.<br>3. Check whether the video is loaded and displayed. |
| Expected Result | Dailymotion video can be downloaded and displayed correctly. |
| Actual Result | Passed |
| Remarks | |

### A.4.3. www.zappiens.br

| | |
|---|---|
| Test Item | Video-stream website |
| Sub-Item | www.zappiens.br |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether videos and content of the Zappiens streaming video website (Brazilian digital content website) can be downloaded and displayed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input the Zappiens address.<br>2. After loading the page, load one of the last videos posted. Alternate between the three formats of display available.<br>3. Check whether the video is loaded and displayed. |
| Expected Result | Zappiens video can be downloaded and displayed correctly in the three available formats. |
| Actual Result | Passed |
| Remarks | |

## A.5. Social-Networking Websites

### A.5.1. www.facebook.com

| | |
|---|---|
| Test Item | Social-networking website |
| Sub-Item | www.facebook.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether a Facebook account can be accessed and Facebook applets (as chat) can be executed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser, input the Facebook address, and perform the login.<br>2. Navigate between profiles.<br>3. Check whether contents are loaded and displayed.<br>4. Open the chat applet and perform messages exchanges.<br>5. Check whether contacts are displayed and messages can be exchanged. |
| Expected Result | Profiles can be accessed and displayed correctly. Applets execute without errors. |
| Actual Result | Passed |
| Remarks | |

### A.5.2. www.twitter.com

| | |
|---|---|
| Test Item | Social-networking websites |
| Sub-Item | www.twitter.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether a Twitter account can be accessed and Twitter applets can be executed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser, input the Twitter address, and perform the login.<br>2. Navigate between profiles.<br>3. Check whether contents are loaded and displayed. |
| Expected Result | Profiles are accessed and displayed correctly. |
| Actual Result | Passed |
| Remarks | |

### A.6. Webmails

#### A.6.1. www.gmail.com

| | |
|---|---|
| Test Item | Webmail |
| Sub-Item | www.gmail.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether Gmail webmail can be accessed and Gmail applets can be executed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser, input Gmail address, and perform the login.<br>2. After loading the page, verify the directories of the account and check for stored emails.<br>3. Check whether the webmail content is accessed and displayed. |
| Expected Result | Account can be accessed and emails can be displayed without errors. |
| Actual Result | Passed |
| Remarks | |

### A.6.2. www.hotmail.com

| | |
|---|---|
| Test Item | Webmails |
| Sub-Item | www.hotmail.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether Hotmail webmail can be accessed behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser, input Hotmail address, and perform the login.<br>2. After loading the page, verify the directories of the account and check for stored emails.<br>3. Check whether the webmail content is accessed and displayed. |
| Expected Result | Account can be accessed and emails can be displayed without errors. |
| Actual Result | Passed |
| Remarks | |

## A.7. Real-Time Internet Text Messaging (Chat) Website

### A.7.1. Chat Rooms of Universo Online (UOL) Content Provider

| | |
|---|---|
| Test Item | Real-time Internet text messaging (chat) website |
| Sub-Item | Chat rooms of UOL content provider |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to access and use chat rooms behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser and input UOL address.<br>2. After loading the page, access the "BATE-PAPO" link, enter a chat room, fill information fields, and submit the solicitation.<br>3. Send messages to the chat room.<br>4. Check whether messages are sent and displayed. |
| Expected Result | The user can enter chat rooms, post messages, and display others’ messages. |
| Actual Result | Passed |
| Remarks | |

### A.8. Image-Hosting Site

#### A.8.1. www.flickr.com

| Test Item | Image-hosting site |
|---|---|
| Sub-Item | www.flickr.com |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Chrome and Firefox (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to access, upload images, and use the interface of the Flickr site behind the double translation of MAP-T. |
| Test Procedure | 1. Open browser, input Flickr address, and perform login.<br>2. After loading the page, upload an image.<br>3. Check whether the image was uploaded. |
| Expected Result | The user can log in to the Flickr site and upload images. |
| Actual Result | Passed |
| Remarks | |

## A.9. Communication Protocol

### A.9.1. Skype

| | |
|---|---|
| Test Item | Communication protocol |
| Sub-Item | Skype |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 4.0.0.7 (Linux), 5.10.0.116 (Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into a Skype account and initiate and maintain a Skype session behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Skype.<br>2. Open Skype and perform login.<br>3. Search for an online contact, start a chat, and exchange messages.<br>4. Check the exchange of messages. |
| Expected Result | One can login to Skype, identify contacts online, establish a session with a contact, and exchange messages. |
| Actual Result | Passed |
| Remarks | |

### A.9.2. Google Talk

| | |
|---|---|
| Test Item | Communication protocol |
| Sub-Item | Google Talk |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Pidgin 2.10.3 (Linux), Pidgin 2.10.6 (Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into a Google Talk account and to initiate and maintain a session behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Pidgin.<br>2. Open Pidgin, configure an Google Talk account, and perform login.<br>3. Search for an online contact, start a chat, and exchange messages.<br>4. Check the exchange of messages. |
| Expected Result | One can log in to Google Talk, identify contacts online, establish a session with a contact, and exchange messages. |
| Actual Result | Passed |
| Remarks | |

### A.9.3. Jabber (XMPP)

| | |
|---|---|
| Test Item | Communication protocol |
| Sub-Item | Jabber (XMPP) |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Pidgin 2.10.3 (Linux), Pidgin 2.10.6 (Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into a Jabber account and initiate and maintain a Jabber session behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Pidgin.<br>2. Open Pidgin, configure an XMPP account and perform login.<br>3. Search for an online contact, start a chat, and exchange messages.<br>4. Check the exchange of messages. |
| Expected Result | One can log into Jabber, identify contacts online, establish a session with a contact, and exchange messages. |
| Actual Result | Passed |
| Remarks | |

### A.9.4. MSN Messenger (Microsoft Notification Protocol)

| | |
|---|---|
| Test Item | Communication protocol |
| Sub-Item | MSN Messenger (Microsoft Notification Protocol) |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Pidgin 2.10.3 (Linux), Pidgin 2.10.6, and Windows Live Messenger 16.4.3503 (Windows 7), Pidgin 2.10.6, and Windows Live Messenger 14.0.8117 (Windows XP) |
| Test Objective | Check whether it is possible to log into an MSN account and initiate and maintain an MSN session behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Pidgin or Windows Live Messenger.<br>2. Open the software installed, configure an MSN account (if Pidgin is the software used) and perform login.<br>3. Search for an online contact, start a chat, and exchange messages.<br>4. Check the exchange of messages. |
| Expected Result | One can log into MSN, identify contacts online, establish a session with a contact, and exchange messages. |
| Actual Result | Passed |
| Remarks | |

### A.9.5. IRC (Internet Relay Chat)

| | |
|---|---|
| Test Item | Communication protocol |
| Sub-Item | IRC (Internet Relay Chat) |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | Pidgin 2.10.3 (Linux), Pidgin 2.10.6 (Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into an IRC account, join a channel, and send/receive messages in a channel, behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Pidgin.<br>2. Open Pidgin, configure an IRC account, and perform login.<br>3. Join a channel and send messages.<br>4. Check whether the channel was joined and messages were displayed. |
| Expected Result | One can log into IRC, join a channel, identify users inside the channel, and send and display messages in the channel. |
| Actual Result | Passed |
| Remarks | |

## A.10. Torrent Clients

### A.10.1. Vuze

| | |
|---|---|
| Test Item | Torrent client |
| Sub-Item | Vuze |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 4.3.0.6 (Linux), 4.7.1.2 (Windows 7, Windows XP) |
| Test Objective | Check whether the Vuze BitTorrent client can connect to a tracker, identify peers, and make a direct connection to them behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install the Vuze client.<br>2. Load a torrent file with many seeds and start the download.<br>3. Wait and check whether the client connects to a tracker, identifies at least one peer, and the download starts. |
| Expected Result | Vuze client can connect to trackers, identify peers and start downloads. |
| Actual Result | Partially Passed |
| Remarks | As it is not possible to receive incoming connections, the software is not capable of performing the seeding of downloaded files. |

### A.10.2. uTorrent

| | |
|---|---|
| Test Item | Torrent client |
| Sub-Item | uTorrent |
| Test OS | Windows 7, Windows XP |
| Software Version | 3.2 (Windows 7, Windows XP) |
| Test Objective | Check whether the uTorrent BitTorrent client can connect to a tracker, identify peers, and make a direct connection to them behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install the uTorrent client.<br>2. Load a torrent file with many seeds and start the download.<br>3. Wait and check whether the client connects to a tracker, identifies at least one peer, and the download starts. |
| Expected Result | uTorrent clients can connect to trackers, identify peers, and start downloads. |
| Actual Result | Partially Passed |
| Remarks | As it is not possible to receive incoming connections, the software is not capable of performing the seeding of downloaded files. |

### A.10.3. Ktorrent

| | |
|---|---|
| Test Item | Torrent client |
| Sub-Item | Ktorrent |
| Test OS | Linux |
| Software Version | 4.8.2 |
| Test Objective | Check whether the Ktorrent BitTorrent client can connect to a tracker, identify peers, and make a direct connection to them behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install the Ktorrent client.<br>2. Load a torrent file with many seeds and start the download.<br>3. Wait and check whether the client connects to a tracker, identifies at least one peer, and the download starts. |
| Expected Result | Ktorrent clients can connect to trackers, identify peers, and start downloads. |
| Actual Result | Partially Passed |
| Remarks | As it is not possible to receive incoming connections, the software is not capable of performing the seeding of downloaded files. |

### A.10.4. Note about BitTorrent Seeders

BitTorrent uses distributed queues, each seeder owns the queues for the files they have. The seeder informs the tracker that it has the file and the tracker informs the clients about this seeder. The client sends messages to this announced seeder to try to download the file. With no incoming connection, the BitTorrent fails here on the MAP-T. Despite being a possible seeder, the machine doesn’t upload the file; without upload, it will be considered a leech and will be penalized on future downloading speeds. This is the same problem that happens on a network with IPv4 without port forwarding. For details about the influence on shared IPv4 addresses on torrent, see "Behavior of BitTorrent service in PCP-enabled networks with Address Sharing" [PCP-BITTORRENT].

## A.11. Remote Access and File Transfer Software

### A.11.1. SSH

| | |
|---|---|
| Test Item | Remote access and file transfer software |
| Sub-Item | ssh |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | openssh 5.9 (Linux), putty 0.62 (Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into a remote machine, via ssh, behind the double translation of MAP-T. |
| Test Procedure | 1. Install openssh-client (Linux) or putty (Windows) on a host inside MAP-T network.<br>2. Attempt a connection to the host from a machine outside the MAP-T network.<br>3. Check whether the remote access is established. |
| Expected Result | MAP-T client can make or accept remote access to hosts outside MAP-T network via ssh. |
| Actual Result | Passed |
| Remarks | |

### A.11.2. FTP

| | |
|---|---|
| Test Item | Remote access and file transfer software |
| Sub-Item | ftp |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | standard command-line FTP (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into a remote FTP server behind the double translation of MAP-T. |
| Test Procedure | 1. Connect to an FTP server outside MAP-T network.<br>2. Attempt to create, delete, and browser folders.<br>3. Attempt to list, send, and receive files. |
| Expected Result | To complete all described actions in the server. |
| Actual Result | Failed |
| Remarks | It is possible to connect to the server with or without authentication.<br>It is possible to create, delete, and browse folders.<br>It is not possible to list, send, and receive files in active mode. Using passive mode in Linux, it is possible to list, send, and receive files. Using passive mode on Windows 7 and XP didn’t solve the problem with list or sending and receiving files.<br>It looks like passive mode is not correctly implemented. Active mode doesn’t work on networks with NAT, so it is acceptable that active mode doesn’t work with MAP-T either. |

### A.11.3. FileZilla FTP

| | |
|---|---|
| Test Item | Remote access and file transfer software |
| Sub-Item | FileZilla ftp |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 3.5.3 (Linux, Windows 7, Windows XP) |
| Test Objective | Check whether it is possible to log into a remote FTP server behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install FileZilla.<br>2. Connect to an FTP server outside MAP-T network.<br>3. Attempt to create, delete, and browse folders.<br>4. Attempt to list, send, and receive files. |
| Expected Result | To complete all de described actions in the server. |
| Actual Result | Passed |
| Remarks | FileZilla default configuration uses passive mode. When using active mode, FileZilla can’t list, send, or receive files. |

### A.11.4. WGET

| | |
|---|---|
| Test Item | Remote access and file transfer software |
| Sub-Item | wget |
| Test OS | Linux |
| Software Version | 1.13.4 |
| Test Objective | Check whether it is possible to download files with the wget tool and utilize its functionalities behind the double translation of MAP-T. |
| Test Procedure | 1. Install the wget tool.<br>2. Perform the download of a file in the Internet.<br>3. Check whether the download is completed. |
| Expected Result | User can download files from the Internet with wget. |
| Actual Result | Passed |
| Remarks | |

## A.12. Antivirus Updates

### A.12.1. Avira

| | |
|---|---|
| Test Item | Antivirus update |
| Sub-Item | Avira |
| Test OS | Windows 7, Windows XP |
| Software Version | 12.0.0.289 (Windows 7, Windows XP) |
| Test Objective | Check whether the update software of Avira Antivirus can connect to the update server and download files behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Avira Antivirus.<br>2. Initiate the update of the software.<br>3. Check whether the main window indicates that the definitions of virus are updated. |
| Expected Result | Avira can update virus definitions from inside a MAP-T network. |
| Actual Result | Passed |
| Remarks | |

### A.12.2. AVG

| | |
|---|---|
| Test Item | Antivirus update |
| Sub-Item | AVG |
| Test OS | Windows 7, Windows XP |
| Software Version | 2012.0.2197 (Windows 7, Windows XP) |
| Test Objective | Check whether the update software of AVG Antivirus can connect to the update server and download files behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install AVG Antivirus.<br>2. Initiate the update of the software.<br>3. Check whether the main window indicates that the definitions of virus are updated. |
| Expected Result | AVG can update virus definitions from inside a MAP-T network. |
| Actual Result | Passed |
| Remarks | |

### A.12.3. Avast

| | |
|---|---|
| Test Item | Antivirus update |
| Sub-Item | Avast |
| Test OS | Windows 7, Windows XP |
| Software Version | 7.0.1456 (Windows 7, Windows XP) |
| Test Objective | Check whether the update software of Avast Antivirus can connect to the update server and download files behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Avast Antivirus.<br>2. Initiate the update of the software.<br>3. Check whether the main window indicates that the definitions of virus are updated. |
| Expected Result | Avast can update virus definitions from inside a MAP-T network. |
| Actual Result | Passed |
| Remarks | |

### A.13. Media Player Updates and Video Streaming

#### A.13.1. VLC

| | |
|---|---|
| Test Item | Media player updates and video streaming |
| Sub-Item | VLC |
| Test OS | Linux, Windows 7, Windows XP |
| Software Version | 2.0.3 Twoflower (Linux, Windows 7), 2.0.1 Twoflower (Windows XP) |
| Test Objective | Check whether VLC can connect to the update server, download files, and access media content providers behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install VLC.<br>2. Initiate the update of the software.<br>3. Check whether the update window indicates a connection to the server.<br>4. Open the menu "Internet" and access a channel.<br>5. Check whether the media content is loaded. |
| Expected Result | VLC can be updated and access content providers from inside a MAP-T network. |
| Actual Result | Passed |
| Remarks | |

### A.13.2. RealPlayer

| | |
|---|---|
| Test Item | Media player updates and video streaming |
| Sub-Item | RealPlayer |
| Test OS | Windows 7, Windows XP |
| Software Version | 15.0.6.14 (Windows 7, Windows XP) |
| Test Objective | Check whether RealPlayer can connect to the update server and download files, and access media content providers behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install RealPlayer.<br>2. Initiate the update of the software.<br>3. Check whether the update window indicates a connection to the server.<br>4. Open the "Online Guide".<br>5. Check whether a web page is loaded. |
| Expected Result | RealPlayer can be updated and connect to content providers from inside a MAP-T network. |
| Actual Result | Passed |
| Remarks | |

### A.13.3. Windows Media Player

| | |
|---|---|
| Test Item | Media player updates and video streaming |
| Sub-Item | Windows Media Player |
| Test OS | Windows 7, Windows XP |
| Software Version | 12.0.7600 (Windows 7), 11.0.5721 (Windows XP) |
| Test Objective | Check whether the Windows Media Player can connect to the update server and download files, and access music content providers behind the double translation of MAP-T. |
| Test Procedure | 1. Download and install Windows Media Player.<br>2. Initiate the update of the software.<br>3. Check whether the update window indicates a connection to the server.<br>4. Open the "Media Guide".<br>5. Check whether a web page is loaded. |
| Expected Result | Windows Media Player can be updated and connected to content providers from inside a MAP-T network. |
| Actual Result | Passed |
| Remarks | |

### A.14. Network Testing Tools

#### A.14.1. ping

| Test Item | Network testing tools |
|---|---|
| Sub-Item | ping |
| Test OS | Linux, Windows 7, Windows XP |
| Test Objective | Check whether the ping tool can send and answer ICMP packets to and from hosts outside the MAP-T network. |
| Test Procedure | 1. Ping a known host outside the MAP-T network (www.google.com, for instance).<br>2. Check whether there are answers to the pings.<br>3. Ping the MAP-T client tested from a known host outside the MAP-T network.<br>4. Check whether there are answers to the pings. |
| Expected Result | MAP-T client can send and answer pings to and from hosts outside the MAP-T network. |
| Actual Result Version | Failed to receive inbound pings, but replies to requested pings are received. |
| Remarks | The version of MAP-T 1.1 tested does not allow incoming connections to the MAP-T client. |

### A.14.2. traceroute

| | |
|---|---|
| Test Item | Network testing tools |
| Sub-Item | traceroute |
| Test OS | Linux |
| Test Objective | Check whether the traceroute tool can identify each router in the path of a packet sent to a host outside the MAP-T network or sent from that host to the MAP-T client. |
| Test Procedure | 1. Install the traceroute tool on both machines considered.<br>2. Open a terminal on the MAP-T client and execute a traceroute to a known host outside the MAP-T network (www.google.com, for instance).<br>3. Check whether the route is traced until the known host and the list of intermediary routers is complete.<br>4. Open a terminal on a host outside the MAP-T network and execute a traceroute to the MAP-T client.<br>5. Check whether the route is traced until the MAP-T client and the list of intermediary routers is complete. |
| Expected Result | The traceroute tool can map the complete route of a packet to and from the MAP-T client. |
| Actual Result | Failed |
| Remarks | After the first v4/v6 translation, the routers are not mapped by the traceroute. |

### A.14.3. tracert

| | |
|---|---|
| Test Item | Network testing tools |
| Sub-Item | tracert |
| Test OS | Windows 7, Windows XP |
| Test Objective | Check whether the tracert tool can identify each router in the path of a packet sent to a host outside the MAP-T network. |
| Test Procedure | 1. Open a terminal on the MAP-T client and execute a tracert to a known host outside the MAP-T network (www.google.com, for instance).<br>2. Check whether the route is traced until the known host and the list of intermediary routers is complete.<br>3. Open a terminal on a host outside the MAP-T network and execute a tracert to the MAP-T client.<br>4. Check whether the route is traced until the MAP-T client and the list of intermediary routers is complete. |
| Expected Result | The tracert tool can map the complete route of a packet to and from the MAP-T client. |
| Actual Result | Failed |
| Remarks | After the first v4/v6 translation, the routers are not mapped by the traceroute. |

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