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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.

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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

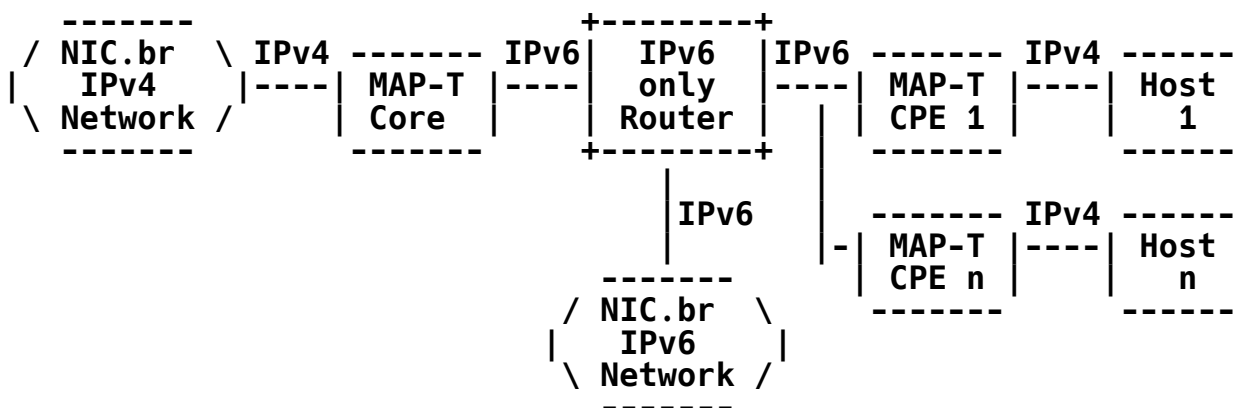


Figure 1: Network Topology Used in the Tests

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:

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

- o interface-ipv6-to-mapt-core=2001:db8:6:e000::1/64
- o interface-ipv6-to-mapt-cpe1=2001:db8:6:e001::1/64
- o 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:

- o ipv6-prefix=2001:db8:6:d600::/56
- o ipv4-prefix=198.51.100.248/29
- o interface-ipv6-only=2001:db8:6:e001::2/64
- o 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:

- o ipv4-address=198.51.100.250/29
- o ipv4-gateway=198.51.100.249
- o ipv4-DNS=8.8.8.8
- o 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	Passed
Image-hosting site	content provider	Passed
Communication protocol	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
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	tracert	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.

8. References

8.1. Normative References

- [RFC959] Postel, J. and J. Reynolds, "File Transfer Protocol", STD 9, RFC 959, DOI 10.17487/RFC959, October 1985, <<http://www.rfc-editor.org/info/rfc959>>.
- [RFC6555] Wing, D. and A. Yourtchenko, "Happy Eyeballs: Success with Dual-Stack Hosts", RFC 6555, DOI 10.17487/RFC6555, April 2012, <<http://www.rfc-editor.org/info/rfc6555>>.
- [RFC6791] Li, X., Bao, C., Wing, D., Vaithianathan, R., and G. Huston, "Stateless Source Address Mapping for ICMPv6 Packets", RFC 6791, DOI 10.17487/RFC6791, November 2012, <<http://www.rfc-editor.org/info/rfc6791>>.

8.2. Informative References

- [MAP-TESTING] Li, X., Bao, C., Han, G., and W. Dec, "MAP Interoperability Testing Results", Work in Progress, draft-xli-software-map-testing-06, July 2015.
- [PCP-BITTORRENT] Boucadair, M., Zheng, T., Deng, X., and J. Queiroz, "Behavior of BitTorrent service in PCP-enabled networks with Address Sharing", Work in Progress, draft-boucadair-pcp-bittorrent-00, May 2012.
- [RFC7597] Troan, O., Ed., Dec, W., Li, X., Bao, C., Matsushima, S., Murakami, T., and T. Taylor, Ed., "Mapping of Address and Port with Encapsulation (MAP-E)", RFC 7597, DOI 10.17487/RFC7597, July 2015, <<http://www.rfc-editor.org/info/rfc7597>>.
- [RFC7599] Li, X., Bao, C., Dec, W., Ed., Troan, O., Matsushima, S., and T. Murakami, "Mapping of Address and Port using Translation (MAP-T)", RFC 7599, DOI 10.17487/RFC7599, July 2015, <<http://www.rfc-editor.org/info/rfc7599>>.

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	<ol style="list-style-type: none"> 1. Open browser and input a content provider address. 2. After loading the page, load one of the latest news pages that has not been accessed yet. 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	<ol style="list-style-type: none"> 1. Open browser and input a content provider address. 2. After loading the page, load one of the latest news pages that has not been accessed yet. 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	<ol style="list-style-type: none"> 1. Open browser and input a content provider address. 2. After loading the page, load one of the latest news pages that has not been accessed yet. 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	<ol style="list-style-type: none"> 1. Open browser and input a content provider address. 2. After loading the page, load one of the latest news pages that has not been accessed yet. 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	<ol style="list-style-type: none"> 1. Open browser, input a webmail address and perform the login. 2. After loading the page, verify the directories of the account and check for stored emails. 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	<ol style="list-style-type: none"> 1. Open browser and input the Google search engine address. 2. After loading the page, perform a new search. 3. Check whether the website addresses Google outputs match the search results. 4. Access the Google Maps service. 5. After loading the page, switch to satellite view. 6. Perform a known street address search. 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	<ol style="list-style-type: none"> 1. Open browser and input the MSN website address. 2. After loading the page, load one of the latest news pages that has not been accessed yet. 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	<ol style="list-style-type: none"> 1. Open browser and input the Adobe website address. 2. Download and install the version of Adobe Flash Player better suited to the system in use. 3. Refresh or reopen the browser and input the YouTube address. 3. After loading the page, load one of the last videos posted, not displayed yet. 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	<ol style="list-style-type: none"> 1. Open browser and input the Microsoft website address. 2. Download and install the version of Microsoft Silverlight better suited to the system in use. 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). 4. After loading the page with an example, check whether the plugin is working properly.
Expected Result	Silverlight applet executes correctly.
Actual Result	Passed
Remarks	<p>Linux must use Moonlight as alternative to Silverlight as it is not available for Linux. 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.</p> <p>Example used: http://flashenabled.wordpress.com/2007/07/09/from-a-to-z-50-silverlight-applications/</p>

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	<ol style="list-style-type: none"> 1. Open browser and input the Java website address. 2. Download and install the version of Java better suited to the system in use. 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). 4. After loading the page with an example, check whether the plugin is working properly.
Expected Result	Java applet executes correctly.
Actual Result	Passed
Remarks	Example used: 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	<ol style="list-style-type: none"> 1. Open browser and input the Google address. 2. Search for a 'HTML5 Example' and open the link of a result (examples can be found in the References). 3. After loading one page with video content, load a video. 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	<ol style="list-style-type: none"> 1. Open browser and input the YouTube address. 2. After loading the page, load one of the last videos posted. 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	<ol style="list-style-type: none"> 1. Open browser and input the Dailymotion address. 2. After loading the page, load one of the last videos posted. 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	<ol style="list-style-type: none"> 1. Open browser and input the Zappiens address. 2. After loading the page, load one of the last videos posted. Alternate between the three formats of display available. 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	<ol style="list-style-type: none"> 1. Open browser, input the Facebook address, and perform the login. 2. Navigate between profiles. 3. Check whether contents are loaded and displayed. 4. Open the chat applet and perform messages exchanges. 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	<ol style="list-style-type: none"> 1. Open browser, input the Twitter address, and perform the login. 2. Navigate between profiles. 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	<ol style="list-style-type: none"> 1. Open browser, input Gmail address, and perform the login. 2. After loading the page, verify the directories of the account and check for stored emails. 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	<ol style="list-style-type: none"> 1. Open browser, input Hotmail address, and perform the login. 2. After loading the page, verify the directories of the account and check for stored emails. 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	<ol style="list-style-type: none"> 1. Open browser and input UOL address. 2. After loading the page, access the "BATE-PAP0" link, enter a chat room, fill information fields, and submit the solicitation. 3. Send messages to the chat room. 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	<ol style="list-style-type: none"> 1. Open browser, input Flickr address, and perform login. 2. After loading the page, upload an image. 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	<ol style="list-style-type: none"> 1. Download and install Skype. 2. Open Skype and perform login. 3. Search for an online contact, start a chat, and exchange messages. 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	<ol style="list-style-type: none"> 1. Download and install Pidgin. 2. Open Pidgin, configure an Google Talk account, and perform login. 3. Search for an online contact, start a chat, and exchange messages. 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	<ol style="list-style-type: none"> 1. Download and install Pidgin. 2. Open Pidgin, configure an XMPP account and perform login. 3. Search for an online contact, start a chat, and exchange messages. 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	<ol style="list-style-type: none"> 1. Download and install Pidgin or Windows Live Messenger. 2. Open the software installed, configure an MSN account (if Pidgin is the software used) and perform login. 3. Search for an online contact, start a chat, and exchange messages. 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	<ol style="list-style-type: none"> 1. Download and install Pidgin. 2. Open Pidgin, configure an IRC account, and perform login. 3. Join a channel and send messages. 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	<ol style="list-style-type: none"> 1. Download and install the Vuze client. 2. Load a torrent file with many seeds and start the download. 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	<ol style="list-style-type: none"> 1. Download and install the uTorrent client. 2. Load a torrent file with many seeds and start the download. 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	<ol style="list-style-type: none"> 1. Download and install the Ktorrent client. 2. Load a torrent file with many seeds and start the download. 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	<ol style="list-style-type: none"> 1. Install openssh-client (Linux) or putty (Windows) on a host inside MAP-T network. 2. Attempt a connection to the host from a machine outside the MAP-T network. 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	<ol style="list-style-type: none"> 1. Connect to an FTP server outside MAP-T network. 2. Attempt to create, delete, and browser folders. 3. Attempt to list, send, and receive files.
Expected Result	To complete all described actions in the server.
Actual Result	Failed
Remarks	<p>It is possible to connect to the server with or without authentication.</p> <p>It is possible to create, delete, and browse folders.</p> <p>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. 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.</p>

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	<ol style="list-style-type: none"> 1. Download and install FileZilla. 2. Connect to an FTP server outside MAP-T network. 3. Attempt to create, delete, and browse folders. 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. 2. Perform the download of a file in the Internet. 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	<ol style="list-style-type: none"> 1. Download and install Avira Antivirus. 2. Initiate the update of the software. 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	<ol style="list-style-type: none"> 1. Download and install AVG Antivirus. 2. Initiate the update of the software. 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	<ol style="list-style-type: none"> 1. Download and install Avast Antivirus. 2. Initiate the update of the software. 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	<ol style="list-style-type: none"> 1. Download and install VLC. 2. Initiate the update of the software. 3. Check whether the update window indicates a connection to the server. 4. Open the menu "Internet" and access a channel. 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	<ol style="list-style-type: none"> 1. Download and install RealPlayer. 2. Initiate the update of the software. 3. Check whether the update window indicates a connection to the server. 4. Open the "Online Guide". 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	<ol style="list-style-type: none"> 1. Download and install Windows Media Player. 2. Initiate the update of the software. 3. Check whether the update window indicates a connection to the server. 4. Open the "Media Guide". 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	<ol style="list-style-type: none"> 1. Ping a known host outside the MAP-T network (www.google.com, for instance). 2. Check whether there are answers to the pings. 3. Ping the MAP-T client tested from a known host outside the MAP-T network. 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	<ol style="list-style-type: none"> 1. Install the traceroute tool on both machines considered. 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). 3. Check whether the route is traced until the known host and the list of intermediary routers is complete. 4. Open a terminal on a host outside the MAP-T network and execute a traceroute to the MAP-T client. 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	<code>tracert</code>
Test OS	Windows 7, Windows XP
Test Objective	Check whether the <code>tracert</code> tool can identify each router in the path of a packet sent to a host outside the MAP-T network.
Test Procedure	<ol style="list-style-type: none"> 1. Open a terminal on the MAP-T client and execute a <code>tracert</code> to a known host outside the MAP-T network (www.google.com, for instance). 2. Check whether the route is traced until the known host and the list of intermediary routers is complete. 3. Open a terminal on a host outside the MAP-T network and execute a <code>tracert</code> to the MAP-T client. 4. Check whether the route is traced until the MAP-T client and the list of intermediary routers is complete.
Expected Result	The <code>tracert</code> 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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