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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Integrated broadband cable telecommunication networks (CABLE).

The present document produced for the transition technologies accommodates an urgent need in the industry to define requirements that enable seemless transition of Cable Networks to IPv6. Considering the depletion of IPv4 addresses, transition to IPv6 is required in order to enable continued growth of the customer base connected to Cable Networks and ensure service continuity for existing and new customers. High-quality connectivity to all kinds of IP-based services and networks is essential in today's business and private life.

A plethora of transition technologies have been proposed in IETF, other standardization organizations and by manufacturers of IP technology to allow coexistence of IPv4 and IPv6 hosts, access and core networks as well as services. Each of these technology options is specified, implemented and deployed in various forms and stages. The present document is based on the requirements of ETSI TS 101 569-1 [1].

The present document is part 2 of a multi-part deliverable covering the conformance test specification for NAT64 technology:

Part 1: "Protocol Implementation Conformance Statement (PICS) proforma";

Part 2: "Test Suite Structure and Test Purposes (TSS&TP)";

Part 3: "Abstract Test Suite (ATS) and Protocol Implementation eXtra Information for Testing (PIXIT)".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document provides the Test Suite Structure and Test Purposes (TSS&TP) descriptions for the IPv6 transition technology NAT64 to validate its implementation within a cable communications networks.

The tests are in reference to [1], the ETSI specifications for IPv6 transition technology.

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [i.1] and ISO/IEC 9646-2 [i.2]) as well as the ETSI rules for conformance testing (ETS 300 406 [i.3]) are used as a basis for the test methodology.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 101 569-1: "Integrated Broadband Cable Telecommunication Networks (CABLE); Cable Network Transition to IPv6 Part 1: IPv6 Transition Requirements".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ISO/IEC 9646-1 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".

[i.2] ISO/IEC 9646-2 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 2: Abstract Test Suite specification".

[i.3] ETSI ETS 300 406 (1995): "Methods for testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ALG Application Layer Gateway
ATS Abstract Test Suite
B4 (NAT64) Basic Bridging BroadBand element

CPE	Customer Premises Equipment
DF	Do not Fragment flag (in IPv4 header)
FTP	File Transfer Protocol
GRT	Global Routing Table
GW	GateWay
HTML	HyperText Markup Language
ICMP	Internet Control Message Protocol
IP	Internet Protocol
IPv4	IP version 4
IPv6	IP version 6
IUT	Implementation Under Test
LSN	Large Scale NAT
MSS	(TCP) Maximum Segment Size
MTS	Methods for Testing and Specification
MTU	Maximum Transmission Unit
NAT	Network Address Translation/Network Address Translator
NPU	Network Processing Unit
PICS	Protocol Implementation Conformance Statement
PPTP	Point to Point Tunelling Protocol
RTSP	Real Time Streaming Protocol
SIP	Session Initiation Protocol
TC	Test Case
TCP	Transmission Control Protocol
TP	Test purpose
VRF	Virtual Routing and Forwarding

4 Test Suite Structure

The identifier of the TP is built according to table 1 as recommended in the MTS methodologies.

Table 1: TP naming convention

TP/<root>/<gr>/<sgr>/<x>/<nn>		
<root> = root	NAT64	Mapping of Address and Port – Encapsulation Mode
<gr> = group	LSN	Large Scale NAT
<sgr> = sub-group	BF	Basic Function
	NP	NAT Pools
	AW	Address Withdrawal
	FRAG	Fragmentation
	MSSC	Maximum Segment Size Clamping
	SPR	Static Port Reservation
	NT	NAT Timers
	ALG	Application Layer Gateways
	RT	Routing Tables
	AA	Anycast Addressing
	RED	Redundancy
	LB	Load-balancing
	FE	Failure Events
<x> = type of testing	BV	Valid Behaviour tests
<nn> = sequential number		01 to 99
NOTE: A sub-group may not apply for all groups.		

5 Test Purposes

Proposes a TP proforma which is used in the present document. The fields of this proforma as used in the present document are explained in table 2.

Table 2: TP proforma field description

TP Header	
TP ID	The TP ID is a unique identifier according to the TP naming conventions in tables
Test objective	Short description of test purpose objective according to the requirements from the base standard.
Reference	The reference indicates the clauses of the reference standard specifications in which the conformance requirement is expressed.
TP Behaviour	
Initial conditions (optional)	The initial conditions define in which initial state the IUT has to be to apply the actual TP. In the corresponding "Test Case" (TC), when the execution of the initial condition does not succeed, it leads to the assignment of an Inconclusive verdict.
Expected behaviour (TP body)	Definition of the events, which are parts of the TP objective, and the IUT are expected to perform in order to conform to the base specification. In the corresponding TC, "Pass" or "Fail" verdicts can be assigned there.

5.1 TPs for LSN

5.1.1 Basic Function

TP Id	TP/NAT64/LSN/BF/BV/01
Test objective	Check that the IUT supports the functionality of NAT64 1:1 NAT mapping
Reference	[1]:6.5.7.9 1:1 IP Mapping
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv6 packets containing IPv6 transport header containing source address indicating client IPv6 address containing destination address indicating IUT GW IPv6 prefix first 64 bits indicating IUT IPv4 embedded into the IPv6 address in last 64 bits from multiple client devices } **then {** the IUT does a 1:1 NAT mapping for each public IPv6 Client address sourced and the IUT forwards packets to the destination with different IPv4 public addresses } }	

P Id	TP/NAT64/LSN/BF/BV/02
Test objective	Check that the IUT supports the functionality of NAT64 1:n NAT mapping with port translation
Reference	[1]:6.4.4.4 Feature: Shared/Split Resources
Initial conditions	

with {
the IUT was properly provisioned
the interfaces are connected & functional
}	

Expected behaviour	

ensure that {
when {
the IUT receives multiple IPv6 packets
containing IPv6 transport header
containing source address
indicating client IPv6 address
containing destination address
indicating IUT GW IPv6 prefix first 64 bits
indicating IUT IPv4 embedded into the IPv6 address in last 64 bits
from multiple client devices
}
then {
the IUT does a 1:n NAT mapping for multiple public IPv6 B4 addresses sourced
and the IUT forwards packets to the destination with the same public IPv4 source address
}
}	

5.1.2 NAT Pools

TP Id	TP/NAT64/LSN/NP/BV/01
Test objective	Check that the IUT supports the functionality of multiple NAT pools per prefix
Reference	[1]:6.4.6.10 Feature: NAT Grouping resource Sharing // [1]:6.4.4.4] Feature: Shared/Split Resources
Initial conditions	

with {
the IUT was properly provisioned
the interfaces are connected & functional and,
the six clients being configured with two separate prefixes, one prefix for three clients.
}	

Expected behaviour	

ensure that {
when {
the IUT receives multiple IPv6 packets
containing IPv6 transport header
containing source address
indicating client IPv6 address
containing destination address
indicating IUT GW IPv6 prefix first 64 bits
indicating IUT IPv4 embedded into the IPv6 address in last 64 bits
from multiple client devices
}
then {
the IUT does a 1:n NAT mapping for multiple public IPv6 client addresses sourced
and the IUT forwards packets to the destination with some of the same and some different public IPv4 source address matching the NAT pools dependent on the prefix assigned
}
}	

5.1.3 Address Withdrawal

P Id	TP/NAT64/LSN/AW/BV/01
Test objective	Check that the IUT supports LSN GW address withdrawal on cache failure
Reference	[1]:6.4.6.16 NAT64 Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv6 packets containing IPv6 transport header containing source address indicating client IPv6 address containing destination address indicating IUT GW IPv6 prefix first 64 bits indicating IUT IPv4 embedded into the IPv6 address in last 64 bits containing TCP payload **and** the cache is removed } **then {** the IUT withdraws its Gateway Prefix } }	

P Id	TP/NAT64/LSN/AW/BV/02
Test objective	Check that the IUT supports LSN GW address withdrawal on route failure
Reference	[1]:6.4.6.16 NAT64 Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv6 packets containing IPv6 transport header containing source address indicating client IPv6 address containing destination address indicating IUT GW IPv6 prefix first 64 bits indicating IUT IPv4 embedded into the IPv6 address in last 64 bits containing TCP payload **and** the routes are removed for the next hop } **then {** the IUT withdraws its Gateway Prefix } }	

P Id	TP/NAT64/LSN/AW/BV/03
Test objective	Check that the IUT supports LSN GW address withdrawal on hardware failure
Reference	[1]:6.4.6.16 NAT64 Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv6 packets containing IPv6 transport header containing source address indicating client IPv6 address containing destination address indicating IUT GW IPv6 prefix first 64 bits indicating IUT IPv4 embedded into the IPv6 address in last 64 bits containing TCP payload **and** the processing hardware simulates a failure } **then {** the IUT withdraws its Gateway Prefix } }	

5.1.4 Fragmentation

TP Id	TP/NAT64/LSN/FRAG/BV/01
Test objective	Check that the IUT fragments an HTML IPv4 packet downstream
Reference	[1]:6.4.6.20 LSN Fragmentation and Buffering
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional the physical MTU (Phy-MTU) size being equal or greater than the IPv4 or IPv6 packet between all devices and the NAT64 MTU being higher than the IPv4 packet }	
Expected behaviour	
ensure that { **when {** the IUT receives an HTML IPv4 packet from the internet containing source address indicating a private IPv4 address containing the DF bit indicating the value 0. with a packet size greater than the NAT64-Tunnel-MTU } **then {** the IUT fragments the IPv4 packet before it encapsulates it in IPv6 and the IUT forwards correctly formatted fragmented packets } }	