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

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Contents

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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 seamless 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 tests specification for 6rd 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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document provides the Test Suite Structure and Test Purposes (TSS&TP) descriptions for the IPv6 transition technology 6rd 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 standards for the methodology of conformance testing (ISO/IEC 9646-1 [i.4] and ISO/IEC 9646-2 [i.5]) as well as the ETSI rules for conformance testing (ETSI ETS 300 406 [i.6]) are used as a basis for the test methodology.

2 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.

2.1 Normative references

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

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

[i.5] ISO/IEC 9646-2 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 2: Abstract Test Suite specification".

[i.6] 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:

6rd	IPv6 Rapid Deployment
ATS	Abstract Test Suite
B4	(6rd) Basic Bridging BroadBand element
BR	Border Relay
CPE	Customer Premises Equipment
DF	Don't Fragment flag (in IPv4 header)
GRT	Global Routing Table
GW	GateWay
HTML	HyperText Markup Language

IP	Internet Protocol
IPv4	IP version 4
IPv6	IP version 6
IUT	Implementation Under Test
MSS	(TCP) Maximum Segment Size
MTS	Methods for Testing and Specification
MTU	Maximum Transmission Unit
NAT	Network Address Translation / Network Address Translator
PICS	Protocol Implementation Conformance Statement
TCP	Transmission Control Protocol
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 for 6rd

TP/<root>/<gr>/<sgr>/<x>/<nn>		
<root> = root	6RD	IPv6 encapsulated within IPv4 – IPv6 rapid deployment
<gr> = group	BR	Border Router
	CPE	Customer Premise Equipment
<sgr> = sub-group	BF	Basic Function
	AA	Anycast Addressing
	AW	Address Withdrawal
	FRAG	Fragmentation
	MSSC	Maximum Segment Size Clamping
	TI	Tunnel Identifiers
	NT	NAT Timers
	SC	Session Control
	RT	Routing Tables
	GWA	Gateway Assignment
<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 (TP)

This clause 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 table 1
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.
PICS selection	Reference to the PICS statement involved for selection of the TP. Contains a Boolean expression. May contain PICS acronyms specified in table. This section is only used in case an optional or conditional behaviour needs to be selected. Mandatory behaviour is not identified here.
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 CPE

5.1.1 Gateway Assignment

TP Id	TP/6RD/CPE/GWA/BV/01
Test objective	Check that IUT sends a DHCPv4 Request to the DHCPv4 Server after initialization
Reference	[1]: clause 6.8.9.3 Feature: 6RD Configuration
Initial conditions	
with { the IUT is properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT goes online the IUT sends a DHCPv4 Request to DHCPv4 Server } **then {** the IUT receives the external interface address assignment } }	

5.1.2 Basic Function

TP Id	TP/6RD/ CPE/BF/BV/01
Test objective	Check that the IUT supports the functionality of 6RD encapsulation
Reference	[1]: clause 6.8.9.12 Feature: NAT
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple HTML IPv6 packets containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from multiple hosts } **then {** the IUT encapsulates each HTML IPv6 packet unchanged into IPv4 packet containing destination address indicating IPv4 BR GW address and the IUT forwards the packet to the BR } }	

5.1.3 Fragmentation

TP Id	TP/6RD/CPE/FRAG/BV/01
Test objective	Check that the IUT fragments an HTML IPv6 packet upstream
Reference	[1]: clause 6.8.7.21 Feature: Fragmentation & Buffering
Initial conditions	
with { the physical MTU (Phy-MTU) size being equal or greater than the 6RD IPv4 packet between all devices and the 6RD Tunnel MTU (6RD-MTU) being lower than the encapsulated softwired packet }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple HTML IPv6 packets containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from multiple hosts containing the DF bit indicating the value 0. with a packet size greater than the 6RD tunnel MTU } **then {** the IUT fragments into IPv4 packets and the IUT forwards correctly formatted IPv4 through the tunnel } }	

TP Id	TP/6RD/CPE/FRAG/BV/02
Test objective	Check that the IUT reassembles an IPv6 payload from the IPv4 packet downstream
Reference	[1]: clause 6.8.7.21 Feature: Fragmentation & Buffering
Initial conditions	

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

Expected behaviour	

ensure that {
when {
the IUT receives multiple IPv4 packets
containing IPv4 transport header
containing source address
indicating B4 IPv4 address
containing destination address
indicating IUT GW IPv4 address
containing IPv6 payload
containing source address
indicating a public IPv6 address
containing destination address
indicating a public IPv6 address
containing the IPv6 fragments within the IPv4 packets
from multiple source hosts
}
then {
the IUT reorders & reassembles into IPv6 packets
and the IUT forwards correctly formatted IPv6
}
}	

5.1.4 MSS Clamping

TP Id	TP/6RD/CPE/MSSC/BV/01
Test objective	Check that the IUT functions with MSS clamping upstream
Reference	[1]: clause 6.8.7.20 Feature: MSS Clamping
Initial conditions	

with {
the physical MTU (Phy-MTU) size being equal or greater than the 6RD IPv6 packet between all devices
and the 6RD Tunnel MTU (6RD-MTU) being lower than the encapsulated softwired packet
and the MSS value is below that of the TCP segment size of the incoming packet
}	

Expected behaviour	

ensure that {
when {
the IUT receives multiple HTML IPv6 packets
containing source address
indicating a public IPv6 address
containing destination address
indicating a public IPv6 address
from multiple hosts
with a segment size greater than the IUT MSS value
}
then {
the IUT receives the packet
and the IUT drops the packet & returns a packet-too-big message to the originator
}
}	

5.1.5 Tunnel Identifiers

TP Id	TP/6RD/CPE/TI/BV/01
Test objective	Check that the IUT functions correctly with tunnel identifiers
Reference	[1]: clause 6.8.7.1 Feature: Tunnel Identifiers/Client-Customer ID
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional, }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple HTML IPv6 packets containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from multiple B4 devices **then {** the tunnel identifier is the unique IPv4 address of the CPE upstream } }	

5.2 TPs for BR

5.2.1 Basic Function

TP Id	TP/6RD/BR/BF/BV/01
Test objective	Check that the IUT supports the functionality of 6RD base NAT
Reference	[1]: clause 6.8.7.5 Feature: Softwire Initialization Dynamic Tunnels
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from multiple CPE devices } **then {** the IUT forwards packets to the destination } }	

5.2.2 Session Control

TP Id	TP/6RD/BR/SC/BV/01
Test objective	Check that the IUT supports session control within port ranges upstream
Reference	[1]: clause 6.8.7.5 Feature: Softwire Initialization Dynamic Tunnels
Initial conditions	
with { the IUT is properly provisioned the interfaces are connected & functional the IUT is configured for a specific port range]	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single CPE device **then {** the IUT port 6RDs to range configured and the IUT forwards the packet correctly } }	

5.2.3 Fragmentation

TP Id	TP/6RD/BR/FRAG/BV/01
Test objective	Check that the IUT fragments an HTML IPv6 packet downstream
Reference	[1]: clause 6.8.7.2 Feature: Fragmentation & Buffering
Initial conditions	
with { the physical MTU (Phy-MTU) size being equal or greater than the 6RD IPv6 packet between all devices and the 6RD Tunnel MTU (6RD-MTU) being lower than the encapsulated softwired packet }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple HTML IPv6 packets containing source address indicating a public IPv6 address containing destination address indicating a private IPv6 address from a multiple IPv6 hosting devices with a packet size greater than the BR tunnel MTU } **then {** the IUT fragments that IPv6 packet and the IUT forwards correctly formatted IPv4 packets to the CPE } }	

TP Id	TP/6RD/BR/FRAG/BV/02
Test objective	Check that the IUT reassembles an HTML IPv6 packet upstream
Reference	[1]: clause 6.8.7.2 Feature: Fragmentation & Buffering
Initial conditions	
with { the physical MTU (Phy-MTU) size being equal or greater than the 6RD IPv6 packet between all devices and the 6RD Tunnel MTU (6RD-MTU) being lower than the encapsulated softwired packet }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv6 fragments containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single B4 device } **then {** the IUT reassembles that IPv6 packet and the IUT forwards correctly formatted IPv6 packets to the CPE } }	

5.2.4 MSS Clamping

TP Id	TP/6RD/BR/MSSC/BV/01
Test objective	Check that the IUT functions with MSS clamping downstream
Reference	[1]: clause 6.8.7.20 Feature: MSS Clamping
Initial conditions	
with { the physical MTU (Phy-MTU) size being equal or greater than the 6RD IPv6 packet between all devices and the 6RD Tunnel MTU (6RD-MTU) being lower than the encapsulated softwired packet and the MSS value is below that of the TCP segment size of the incoming packet }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple HTML IPv6 packets containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from multiple CPE devices with a segment size greater than the IUT MSS value } **then {** and the IUT receives the packet and the IUT drops the packet & returns a packet-too-big message to the originator } }	

5.2.5 NAT Timers

TP Id	TP/6RD/BR/NT/BV/01
Test objective	Check that the IUT TCP_time_wait timer expires when required
Reference	[1]: clause 6.8.7.3 6RD Timers
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional and **the IUT TCP_time_wait timer being set** **and** the IUT having received an IPv4 packet containing TCP payload indicating port numbers }	
Expected behaviour	
ensure that { **when {** the TCP_time_wait timer expires **and** the IUT having received a second IPv4 packet containing payload source address indicating a different IPv6 address to the first IPv6 packet containing TCP payload indicating the same port numbers as the first originating packet } **then {** the IUT decapsulates the IPv4 packet and the IUT forwards on the IPv6 packet } }	

5.2.6 Anycast Addressing

TP Id	TP/6RD/BR/AA/BV/01
Test objective	Check that the IUT supports IPv4 Anycast GW addressing upstream
Reference	[1]: clause 6.8.7.13 Feature: Anycast Gateway Address
Initial conditions	
with { the IUT is properly provisioned the interfaces are connected & functional the IUT is configured with an Anycast address]	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 anycast address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single CPE device **then {** the IUT receives the packet correctly and the IUT forwards packets to the destination } }	

5.2.7 Address Withdrawal

P Id	TP/6RD/BR/AW/BV/01
Test objective	Check that the IUT supports BR GW address withdrawal on cache failure
Reference	[1]: clause 6.8.7.15 BR Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single B4 device **and** the cache is removed } **then {** the IUT withdraws its IPv4 Gateway address from the routing table } }	

P Id	TP/6RD/BR/AW/BV/02
Test objective	Check that the IUT supports BR GW address withdrawal on route failure
Reference	[1]: clause 6.8.7.15 BR Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single B4 device **and** the routes are removed for the next hop } **then {** the IUT withdraws its IPv4 Gateway address from the routing table } }	

P Id	TP/6RD/BR/AW/BV/03
Test objective	Check that the IUT supports BR GW address withdrawal on hardware failure
Reference	[1]: clause 6.8.7.15 BR Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single B4 device **and** the processing hardware simulates a failure } **then {** the IUT withdraws its IPv4 Gateway address from the routing table } }	

5.2.8 Routing Tables

TP Id	TP/6RD/BR/RT/BV/01
Test objective	Check that the IUT supports forwarding from GRT TO VRF
Reference	[1]: clause 6.8.2 BR Feature Summary
Initial conditions	
with { the IUT being properly provisioned, and the interfaces are connected & functional, and the routing tables are configured GRT upstream ingress & VRF upstream egress }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv4 packets containing IPv4 transport header containing source address indicating CPE IPv4 address containing destination address indicating IUT GW IPv4 address containing IPv6 payload containing source address indicating a public IPv6 address containing destination address indicating a public IPv6 address from a single B4 device } **then {** the IUT forwards the IPv4 packets once translated } }	

TP Id	TP/6RD/BR/RT/BV/02
Test objective	Check that the IUT supports forwarding from VRF TO GRT
Reference	[1]: clause 6.8.2 BR Feature Summary

Initial conditions

```
with {
    the IUT being properly provisioned,
    and the interfaces are connected & functional,
    and the routing tables are configured VRF upstream ingress & GRT upstream egress
}
```

Expected behaviour

```
ensure that {
    when {
        the IUT receives multiple IPv4 packets
            containing IPv4 transport header
                containing source address
                    indicating CPE IPv4 address
                containing destination address
                    indicating IUT GW IPv4 address
            containing IPv6 payload
                containing source address
                    indicating a public IPv6 address
                containing destination address
                    indicating a public IPv6 address
        from a single B4 device
    }
    then {
        the IUT forwards the IPv4 packets once translated
    }
}
```

Annex A (informative): Bibliography

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History

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