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Integrated broadband cable telecommunication networks (CABLE); Testing; Conformance test specifications for DS-Lite technology; Part 2: Test Suite Structure and Test Purposes (TSS&TP)

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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 test specification for DS-Lite 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 DS-Lite 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 [2] and ISO/IEC 9646-2 [3]) as well as the ETSI rules for conformance testing (ETSI ETS 300 406 [4]) 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] ISO/IEC 9646-1 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

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

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

[5] IETF RFC 6333: "Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion".

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.

Not applicable.

3 Abbreviations

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

AFTR	Address Family Transition Router
ALG	Application Layer Gateway
ATS	Abstract Test Suite
B4	(DS-Lite) Basic Bridging BroadBand element
CPE	Customer Premises Equipment
DF	Don't Fragment flag (in IPv4 header)

DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DSLITE	Dual-Stack Lite
DS-MTU	DS-Lite Tunnel MTU
FTP	File Transfer Protocol
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
TC	Test Case
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

TP/<root>/<gr>/<sgr>/<x>/<nn>		
<root> = root	DSLITE	Dual-Stack Lite
<gr> = group	B4	
	AFTR	
<sgr> = sub-group	GWA	Gateway Assignment
	BF	Basic Function
	MSS	Maximum Segment Size
	FRAG	Fragmentation
	ALG	Application Layer Gateway
	RT	Routing Tables
	AW	Address Withdrawal
<x> = type of testing	BV	Valid Behaviour tests
	TI	Timer
<nn> = sequential number		01 to 99

5 Test purposes

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 convention 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.
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 B4

5.1.1 Gateway Assignment

TP Id	TP/DSLITE/B4/GWA/BV/01
Test objective	Check that IUT sends a DHCPv6 Request to the DHCPv6 Server after initialization.
Reference	[1]: clause 6.3.8 Feature: DS-Lite CPE Requirements
Initial conditions	
with { the IUT is properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT goes online } **then {** the IUT sends a DHCPv6 Request to DHCPv6 Server containing the Option field indicating the AFTR-name DHCPv6 Option (value 64) } }	

TP Id	TP/DSLITE/B4/GWA/BV/02
Test objective	**Check that IUT sends a DNS Query to the DNS Server**
Reference	[1]: clause 6.3.8 Feature: DS-Lite CPE Requirements
Initial conditions	
with { the IUT having sent a DHCPv6 Request to the DHCPv6 Server }	
Expected behaviour	
ensure that { **when {** the IUT receives a DHCPv6 Reply from the DHCPv6 Server } **then {** the IUT sends a DNS query containing the Resolver request name indicating the AFTR-name received in the DHCPv6 Reply } }	

TP Id	TP/DSLITE/B4/GWA/BV/03
Test objective	**Check that IUT correctly adds the AFTR IPv6 address**
Reference	[1]: clause 6.3.6.13 Feature: AFTR Address
Initial conditions	
with { the IUT having sent a DNS query }	
Expected behaviour	
ensure that { **when {** the IUT receives the DNS response } **then {** the IUT adds the AFTR GW IPv6 address to the default route configuration } }	
NOTE: To check the default route configuration for DS-Lite a HTML IPv4 packet is sent from Test System to the IUT.	

5.1.2 Basic Function

TP Id	TP/DSLITE/B4/BF/BV/01
Test objective	Check that the IUT correctly encapsulates and forwards the IPv4 packets from multiple hosts
Reference	[1]: clause 6.3.1 DS-Lite Technology Feature Summary
Initial conditions	
with { the IUT being configured with a correct AFTR GW IPv6 address }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple HTML IPv4 packets containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address from multiple hosts } **then {** the IUT encapsulates each HTML IPv4 packet unchanged into IPv6 packet containing destination address indicating IPv6 AFTR GW address and the IUT forwards the packet to the AFTR GW } }	

5.1.3 Fragmentation

TP Id	TP/DSLITE/B4/FRAG/BV/01
Test objective	Check that the IUT fragments an HTML IPv4 packet when DF bit is not set
Reference	[1]: clause 6.3.6.22 Feature: DS-Lite Fragmentation and Buffering according to RFC 6333 [5]
Initial conditions	
with { the physical MTU (Phy-MTU) size being equal or greater than the IPv4 or IPv6 packet between all devices and the DS-lite Tunnel MTU (DS-MTU) being lower than the encapsulated softwired packet }	
Expected behaviour	
ensure that { **when {** the IUT receives an HTML IPv4 packet containing source address indicating a private IPv4 address containing the DF bit indicating the value 0. with a packet size greater than the DS-MTU } **then {** the IUT fragments that packet before it encapsulates it in IPv6 and the IUT forwards correctly formatted fragmented packets to the AFTR } }	

TP Id	TP/DSLITE/B4/FRAG/BV/02
Test objective	Check that the IUT fragments an HTML IPv4 packet when DF bit is set
Reference	[1]: clause 6.3.6.22 Feature: DS-Lite Fragmentation and Buffering according to RFC 6333 [5]
Initial conditions	

with {
the physical MTU (Phy-MTU) size being equal or less than the IPv4 or IPv6 packet between all devices
and the DS-lite Tunnel MTU (DS-MTU) being lower than the encapsulated softwired packet
}	

Expected behaviour	

ensure that {
when {
the IUT receives an HTML IPv4 packet
containing source address
indicating a private IPv4 address
containing the DF bit
indicating the value 1.
with a packet size greater than the DS-MTU
}
then {
the IUT encapsulates it in an IPv6 packet
and the IUT fragments that IPv6 packet
and the IUT forwards correctly formatted fragmented packets to the AFTR
}
}	

5.1.4 Maximum Segment Size

TP Id	TP/DSLITE/B4/MSS/BV/02
Test objective	Check that the IUT functions with MSS clamping
Reference	[1]: clause 6.3.6.20 Feature: Tunnel MTU Sizing
Initial conditions	

with {
the physical MTU (Phy-MTU) size being equal or greater than the IPv6 packet between all devices
and the MTU (IPv6-MTU) being lower than the originating IPv6 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 an HTML IPv4 packet
containing source address
indicating a private IPv4 address
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 TPs for AFTR

5.2.1 Basic Function

TP Id	TP/DSLITE/AFTR/BF/BV/01
Test objective	Check that the IUT supports the functionality of DS-lite 1:1 NAT mapping
Reference	[1]: clause 6.3.1 DS-Lite Technology Feature Summary
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 B4 IPv6 address containing destination address indicating IUT GW IPv6 address containing IPv4 payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address from multiple B4 devices } **then {** the IUT does a 1:1 NAT mapping for each public IPv6 B4 address sourced and the IUT forwards packets to the destination with different IPv4 public addresses } }	

TP Id	TP/DSLITE/AFTR/BF/BV/02
Test objective	Check that the IUT supports the functionality of DS-lite 1:n NAT mapping and port translation
Reference	[1]: clause 6.3.1 DS-Lite Technology Feature Summary
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional and the IUT being configured to allow 1:n across a single public IPv4 address }	
Expected behaviour	
ensure that { **when {** the IUT receives multiple IPv6 packets containing IPv6 transport header containing source address indicating B4 IPv6 address containing destination address indicating IUT GW IPv6 address containing IPv4 payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address from multiple B4 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 } }	

TP Id	TP/DSLITE/AFTR/BF/TI/01
Test objective	Check that the IUT TCP_time_wait timer expires when required
Reference	[1]: clause 6.3.6.4 Feature: DS-Lite 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 IPv6 packet
containing IPv4 packet as payload
containing source address
indicating a private IPv4 address
containing destination address
indicating a public IPv4 address
containing TCP payload
indicating port numbers
}

Expected behaviour

ensure that {
when {
the TCP_time_wait timer expires
and the IUT having received a second IPv6 packet
containing source address
indicating a different IPv6 address to the first IPv6 packet
containing IPv4 packet as payload
containing source address
indicating the same private IPv4 address as the first originating packet
containing destination address
indicating a public IPv4 address
containing TCP payload
indicating the same port numbers as the first originating packet
}
then {
the IUT decapsulates the IPv4 packet
and the IUT forwards it on
}
}

5.2.2 Application Layer Gateway

TP Id	TP/DSLITE/AFTR/ALG/BV/01
Test objective	Check that the IUT supports FTP forwarding through an ALG
Reference	[1]: clause 6.3.1 DS-Lite Technology Feature Summary
Initial conditions	
with { the IUT being properly provisioned and the interfaces are connected & functional and the IUT being configured with FTP ALG set to active and the FTP client being authenticated with the FTP server }	
Expected behaviour	
ensure that { **when {** the IUT receives an IPv6 packet containing IPv4 packet as payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address containing TCP payload indicating port number 20 } **then {** the IUT forwards the FTP packet to the FTP server } }	

5.2.3 Routing tables

TP Id	TP/DSLITE/AFTR/RT/BV/01
Test objective	Check that the IUT supports forwarding from GRT TO VRF
Reference	[1]: clause 6.3.1 DS-Lite Technology 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 an IPv6 packet containing IPv4 packet as payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address } **then {** the IUT forwards the IPv4 packets once translated from GRT into the VRF } }	

TP Id	TP/DSLITE/AFTR/RT/BV/02
Test objective	Check that the IUT supports forwarding from VRF TO VRF
Reference	[1]: clause 6.3.1 DS-Lite Technology 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 & VRF upstream egress }	
Expected behaviour	
ensure that { **when {** the IUT receives an IPv6 packet containing IPv4 packet as payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address } **then {** the IUT forwards the IPv4 packets once translated from VRF into the VRF } }	

5.2.4 Address Withdrawal

P Id	TP/DSLITE/AFTR/AW/BV/01
Test objective	Check that the IUT supports AFTR GW address withdrawal on route failure
Reference	[1]: clause 6.3.6.16 Feature: AFTR Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives an IPv6 packet containing IPv4 packet as payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address **and** the route is removed } **then {** the IUT withdraws its Gateway Prefix } }	

P Id	TP/DSLITE/AFTR/AW/BV/02
Test objective	Check that the IUT supports AFTR GW address withdrawal on cache failure
Reference	[1]: clause 6.3.6.16 Feature: AFTR Address Withdrawal
Initial conditions	
with { the IUT was properly provisioned the interfaces are connected & functional }	
Expected behaviour	
ensure that { **when {** the IUT receives an IPv6 packet containing IPv4 packet as payload containing source address indicating a private IPv4 address containing destination address indicating a public IPv4 address **and** the cache is removed } **then {** the IUT withdraws its Gateway Prefix } }	

5.2.5 Fragmentation

TP Id	TP/DSLITE/AFTR/FRAG/BV/01
Test objective	Check that the IUT fragments on IPv6 packet downstream
Reference	[1]: clause 6.3.6.22 Feature: DS-Lite Fragmentation and Buffering according to RFC 6333 [5]
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 DS-LITE MTU (DS-LITE-MTU) being lower than the IPv6 packet }	
Expected behaviour	
ensure that { **when {** the IUT receives an IPv4 packet containing source address indicating a public IPv4 address containing destination address indicating a public IPv4 address with an IPv4 packet size greater than the DS-lite tunnel MTU } **then {** the IUT fragments that IPv4 packet during translation and the IUT forwards correctly formatted IPv6 packets to the CPE } }	

Annex A (informative): Bibliography

ETSI TR 102 881 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Cable Network Handbook", June 2010.

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History

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