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Intelligent Transport Systems (ITS);
Testing;
Conformance test specifications for Transmission of IP packets over GeoNetworking;
Part 3: Abstract Test Suite (ATS) and Protocol Implementation eXtra Information for Testing (PIXIT)

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 3 of a multi-part deliverable covering Conformance test specifications for Transmission of IP packets over GeoNetworking, as identified below:

Part 1: "Test requirements and Protocol Implementation Conformance Statement (PICS) pro forma";

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**", "**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 contains the Abstract Test Suite (ATS) for Transmission of IP packets over GeoNetworking as defined in ETSI EN 302 636-6-1 [1] in compliance with the relevant requirements and in accordance with the relevant guidance given in ISO/IEC 9646-7 [i.5] .

The objective of the present document is to provide a basis for conformance tests for Transmission of IP packets over GeoNetworking equipment.

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [i.2] and ISO/IEC 9646-2 [i.3]) as well as the ETSI rules for conformance testing (ETSI ETS 300 406 [i.6]) are used as a basis for the test methodology.

Annex A provides the Tree and Tabular Combined Notation (TTCN) part of the ATS.

Annex B provides the Partial Protocol Implementation Extra Information for Testing (PIXIT) Pro forma of the ATS.

Annex C provides the Protocol Conformance Test Report (PCTR) Pro forma of the ATS.

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 referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://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 EN 302 636-6-1 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 6: Internet Integration; Sub-part 1: Transmission of IPv6 Packets over GeoNetworking Protocols".

[2] ETSI TS 102 859-1 (V1.3.1): "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for Transmission of IP packets over GeoNetworking; Part 1: Test requirements and Protocol Implementation Conformance Statement (PICS) pro forma".

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 referenced 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] ETSI EG 202 798 (V1.1.1): "Intelligent Transport Systems (ITS); Testing; Framework for conformance and interoperability testing".

[i.2] ISO/IEC 9646-1 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".

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

[i.4] ISO/IEC 9646-6 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 6: Protocol profile test specification".

[i.5] ISO/IEC 9646-7 (1995): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statements".

[i.6] ETSI ETS 300 406 (1995): "Methods for testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

[i.7] ETSI ES 201 873-1 (V4.9.1): "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 1: TTCN-3 Core Language".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 302 636-6-1 [1], ISO/IEC 9646-1 [i.2] and in ISO/IEC 9646-7 [i.5] apply.

3.2 Symbols

Void.

3.3 Abbreviations

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

ATM	Abstract Test Method
ATS	Abstract Test Suite
BI	Invalid Behaviour
BV	Valid Behaviour
EVI	Expired virtual interfaces
GVL	Geographical Virtual Link
IP	Internet Protocol
IPv6	Internet Protocol version 6
ITS	Intelligent Transportation Systems
IUT	Implementation Under Test
MG	Message Generation
MR	Message Reception
MTC	Main Test Component
NVI	New virtual interfaces
PA	Platform Adaptor
PCTR	Protocol Conformance Test Report
PICS	Protocol Implementation Conformance Statement
PIXIT	Partial Protocol Implementation Extra Information for Testing
PX	PiXit
SA	System Adaptor
SAP	Service Access Point
SCS	System Conformance Statement
SCTR	System Conformance Test Report
SUT	System Under Test
TC	Test Case
TP	Test Purposes
TSS	Test Suite Structure
TTCN	Tree and Tabular Combined Notation

TVL	Topological Virtual Link
VM	Virtual Interface Management

4 Abstract Test Method (ATM)

4.1 Abstract protocol tester

The abstract protocol tester used by the IPv6OverGeoNetworking test suite is described in figure 1. The test system will simulate valid and invalid protocol behaviour, and will analyse the reaction of the IUT.

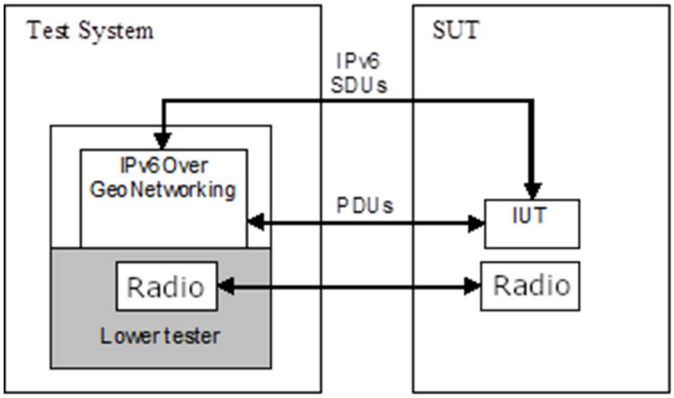

Figure 1: Abstract protocol tester - IPv6OverGeoNetworking

4.2 Test Configuration

The IPv6OverGeoNetworking test suite uses a unique test configuration in order to cover the different test scenarios. In this configuration, the tester simulates one ITS station implementing the IPv6OverGeoNetworking protocol.

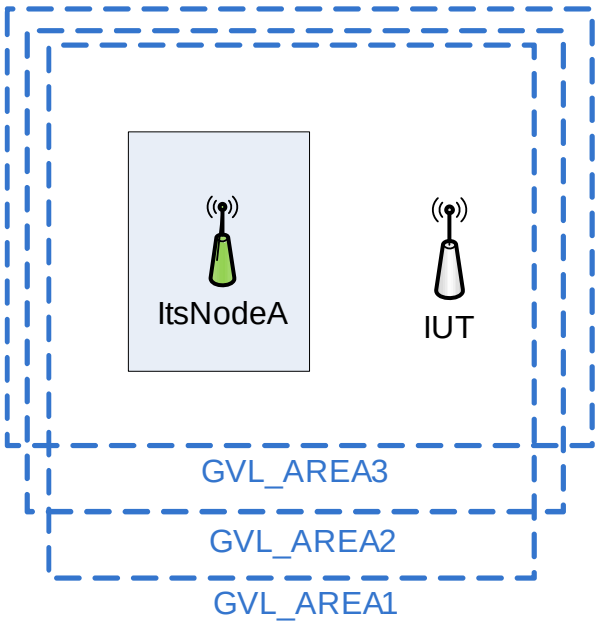

Figure 2: Test configuration CF01

Both IUT and Test system are located in the GeoAreas associated with the three predefined GVLs. Each GVL is associated with an IPv6 prefix which can be parameterized using module parameters.

Table 1: Association between IPv6 prefixes and GVLs

GVL	IPv6 Prefix
GVL_AREA1	PX_GN6_PREFIX_1
GVL_AREA2	PX_GN6_PREFIX_2
GVL_AREA3	PX_GN6_PREFIX_3

4.3 Test Architecture

The present document implements the general TTCN-3 test architecture described in ETSI EG 202 798 [i.1], clause 6.3.2.

Figure 3 shows the TTCN-3 test architecture used in for the GeoNetworking ATS. The IPv6OverGeoNetworking test component requires using only the Main Test Component (MTC). The MTC communicates with the IPv6OverGeoNetworking SUT over the ipv6OverGeoNetworkingPort and geoNetworkingPort. The ipv6OverGeoNetworkingPort port is used to exchange IPv6 protocol messages between the test component and the IUT. The geoNetworkingPort port is used to exchange GeoNetworking protocol messages between the test component and the IUT.

The Upper tester entity in the SUT enables triggering IPv6OverGeoNetworking functionalities by simulating primitives from applications. It is required to trigger the IPv6OverGeoNetworking layer in the SUT to send IPv6OverGeoNetworking messages, which are resulting from upper layer primitives. Furthermore, receiving IPv6OverGeoNetworking messages may result for the IPv6OverGeoNetworking layer in sending primitives to the upper layer.

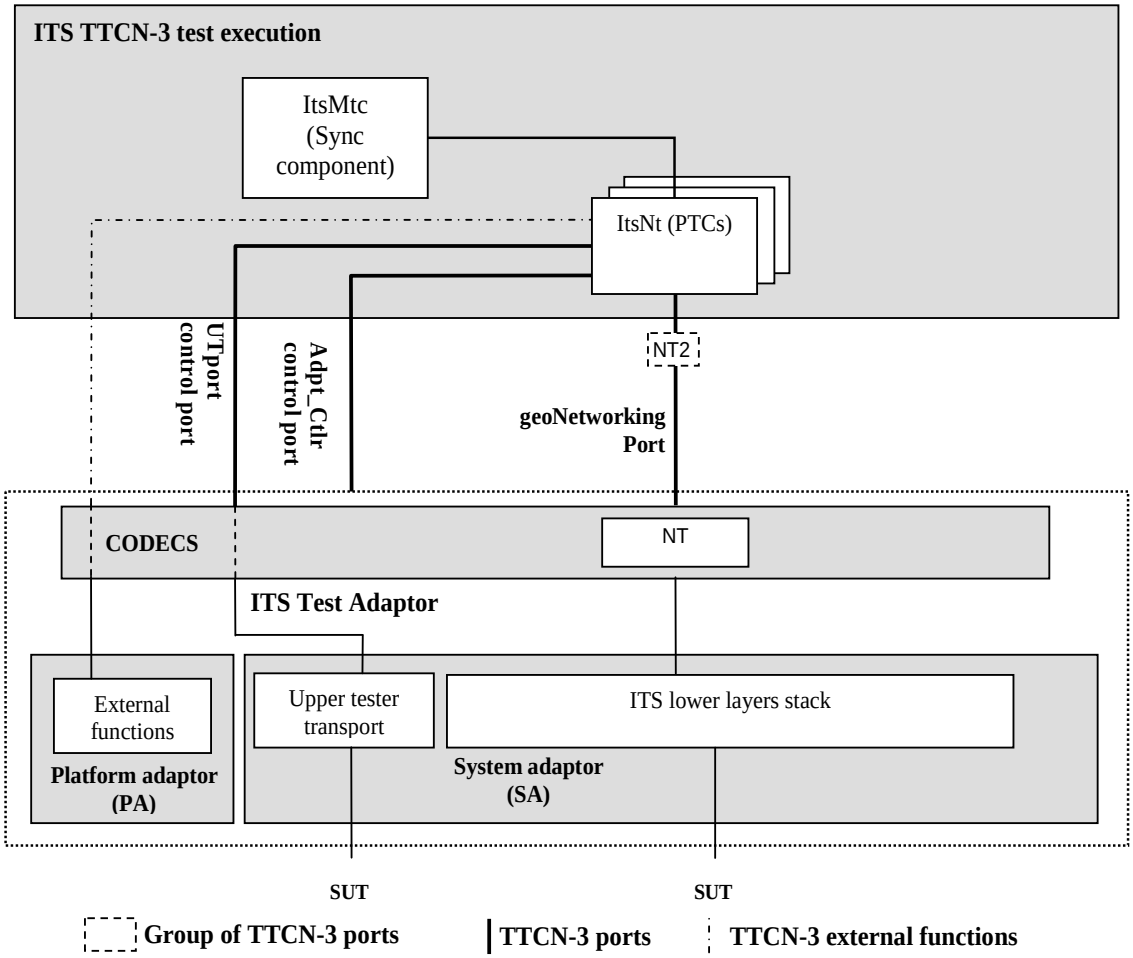

Figure 3: Test System Architecture

4.4 Ports and ASPs (Abstract Services Primitives)

4.4.1 Introduction

Three ports are used by the IPv6OverGeoNetworking ATS:

- The geoNetworkingPort, of type GeoNetworkingPort.
- The ipv6OverGeoNetworkingPort, of type Ipv6OverGeoNetworkingPort.
- The utPort of type UpperTesterPort.

4.4.2 Primitives of the geoNetworkingPort

Two types of primitives are used in the geoNetworkingPort:

- The geoNetworkingInd primitive used to receive messages of type GeoNetworkingPacket.
- The geoNetworkingReq primitive used to send messages of type GeoNetworkingPacket.

4.4.3 Primitives of the ipv6OverGeoNetworkingPort

Two types of primitives are used in the geoNetworkingPort:

- The Ipv6OverGeoNetworkingInd primitive used to receive messages of type IPv6.
- The Ipv6OvergeoNetworkingReq primitive used to send messages of type IPv6.

4.4.4 Primitives of the utPort

This port uses two types of primitives:

- The UtInitialize primitive used to initialise IUT.
- The UtTrigger primitive used trigger upper layer events in IUT.

4.4.5 Primitives of the taPort

This port uses the following primitives to trigger special behaviour in Test Adapter:

- AcGn6InterfaceInfoList used to retrieve the list of IUT's link-layer interfaces with their configured IPv6 addresses.
- AcGetLongPosVector used to retrieve IUT's position (extracted from IUT's beacon messages).

5 Untestable Test Purposes

Table 2 gives a list of TPs, which are not implemented in the ATS due to the chosen ATM or other restrictions.

Table 2: Untestable TP

Test purpose	Reason

6 ATS conventions

6.1 Introduction

The ATS conventions are intended to give a better understanding of the ATS but they also describe the conventions made for the development of the ATS. These conventions shall be considered during any later maintenance or further development of the ATS.

The ATS conventions contain two clauses, the naming conventions and the implementation conventions. The naming conventions describe the structure of the naming of all ATS elements. The implementation conventions describe the functional structure of the ATS.

To define the ATS, the guidelines of the document ETSI ETS 300 406 [i.6] was considered.

6.2 Testing conventions

6.2.1 Testing states

6.2.1.1 Initial state

All test cases start with the function f_prInitialState. This function brings the IUT in an "initialized" state by invoking the upper tester primitive UtInitialize.

6.2.1.2 Final state

All test cases end with the function f_poDefault. This function brings the IUT back in an "idle" state. As no specific actions are required for the idle state in the base standard, the function f_poDefault does not invoke any action.

As necessary, further actions may be included in the f_poDefault function.

6.3 Naming conventions

6.3.1 Introduction

This test suite follows the naming convention guidelines provided in ETSI EG 202 798 [i.1].

6.3.2 General guidelines

The naming convention is based on the following underlying principles:

- in most cases, identifiers should be prefixed with a short alphabetic string (specified in table 3) indicating the type of TTCN-3 element it represents;
- suffixes should not be used except in those specific cases identified in table 2;
- prefixes and suffixes should be separated from the body of the identifier with an underscore ("_");

EXAMPLE 1: `c_sixteen, t_wait`.

- only module names, data type names and module parameters should begin with an upper-case letter. All other names (i.e. the part of the identifier following the prefix) should begin with a lower-case letter;
- the start of second and subsequent words in an identifier should be indicated by capitalizing the first character. Underscores should not be used for this purpose.

EXAMPLE 2: `f_initialState`.

Table 3 specifies the naming guidelines for each element of the TTCN-3 language indicating the recommended prefix, suffixes (if any) and capitalization.

Table 3: ETSI TTCN-3 generic naming conventions

Language element	Naming convention	Prefix	Example identifier
Module	Use upper-case initial letter	none	IPv6Templates
Group within a module	Use lower-case initial letter	none	messageGroup
Data type	Use upper-case initial letter	none	SetupContents
Message template	Use lower-case initial letter	m_	m_setupInit
Message template with wildcard or matching expression	Use lower-case initial letters	mw_	mw_anyUserReply
Modifying message template	Use lower-case initial letter	md_	md_setupInit
Modifying message template with wildcard or matching expression	Use lower-case initial letters	mdw_	mdw_anyUserReply
Signature template	Use lower-case initial letter	s_	s_callSignature
Port instance	Use lower-case initial letter	none	signallingPort
Test component instance	Use lower-case initial letter	none	userTerminal
Constant	Use lower-case initial letter	c_	c_maxRetransmission
Constant (defined within component type)	Use lower-case initial letter	cc_	cc_minDuration
External constant	Use lower-case initial letter	cx_	cx_macId
Function	Use lower-case initial letter	f_	f_authentication()
External function	Use lower-case initial letter	fx_	fx_calculateLength()
Altstep (incl. Default)	Use lower-case initial letter	a_	a_receiveSetup()
Test case	Use ETSI numbering	TC_	TC_COR_0009_47_ND
Variable (local)	Use lower-case initial letter	v_	v_macId
Variable (defined within a component type)	Use lower-case initial letters	vc_	vc_systemName
Timer (local)	Use lower-case initial letter	t_	t_wait
Timer (defined within a component)	Use lower-case initial letters	tc_	tc_authMin
Module parameters for PICS	Use all upper case letters	PICS_	PICS_DOOROPEN
Module parameters for other parameters	Use all upper case letters	PX_	PX_TESTER_STATION_ID
Formal Parameters	Use lower-case initial letter	p_	p_macId
Enumerated Values	Use lower-case initial letter	e_	e_syncOk

6.3.3 ITS specific TTCN-3 naming conventions

Next to such general naming conventions, table 4 shows specific naming conventions that apply to the ITS TTCN-3 test suite.

Table 4: ITS specific TTCN-3 naming conventions

Language element	Naming convention	Prefix	Example identifier
ITS Module	Use upper-case initial letter	Its"IUTname"_	ItsIpv6OverGeoNetworking_
Module containing types and values	Use upper-case initial letter	Its"IUTname"_TypesAndValues	ItsIpv6OverGeoNetworking_TypesAndValues
Module containing Templates	Use upper-case initial letter	Its"IUTname"_Templates	ItsIpv6OverGeoNetworking_Templates
Module containing test cases	Use upper-case initial letter	Its"IUTname"_TestCases	ItsIpv6OverGeoNetworking_TestCases
Module containing functions	Use upper-case initial letter	Its"IUTname"_Functions	ItsIpv6OverGeoNetworking_Functions
Module containing external functions	Use upper-case initial letter	Its"IUTname"_ExternalFunctions	ItsIpv6OverGeoNetworking_ExternalFunctions
Module containing components, ports and message definitions	Use upper-case initial letter	Its"IUTname"_Interface	ItsIpv6OverGeoNetworking_Interface
Module containing main component definitions	Use upper-case initial letter	Its"IUTname"_TestSystem	ItsIpv6OverGeoNetworking_TestSystem
Module containing the control part	Use upper-case initial letter	Its"IUTname"_TestControl	ItsIpv6OverGeoNetworking_TestControl

6.3.4 Usage of Log statements

All TTCN-3 log statements use the following format using the same order:

- Three asterisks.
- The TTCN-3 test case or function identifier in which the log statement is defined.
- One of the categories of log: INFO, WARNING, ERROR, PASS, FAIL, INCONC, TIMEOUT.
- Free text.
- Three asterisks.

EXAMPLE 1:
```
log("*** f_utInitializeIut: INFO: IUT initialized ***");
```

Furthermore, the following rules are applied for the IPv6OverGeoNetworking ATS:

- Log statements are used in the body of the functions, so that invocations of functions are visible in the test logs.
- All TTCN-3 setverdict statements are combined (as defined in TTCN-3 - ETSI ES 201 873-1 [i.7]) with a log statement following the same above rules (see example 2).

EXAMPLE 2:
```
setverdict(pass, "*** TC_IPV6GEO_MG_GVL_BV_01: PASS: Received
correct GeoNetworking GeoBroadcast ***");
```

6.3.5 Test Case (TC) identifier

Table 5: TC naming convention

Identifier:	**TC_<root>_<gr>_<sgr>_<x>_<nn>**		
	<root> = root	IPv6GEO	IPv6 over GeoNetworking
	<gr> = group	MG	Message Generation
		MR	Message Reception
		VM	Virtual Interface Management
	<sgr> = subgroup	GVL	GVL
		TVL	TVL
		NVI	New virtual interfaces
		EVI	Expired virtual interfaces
	<x> = type of testing	BV	Valid Behaviour tests
		BI	Invalid Syntax or Behaviour Tests
	<nn> = sequential number		01 to 99

EXAMPLE: TP identifier: TP/IPv6GEO/MG/GVL/BV/03
TC identifier: TC_IPv6GEO_MG_GVL_BV_03

Annex A (normative): TTCN-3 library modules

A.1 Electronic annex, the TTCN-3 code

This ATS has been produced using the Testing and Test Control Notation (TTCN) according to ETSI ES 201 873-1 [i.7].

This test suite has been compiled error-free using two different commercial TTCN-3 compilers.

The TTCN-3 library modules, which form parts of the present technical standard, are released in the ETSI forge repository: https://forge.etsi.org/rep/ITS/ttcn/ats_gnipv6_ts102859-3/-/releases/v1.3.1

Annex B (normative): Partial PIXIT pro forma for IPV6overGEONET

B.1 The right to copy

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the Partial PIXIT pro forma in this annex so that it can be used for its intended purposes and may further publish the completed Partial PIXIT.

B.2 Identification summary

Table B.1

PIXIT Number:	
Test Laboratory Name:	
Date of Issue:	
Issued to:	

B.3 ATS summary

Table B.2

Protocol Specification:	ETSI EN 302 636-6-1
Protocol to be tested:	IPV6overGEONET
ATS Specification:	ETSI TS 102 859-3
Abstract Test Method:	Clause 4

B.4 Test laboratory

Table B.3

Test Laboratory Identification:	
Test Laboratory Manager:	
Means of Testing:	
SAP Address:	

B.5 Client identification

Table B.4

Client Identification:	
Client Test manager:	
Test Facilities required:	

B.6 SUT

Table B.5

Name:	
Version:	
SCS Number:	
Machine configuration:	
Operating System Identification:	
IUT Identification:	
PICS Reference for IUT:	
Limitations of the SUT:	
Environmental Conditions:	

B.7 Protocol layer information

B.7.1 Protocol identification

Table B.6

Name:	ETSI EN 302 636-6-1
Version:	
PICS References:	ETSI TS 102 859-1

B.7.2 IUT information

Table B.7: Ipv6OverGeonetw PIXITs

Identifier	Description	
PX_T_BUILD_CONFIG	**Comment**	Time for building the configuration and virtual interfaces dynamically
	Type	float
	Default value	5,0
PX_GN6_PREFIX_1	**Comment**	IPv6 prefix 1 to be used for defining GVL 1
	Type	Oct16
	Default value	'3FFE0000000000010000000000000000'O
PX_GN6_PREFIX_2	**Comment**	IPv6 prefix 2 to be used for defining GVL 2
	Type	Oct16
	Default value	'3FFE0000000000010000000000000000'O
PX_GN6_PREFIX_3	**Comment**	IPv6 prefix 3 to be used for defining GVL 3
	Type	Oct16
	Default value	'3FFE0000000000010000000000000000'O
PX_GN6_PREFIX_LENGTH_1	**Comment**	Length of IPv6 prefix 1
	Type	UInt8
	Default value	64
PX_GN6_PREFIX_LENGTH_2	**Comment**	Length of IPv6 prefix 2
	Type	UInt8
	Default value	64
PX_GN6_PREFIX_LENGTH_3	**Comment**	Length of IPv6 prefix 3
	Type	UInt8
	Default value	64
PX_GN6_TVL_INTERFACE_NAME	**Comment**	Name of IUT's virtual interface associated with TVL
	Type	charstring
	Default value	"tvl0"

Annex C (normative): PCTR Pro forma for IPv6overGEONET

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Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the PCTR pro forma in this annex so that it can be used for its intended purposes and may further publish the completed PCTR.

C.2 Introduction

The PCTR pro forma is based on ISO/IEC 9646-6. Any needed additional information can be found in this International standard document.

C.3 Identification summary

C.3.1 Protocol conformance test report

Table C.1

PCTR Number:	
PCTR Date:	
Corresponding SCTR Number:	
Corresponding SCTR Date:	
Test Laboratory Identification:	
Test Laboratory Manager:	
Signature:	

C.3.2 IUT identification

Table C.2

Name:	
Version:	
Protocol specification:	
PICS:	
Previous PCTR if any:	

C.3.3 Testing environment

Table C.3

PIXIT Number:	
ATS Specification:	
Abstract Test Method:	
Means of Testing identification:	
Date of testing:	
Conformance Log reference(s):	
Retention Date for Log reference(s):	

C.3.4 Limits and reservation

Additional information relevant to the technical contents or further use of the test report, or the rights and obligations of the test laboratory and the client, may be given here. Such information may include restriction on the publication of the report.

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C.3.5 Comments

Additional comments may be given by either the client or the test laboratory on any of the contents of the PCTR, for example, to note disagreement between the two parties.

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C.4 IUT Conformance status

This IUT has or has not been shown by conformance assessment to be non-conforming to the specified protocol specification.

Strike the appropriate words in this sentence. If the PICS for this IUT is consistent with the static conformance requirements (as specified in clause C.3 in the present document) and there are no "FAIL" verdicts to be recorded (in clause C.6 in the present document) strike the words "has or", otherwise strike the words "or has not".

C.5 Static conformance summary

The PICS for this IUT is or is not consistent with the static conformance requirements in the specified protocol.

Strike the appropriate words in this sentence.

C.6 Dynamic conformance summary

The test campaign did or did not reveal errors in the IUT.

Strike the appropriate words in this sentence. If there are no "FAIL" verdicts to be recorded (in clause C.8 of the present document) strike the words "did or" otherwise strike the words "or did not".

Summary of the results of groups of test:

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C.7 Static conformance review report

If clause C.3 indicates non-conformance, this clause itemizes the mismatches between the PICS and the static conformance requirements of the specified protocol specification.

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C.8 Test campaign report

Table C.4: test cases

ATS Reference	Selected?	Run?	Verdict	Observations (Reference to any observations made in clause C.7)
TC_IPv6GEO_MG_GVL_BV_01	Yes/No	Yes/No		
TC_IPv6GEO_MG_GVL_BV_02	Yes/No	Yes/No		
TC_IPv6GEO_MG_GVL_BV_03	Yes/No	Yes/No		
TC_IPv6GEO_MG_GVL_BV_04	Yes/No	Yes/No		
TC_IPv6GEO_MG_GVL_BV_05	Yes/No	Yes/No		
TC_IPv6GEO_MG_TVL_BV_01	Yes/No	Yes/No		
TC_IPv6GEO_MG_TVL_BV_02	Yes/No	Yes/No		
TC_IPv6GEO_MG_TVL_BV_03	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_01	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_02	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_03	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_04	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_05	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_06	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_07	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_08	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_09	Yes/No	Yes/No		
TC_IPv6GEO_MR_GVL_BV_10	Yes/No	Yes/No		
TC_IPv6GEO_MR_TVL_BV_01	Yes/No	Yes/No		
TC_IPv6GEO_VM_NVI_BV_01	Yes/No	Yes/No		
TC_IPv6GEO_VM_EVI_BV_01	Yes/No	Yes/No		

C.9 Observations

Additional information relevant to the technical content of the PCTR is given here.

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Annex D (informative): Bibliography

ETSI TS 102 859-2 (V1.2.1): "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for Transmission of IP packets over GeoNetworking; Part 2: Test Suite Structure and Test Purposes (TSS & TP)".

History

Document history		
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