ETSI TS 103 192-3 V1.2.1 (2022-02)

TECHNICAL SPECIFICATION

Intelligent Transport Systems (ITS);
Testing;
Interoperability test specifications for ITS V2X use cases;
Part 3: Abstract Test Suite (ATS) and
Protocol Implementation eXtra Information for Testing (PIXIT)

Reference

RTS/ITS-217

Keywords

ATS, interoperability, ITS, testing

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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 C-ITS test specification for automated interoperability testing as identified below:

Part 1: "Test requirements and Interoperability Feature Statement (IFS) 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)".

The development of ITS test specifications follows the guidance provided in the ETSI EG 202 798 [i.1]. Therefore, the ATS documentation outlined in the present document is also based on the guidance provided in ETSI EG 202 798 [i.1].

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 provides parts of the Abstract Test Suite (ATS) for ITS Interoperability scenarios. The objective of the present document is to provide a basis for automated interoperability testing.

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.

Not applicable.

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

[i.2]   ETSI EN 302 637-2: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[i.3]   ISO/IEC 9646-1 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

[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 ES 201 873-1: "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 302 637-2 [i.2], ISO/IEC 9646-1 [i.3] and 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
BO	Inopportune test events for Behaviour tests
BV	Valid test events for Behaviour tests
CA	Cooperative Awareness
CAM	Cooperative Awareness Message
CAN	Controller Area Network
CF	Configuration
COH	Common Header
CRW	Collision Risk Warning
DAD	Duplicate Address Detection
DEN	Decentralized Environmental Notification
DENM	Decentralized Environmental Notification Message
EN	European Standard
ES	ETSI Standard
EUT	Equipment Under Test
FDV	Formatting and Data Validity
GEONW	GeoNetworking
GMC	Geo-broadcast Message Caching
HMI	Human Machine Interface
ISO	International Organization for Standardization
ITS	Intelligent Transportation Systems
IUT	Implementation Under Test
LOT	Location Table
MAC	Media Access Control
MFW	Message Forwarding
NBD	Neighbours Detection
PCTR	Protocol Conformance Test Report
PICS	Protocol Implementation Conformance Statement
PIXIT	Partial Protocol Implementation eXtra Information for Testing
PON	Protocol Operation
PX	Pixit
RHS	Road Hazard Signals
RSU	Road Side Unit
RWW	Road Works Warning configuration
SAP	Service Access Point
SCS	System Conformance Statement
SCTR	Static Conformance Test Report
SUT	System Under Test
SVW	Stationary Vehicle Warning
TC	Test Case
TI	Timer test
TP	Test Purposes

TS	Technical Specification
TSS	Test Suite Structure
TTCN	Testing and Test Control Notation

4   Abstract Test Method (ATM)

4.1   Test Configuration

4.1.1   CF-01: Verify complete forwarding message scenario

There are two independent geonetworking areas defined:

1) EUT1 is the source

2) EUT2 is closer to TARGET_GEOAREA than EUT3

3) EUT4 is in the destination area (TARGET_GEOAREA)

4) EUT1, EUT2 and EUT3 are on-link

5) EUT2, EUT3 and EUT4 are on-link

6) EUT1 and EUT4 are off-link
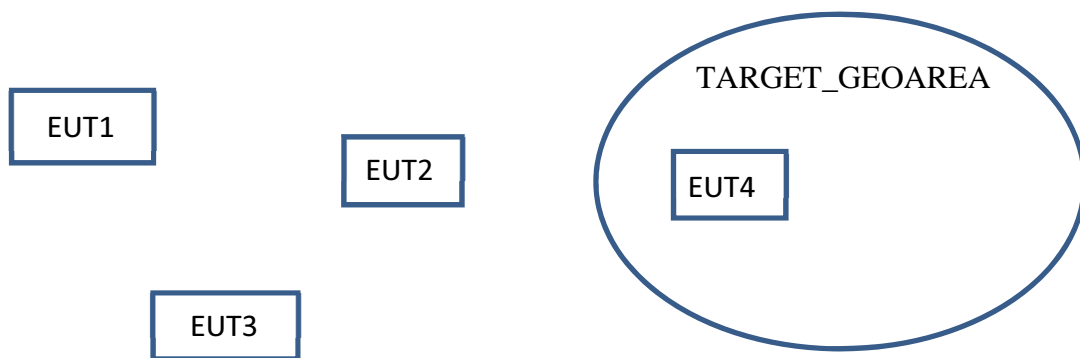
Figure 1: DEN message forward

4.1.2   CF-02: Road Works Warning configuration

1) EUT1 and EUT2 are on-link.

2) EUT1 and EUT2 are located in the same Geonetworking area.

3) EUT1 acts as a RSU.

4) EUT2 acts as a vehicle.

5) EUT2 is moving from Start position to End position.
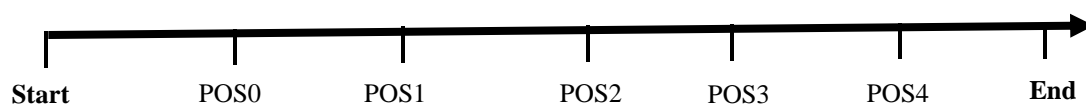
Figure 2: Road Works Warning configuration

4.1.3   CF-03: CA messages

1)   EUT1, EUT2 and EUT3 are on-link.

2)   EUT1, EUT2 and EUT3 are located in the same Geonetworking area.

3)   EUT1, EUT2 and EUT3 act as vehicle.

4)   EUT1, EUT2 and EUT3 are moving.

4.1.4   CF-04: Intersection Collision Warning configuration

1)   EUT1 and EUT2 are on-link.

2)   EUT1 and EUT2 are located in the same Geonetworking area.

3)   EUT1 (vehicle) in moving from Start1 position to End1 position.

4)   EUT2 (vehicle) in moving from Start2 position to End2 position.

5)   Positions POS0 and POS1 are located at the same distance from the intersection.

6)   EUT1 respectively EUT2 shall pass the position POS0 respectively POS1 at the same time.
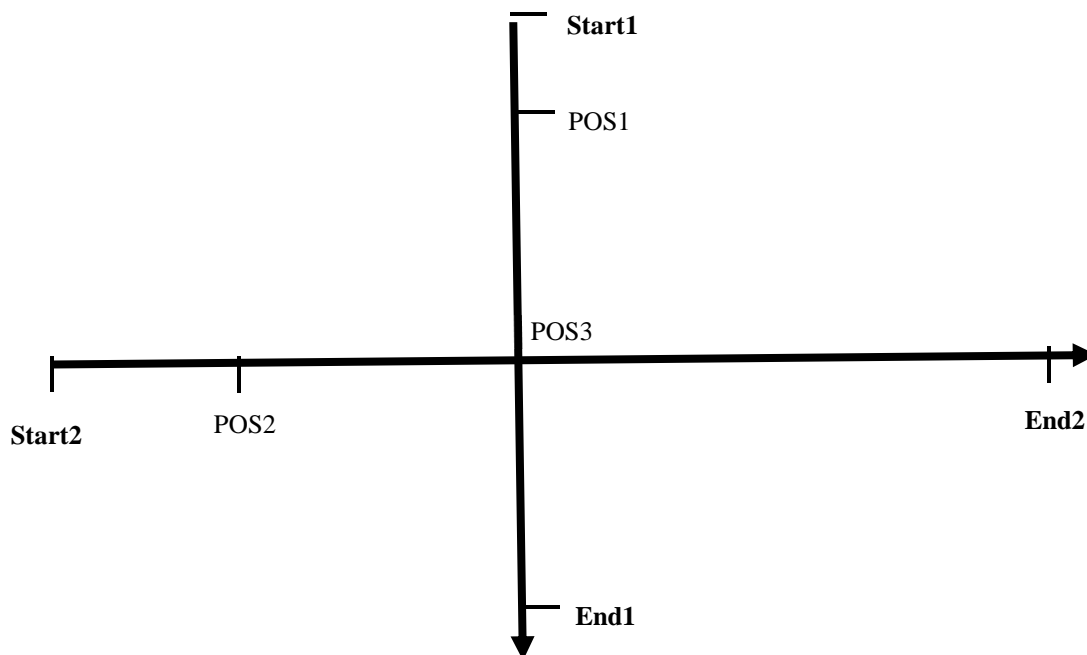
Figure 3: Road Works Warning configuration

4.2   Ports and ASPs (Abstract Services Primitives)

4.2.1   Introduction

Two ports are used by the GeoNetworking ATS:

* The geoNetworkingPort, of type GeoNetworkingPort

* The utPort of type UpperTesterPort

* The hmiPort of type HmiPort

4.2.2   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

4.2.3   Primitives of the utPort

This port uses two types of primitives:

- The UtGnInitialize primitive used to initialize EUT

- The UtTrigger primitive used trigger upper layer events in EUT

4.2.4   Primitives of the hmiPort

This port uses two types of primitives:

- The HmiInitialize primitive used to initialize HMI EUT

- The HmiTrigger primitive used trigger upper layer events in HMI EUT

4.2.5   Primitives of the taPort

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

- AcStartBeaconing: Test adapter shall start sending beacon messages for a simulated ITS node

- AcStopBeaconing: Test adapter shall stop sending beacon messages for a simulated ITS node

- AcStartPassBeaconing: Test adapter shall transmit received beacon messages to TTCN-3 script

- AcStopPassBeaconing: Test adapter shall not transmit received beacon messages to TTCN-3 script

- AcStartBeaconingMultipleNeighbour: Test adapter shall start sending beacon messages for multiple simulated ITS nodes

- AcStopBeaconingMultipleNeighbour: Test adapter shall stop sending beacon messages for multiple simulated ITS nodes

- AcGetLongPosVector used to retrieve EUT's position (extracted from EUT's beacon messages)

5   Untestable Test Purposes

Table 1 gives a list of TP, which are not implemented in the ATS due to the restriction of the chosen ATM.

Table 1: Untestable TP

Test purpose	Reason
None	

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 testing conventions and the naming conventions. The testing conventions describe the functional structure of the ATS. The naming conventions describe the structure of the naming of all ATS elements.

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 EUT 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 EUT 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 2) 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 2 specifies the naming guidelines for each element of the TTCN-3 language indicating the recommended prefix, suffixes (if any) and capitalization.

Table 2: 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
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 3 shows specific naming conventions that apply to the ITS TTCN-3 test suite.

Table 3: ITS specific TTCN-3 naming conventions

Language element	Naming convention	Prefix	Example identifier
ITS Module	Use upper-case initial letter	Its"IUTname"_	ItsGeoNetworking_
Module containing types and values	Use upper-case initial letter	Its"IUTname"_TypesAndValues	ItsGeoNetworking_TypesAndValues
Module containing Templates	Use upper-case initial letter	Its"IUTname"_Templates	ItsGeoNetworking_Templates
Module containing test cases	Use upper-case initial letter	Its"IUTname"_TestCases	ItsGeoNetworking_TestCases
Module containing functions	Use upper-case initial letter	Its"IUTname"_Functions	ItsGeoNetworking_Functions
Module containing external functions	Use upper-case initial letter	Its"IUTname"_ExternalFunctions	ItsGeoNetworking_ExternalFunctions
Module containing components, ports and message definitions	Use upper-case initial letter	Its"IUTname"_Interface	ItsGeoNetworking_Interface
Module containing main component definitions	Use upper-case initial letter	Its"IUTname"_TestSystem	ItsGeoNetworking_TestSystem
Module containing the control part	Use upper-case initial letter	Its"IUTname"_TestControl	ItsGeoNetworking_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("*** TC_GEONW_PON_LOT_BV_02: INFO: Preamble: Received and answered Location Service Request
***");
```

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

- Log statements are used in the body of the functions, so that invocation of functions are visible in the test logs

- All TTCN-3 set verdict statement are combined (as defined in TTCN-3 as defined in ETSI ES 201 873-1 [i.6]) with a log statement following the same above rules (see example 2)

EXAMPLE 2:

```
setverdict(pass, "*** TC_GEONW_FDV_COH_BV_01: PASS: Common Header correctly formatted ***");
```

6.3.5   Test Case (TC) identifier

Table 4 shows the test case naming convention, which follows the same naming convention as the test purposes.

Table 4: TC naming convention

Identifier:	TC_<root>_<gr>_<x>_<nn>		
	<root> = root	AUTO_IOT	ITS interoperability testing
	<gr> = group	CAM	CAM messages testing
		DENM	DENM message testing
	<sgr> = sub-group	MFW	Message forwarding
		RWW	Road Works Warning
		RHS	Road Hazard Signal
		SVW	Stationary Vehicle Warning
		GMC	Geo-broadcast message caching
		NBD	Neighbours detection
		CRW	Collision risk Warning
		DAD	Duplicate Address Detection
	<x> = type of testing	BV	Valid Behaviour tests
		BO	Invalid Syntax or Behaviour Tests
		TI	Timer tests
	<nn> = sequential number		01 to 99

EXAMPLE: TD identifier: TD_AUTO_IOT_DENM_MFW_BV_01
                TC identifier: TC_AUTO_IOT_DENM_MFW_BV_01

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.6].

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 document, are released as a tagged version "v1.2.1" at ETSI forge repository:

- https://forge.etsi.org/rep/ITS/ttcn/autointerop_ts103192_3/-/releases/v1.2.1

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

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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 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 Introduction

The PIXIT Pro forma is based on ISO/IEC 9646-6. Any needed additional information can be found in ISO/IEC 9646-6.

B.3 Identification summary

Table B.1

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

B.4 ATS summary

Table B.2

Protocol Specification:	ETSI EN 302 636-4-1
Protocol to be tested:	AUTOIOP (ITS Interoperability)
ATS Specification:	ETSI TS 103 192-3
Abstract Test Method:	Clause 4

B.5 Test laboratory

Table B.3

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

B.6 Client identification

Table B.4

Client Identification:	
Client Test manager:	
Test Facilities required:	

B.7 SUT

Table B.5

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

B.8 Protocol layer information

B.8.1 Protocol identification

Table B.6

Name:	
Version:	
PICS References:	

B.8.2 EUT information

Table B.7: AutoInterop PIXITS

Identifier	Description	
PX_CAPTURE_MODE	Comment	ITS capture mode: on-link or off-link
	Type	Charstring
	Def. value	"on-link"
PX_PCAP_FILE_NAME	Comment	The PCAP file name containing the ITS captures
	Type	Charstring
	Def. value	
PX_PCAP_MIDs_FILTER	Comment	The PCAP filtering to apply
	Type	Charstring
	Def. value	
PX_T_DELTA	Comment	Delta for timers to reflect processing time
	Type	float
	Def. value	0,1
PX_PCAP_START_OFFSET	Comment	The PCAP frame offsets to skip when starting to play the PCAP file
	Type	integer
	Def. value	0
PX_EUT_DESC	Comment	EUTs descriptions
	Type	EutDescriptions
	Def. value	
PX_EUT1_ID PX_EUT2_ID PX_EUT3_ID PX_EUT4_ID	Comment	EUT role identifier
	Type	integer
	Def. value	0..sizeof(PX_EUT_DESC)-1
PX_PRE_DEFINED_SECURITY_DISTANCE	Comment	Pre-defined security distance
	Type	float
	Def. value	0
PX_FORWARD_COLLISION_SECURITY_DISTANCE	Comment	Pre-defined security distance for forward collision risk condition
	Type	float
	Def. value	0.0
PX_LATERAL_COLLISION_SECURITY_DISTANCE	Comment	Pre-defined security distance for forward collision risk condition
	Type	Float
	Def. value	0.0
PX_DISTANCE_EPSILON	Comment	Acceptable error (in meter) when calculating difference between the positions of the IUT and RSU
	Type	Float
	Def. value	1.0
PX_DENM_CAUSE_VA	Comment	Variant for DENM Cause
	Type	integer
	Def. value	94
PX_DENM_SUBCAUSE_VA	Comment	Variant for DENM SubCause
	Type	integer
	Def. value	5

Annex C (normative):
PCTR pro forma for GeoNetworking

## C.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 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 ISO/IEC 9646-6.

## 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	EUT 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   EUT Conformance status

This EUT 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 EUT 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 EUT 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 EUT.

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_AUTO_IOT_DENM_MFW_BV_01	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_02	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_03	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_04	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_05	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_06	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_03	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_MFW_BV_08	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_RWW_BV_01	Yes/No	Yes/No		

ATS Reference	Selected?	Run?	Verdict	Observations (Reference to any observations made in clause C.7)
TC_AUTO_IOT_DENM_RHS_BV_01	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_SVW_BV_01	Yes/No	Yes/No		
TC_AUTO_IOT_DENM_GMC_BV_01	Yes/No	Yes/No		
TC_AUTO_IOT_CAM_NBD_BV_01	Yes/No	Yes/No		
TC_AUTO_IOT_CAM_CRW_BV_01	Yes/No	Yes/No		
TC_AUTO_IOT_GN_DAD_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

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- ETSI EN 302 636-5-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".

- ETSI EN 302 637-3: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

- ETSI TS 101 556-1: "Intelligent Transport Systems (ITS); Infrastructure to Vehicle Communication; Electric Vehicle Charging Spot Notification Specification".

- ETSI TS 102 894-2 (V1.3.1): "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

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History

Document history		
V1.1.1	September 2018	Publication
V1.2.1	February 2022	Publication