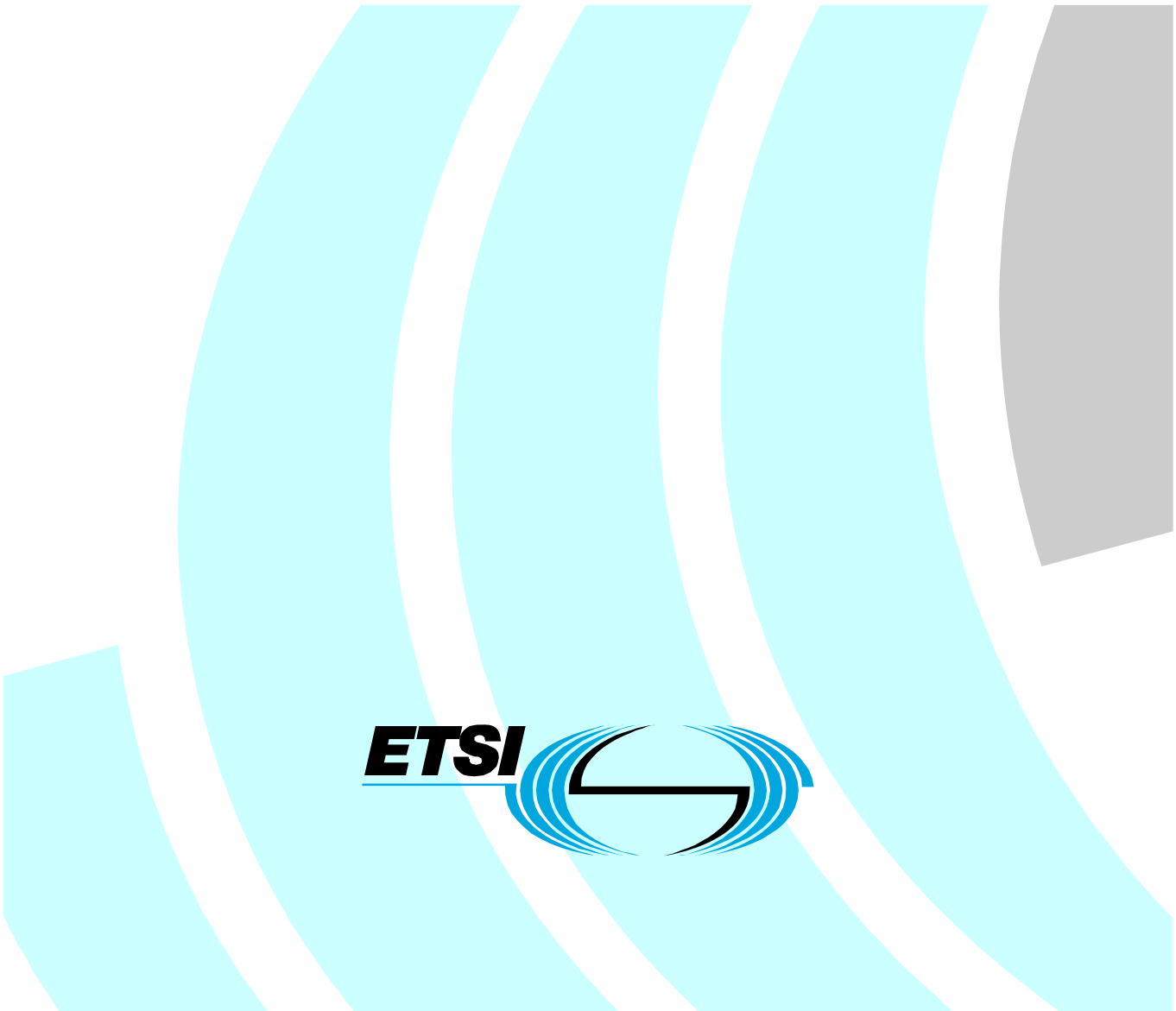
ETSI TS 102 869-3 V1.1.1 (2011-03)

Technical Specification

Intelligent Transport Systems (ITS);
Testing;
Conformance test specification for
Decentralized Environmental Notification Messages (DENM);
Part 3: Abstract Test Suite (ATS) and
Protocol Implementation eXtra Information for Testing (PIXIT)



Reference
DTS/ITS-0010008-3

Keywords
ATS, ITS, testing

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Contents

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Foreword

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

The present document is part 1 of a multi-part deliverable covering Conformance test specification for Decentralized Environmental Notification Messages (DENM) as identified below:

Part 1: "Test requirements and 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)".

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

1 Scope

The present document contains the Abstract Test Suite (ATS) for Decentralized Environmental Notification Basic Service (DENM) as defined in TS 102 637-3 [1] in compliance with the relevant requirements and in accordance with the relevant guidance given in ISO/IEC 9646-7 [5].

The objective of the present document is to provide a basis for conformance tests for Decentralized Environmental Notification Basic Service (DENM) equipment giving a high probability of inter-operability between different manufacturer's equipment.

The ISO standard 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 (ETS 300 406 [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 102 637-3 (V1.1.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

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

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

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

[7] 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".

[8] ETSI ES 201 873-7: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 7: Using ASN.1 with TTCN-3".

[9] ETSI TS 102 869-1: "Intelligent Transport Systems (ITS); Testing; Conformance test specification for Decentralized Environmental Notification Messages (DENM); Part 1: Test requirements and Protocol Implementation Conformance Statement (PICS) proforma".

[10] ETSI TS 102 869-2: "Intelligent Transport Systems (ITS); Testing; Conformance test specification for Decentralized Environmental Notification Messages (DENM); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".

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

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

- terms given in TS 102 637-3 [1];
- terms given in ISO/IEC 9646-1 [2] and in ISO/IEC 9646-7 [5].

3.2 Abbreviations

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

ATM	Abstract Test Method
ATS	Abstract Test Suite
CAM	Co-operative Awareness Message
CAN	Controller Area Network
DENM	Decentralized Environmental Notification Message
FA	name of interface between facilities layer and ITS-S applications
ITS	Intelligent Transportation Systems
IUT	Implementation Under Test
LDM	Local Dynamic Map
MTC	Main Test Component
PIXIT	Partial Protocol Implementation Extra Information for Testing
SA	System Adaptor
SCS	System Conformance Statement
SUT	System Under Test
TC	Test Case
TP	Test Purposes
TTCN	Tree and Tabular Combined Notation
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle

4 Abstract Test Method (ATM)

This clause describes the ATM used to test the Decentralized Environmental Notification Basic Service (DENM).

4.1 Abstract protocol tester

The abstract protocol tester used by this 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.

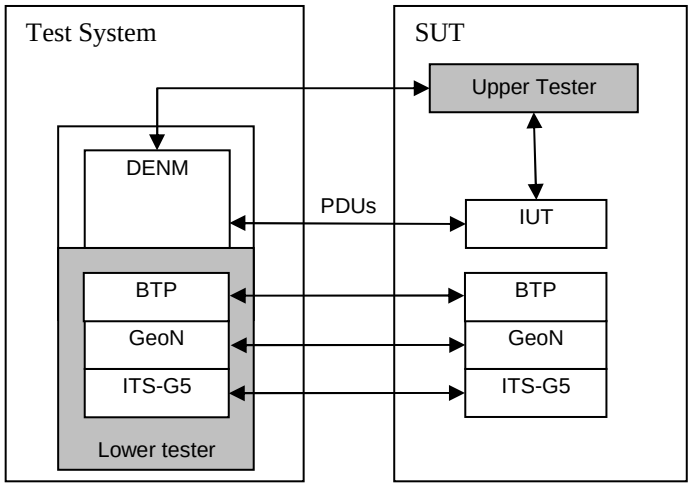

Figure 1: Abstract protocol tester - DENM

4.2 Test Configuration

This 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 DENM protocol.

4.3 Test architecture

This ITS DENM test specification implements the general TTCN-3 test architecture described in EG 202 798 [i.1], clauses 6.3.2 and 8.3.1.

Figure 2 shows the test architecture used in for the DENM ATS. The DENM test component requires using only the Main Test Component (MTC). The MTC communicates with the DENM SUT over the denmPort. The denmPort port is used to exchange DENM protocol messages between the DENM test component and the DENM IUT.

The Upper tester entity in the SUT enables triggering DENM functionalities by simulating primitives from application or LDM entities. It is required to trigger the DENM layer in the SUT to send DENM messages, which are resulting from upper layer primitives. Furthermore, receiving DENM messages may result for the DENM layer in sending primitives to the upper layer (sending Data to LDM for instance).

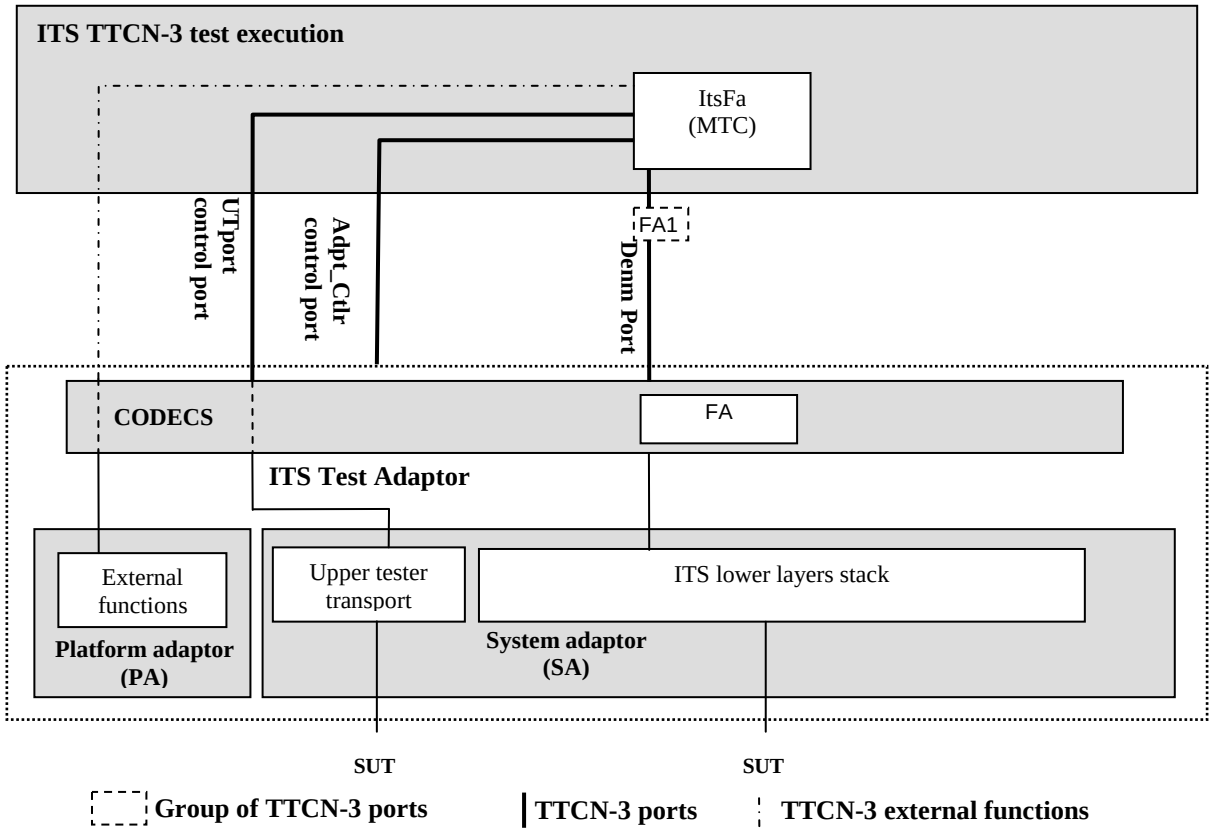

Figure 2: test system architecture

4.4 Ports and ASPs (Abstract Services Primitives)

Two ports are used by the DENM ATS:

- The denmPort, of type DenmPort.
- The utPort of type UpperTesterPort.

4.4.1 Primitives of the denmPort

Two types of primitives are used in the denmPort:

- The DenmInd primitive, containing the received messages of type DenmPdu, and a timestamp corresponding to the receipt time.
- The DenmReq primitive containing the sent messages of type DenmPdu.

The DenmPdu type,is declared in the DENM.asn ASN.1 module, following the ASN.1 definition from the base standard.

```
DenmPdu ::= SEQUENCE {
    header  ItsPduHeader,
    denm    DecentralizedEnvironmentalNotificationMessage
}
```

4.4.2 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.

5 Untestable Test Purposes

This clause gives a list of TP, which are not implemented in the ATS due to the chosen ATM or other restrictions.

Table 1: Untestable TP

Test purpose	Reason
None	

6 ATS conventions

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.

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

6.1 Testing conventions

6.1.1 Testing states

6.1.1.1 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.

6.1.1.2 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.

6.1.2 Message types - ASN.1 definitions

As in the DENM base standard, message types are defined in ASN.1. ASN.1 definitions from the base standard are directly imported in TTCN-3 using the ASN.1 import method specified in ES 201 873-7 [8].

The following example shows the TTCN-3 import statement used to import ASN.1 definitions in the TTCN-3 modules:

```
import from DENM_PDU_Descriptions language "ASN.1:1997" all;
```

6.2 Naming conventions

6.2.1 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 7;
- 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
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

6.2.2 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"_	ItsDenm_
Module containing types and values	Use upper-case initial letter	Its"IUTname"_TypesAndValues	ItsDenm_TypesAndValues
Module containing Templates	Use upper-case initial letter	Its"IUTname"_Templates	ItsDenm _Templates
Module containing test cases	Use upper-case initial letter	Its"IUTname"_TestCases	ItsDenm _TestCases
Module containing functions	Use upper-case initial letter	Its"IUTname"_Functions	ItsDenm _Functions
Module containing external functions	Use upper-case initial letter	Its"IUTname"_ExternalFunctions	ItsDenm_ExternalFunctions
Module containing components, ports and message definitions	Use upper-case initial letter	Its"IUTname"_Interface	ItsDenm _Interface
Module containing main component definitions	Use upper-case initial letter	Its"IUTname"_TestSystem	ItsDenm _TestSystem
Module containing the control part	Use upper-case initial letter	Its"IUTname"_TestControl	ItsDenm _TestControl

6.2.3 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_awaitDenMessageOut: INFO: Timeout while awaiting the
reception of a message ***");
```

Furthermore, the following rules are applied for the DENM 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 setverdict statement are combined (as defined in TTCN-3 v3.4.1) with a log statement following the same above rules (see example 2).

EXAMPLE 2:
```
setverdict (pass, "*** f_utInitializeIut: PASS: IUT initialized
***");
```

6.2.4 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	DEN	
	<gr> = group	MSGF	Message Format
		EVGN	Event Generation
		SSCI	Specific Situation Container Information
		SLCI	Specific Location Container Information
		PETY	Periodicity
		TDEV	Two different events
		EXTI	Expiration Time
		EUPD	Event Update
		TNEV	Termination/Negation of an Event
		DRCX	DENM Reception
	<x> = type of testing	BV	Valid Behaviour tests
	<nn> = sequential number		01 to 99

EXAMPLE: TP identifier: TP/DEN/MSGF/BV/01
TC identifier: TC_DEN_MSGF_BV_01

6.3 On line documentation

Using the T3D tool enables providing on-line documentation browser in HTML, by tagging TTCN-3 comments. These tags are defined in table 5.

Table 5: TTCN-3 comment tags

Tag	Description
@author	Specifies the names of the authors or an authoring organization which either has created or is maintaining a particular piece of TTCN-3 code.
@desc	Describes the purpose of a particular piece of TTCN-3 code. The description should be concise yet informative and describe the function and use of the construct.
@remark	Adds extra information, such as the highlighting of a particular feature or aspect not covered in the description.
@see	Refers to other TTCN-3 definitions in the same or another module.
@return	Provides additional information on the value returned by a given function.
@param	Documents the parameters of parameterized TTCN-3 definitions.
@version	States the version of a particular piece of TTCN-3 code.

The HTML files result from the compilation of the TTCN-3 modules with the T3Doc tool. These HTML files are ready for browsing and contain links enabling to navigate through the ATS.

EXAMPLE:

```
/**
 * @desc    Checks the DENM message is well-formatted and contains mandatory
 *          DENM mandatory, situation and location
 * @version 0.0.3
 * @see     TS 102 869-2 TP/DEN/MSGF/BV/01
*/
```

Annex A (normative): TTCN-3 library modules

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

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

A.1 Electronic annex, zip file with TTCN-3 code

The TTCN-3 library modules, which form parts of the present technical standard, are contained in the file ts_10286903v010101p_TTCN.zip which is part of the archive ts_10286903v010101p0.zip which accompanies the present document.

A.2 Electronic annex, zip file with HTML documentation

The HTML documentation, which forms parts of the present technical standard, is contained in the file ts_10286903v010101p_HTML.zip which is part of the archive ts_10286903v010101p0.zip which accompanies the present document.

Start the index.htm file in any preferred web browser.

Annex B (normative): Partial PIXIT proforma for DENM

The PIXIT Proforma is based on ISO/IEC 9646-6 [4]. Any needed additional information can be found in this international standard document.

B.1 Identification summary

Table B.1

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

B.2 ATS summary

Table B.2

Protocol Specification:	TS 102 637-3 [1]
Protocol to be tested:	DENM (Decentralized Environmental Notification Messages)
ATS Specification:	TS 102 869-3
Abstract Test Method:	Clause 4

B.3 Test laboratory

Table B.3

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

B.4 Client identification

Table B.4

Client Identification:	
Client Test manager:	
Test Facilities required:	

B.5 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.6 Protocol layer information

B.6.1 Protocol identification

Table B.6

Name:	TS 102 637-3 [1]
Version:	
PICS References:	TS 102 869-1 [9]

B.6.2 IUT information

Table B.7: DENM pixits

Identifier	Description	
PX_TESTER_STATION_ID	**Comment**	Station Id used in messages sent by the tester
	Type	StationID
	Default value	111111
PX_TS_POSITION	**Comment**	The position of the tester
	Type	ReferencePosition
	Default value	longitude := {hemisphere := east, degree := 0} latitude := {hemisphere := north, degree := 0}, elevation := 0 heading := omit, streetName := omit, positionConfidence := omit, elevationConfidence := omit, roadSegmentID := 0

Annex C (normative): PCTR Proforma for DENM

The PCTR proforma is based on ISO/IEC 9646-6 [4]. Any needed additional information can be found in this International standard document.

C.1 Identification summary

C.1.1 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.1.2 IUT identification

Table C.2

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

C.1.3 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.1.4 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.1.5 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.2 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.3 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.4 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.6 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.5 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.6 Test campaign report

Table C.4: test cases

ATS Reference	Selected?	Run?	Verdict	Observations (Reference to any observations made in clause C.7)
TC_DEN_MSGF_BV_01	Yes/No	Yes/No		
TC_DEN_MSGF_BV_02	Yes/No	Yes/No		
TC_DEN_EVGN_BV_01	Yes/No	Yes/No		
TC_DEN_EVGN_BV_02	Yes/No	Yes/No		
TC_DEN_EVGN_BV_03	Yes/No	Yes/No		
TC_DEN_EVGN_BV_04	Yes/No	Yes/No		
TC_DEN_EVGN_BV_05	Yes/No	Yes/No		
TC_DEN_EVGN_BV_06	Yes/No	Yes/No		
TC_DEN_EVGN_BV_07	Yes/No	Yes/No		
TC_DEN_EVGN_BV_08	Yes/No	Yes/No		
TC_DEN_EVGN_BV_09	Yes/No	Yes/No		
TC_DEN_EVGN_BV_10	Yes/No	Yes/No		
TC_DEN_EVGN_BV_11	Yes/No	Yes/No		
TC_DEN_EVGN_BV_12	Yes/No	Yes/No		
TC_DEN_EVGN_BV_13	Yes/No	Yes/No		
TC_DEN_EVGN_BV_14	Yes/No	Yes/No		
TC_DEN_EVGN_BV_15	Yes/No	Yes/No		
TC_DEN_SSCI_BV_01	Yes/No	Yes/No		
TC_DEN_SSCI_BV_02	Yes/No	Yes/No		
TC_DEN_SSCI_BV_03	Yes/No	Yes/No		
TC_DEN_PETY_BV_01	Yes/No	Yes/No		
TC_DEN_PETY_BV_02	Yes/No	Yes/No		
TC_DEN_TDEV_BV_01	Yes/No	Yes/No		
TC_DEN_EXTI_BV_01	Yes/No	Yes/No		
TC_DEN_EXTI_BV_02	Yes/No	Yes/No		
TC_DEN_EXTI_BV_03	Yes/No	Yes/No		
TC_DEN_EUPD_BV_01	Yes/No	Yes/No		
TC_DEN_TNEV_BV_01	Yes/No	Yes/No		
TC_DEN_TNEV_BV_02	Yes/No	Yes/No		
TC_DEN_TNEV_BV_03	Yes/No	Yes/No		
TC_DEN_TNEV_BV_04	Yes/No	Yes/No		
TC_DEN_DRCX_BV_01	Yes/No	Yes/No		
TC_DEN_DRCX_BV_02	Yes/No	Yes/No		
TC_DEN_DRCX_BV_03	Yes/No	Yes/No		
TC_DEN_DRCX_BV_04	Yes/No	Yes/No		

C.7 Observations

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

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History

Document history		
V1.1.1	March 2011	Publication