



**Intelligent Transport Systems (ITS);
Testing;
Conformance test specifications for ITS Security;
Part 6: Validation report**

Reference

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Keywords

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

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

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

This Technical Report (TR) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 6 of a multi-part deliverable covering Intelligent Transport Systems (ITS); Testing; Conformance test specifications for ITS Security, as identified below:

- Part 1: "Conformance test specifications for Co-operative Awareness Messages (CAM); CAM validation report";
 - Part 2: "Conformance test specifications for Decentralized Environmental Notification basic service Messages (DENM); DENM validation report";
 - Part 3: "Conformance test specifications for Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; GeoNetworking validation report";
 - Part 4: "Conformance test specification for GeoNetworking Basic Transport Protocol (BTP); GeoNetworking BTP validation report";
 - Part 5: "IPv6 over GeoNetworking validation report";
 - Part 6: "Validation report".**
-

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).

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Introduction

In response to EC mandate M/453 [i.6], ETSI Technical Committee ITS has standardized base and test specifications for ITS protocols. In a next step a prototype TTCN-3 test system was built and validated. The present document and its related ETSI TR 103 099 [i.3] (Architecture of Conformance Validation Framework), describe the validation and design of the prototype TTCN-3 test system.

The action described in the present document has supported the implementation of ITS standards by:

- Making available validated and standardized test specifications and thus enabling the application of reliable certification schemes.
- Executing conformance validation framework against real Implementations Under Test (IUTs) from industry and thus providing these companies with a conformance assessment of their implementations. During the lifetime of this action, the conformance validation framework was as well provided at ITS Cooperative Mobility Services Interoperability events.

- Releasing all software as open source and thus allowing industry to build and run their own conformance validation framework.

1 Scope

The present document is the validation report of the ITS Security conformance tests defined in ETSI TS 103 096-3 [i.2] derived from ETSI TS 103 097 (V1.2.1) [i.1]. It provides statistics of executed and validated GeoNetworking conformance tests. The information provided has been produced by validation against at least two prototype implementations from industry.

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 reference document (including any amendments) applies.

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Not applicable.

2.2 Informative references

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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 TS 103 097 (V1.2.1): "Intelligent Transport Systems (ITS); Security; Security header and certificate formats".
- [i.2] ETSI TS 103 096-3 (V1.2.1): "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for ITS Security; Part 3: Abstract Test Suite (ATS) and Protocol Implementation eXtra Information for Testing (PIXIT)".
- [i.3] ETSI TR 103 099 (V1.2.1): "Intelligent Transport Systems (ITS); Architecture of conformance validation framework".
- [i.4] ETSI EG 201 015 (V1.1.1): "Methods for Testing and Specification (MTS); Specification of protocols and services; Validation methodology for standards using SDL; Handbook".
- [i.5] ETSI ES 201 873-1 (V4.5.1): "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 1: TTCN-3 Core Language".
- [i.6] EC mandate M/453: "Standardisation mandate addressed to CEN, CENELEC and ETSI in the field of Information and Communication Technologies to support the interoperability of co-operative Systems for Intelligent Transport in the European Community".
- [i.7] ETSI TS 102 894-2: "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

3 Abbreviations

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

AA	Authorization Authority
ASN.1	Abstract Syntax Notation One
AT	Authorization Ticket
ATS	Abstract Test Suite
BTP	Basic Transport Protocol
CAM	Co-operative Awareness Message
CERT	Certificate testing
DENM	Decentralized Environmental Notification Messages basic service
DEPV	Destination Position Vector
EC	European Commission
ES	ETSI Standard
ITS	Intelligent Transport Systems
ITS-S	Intelligent Transport System - Station
IUT	Implementation Under Test
LS	Location Service
MAC	Media Access Control
SO	SOurce
SQN	SeQuence Number
SUT	System Under Test
TC	Test Cases
TP	Test Purposes
TR	Technical Report
TS	Technical Standard
TTCN	Testing and Test Control Notation
UT	Upper Tester
UTC	Coordinated Universal Time

4 Validation report

4.1 Validation level

Level 3 (Rigorous) abstract test suite validation has been performed, according to the validation handbook ETSI EG 201 015 [i.4]:

- the test suite has been compiled on more than one TTCN-3 tool;
- the complete suite of tests has been implemented and executed on more than one test platform;
- the complete suite of tests has been executed against SUTs from a range of different suppliers;
- the operation and output traces of all the tests have been validated.

4.2 Source code evaluation

4.2.1 TTCN-3 version

The ITS Security abstract test suite is based on ETSI ES 201 873-1 (V4.5.1) [i.5].

4.2.2 TTCN-3 tools used for compilation

The test suite has been compiled using two different TTCN-3 tools, as detailed in table 1.

Table 1: TTCN-3 tools used for compilation

Supplier	Tool name	Version	Settings	Compilation result
TestingTech	TTworkbench®	1.1.18	Support for very large integers ASN.1-Language-Support-v1.1.4	No error, no warning
Elvior™	TestCast T3™	6.8.2		No error, no warning

NOTE: This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of these products.

4.3 Validation Process

4.3.1 Test Platforms

The validation test platform has been built as described in conformance validation framework ETSI TR 103 099 [i.3] using the components as described in table 2.

Table 2: Validation test platform components

TTCN-3 Tool	TestingTech TTworkbench® with ASN.1 support plugin
Test Adapter	The applicable software tag is: http://forge.etsi.org/websvn/listing.php?repname=ITS.ITS&path=/tags/v1.2.1/ G5 Radio hardware: Cohda Wireless™ MK2 connected via Ethernet cable
Codec	The applicable software tag is: http://forge.etsi.org/websvn/listing.php?repname=ITS.ITS&path=/tags/v1.2.1/

4.3.2 SUTs

The SUTs listed in table 3 have been used to validate the GeoNetworking test suite.

Table 3: SUTs used for validation

Manufacturer	Product name	Version
COHDA™	ITS Security	Development
COMMSIGNIA™	ITS Security	Development
Hitachi™	ITS Security	Development
IMTECH™	ITS Security	Development
ITRI™	ITS Security	Development
MARBEN™	ITS Security	Development
QMIC™	ITS Security	Development
SIEMENS™	ITS Security	Development
TRIALOG™	ITS Security	Development
UNEX™	ITS Security	Development

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4.3.3 Validation Status

Table 4 shows the validation status of each test case of the GeoNetworking abstract test suite.

Table 4: Test case validation status

ATS Reference	Verdict	Log analysis	Validated
TP_SEC_ITSS_SND_MSG_01_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_MSG_04_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_MSG_04_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_MSG_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_02_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_05_02_BV	PASS	Yes	Yes

ATS Reference	Verdict	Log analysis	Validated
TP_SEC_ITSS_SND_CAM_06_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_07a_01_TI	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_08_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_09_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_10_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_11_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_12_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_14_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CAM_16_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_02_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_03_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_04_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_05_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_05_03_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_05_04_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_05_05_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_05_06_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_06_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_08_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_DENM_10_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_02_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_03_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_04_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_05_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_05_03_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_05_04_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_05_05_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_05_06_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_06_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_GENMSG_07_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_01_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_01_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_02_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_04_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_04_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_05_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_06_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_06_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_06_03_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_06_04_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_07_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_08_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_09_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_09_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AA_01_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AA_02_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AA_04_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AA_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AA_06_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AA_08_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_01_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_02_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_03_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_04_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_05_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_07_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_08_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_SND_CERT_AT_09_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_01_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_01_02_BV	PASS	Yes	Yes

ATS Reference	Verdict	Log analysis	Validated
TP_SEC_ITSS_RCV_CAM_01_03_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_02_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_02_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_03_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_04_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_06_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_08_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_04_09_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_07_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_09_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_09_03_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_09_04_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_09_05_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_09_06_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_10_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_10_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_11_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_11_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_12_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_CAM_12_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_01_01_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_01_02_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_01_03_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_01_04_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_01_05_BV	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_07_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_08_01_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_08_02_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_08_03_BO	PASS	Yes	Yes
TP_SEC_ITSS_RCV_DENM_08_04_BO	PASS	Yes	Yes

4.4 Feedback to standardization process

4.4.1 Base standard issues

The following issues have been reported to the ETSI TC ITS WG5 on ETSI TS 103 097 [i.1]:

- Wrong description of considering the signer info field in the signature of CAMs.
The certificate profile in ETSI TS 103 097 [i.1], clause 7.4 lists the elements that are part of the signature. It is written that the length field of the signer_info is part of the signature. However, in the latest version there is only one signer_info contained in the certificate structure (ETSI TS 103 097 [i.1], clause 6.1). Delete the comment "vector including its length" behind signer_info in ETSI TS 103 097 [i.1], clause 7.4.
- Wrong description of considering the public key algorithm in the signature of CAMs.
There is an error in ETSI TS 103 097 [i.1], table 6 because the right column shows that the "PublicKeyAlgorithm algorithm" of the Signature is covered by the signature. Correct ETSI TS 103 097 [i.1], table 6 and make clear that the PublicKeyAlgorithm is not part of the signature.
- Incomplete description of creating hash for signature of secured messages.
In ETSI TS 103 097 [i.1], clause 5.6 it is written in the first bullet that "the length of the trailer_fields field of the SecuredMessage shall be included in the hash." in order to create the signature. In the CAM profile in ETSI TS 103 097 [i.1], clause 7.1 it is written that "The length of the variable-length vector trailer_fields and the type of the signature trailer field shall be considered by the signature hash". In ETSI TS 103 097 [i.1], clause 5.6 it should be mentioned that "the type of the signature trailer field shall be added to the hash in order to have a consistent description".

4.4.2 New features

During validation the following topics for new features were discussed and reported to TC ITS:

- Security link between CertID and relevant IDs such as MAC address, Facility Station ID needs to be defined. CERT ID is master. From there all other IDs are derived.
Which bytes are changed and how?
MAC ID: use global unique bit set to 1 to indicate that all 5 bytes and 6 bits are modifiable by pseudonym change.
- Add example how to define time.
ETSI TS 102 894-2 [i.7], clause A.82 gives an example how to define time conversion between UTC and ITSTimestamp.
- Do we need certificates in CAM each second?
The certificate can be received much faster using the certificate request mechanism than unattended sending. All devices send either CAM or beacon, so all devices are capable to request the certificate if they do not have one. To reduce the rate a limitation could be added that certificates should not be sent more often than once per second.
- Request of unrecognized AA certificate create high channel load when all receivers reply with a certificate chain.
As specified in the CAM profile of ETSI TS 103 097 [i.1], clause 7.1 "If the ITS-S finds a HashedId3 of its own, currently used authorization authority in that list, it shall include a signer_info field of type certificate_chain". This leads to high channel load if several ITS-Ss send in their next CAM a certificate chain instead of their certificate or digest. In addition, an attacker can easily misuse this feature to create a DoS attack in its single-hop communication range.
- ITS-S should stop requesting an unrecognized AA certificate if the issuer of the AA certificate is untrusted
In ETSI TS 103 097 [i.1] it is not specified whether an ITS-S should repeat or stop sending request of unrecognized AA certificate if it does not trust the issuer of the AA certificate. For example, the ITS-Ss belong to different root domains and do not trust each other.
- ITS-S should accept request of unrecognized AA certificate from untrusted sender.
In ETSI TS 103 097 [i.1] it is not specified whether an ITS-S should accept a request of unrecognized certificate from a sender if the certificate chain of the requester is not complete or trusted. This is not critical if the AT certificate is requested because every ITS-S that has a new unknown sender in its communication range should add its own certificate to the signer info. However, if the AA certificate is requested the ITS-S has to accept the request even if the message and the signer certificate chain cannot be verified. Add in the CAM profile of ETSI TS 103 097 [i.1], clause 7.1 a statement that "a receiver shall respond to a request of unrecognized AA certificate even if the certificate chain of the requester cannot be verified".

4.4.3 Test specification issues

The following problems have been fixed in ETSI TS 103 096-3 [i.2]:

- Wrong parameters in the different test configurations
- Issues with Upper Tester primitives
- Wrong bit order of messages
- Adjustments in TTCN-3 altsteps required
- TTCN-3 template corrections

4.4.4 Typical SUT issues

Issues found in SUT implementations have been signalled directly to the concerned manufacturers, including detailed explanations and test logs.

The following SUT problems have been often encountered during GeoNetworking test suite validation:

- UT endianness issue
- IUT does not start SQN to 0
- IUT does not increment SQN by 1
- IUT's LS buffer can hold only 1 packet
- UInitialize should flush Neighbour table and buffers
- IUT does not update DEPV
- UtIndication not implemented

History

Document history		
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