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Intelligent Transport Systems (ITS);
Testing;
Part 3: Conformance test specification for Geographical addressing and forwarding for point-to-point and point-to-multipoint communications;
GeoNetworking validation report

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DTR/ITS-0030020

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Contents

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Foreword

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

The present document is part 3 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.2].

Introduction

In response to EC mandate M/453, 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 TR 103 099 [i.1] (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 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 GeoNetworking conformance tests and it provides statistics of executed and validated GeoNetworking conformance tests. The information provided has been produced by validation against two prototype implementations from industry.

Furthermore, identified base specifications and test specification issues are listed in the present document.

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.

Not applicable.

2.1 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 TR 103 099 (V1.1.1): "Intelligent Transport Systems (ITS); Architecture of conformance validation framework".

[i.2] ETSI TR 103 061-1: "Intelligent Transport Systems (ITS); Testing; Part 1: Conformance test specification for Co-operative Awareness Messages (CAM); CAM validation report".

[i.3] 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".

3 Abbreviations

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

ATS	Abstract Test Suite
BTP	Basic Transport Protocol
CAM	Co-operative Awareness Message
DAD	Duplicate Address Detection
DENM	Decentralized Environmental Notification Basic Service
EC	European Commission
GAC	Geographically-Scoped Anycast
GN	GeoNetworking
INCONC	Test Case Verdict Inconclusive
ITS	Intelligent Transportation Systems
IUT	Implementation Under Test
MAC	Media Access Control

MAC	Medium Access Control
MIB	Management Information Base
MID	MAC ID
PICS	Protocol Implementation Conformance Statement
SHB	Single Hop Broadcast
SUT	Implementation Under Test
TC	Test cases
TP	Test Purposes
TSB	Topology Scoped Broadcast
TTCN	Testing and Test Control Notation (TTCN-3)
TTCN-3	Testing and Test Control Notation 3

4 Validation report

4.1 Validation level

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

- 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 have 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 GeoNetworking abstract test suite is based on TTCN-3 edition 4.2.1 (TTCN3:2010).

4.2.2 TTCN-3 tools used for compilation

The test suite has been compiled using three 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	1.1.13	• Support for very large integers • ASN.1-Language-Support-v1.1.4	No error, no warning
Elvior	TestCast T3	6.3.1		No error, no warning
OpenTTCN	OpenTTCN Tester 2012	4.2.2		No error, no warning

4.3 Validation Process

4.3.1 Validation method

4.3.2 Test Platforms

The validation test platform has been built as described in conformance validation framework [i.1] using the following components:

Table 2: Validation test platform components

TTCN-3 Tool	TestingTech TTworkbench v13 with ASN.1 support plugin
Test Adapter	• Software: Implemented by STF424. ITS Test Adapter v1.1.1 • G5 Radio hardware: Cohda Wireless™ MK2 connected via Ethernet cable
Codec	Implemented by STF424. ITS Codec v1.1.1

4.3.3 SUTs

The following SUTs have been used to validate the GeoNetworking test suite.

Table 3: SUTs used for validation

Manufacturer	Product name	Version
Hitachi™ Europe SAS	GN	2.1.0
NEC™ Europe LTD	GN	2.1.3

4.3.4 Validation Status

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

Table 4: Testcase validation status

TC identifier	Verdict	Log analysis	Validated	Required test suite corrections
TC_GEONW_FDV_COH_BV_01	PASS	OK	Yes	
TC_GEONW_FDV_COH_BV_02	PASS	OK	Yes	
TC_GEONW_FDV_COH_BV_03	PASS	OK	Yes	
TC_GEONW_FDV_COH_BV_04	PASS	OK	Yes	
TC_GEONW_FDV_COH_BV_05	PASS	OK	Yes	
TC_GEONW_FDV_COH_BV_06	PASS	OK	Yes	
TC_GEONW_FDV_BEA_BV_01	PASS	OK	Yes	
TC_GEONW_FDV_GUC_BV_01	PASS	OK	Yes	
TC_GEONW_FDV_GBC_BV_01	PASS	OK	Yes	
TC_GEONW_FDV_GAC_BV_01	FAIL	IUT#1 not sending GAC if inside destination area	No	Question raised on working group mailing list. No answer so far
TC_GEONW_FDV_SHB_BV_01	PASS	OK	Yes	
TC_GEONW_FDV_TSB_BV_01	PASS	OK	Yes	
TC_GEONW_PON_LOT_BV_01	PASS	OK	Yes	
TC_GEONW_PON_LOT_BV_02	PASS	OK	Yes	
TC_GEONW_PON_LOT_BV_03	PASS	OK	Yes	
TC_GEONW_PON_LOT_BV_04	PASS	OK	Yes	
TC_GEONW_PON_LOT_BV_05	PASS	OK	Yes	
TC_GEONW_PON_LPV_BV_01	PASS	OK	Yes	
TC_GEONW_PON_SQN_BV_01	PASS	OK	Yes	
TC_GEONW_PON_SQN_BV_02	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_01	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_02	PASS	OK	Yes	

TC identifier	Verdict	Log analysis	Validated	Required test suite corrections
TC_GEONW_PON_LOS_BV_03	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_04	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_05	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_06	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_07	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_08	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_09	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_10	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_11	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_12	PASS	OK	Yes	
TC_GEONW_PON_LOS_BV_13	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_01	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_02	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_03	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_04	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_05	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_06	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_07	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_08	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_09	PASS	OK	Yes	
TC_GEONW_PON_FPB_BV_10	PASS	OK	Yes	
TC_GEONW_PON_GNA_BV_01	PASS	OK	Yes	
TC_GEONW_PON_GNA_BV_02	INCONC	DAD behaviour not clear in base spec	No	
TC_GEONW_PON_BEA_BV_01	PASS	OK	Yes	
TC_GEONW_PON_BEA_BV_02	FAIL	Bad TP: change GeoUnicast to TSB => GUCs are not broadcasted	No	Mantis #5940
TC_GEONW_PON_GUC_BV_01	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_02	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_03	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_04	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_05	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_06	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_07	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_08	PASS	OK	Yes	
TC_GEONW_PON_GUC_BV_08	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_01	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_02	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_03	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_04	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_05	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_06	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_07	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_08	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_09	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_10	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_11	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_12	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_13	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_14	PASS	OK	Yes	
TC_GEONW_PON_GBC_BV_15	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_01	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_02	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_03	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_04	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_05	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_06	PASS	OK	Yes	
TC_GEONW_PON_TSB_BV_07	PASS	OK	Yes	
TC_GEONW_PON_SHB_BV_01	PASS	OK	Yes	
TC_GEONW_PON_SHB_BV_02	PASS	OK	Yes	

TC identifier	Verdict	Log analysis	Validated	Required test suite corrections
TC_GEONW_PON_GAC_BV_01	FAIL	IUT#1 not sending GAC if inside destination area	No	Question raised on working group mailing list. No answer so far
TC_GEONW_PON_GAC_BV_02	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_03	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_04	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_05	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_06	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_07	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_08	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_09	PASS	OK	Yes	
TC_GEONW_PON_GAC_BV_10	PASS	OK	Yes	
TC_GEONW_CAP_LOS_BV_01	PASS	OK	Yes	
TC_GEONW_CAP_FPB_BV_01	-	SUT's buffer capacity not disclosed	No	
TC_GEONW_CAP_FPB_BV_02	-	SUT's buffer capacity not disclosed	No	
TC_GEONW_MDE_LT_TIC_BV_01	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_02	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_03	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_04	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_05	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_06	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_07	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_08	-	No MediaDependent Implementation	No	
TC_GEONW_MDE_LT_TIC_BV_09	-	No MediaDependent Implementation	No	

4.4 Feedback to standardization process

During the GeoNetworking validation exercise, a number of issues were raised.

For each issue concerning PICS, TP or ATS, a bug report has been filled in ETSI's bug reporting tool (Mantis).

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

4.4.1 Base standard issues

The following issues have been reported by STF424 to the ETSI TC ITS WG3:

- Clause 8.5.2 Table 4 'Length of the Network Header payload' should be called 'Length of the GN payload' (e.g. BTP + CAM).
- In Table 1/MID it says: 'This field represents the LL_ADDR', Is this link needed and if yes, does the MAC address need to change as well when the GN address is changed?
- Clause C.1 - corrections in the activity diagram.
- Wrong order of execution steps in clause 9.3.4.3. Step 7 should come before step 5 (latest version of base spec).

- Should it be mentioned that you should drop a packet if the GN address is not built according to the MAC address? Wait for a decision from WG5 on pseudonym handling, and decide then.
- Add a new MIB parameter to handle the itsGnLineForwardingAlgorithm (to make distinction from itsGnGeoUnicastForwardingAlgorithm during line forwarding).

4.4.2 Test specification issues

Following problems have been found and reported. They will be addressed in the maintenance process.

- Mantis #5951 TPs, minor, "TP/GEONW/PON/FPB/BV/07: TP should use different payloads to distinguish packet instead of Sequence Number".
- Mantis #5940 TPs, major, "TP/GEONW/PON/BEA/BV/02: Delaying beacons when sending other packets is only valid if the other packets are link-layer-broadcasted".
- Mantis #5943 TPs, minor, "TP/GEONW/PON/GAC/BV/01 => 10: Replace GeoBroadcast by GeoAnycast".
- Mantis #5932 TPs, minor, "New tests for buffering of SHB/TSB packets while no neighbour available".
- Mantis #5931 TPs, minor, "TP/GEONW/PON/GUC/BV/08: Typo issue".
- Mantis #6141 ATS, feature, "Add Upper Tester command for changing MIB parameter".
- Mantis #6140 ATS, minor, "utCheckEvent: Change concept".
- Mantis #6136 TSS&TP, minor, "TC_GEONW_PON_BEA_BV_02: Add new tests with different message types".
- Mantis #6135 TSS&TP, minor, "Add new tests for sequence number".
- Mantis #6132 Test Adapter, minor, "TC_GEONW_PON_GNA_BV_02: beacon filter is blocking new beacons".
- Mantis #6128 TSS&TP, trivial, "TP/GEONW/FDV/GBC/BV/02: typo".

4.4.3 Typical SUT issues

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

- Unicast is sent with HopLimit set to 1 instead of default HopLimit value.
- GeoAnycast initiated by IUT is not sent if IUT is inside the destination GeoArea (open discussion).
- Reserved fields not set to 0.
- Initial sequence number randomly chosen instead of using 0.
- Corrupted payload when packet are forwarded.
- Corrupted payload when transmitted to upper layer.
- Bad PayloadLength computation.
- SHB should not include extended header.
- Bad value for GN Version.
- GeoUnicast Buffering and forwarding: Buffered GeoUnicast (due to lack of suitable next hop) is not forward once a good forwarder appears.
- GN packets sent a bit ahead in time are considered to be extremely old by IUT and discarded (small tolerance is required) <= This could be a major interop issue.

Annex A: Bibliography

ETSI TS 102 636-4-1 (V1.1.1): "Intelligent Transport System (ITS); Vehicular communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality".

ETSI TS 102 869-1 (V1.1.1): "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".

ETSI TS 102 869-2 (V1.1.1): "Intelligent Transport Systems (ITS); Testing; Conformance test specification for Decentralized Environmental Notification Messages (DENM); Part 2: Test Suite Structure and Test Purposes (TSS&TP)".

ETSI TS 102 869-3 (V1.1.1): "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)".

ETSI ES 201 873-1 (V4.3.1): "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 1: TTCN-3 Core Language".

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

List of tables

History

Document history		
V1.1.1	November 2012	Publication