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Methods for Testing and Specification (MTS); TTCN-3 Conformance Test Suite; Part 3: Abstract Test Suite (ATS) and Implementation eXtra Information for Testing (IXIT)

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Methods for Testing and Specification (MTS).

The present document is part 3 of a multi-part deliverable covering a TTCN-3 conformance test suite, as identified below:

Part 1: "Implementation Conformance Statement (ICS)";

Part 2: "Test Suite Structure and Test Purposes (TSS&TP)";

Part 3: "Abstract Test Suite (ATS) and Implementation eXtra Information for Testing (IXIT)".

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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1 Scope

The present document specifies the Abstract Test Suite (ATS) for the TTCN-3 conformance test suite, as defined in ETSI ES 201 873-1 [1] in compliance with the relevant guidance given in the pro forma for TTCN-3 reference test suite ETSI TS 102 950-2 [8].

The objective of the present document is to provide a basis for conformance tests for TTCN-3 tools giving a high probability of standard conformance with respect to TTCN-3 tools from different vendors. In the present document only the core language features, specified in ETSI ES 201 873-1 [1] have been considered but not the tool implementation (see ETSI ES 201 873-5 [i.1] and ETSI ES 201 873-6 [i.2]), language mapping (see ETSI ES 201 873-7 [i.3], ETSI ES 201 873-8 [i.4] and ETSI ES 201 873-9 [i.5]) and language extension (see ETSI ES 202 781 [i.6], ETSI ES 202 784 [i.7] and ETSI ES 202 785 [i.8]) aspects. The test notation used in the ATS attached in a zipped file is in TTCN-3 and it is part of the present document.

Annex A provides the Tree and Tabular Combined Notation (TTCN-3) part of the ATS.

Annex B provides the partial Protocol Implementation eXtra Information for Testing (PIXIT) 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 ES 201 873-1 (V4.14.1): "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 1: TTCN-3 Core Language".

[2] ETSI ES 201 873-10: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 10: TTCN-3 Documentation Comment Specification".

[3] ETSI TS 102 351: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); IPv6 Testing: Methodology and Framework".

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

[5] ISO/IEC 9646-4:1994: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 4: Test realization".

[6] ISO/IEC 9646-5:1994: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 5: Requirements on test laboratories and clients for the conformance assessment process".

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

[8] ETSI TS 102 950-2: "Methods for Testing and Specification (MTS); TTCN-3 Conformance Test Suite; Part 2: Test Suite Structure and Test Purposes (TSS&TP)".

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.

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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 ES 201 873-5: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 5: TTCN-3 Runtime Interface (TRI)".

[i.2] ETSI ES 201 873-6: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 6: TTCN-3 Control Interface (TCI)".

[i.3] 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".

[i.4] ETSI ES 201 873-8: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 8: The IDL to TTCN-3 Mapping".

[i.5] ETSI ES 201 873-9: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 9: Using XML schema with TTCN-3".

[i.6] ETSI ES 202 781: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; TTCN-3 Language Extensions: Configuration and Deployment Support".

[i.7] ETSI ES 202 784: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; TTCN-3 Language Extensions: Advanced Parameterization".

[i.8] ETSI ES 202 785: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; TTCN-3 Language Extensions: Behaviour Types".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ISO/IEC 9646-1 [4], ISO/IEC 9646-7 [7], ETSI ES 201 873-1 [1] (TTCN-3) and the following apply:

Abstract Test Method (ATM): description of how an IUT is to be tested, given at an appropriate level of abstraction to make the description independent of any particular realization of a Means of Testing, but with enough detail to enable abstract test cases to be specified for this method

Abstract Test Suite (ATS): test suite composed of abstract test cases

ICS pro forma: document, in the form of a questionnaire, which when completed for an implementation or system becomes an ICS

Implementation Conformance Statement (ICS): statement made by the supplier of an implementation claimed to conform to a given specification, stating which capabilities have been implemented

Implementation eXtra Information for Testing (IXIT): statement made by a supplier or implementor of an IUT which contains or references all of the information related to the IUT and its testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT

Implementation Under Test (IUT): implementation of one or more OSI protocols in an adjacent user/provider relationship, being part of a real open system which is to be studied by testing

IXIT pro forma: document, in the form of a questionnaire, which when completed for the IUT becomes the IXIT

Means Of Testing (MOT): combination of equipment and procedures that can perform the derivation, selection, parameterization and execution of test cases, in conformance with a reference standardized ATS and can produce a conformance log

3.2 Symbols

Void.

3.3 Abbreviations

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

ASCII	American Standard Code for Information Interchange
ATM	Abstract Test Method
ATS	Abstract Test Suite
BNF	Backus-Naur Form
ETS	Executable Test Suite
HTML	HyperText Markup Language
ICS	Implementation Conformance Statement
ISO	International Organization for Standardization
IUT	Implementation Under Test
IXIT	Implementation eXtra Information for Testing
MOT	Means Of Testing
MTS	Methods for Testing and Specification
OSI	Open Systems Intercommunication
PIXIT	Protocol Implementation eXtra Information for Testing
TC	Test Case
TCI	TTCN-3 Control Interface
TP	Test Purpose
TS	Test System
TSS	Test Suite Structure
TSS&TP	Test Suite Structure and Test Purposes
TTCN	Testing and Test Control Notation
TTCN-3	Testing and Test Control Notation edition 3

4 Abstract Test Method (ATM)

This clause describes the ATM used to test the conformance of TTCN-3 tool implementations as described in part 1 of the TTCN-3 core language standard ETSI ES 201 873-1 [1]. In the ATM, the work is performed on two levels:

- The TTCN-3 tool level. In TTCN-3 conformance tests, it is the TTCN-3 tool which is under test, i.e. the IUT. However, unlike in protocol conformance testing, it is not standardized how test inputs, i.e. TTCN-3 modules, are provided. Neither are there any standardized interfaces to monitor the reaction of the TTCN-3 tool to the test input. Outputs can only be observed indirectly by monitoring tool outputs such as tool specific command line information, graphical user interfaces, or test execution logs. The tool output is processed further in the tool output evaluation level in order to derive the tool conformance verdicts.

- The TTCN-3 tool output evaluation level. Here, the output of a TTCN-3 tool is indirectly observed, e.g. rejection of TTCN-3 code due to a compile-time error in a command line notification, logging of one or multiple test verdicts in a tool specific window or an execution trace. The observation is evaluated to assess the tool conformance as a result of stimulating the tool with the TTCN-3 modules. Compliance or support of the logging interface specified as part of the TTCN-3 Control Interface standard (TCI) is not required.

NOTE: The loading of the TTCN-3 modules and presentation of the output by the TTCN-3 tools is beyond the scope of the present document.

The ATS document contains the test inputs, i.e. TTCN-3 modules, for TTCN-3 tools do not automate the execution of TTCN-3 tool conformance tests. TTCN-3 tool conformance test decisions shall be made on the basis of expected outputs as specified in the test purposes provided in the documentation and as part of the documentation of TTCN-3 tests in the ATS. Three different tool output classifications for TTCN-3 inputs exist:

- Rejection as invalid, i.e. the TTCN-3 input is declared syntactically or semantically incorrect by the tool. This can either happen at compile-time or at runtime.
- Rejection to execute, i.e. an ETS is produced from the test input, but an execution does not take place.
- Execution with results, i.e. the compiled or interpreted TTCN-3 code is executed and different kinds of outputs are produced that can be subject of an evaluation, for example, a logged TTCN-3 test verdict in a test execution trace (none, pass, fail, inconc) in a file or the console output. The respective tool outputs have to specify the expected execution results in order to be able to evaluate whether the conformance test is successful.

A TTCN-3 tool conformance test can attempt to trigger every kind of such outputs in a controlled way, i.e. a test input that is rejected as invalid does not imply a failing conformance test verdict, but instead results in a pass verdict for the conformance test if the test is designed to trigger the rejection. More generally: a TTCN-3 tool conformance test passes if the tool output corresponds to the expected output. The range of expected outputs is described by the tool output classification above.

For a detailed description on how test verdict and test purposes are encoded and how they shall be evaluated with the ATS of annex A, refer to clause 5.3.1.3 and the descriptions for the document tags @verdict and @purpose.

5 The ATS development process

5.1 Requirements and test purposes

For each test purpose there is a table defined in clause A.2 of ETSI TS 102 950-2 [8]. The requirements applicable to this TP are given by a reference to ETSI ES 201 873-1 [1]. There are no explicit formulations of requirements.

5.2 ATS structure

5.2.1 Test case grouping

The ATS structure defined in table 1 is based on the structuring of Test Purposes in clause A.2 of ETSI TS 102 950-2 [8]. The group names in columns 1 to 3 of table 1 are those assigned in the ATS; they are based on the names provided in clause A.2 of ETSI TS 102 950-2 [8], but use the naming conventions defined for the ATS (see clause 5.3.1.2). The test case identifier naming scheme differentiates between positive and negative tests as well as syntactical and semantics tests:

- Syntactical tests are tests that refer to annex A of ETSI ES 201 873-1 [1]. They include pure syntactical tests and tests regarding the static semantics to the degree of detail that annex A provides.
- Semantic tests are tests that refer to the checking of properties regarding the static and dynamic semantics of TTCN-3 according to the specific clauses of ETSI ES 201 873-1 [1].
- Positive tests are tests that shall work with a standards compliant TTCN-3 tool.
- Negative tests are tests that shall not work with a standards compliant TTCN-3 tool.

The test cases shall conform to the following correctness rules:

- Negative syntactic tests shall be correct with respect to the TTCN-3BNF and the static semantics of TTCN-3, but violate only one specific TTCN-3BNF rule or static semantic rule specified in annex A of ETSI ES 201 873-1 [1]. They shall not produce an ETS.

- Positive syntactic tests shall be correct with respect to the TTCN-3BNF and the static semantics of TTCN-3. They may produce an ETS and if it contains a control-part or a test case, it should be executed.
- Negative semantic tests shall be correct with respect to the TTCN-3BNF and the static semantics of TTCN-3, but violate the semantics of one specific text clause of ETSI ES 201 873-1 [1]. They may produce an ETS. If an ETS is produced and if it contains a control-part or a test case, it should be executed.
- Positive semantic tests shall be correct with respect to the TTCN-3BNF, the static semantics of TTCN-3, and the respective text clauses of ETSI ES 201 873-1 [1]. They shall produce an ETS. If an ETS is produced and if it contains a control-part or a test case, it should be executed.

The test case identifiers and their group index do not imply the correct execution order of a TTCN-3 tool conformance test. Grouping and sub-grouping in the ATS is realized with the help of the ATS directory structure.

Table 1: Example ATS structure of positive tests

Group	Subgroup	Group Index
Basic language elements	Identifiers and keywords	Syn_0501_Identifier
	Identifiers and keywords	Sem_0501_Identifier
	Scope rules	Syn_0502_Scopes
	Scope rules	Sem_0502_Scopes
	Ordering of language elements	Syn_0503_Ordering
	Ordering of language elements	Sem_0503_Ordering
	Parameterization	Syn_0504_Parameterization
	Parameterization	Sem_0504_Parameterization
	Cyclic Definitions	Syn_0505_Cyclic
	Cyclic Definitions	Sem_0505_Cyclic
		Sem_0505_Cyclic

Table 2: Example ATS structure of negative tests

Group	Subgroup	Group Index
Basic language elements	Identifiers and keywords	NegSyn_0501_Identifier
	Identifiers and keywords	NegSem_0501_Identifier
	Scope rules	NegSyn_0502_Scopes
	Scope rules	NegSem_0502_Scopes
	Ordering of language elements	NegSyn_0503_Ordering
	Ordering of language elements	NegSem_0503_Ordering
	Parameterization	NegSyn_0504_Parameterization
	Parameterization	NegSem_0504_Parameterization
	Cyclic Definitions	NegSyn_0505_Cyclic
	Cyclic Definitions	NegSem_0505_Cyclic
		NegSem_0505_Cyclic

5.2.2 Test case identifiers

The test case names are built up according to the following scheme:

<"TC">"_"<Group index>"_"<TC number>

where:

a) double quotes (") are used to enclose literal strings;

b) <Group index> containing positive and negative syntactic and semantic test, refers to ETSI ES 201 873-1 [1] clause numbers and names;

c) <TC number> is a running 3-digit decimal number, starting in each subgroup path with "001".

EXAMPLE: TC_Syn_0501_Identifier_001:

i) The example refers to a positive syntactical identifier and keyword test case.

ii) It is the first test case of this group/subgroup.

NOTE 1: This naming scheme corresponds to the TP identifiers and test case names as defined in clause A.2 of ETSI TS 102 950-2 [8].

NOTE 2: The TP identifier of TC_Syn_0501_Identifier_001 is TP_Syn_0501_Identifier_001.

5.3 ATS specification framework

5.3.1 Use of TTCN-3

5.3.1.1 General

TTCN-3, as defined in ETSI ES 201 873-1 [1], is used as the ATS specification language.

A number of requirements have been identified for the development and production of the TTCN-3 specification for the ATS:

1) Top-down design.
2) A uniquely defined testing architecture and test method.
3) Uniform TTCN-3 style and naming conventions.
4) Human-readability.
5) The TTCN-3 specification shall be feasible, implementable, compilable, and maintainable.
6) Test cases shall be designed in a way to be easily adaptable, upwards compatible with the evolution of the base protocol and protocol interworking of future releases.
7) The test declarations, data structures, and data values shall be largely reusable.
8) Modularity and modular working method.
9) Minimizing the requirements of intelligence on the emulators of the lower testers.
10) Giving enough design freedom to the test equipment manufacturers.

Fulfilling these requirements should ensure the investment of the TTCN-3 implementation vendors and users of the ATS having stable testing means for a relatively long period.

5.3.1.2 TTCN-3 naming conventions

Like in other software projects using a programming language, the use of naming conventions supports or increases:

a) the readability;
b) the detection of semantic errors;
c) the shared work of several developers;
d) the maintainability.

The naming conventions applied to Reference Test suite ATS are based on the following underlying principles:

- when constructing meaningful identifiers, the general guidelines specified for naming in clause 9 of ETSI TS 102 351 [3] should be followed;
- the names of TTCN-3 objects being associated with standardized data types (e.g. in the base protocols) should reflect the names of these data types as close as possible (of course not conflicting with syntactical requirements or other conventions being explicitly stated);