STF **409**

Title: Conformance tests for TTCN-3 tools

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TB **MTS**

TB responsible: **Mr. Stephan Schulz** stephan.schulz@conformiq.com

Milestone: **A**

Milestone description: Final Report and revised TS's endorsed by the MTS Chairman and approved by correspondence by TC MTS, accepted by the ETSI editHelp for publication.

To be approved by: ETSI Director-General and TB responsible

Activities carried out by the STF and results obtained in the STF working period, from 2010-10-04 to 2010-12-31

1 Executive summary

Over the last 10 years TTCN-3 has become a significantly important testing technology with very high deployment at various ETSI member companies as well as other organizations internationally. With its uptake by 3GPP, OMA and the AUTOSAR (a consortium of car makers and OEM suppliers), its role in standardization is further growing. 3GPP is using TTCN-3 as the test specification language for IMS call control testing from Rel. 8 onward and. TC TISPAN is using TTCN-3 for NGN supplementary service and interworking test specification. TC INT is using TTCN-3 for automating IMS core network interoperability testing. TC ITS is using TTCN-3 to specify all its test suites under the EC mandate M/ 453. Since 2004, ETSI organizes an annual, international user conference where it collects feedback from the wide TTCN-3 user community. The first ETSI TTCN-3 tools Plugtest has been organized in 2009.

A significant number of TTCN-3 compilers are available on the market (at least 7 commercial tools and 2 internal tools of industrial ETSI members) that also indicate the high interest and use of the language. The TTCN-3 standards which provide the foundation for this testing technology, however, are quite complex and encompass multiple hundreds of pages. Part 1 of the TTCN-3 series, the TTCN-3 core language, alone is estimated to contain on the order of 5,000 requirements. Although there has been to this day no evidence of incorrect tool implementations, the TTCN-3 community has been repeatedly requesting over the past 10 years for some kind of assurance that tools comply to the TTCN-3 standards, i.e., a conformance test suite. This STF has created a first TTCN-3 conformance test suite for the purpose of ensuring that TTCN-3 tools actually comply to ETSI TTCN-3 standards. The basis for the development of such a tests, i.e., a proforma for TTCN-3 tool conformance test specification, has been created previously in TC MTS by STF 380/393.

2 Introduction

2.1 Scope, major aims of the STF work

The purpose of this work was to start the implementation of a TTCN-3 tool conformance test specification, i.e., more concrete to specify ICS, test purposes/test suite structure, and TTCN-3 tests for selected clauses of the TTCN-3 core language standard based on the proforma developed in earlier MTS work.

The result is a first version of a well-documented TTCN-3 reference test specification.

2.2 STF activity and expected output

This STF directly supports the ETSI strategic objectives 3rd Generation partnership, "Interoperability and Testing" and "Next Generation Networks (NGN)" and “Intelligent Transport Systems (ITS)”.

Strategic importance behind the work: the decisions by 3GPP RAN5 to move to TTCN-3 from Release 8 onwards, TC TISPAN to develop NGN test suites, TC INT to develop core IMS network test suites, and TC ITS to develop conformance and interoperability test suites in TTCN-3, all require the availability of a number of different, high quality, commercial TTCN-3 tools and well as the ability for ETSI members to assess that these TTCN-3 tools really comply to the ETSI TTCN-3 standards.

With respect to the original ToR, the following changes were decided by MTS#51 and implemented by STF409:

- MTS#51-D9: @purpose tag to be used for test purpose specification (technical)
- MTS#51-D10: STF 409 shall not cover first clauses of core language but instead sample clauses and major concepts throughout the standard. (general)

The following deliverables have been expected and produced as output of STF409:

DTS/MTS-00132-1T3Conf_ICS	TTCN-3 Conformance Test Suite; Part 1 : Implementation Conformance Statement
DTS/MTS-00132-2T3Conf_TPs	TTCN-3 Conformance Test Suite; Part 2: Test Suite Structure & Test Purposes
DTS/MTS-00132-3T3Conf_ATS	TTCN-3 Conformance Test Suite; Part 3: Abstract Test Suite & IXIT

2.3 Relation with the reference TB and with other bodies, inside and outside ETSI

So far, no “official” liaisons with ETSI TBs except for MTS have been established. However, the work of STF409 will have a direct impact on the working groups mentioned in clause 1 and 2.1 as the STF409 work helps to improve the quality and compatibility of TTCN-3 tools.

As planned in the ToR, several groups outside ETSI (and STF409) have participated and actively monitored the STF409 work. Noteworthy for special efforts and interest are the following companies or institutes (in no particular order):

- Elvior
- MTP
- ISPRAS
- Ericsson
- Conformiq

Through the STF409 mailing list, all interested parties were informed about new milestones and drafts which have been made available shortly after each session and before the MTS#52 meeting. STF409 received a lot of feedback in the initialization phase, especially from ISPRAS, Elvior, and MTP. During the development phase, especially Elvior and MTP provided a lot of voluntary help and validation support. At all times, STF409 tried to communicate transparently with all interested parties about the status, the work progress, and the remaining work.

3 Overview of the organization of the activity

3.1 Team composition and experts’ qualification

STF409 consisted of three members:

- Benjamin Zeiss, University of Göttingen

    - TTCN-3 researcher and tool developer (TRex)
- Andras Kovacs, Broadbit
    - TTCN-3 expert and tool developer (BTT)
- Bogdan Stanca-Kaposta, Testing Technologies
    - TTCN-3 tool developer (TTworkbench)

3.2 STF teamwork, distribution of tasks, working methods

First 10 days: all STF members developed TTCN-3 conformance tests, Benjamin Zeiss communicated results back to MTS and STF409 mailing list.

Last 10 days:
- Benjamin Zeiss: documentation, validation, coordination of external reports from Elvior and MTP. Tool development for documentation purposes and TestCast conformance testing.
- Andras Kovacs: test development, validation, and fixing of issues.
- Bogdan-Stance Kaposta: test development, validation, and fixing of issues.

The work climate in STF409 was very friendly, uncomplicated, and productive.

3.3 Liaison with the reference TB and/or the Steering Group

Communication with MTS and the STF409 interest mailing list took place as discussions came up. All feedback was very welcome to STF409 and has influenced how the STF409 performed its work. STF409 provided regular status update reports after each session and made the current drafts of the ATS and documents available for the tool vendors for discussion, evaluation, and validation. The most significant influence of MTS and STF409 list was the feedback provided after the first session and after making the first draft available. At that point and after evaluating the feedback, STF409 decided to focus on validating the existing tests for the remaining time rather than writing new test cases.

Internal STF meetings took place daily during the first session. Afterwards, we coordinated a meeting roughly every second day and discussed questions on demand as they came up. As mentioned in clause 2.3, the following parties provided very valuable contributions to the discussion and the validation/review of the drafts:
- Elvior
- MTP
- ISPRAS
- Ericsson
- Conformiq.

In addition to the reports and discussions that took place in the MTS and STF409 interest mailing list, Elvior and MTP have written concrete issue reports in the TTCN-3 reference test suite mantis. A total of 14 issues have been reported. 13 issues have been fixed by STF409. 1 issue is waiting for a clarification from the TTCN-3 maintenance STF. Conformance tests with pending clarifications have been agreed to be excluded from the final deliverable. These pending conformance tests are stored on ETSI's SVN server, and can be used for future updates of STF409's deliverables in parallel with the corresponding updates of the TTCN-3 core language standard.

3.4 Meetings attended on behalf of the STF with the reference TB and other ETSI TBs

Andras Kovacs participated in the MTS#51 (September 7-8, 2010) meeting, while other STF team members attended it remotely via Gotomeeting. The participation of all members in this meeting was of high importance as some technical issues, especially with respect to the corresponding Proforma document, had to be discussed and clarified.

Benjamin Zeiss participated in the MTS#52 (December 14-15, 2010) meeting in person to present the STF409 results in a status report presentation. Andras Kovacs participated in the MTS#52 remotely via Gotomeeting. Direct feedback provided in response to the report was the wish for continuation of this work (Elvior).

3.5 STF communications, presentations, promotion, inside and outside ETSI, WEB pages etc

STF communication took place via the MTS and STF409 interest mailing list. A status presentation was given at MTS#52. A presentation proposal has been submitted for the 2011 TTCN-3 user

conference to raise attention to the work done by STF409, its importance, and how other tool developers, can make use of the STF output.

4 Final status of the activity

4.1 Overview of the STF work

All objectives of the original ToR have been achieved. The STF has produced the following deliverables that were the expected output:

DTS/MTS-00132-1T3Conf_ICS	TTCN-3 Conformance Test Suite; Part 1 : Implementation Conformance Statement
DTS/MTS-00132-2T3Conf_TPs	TTCN-3 Conformance Test Suite; Part 2: Test Suite Structure & Test Purposes
DTS/MTS-00132-3T3Conf_ATS	TTCN-3 Conformance Test Suite; Part 3: Abstract Test Suite & IXIT

For Part 3, there is a zip-file attachment containing the actual ATS. In addition, STF409 developed tooling that would ease the validation and documentation work. In principle, this tooling can be made available for other tool developers to speed-up their own internal conformance testing.

The proforma improvements have been discussed in terms of the MTS#51 discussion.

- ATS Metrics:
  - Total number of conformance tests: **733**
  - Number of positive syntactic conformance tests: **110**
  - Number of negative syntactic conformance tests: **34**
  - Number of positive semantic conformance tests: **335**
  - Number of negative semantic conformance tests: **254**
  - Total number of clauses (incl. subsections and subsubsections) in the TTCN-3 standard: **342**
  - Total number of clauses (at least partially) covered: **110**

That means that we have covered almost 1/3 of the clauses in the standard at least with some test cases. The coverage does not imply and kind of completeness with respect to the clause, but only that tests have been written for that clause.

- ATS has been validated with 4 tools:
  - **TTworkbench: compile-time and execution by STF409.**
  - **TestCast: compile-time and execution by STF409 and Elvior.**
  - IBM: some initial compile-time validation.
  - MTP: as voluntary reports are sent in.

The work had a direct influence on the maintenance work of the STF maintaining and extending TTCN-3 (STF393). As a result of the test case writing, several clarifications of the standard became necessary. 9 change requests have been reported to STF393 (in Mantis):

- CR5785: STF409 question on [Part 1: TTCN-3 Core Language / Section 6.3.2]
  http://t-ort.etsi.org/view.php?id=5785
- CR5791: STF409 question on [Part 1: TTCN-3 Core Language / Section B.1.2.3]
  http://t-ort.etsi.org/view.php?id=5791
- CR5789: STF409 question on [Part 1: TTCN-3 Core Language / Section 8.2.3.6]
  http://t-ort.etsi.org/view.php?id=5789
- CR5803: STF409 comment on [Part 1: TTCN-3 Core Language / Section 19.11]: ad-hoc restrictions
  http://t-ort.etsi.org/view.php?id=5803
- CR5795: STF409 question on [Part 1: TTCN-3 Core Language / Section 16.1.4]
  http://t-ort.etsi.org/view.php?id=5795
- CR5786: STF409 question on [Part 1: TTCN-3 Core Language / Section 6.3.4]
  http://t-ort.etsi.org/view.php?id=5786
- CR5513: resolution of CR5092 contains bogus examples for charstring
  http://t-ort.etsi.org/view.php?id=5513
- CR5809: CL chapter 15.11 Concatenating templates of string and list types is not supported by BNF
  http://t-ort.etsi.org/view.php?id=5809

- CR5845: BNF does not allow identificator after keyword pattern
  http://t-ort.etsi.org/view.php?id=5845

It turns out that the work of STF409 is not only valuable with respect to the ATS that is produced, but it can also be considered as an additional review for the actual TTCN-3 standards that are produced. With roughly 140 pages, the test purpose document illustrates the amount of work achieved in the short period of time given.

4.2 Technical risk, difficulties encountered and corrective actions taken

The main risks identified are the actual clause selection, the target quality of the produced ATS, and the little available time.

Clause selection: from the discussion in MTS#51, it was clear that the STF409 will be unable to cover the whole core language standard in this initial work. On the other hand, the selection made in the original ToR also did not seem to capture the necessary variety for the initial work. After initial discussions, STF409 compiled a priority list of sections to be covered in the standard and gathered feedback via the MTS and STF409 interest mailing list. As a result, there is an overall agreement on the priorities between STF409 and the interested parties.

The target quality of ATS was initially unclear. The ToR stated that validation should be provided on a voluntary basis from tool vendors and a statement about the desired target quality was missing. Hence, it was originally outside the scope of STF409 work to actually make sure that the conformance tests produced are valid. However, after the first draft has been made available after the first session, it became clear that more focus should be put on the quality – an overall agreement reached between MTS, CTI, STF409, and tool vendors. Hence, the remaining time was primarily spent on validating and fixing issues reported primarily by Elvior and MTP as well as reports produced by STF409 internal tools. STF409 is confident that this decision to shift the focus to quality rather than the production of additional test cases was good and it made the overall ATS a lot better.

The overall time available was unfortunately a real difficulty for STF409. With already 10 days (i.e. same amount as funded) voluntary work required, the actual amount of voluntary work provided is much higher than these 10 days for all involved parties in the STF. This is due to the fact that a thorough validation amount for **at least** half of the development time and even more if you include not only the identification of issues, but also the evaluation and fixing of the issues. Therefore, given that tools had to be developed to support the conformance testing (for TTworkbench and Testcast) as well as the preparation of documents and documentation tools had to be written, the overall time necessary simply to improve the results of the first 10-day session amounted for more the rest of the time. While a lot of tooling is now in place which will create less overhead for future possible STFs continuing this work, it is still expected that validation and fixing issues will still take **more than** half of the time if the same target quality as in the first release is desired.

Finally, one partially unresolved challenge is how to maintain the conformance test suite in the future with respect to the maintenance of the TTCN-3 core language on the one hand and the proforma for the TTCN-3 reference test suite on the other hand. Currently, the TTCN-3 tool conformance test suite is developed against the stable version 4.2.1 of the TTCN-3 core language. The question came up against which version of the core language future development of the conformance test suite should take place. If always the latest stable version of the core language is chosen, there will always be a gap between the development of the conformance test suite and the most recent standard. Furthermore, newly developed tests may or may not be compatible with previous versions of the core language. Future STFs continuing the development of the conformance test suite must have a proper plan how to proceed with respect to the standard that the conformance test suite is developed against and whether they should maybe mark backwards compatible test cases as such.

Another unresolved issue exists with respect to the proforma document for the conformance test suite. As the three deliverables produced by STF409 essentially implement the proforma given by the TTCN-3 maintenance and extension STF, there are two document groups with largely same content which are maintained by different STFs, namely the TTCN-3 maintenance STF (for the proforma document) and the TTCN-3 conformance test suite STF (for the TTCN-3 conformance test suite). A change made by either STF must be synchronized with the documents of the other STF if both document groups are planned to be maintained further. As this likely leads to a lot of problems in the maintenance (it requires a lot of communication between these STFs) and as the STF409 documents implement the proforma anyway, STF409 suggests to deprecate the proforma and to leave further

developments and changes in the responsibility of possible future TTCN-3 conformance test suite STFs.

4.3 Lessons learnt

A lesson learnt is that the desired target quality **should really be specified in ToR** already to allocate the time correctly and to make the expectations clear. Furthermore, while the reports from Elvior and MTP were very much appreciated, it is not a good idea to make validation and therefore quality depend on voluntary contributions: the vast majority of the applied fixes after the first session are the result of working through internal validation reports created by STF409 and not the reports provided from the outside.

Interested tool vendors should be asked to make their tools available to the STF members (i.e., time-limited full licenses for STF member laptops) prior to the first session to reduce possible waiting times for the internal validation (as done by Elvior and Testing Tech for STF409).

4.4 Recommendations for future activities in related domains

- The target quality of the test suite should be specified in the ToR already (see MTS#52 CTI proposal on test suite quality and continuous quality checking).
- It is better if quality does not depend on voluntary contributions from outside the STF.
- If the test suite should be well validated, the time allocated for validating and fixing bugs should be at least half of time development time.

5 Final deliverables

STF409 produced all the expected deliverables:

- DTS/MTS-00132-1T3Conf_ICS – **MTS APPROVED**
  - TTCN-3 Conformance Test Suite; Part 1: Implementation Conformance Statement
- DTS/MTS-00132-2T3Conf_TPs – **MTS APPROVED**
  - TTCN-3 Conformance Test Suite; Part 2: Test Suite Structure & Test Purposes
- DTS/MTS-00132-3T3Conf_ATS – **MTS APPROVED**
  - TTCN-3 Conformance Test Suite; Part 3: Abstract Test Suite & IXIT

Part 3 includes a zip-file attachment with the actual ATS. There are no other deliverables pending, expected, untreated, or not approved.

Deliverable • DTS/MTS-00132-1-T3Conf_ICS • TTCN-3 tool conformance ICS	**Current Status** *(from WPM)*	**Milestone** *(from WPM)*	**Date milestone achieved**
• **Title:** Methods for Testing and Specification (MTS); TTCN-3 Conformance Test Suite; Part 1: Implementation Conformance Statement. TTCN-3 tool conformance ICS • **Scope and Field of Application:** Specification of ICS for the type, module, and constants clauses of the TTCN-3 core language standard based on the proforma developed in earlier MTS work. • **Supporting Organizations:** Ericsson, Fraunhofer Fokus, Elvior, Testing Technologies, MTP, Conformiq • **Keywords:** ICS, TESTING, TTCN Notes: none	TB approval	Start of work	2010-05-17
		TB adoption of WI	2010-05-28
		Start of work	2010-05-28
		Stable draft	2010-12-10
		Final draft for approval	2010-12-23
		TB approval	
		Publication	

Deliverable •DTS/MTS-00132-2-T3Conf_TPs • TTCN-3 tool conformance TPs	**Current Status** *(from WPM)*	**Milestone** *(from WPM)*	**Date milestone achieved**
• **Title:** Methods for Testing and Specification (MTS); TTCN-3 Conformance Test Suite; Part 2: Test Suite Structure & Test Purposes. TTCN-3 tool conformance TPs • **Scope and Field of Application:** Scope of work to be undertaken: Specification of test suite structure and test purposes for the type, module, and constants clauses of the TTCN-3 core language standard based on the proforma developed in earlier MTS work. • **Supporting Organizations:** Ericsson, Fraunhofer Fokus, Elvior, Testing Technologies, MTP, Conformiq • **Keywords:** TESTING, TSS&TP, TCN Notes: none	TB approval	Start of work	2010-05-17
		TB adoption of WI	2010-05-28
		Start of work	2010-05-28
		Stable draft	2010-12-10
		Final draft for approval	2010-12-23
		TB approval	
		Publication	

Deliverable • DTS/MTS-00132-3-T3Conf_ATS • TTCN-3 tool conformance ATS	**Current Status** *(from WPM)*	**Milestone** *(from WPM)*	**Date milestone achieved**
• **Title:** Methods for Testing and Specification (MTS); TTCN-3 Conformance Test Suite; Part 3: Abstract Test Suite & IXIT. TTCN-3 tool conformance ATS • **Scope and Field of Application:** Specification of TTCN-3 test cases for the type, module, and constants clauses of the TTCN-3 core language standard based on the proforma developed in earlier MTS work. • **Supporting Organizations:** Ericsson, Fraunhofer Fokus, Elvior, Testing Technologies, MTP, Conformiq • **Keywords:** ATS, IXIT, TESTING, TTCN Notes: none	TB approval	Start of work	2010-05-17
		TB adoption of WI	2010-05-28
		Start of work	2010-05-28
		Stable draft	2010-12-10
		Final draft for approval	2010-12-23
		TB approval	
		Publication	

6 Resources allocated and spent

Table 1: Summary of resources allocated and spent

Manpower		Travel	Sub-contracts	Total	Notes
60 days	*18.000 EUR*	*0 EUR*	*0 EUR*	*18.000 EUR*	
Budget allocation					
10 days	6000 EUR	0 EUR	0 EUR	6000 EUR	Benjamin Zeiss (funded)
10 days	0 EUR	0 EUR	0 EUR	0 EUR	Benjamin Zeiss (voluntary)
10 days	6000 EUR	0 EUR	0 EUR	6000 EUR	Bogdan Stance-Kaposta (funded)
10 days	0 EUR	0 EUR	0 EUR	0 EUR	Bogdan Stance-Kaposta (voluntary)
10 days	6000 EUR	0 EUR	0 EUR	6000 EUR	Andras Kovacs (funded)
10 days	0 EUR	0 EUR	0 EUR	0 EUR	Andras Kovacs (voluntary)
Actual spent					
10 days	6000 EUR	0 EUR	0 EUR	6000 EUR	Benjamin Zeiss (funded)
10 days	0 EUR	0 EUR	0 EUR	0 EUR	Benjamin Zeiss (voluntary)
10 days	6000 EUR	0 EUR	0 EUR	6000 EUR	Bogdan Stance-Kaposta (funded)
10 days	0 EUR	0 EUR	0 EUR	0 EUR	Bogdan Stance-Kaposta (voluntary)
10 days	6000 EUR	0 EUR	0 EUR	6000 EUR	Andras Kovacs (funded)
10 days	0 EUR	0 EUR	0 EUR	0 EUR	Andras Kovacs (voluntary)
Unused resources					

Table 2: Time spent by experts

Expert	Company / ETSI Member	Start date	End date	Time spent (days)
Benjamin Zeiss	University of Göttingen	04-10-10	31-12-10	20
Bogdan-Stance Kaposta	Testing Technologies	04-10-10	31-12-10	20

Andras Kovacs	Broadbit	04-10-10	31-12-10	20
Total				**60**

Table 3: Travels

Meeting	Place	Expert(s) attending	Start date	End date	Cost (EUR)
					0
					0
Total					**0**

Table 4: Subcontracts

Subject	Subcontractor	Start date	End date	Cost (EUR)	Notes
				0	
				0	
Total				**0**	

7 In-kind contribution

7.1 In-kind contribution required in the EC/EFTA contract

Not applicable.

7.2 In-kind contribution objectives achieved

Not applicable.

7.3 In-kind contribution objectives not achieved

Not applicable.

8 Performance indicators

8.1 Performance indicators required in the EC/EFTA contract

Not applicable.

8.2 Performance Indicators objectives not achieved

Not applicable, as all objectives have been achieved.