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|  | ***ToR STF XF (TC MTS)*** |
| Version: 0.6 |
| Author: Andreas Ulrich – Date:10 Oct 2012 |
| Last updated by: Alberto Berrini– Date:17 October 2012 |
| page of |

Terms of Reference - Specialist Task Force

STF XF (TC MTS)

Design of the Test Description Language (TDL)

**Summary information**

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| --- | --- |
| Approval status | To be approved by TC MTS by Remote Consensus (ending 24-Oct)  To be approved by Board#90 (15/11/2012) |
| Funding | 81 600 €  voluntary contribution 20-30% of total manpower |
| Time scale | Jan 2013 to Oct 2013 |
| Work Items | DES/MTS-140\_TDL “Test Description Language” |

Part I – Reason for proposing the STF

# Rationale

The proposed STF will contribute to TC MTS work on the development of the “Test Description Language” (TDL) as a complement to TPLan (ES 202 553) and TTCN-3 (ES 201 873).

TTCN-3 has been a remarkable success story for ETSI in that it is internationally regarded as the standardized test specification language with world-wide adoption in many domains. However, there has always been a methodology gap between the simple expression of what needs to be tested i.e., the test purposes described in prose or TPLan and the complex coding of the executable tests in TTCN-3.

TDL covers that gap. Dedicated test descriptions will have a positive impact on the quality of the tests through better design and by making them easier to review by non-testing experts. This will improve the general productivity of test development. It opens the door to a new generation of programmers looking to a faster test development process without sacrificing quality.

This approach is driven by industry to foster the benefits of model-based software engineering at the testing side. TDL is planned to fit into the ETSI test specification development process and is the second (and currently missing) step in a potentially seamless test development methodology.

TDL introduces modelling techniques (with graphical and textual syntax) to the specification of test descriptions for testing communicating, reactive real-time systems. Many of them are designed and standardized by ETSI and related bodies, e.g., Intelligent Transportation Systems (ITS), TISPAN, Long Term Evolution (LTE) and others. However, the scope of TDL goes beyond “typical” communicating systems. It will also support the description of tests in other domains that do not necessarily rely entirely on message-passing communication interfaces. With the advent of new software engineering technologies supporting the design of languages with multiple syntaxes the realization of TDL becomes a feasible task.

Furthermore, TDL can be used as an intermediate representation of tests generated from other sources, e.g. simulators, test case generators, or logs from existing test runs. TDL therefore contributes to the ongoing activities in TC MTS to establish model-based testing (MBT) technologies within ETSI that are expressed, for example, in the ETSI standard on requirements on MBT notations (ES 202 951).

# Objective

The final result of this STF will be the delivery of a final draft ETSI standard on the Test Description Language in October 2013. To arrive there the work in the STF will be partitioned into the following activities:

* Detailed description of the TDL concepts and main features; provision of a TDL meta-model that captures these concepts (start: Jan 2013; end: Sep 2013)
* Provision of a TDL concrete syntax suitable for end-users and addressing particularly ETSI’s needs (start: Apr 2013; end: Sep 2013)
* Definition of a formal operational semantics of TDL concepts (start: Apr 2013; end; Sep 2013)
* Consolidation of all results from TDL concepts, concrete syntax, and semantics and integration into the document describing the standard (start: Sep 2013; end: Oct 2013)
* Provision of a proof-of-concept implementation that demonstrates some important TDL concepts and shows the feasibility of the proposed solution (start: Jul 2013; end: Oct 2013)

# Relation with ETSI strategy and priorities

The proposed STF relates to the following aspects of the ETSI long term strategy and priorities:

Keep ETSI effective, efficient and recognised as such

Create high quality standards for global use and with low time-to-market.

Stay in tune with changing nature of the global ICT industry (innovation)

Establish leadership in key areas impacting members' future activities

Engage in other industry sectors besides telecoms, (cross-sector ICT)

This proposal belongs to the following priority categories, set by the Board:

Innovation in mature domains

Emerging domains for ETSI

Standards enablers/facilitators (conformance testing, interoperability, methodology)

Horizontal activities (quality, security, etc.)

# Context of the proposal

## ETSI Members support

Motivation by Conformiq (Dr. Stephan Schulz)

Over the past 10 years industrial testing practice has moved from a programmatic approach to higher level approaches. This work is critical for ETSI to remain at the forefront of testing methods & practice. In other standardization bodies the specification of *informal* test description has been already practice for many years. With TDL ETSI will gain another strong differentiator – it is the natural add-on to TTCN-3. Conformiq strongly supports this STF.

Motivation by Elvior (Dr. Andres Kull)

Elvior sees TDL as an easy-to-use formal notation for test descriptions that can fill the gap between model-based test design and manual scripting methods such as TTCN-3. TDL should be an easier alternative for those who see model-based and scripting based approaches as too much of a time investment. TDL should also be able to serve as an intermediary between generated test cases and their execution platform.

Motivation by Ericsson (Dr. György Rethy)

Over the past decade automated testing and in particular TTCN-3 has gained a major role in our software product development from functional testing to performance and robustness testing. However product development efficiency shall continuously be increased and time-to-market shall be shortened. This requires raising the abstraction level at which testers are working with their test cases and test execution results. Except increasing the efficiency of existing users of test automation technologies, the test description language (TDL) will also open the door to employ automated test systems for users not familiar with programming. Therefore, TDL is a key factor not only in technologies, like model-based testing (MBT), but also in “traditional” test case-based software development ways of working, market adaptation of software products and customer support. Ericsson strongly supports the request for this STF.

Motivation by Siemens (Dr. Andreas Ulrich)

Siemens endorses TDL as the way forward to establish model-driven software engineering methods in testing. Current model-based testing solutions that rely on elaborated system models often do not live up to their promises since in practice these models are hard to deliver and available tools frequently suffer from the test explosion problem of generating too many tests with an unknown purpose and benefit. TDL offers a simpler approach by raising the abstraction of individual tests (or test fragments) without the costs of system modelling. Based on experiences made with TTCN-3 in the past, TDL is a big step forward on the evolution path of test specification languages. It is expected to revive the tool market for a new generation of black-box testing tools based on standards. Therefore Siemens embraces and strongly supports the request for this STF.

Motivation by CTI (Anthony Wiles)

CTI strongly supports this STF proposal. TDL offers a *standardized* approach for the systematic design of tests before they are coded in TTCN-3. With full tool support, this can lead to an increased efficiency and quality of test suites developed by ETSI STFs. Another benefit is that TDL can be used in applications where TTCN-3 may not be suitable or even needed, for example, as a precise format for the specification of interoperability tests.

## Market impact

There is a strong tendency towards model-driven engineering approaches that deploy individual, home-grown testing languages that may lead to a wide diversification in the testing market with many diverging and competing technologies. In this respect TDL will counteract this development by harmonizing the most important concepts for black-box testing of a wide area of applications.

Subsequently:

TC MTS believes that it is highly desirable to develop an established ETSI standard on a common Test Description Language to set the pace for the design of tests for current and future systems. If this work would be delayed, there is the danger that ETSI can lose the grip on the testing market;

the penetration of ETSI’s TTCN-3 test language has reached a mature level and will not likely progress beyond the current scope of covered domains and applications, most of them are already in a mature state. TDL will offer a clear way forward from test case specifications in TTCN-3 to a model-driven design of test scenarios. A TDL standard can have a tremendous impact on the way tests are designed and described for a large set of application areas;

UML (Universal Modelling Language, in existence for over 15 years) has become the ubiquitous modelling notation replacing even well established technologies such as SDL or MSC. Although ubiquitous, the ambiguous semantics of UML leads to very different tool-dependent solutions, even for the same kind of modelling diagrams. This observation extends also to the UML Testing Profile. TDL will improve on this deficiency by providing a precise notation for the very specific task of specifying test descriptions for testing communicating and reactive systems.

3GPP has a large quantity of test specifications in prose (MS Word format) for 3G, 3G and 4G mobiles / UEs. The development of TDL will further provide a methodology for describing these tests and help develop better test standards for 3GPP UE interoperability. Future TDL-based tools will be also helpful to support the semi-automatic generation of 3GPP executable tests.

## Tasks that cannot be done within the TB and for which the STF support is necessary

The work on TDL is currently done completely by voluntary efforts of some key actors. To boost the efficiency of this standardisation effort it is advisable to organize the work within an STF. In addition, an STF will make it easier to allow academic partners that lack sufficient financial support to bring in their expertise.

The work on standardizing TDL encompasses also the creation of a concrete syntax for end users of TDL. Clearly, this work on defining the syntax for a new language can be done effectively only while working at ETSI since the close link with other experts working at ETSI will be a boon for this task.

Finally, because the development of a consistent, practical and implementable language is best done by a small group of experts TC MTS believes that this STF would serve as the catalyst to solve the hard task of developing a first version of a completely new standardized language from scratch within a short time period.

## Related voluntary activities in the TB

Besides review activities that are expected from partners interested in TDL additional efforts will be spent to validate the TDL concepts in terms of a reference implementation.

Other funded activities within the proposed STF will contain 20% of voluntary efforts to meet ETSI’s STF funding guidelines.

## Outcome from previous funded activities in the same domain

No funded activities on TDL have been performed yet.

## Consequences if not agreed

The intention to set up this STF is mainly to speed up the progress in the standardization efforts on TDL. If no STF would be set up, a standard on TDL could be delayed further or not even published at all since other initiatives pushed forward by other standardization bodies, notably OMG, could pop up and gain popularity that might not covering ETSI’s interests and needs for describing conformance and interoperability test suites. Moreover, ETSI would lose influence in the area of model-driven engineering.

Part II - Execution of the work

# Technical Bodies and other Organizations involved

## Leading TB

The work in this STF is embedded within the MTS Work Item “Test Description Language” that is managed by Dr. Andreas Ulrich, Siemens AG (rapporteur).

## Other interested ETSI Technical Bodies

Similar to the maintenance of the TTCN-3 standards, the following ETSI TBs are expected to contribute to the STF by providing feedback on the developed TDL methodology:, LTE, ITS, ERM.

## Other interested Organizations outside ETSI

The following organizations are expected to be interested in the outcome from this STF: WiMAX Forum, TETRA Association, OMA and others.

Moreover, the automotive industry took already initiative in providing solutions for their specific needs of hardware-in-the-loop testing. These initiatives should be also interested in the results of the proposed ETSI STF. At least the following initiatives are known:

* IEEE SCC20 ATML 1671.x; it defines a framework for automotive test data and test scripts based on XML; <http://grouper.ieee.org/groups/scc20/tii/>.
* ASAM AE ATX; Automotive Test Exchange Format; ATX is a standardized test exchange format, which allows reusing existing test cases in different test automation software systems; <http://www.asam.net/>.
* ISO/TC22/SC3/WG1: ISO13209-x:2012; Open Test sequence eXchange (OTX); definition of a standardized exchange format for diagnostic sequences.

The ITEA research project “Combined Methods for Analysis and Testing (MBAT)” brings together academia and industry from the transportation domain (automotive/avionics/rail) to work on a so-called reference technology platform intended to support, among other things, testing activities across the different transportation domains. Therefore the provision of platform-independent test descriptions is one of the key issues; <http://www.mbat-artemis.eu/home/>.

# Working method/approach

## Organization of the work

The goal of this STF is to bring up an ETSI standard on the “Test Description Language (TDL)”. Therefore the work is organized around the usual stages of developing standards, i.e. delivery of an early draft, stable draft, and final draft that are defined as milestones M1–M4 below. The STF consists of just one single phase of development.

Once draft versions of the TDL standard become available, they will be send out to ETSI MTS and other TBs as well as parties that are outside of ETSI for review and feedback. Since there are four milestones foreseen to solicit feedback, there is plenty of room for delivering an accepted TDL standard that fits the needs of different organizations and users.

The TDL standard will encompass the following parts: TDL concepts, TDL concrete syntax, TDL semantics, which are reflected in the technical Tasks 1–3. In addition, an extra Task 4 is foreseen that will implement, at least partially, the defined TDL concepts and syntax as a proof of concept. This way, Task 4 acts as a quality assurance measure for this STF. The final Task 5 will consolidate all results from the previous tasks and deliver the final draft on TDL for approval.

Effort estimation for the various tasks of the STF is in general difficult for a new standard. Therefore estimations are done in alignment with experiences from similar STFs and expectations from different stakeholders.

The proposed STF considers no dedicated steering group. Instead it is controlled directly by MTS, to which it also reports back.

## Base documents

|  |  |  |  |
| --- | --- | --- | --- |
| **Document** | **Title** | **Current Status** | **Stable document** |
| ETSI ES 202 553 V2.0.1 | Methods for Testing and Specification (MTS); Extensible notation for expressing Test Purposes, Requirements and Assertions (ExTRA) | Final Draft | Available |
| ETSI ES 202 951 V1.1.1 | Model-Based Testing (MBT); Requirements for Modelling Notations. | Published | Available |
| ETSI ES 201 873 V4.4.1 | The Testing and Test Control Notation version 3 | Published | Available |

Note, there is no ETSI document on TDL available yet. The documents mentioned in the table above will serve as input to the anticipated TDL standard, but they will be not the subject of work in this STF.

## Deliverables

|  |  |  |
| --- | --- | --- |
| **Deliv.** | **Work Item, Standard number** | **Working title, Scope** |
| D1 | DES/MTS-140\_TDL ES 203 119 | Test Description Language  Scope: common concepts, concrete syntax, semantics |

## Deliverables schedule:

DES/MTS-140\_TDL Test Description Language (TDL)

* Start of work 01-Jan-2013
* ToC and scope 31-Jan-2013
* Early draft 31-Mar-2013
* Stable draft 30-Jun-2013
* Final draft 31-Oct-2013
* TB approval 30-Nov-2013 MTS#61
* Publication 31-Dec-2013

## Work plan, time scale and resources

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **N** | **Task / Milestone / Deliverable** | From | To | Contr’d experts (days) | CTI experts (days) | Other experts (days) |
| M0 | Start of work | 01-Jan-2013 | |  |  |  |
| T0 | Project management | 01-Jan-2013 | 31-Oct-2013 | 5 |  |  |
| T1 | Task 1: TDL concepts | 01-Jan-2013 | 30-Sep-2013 | 62 | 10 |  |
| M1 | Early draft for review | 31-Mar-2013 | |  |  |  |
| T2 | Task 2: TDL concrete syntax | 01-Apr-2013 | 30-Sep-2013 | 28 | 8 |  |
| T3 | Task 3: TDL semantics | 01-Apr-2013 | 30-Sep-2013 | 48 |  |  |
| M2 | Stable draft for review | 30-Jun-2013 | |  |  |  |
| T4 | Task 4: TDL reference implementation | 01-Jul-2013 | 31-Oct-2013 |  |  | 40 |
| M3 | Final draft for review | 30-Sep-2013 | |  |  |  |
| T5 | Task 5: Consolidation of results | 30-Sep-2013 | 31-Oct-2013 | 8 | 2 |  |
| M4 | Final draft for TB approval & STF Final Report | 31-Oct-2013 | |  |  |  |
| M5 | TB approval (MTS#61) | 30-Nov-2013 | |  |  |  |
| M6 | Publication | 31-Dec-2013 | |  |  |  |
| **Total** | | | | **151** | **20** | **40** |

**Notes**:

* ”Contracted experts” refers to external experts who are funded by ETSI for the purpose of this STF. The effort estimate for contracted experts includes voluntary efforts as detailed in “Part III: Financial conditions”, below.
* “CTI experts” refers to ETSI CTI experts. Their effort estimate also includes voluntary efforts.
* “Other experts” refers to external experts who are not funded by ETSI, but solely by the organisations participating in this STF. They are listed here since their contribution on a “TDL reference implementation” in Task 4 is essential to ensure the quality of the STF and also provide input to the other STF tasks.



**Figure 1**. Project Gantt chart

## Task and milestone description

Task 0 – Project management

Activities:

* Planning, organisation, and preparation of STF meetings;
* Ongoing reporting;
* Delivery of the STF final report.

**Efforts estimation**: 5 days, i.e. ½ days per project month for the STF lead

Task 0 contains the usual project management done by the STF, including the writing and delivery of the final report.

Task 1 – TDL concepts

Activities:

* Agreement on the ToC and structure of the TDL standard
* Solicitation of expected features from experts inside and outside of ETSI
* Definition of the TDL concepts according to the categories:
  + structuring/scoping,
  + tester/SUT interactions,
  + behaviour of interaction flows,
  + test data and parameterisation,
  + real-time constraints in interactions,
  + requirement tracing
* Elaboration of the concepts

**Efforts estimation**: 72 days; 4 days per month and expert assuming 4 experts between M0 and M1 (3 months) and 2 days per month and expert assuming 2 experts between M1 and M3 (6 months).

Task 1 defines the foundation of the anticipated TDL standard by providing the concepts of the language according to the mentioned categories. Input to this task in terms of expected TDL features is expected from experts from within MTS, but also from other TBs and also non-members of ETSI. The definitions of these concepts will be the basis for Tasks 2 and 3 on the TDL syntax and semantics and also for Task 4 on a reference implementation later. Task 1 will start first to allow some general discussion about the scope and contents of the anticipated TDL standard and provide a headway for the other tasks. Most progress is expected to occur between M0 and M1. The definitions of TDL concepts will be normative part of the TDL standard.

Task 2 – TDL concrete syntax

Activities:

* Solicitation of requirements from an end user’s perspective on a TDL concrete syntax; input from other ETSI TBs expected
* Decision on the general format (graphical vs. textual) and decision on the approach of defining the syntax (e.g. LR(1) grammar for a textual syntax)
* Definition and specification of 1 or 2 concrete syntaxes for TDL, e.g. a textual and a graphical syntax, according to the requirements

**Efforts estimation**: 36 days; 3 days per month and expert assuming 2 experts between M1 and M3 (6 months)

Task 2 deals with the specification of 1 or 2 concrete syntaxes of TDL according to ETSI’s specific needs to support conformance and interoperability testing. The goal is to support all TDL concepts defined in Task 1 by means of a concrete syntax. These definitions will be normative part of the TDL standard.

Task 3 – TDL semantics

Activities:

* Decision on the approach to be chosen, e.g. using translational or operational semantics to define TDL concepts
* Definition of the formal semantics preferably for all TDL concepts
* Mark possible gaps in the semantics definitions that cannot be closed immediately without large additional efforts

**Efforts estimation**: 48 days; 4 days per month and expert assuming 2 experts between M1 and M3 (6 months)

Task 3 defines the semantics of the TDL concepts defined in Task 1. If parts of the TDL concepts cannot be sufficiently covered by means of semantics definitions given the available resources and timeframe, they will be marked for future work. These semantics definitions will be normative part of the TDL standard.

Task 4 – TDL reference implementation

Activities:

* Decision about scope of the reference implementation, i.e. supported TDL features and concrete syntax
* Definition and implementation of the TDL meta-model based on the agreed TDL concepts
* Implementation of a TDL editor that maps the input of a TDL specification to an instance of the TDL meta-model
* Implementation of means to visualize the TDL meta-model representation of a TDL spec

**Efforts estimation**: 40 days; performed by 1 or 2 non-contracted experts; 10 days per month between M2 and M4 (4 months)

Task 4 is a completely voluntary effort provided by 1 or 2 supporting organizations. Its goal is to provide a proof of concept for the TDL specifications elaborated in Tasks 1 and 2 and provide reasoning on the semantics definitions in Task 3. It will implement an agreed set of TDL (core) features as a meta-model (abstract syntax) and realize a TDL concrete syntax. The output of this task is a simple editor for TDL specifications with means for additional visualizations of TDL specs.

Task 5 – Consolidation of results

Activities:

* Summarizing and consolidating results from Tasks 1 to 3;
* Incorporation of findings from Task 4;
* Incorporation of feedback from review of stable draft;
* Creation of the final draft for TB approval

**Efforts estimation**: 10 days; 2½ days per expert assuming 4 experts are involved (1 month)

Task 5 summarizes the results from the previous Tasks 1, 2, and 3 and considers the feedback from the TB review of the stable draft and findings when realizing the reference implementation in Task 4. The goal of this task is to prepare the final draft of the TDL standard for TB approval.

Milestone 1 – Early draft for review

Delivery of an early draft on TDL setting the scope of TDL and describing the main concepts of TDL.

Milestone 2 – Stable draft for review

Delivery of a stable draft on TDL that contains complete coverage of TDL concepts. It takes into account feedback from the previous review and extends the document to contain also the TDL concrete syntax and a description of the TDL semantics.

Milestone 3 – Final draft for review

Delivery of a final draft on TDL that takes into account feedback from the previous review and completes the document by closing any open parts.

Milestone 4 – Final draft for TB approval & STF Final Report

Delivery of the final draft for TB approval in MTS#61 that takes into account any feedback on the previous version and all findings from the work in the STF. In addition, the STF final report will be made available summarizing the achievements and providing the agreed key performance indicators. This milestone concludes the work of this STF.

Milestone 5 – TB approval

Delivery of the final report at the end of the STF summarizing the achievements and providing the agreed key performance indicators.

Milestone 6 – Publication

Publication of the ETSI Standard on TDL.

# Required expertise

Up to 4 experts to ensure the following mix of skills:

* Deep understanding of black-box testing and the peculiarities of testing communicating real-time systems;
* Experiences in modelling and description techniques such as TTCN-3, UML, MSC;
* Experiences in the design of software languages and compiler/transformation techniques, including model-transformation techniques;
* Experiences in the design of formal semantics for software languages using notations such as statecharts, process algebra, Petri nets and others.

Part III: Financial conditions

# Estimated cost

## Manpower cost

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Working days** | **Rate €/day** | **Total cost  €** |
| Contracted experts (remunerated) | 121 | 600 | 72 600 |
| Contracted experts (voluntary, 20% from total) | 30 | 0 | 0 |
| CTI staff from ETSI budget | 10 | 600 | 6 000 |
| CTI staff (voluntary) | 10 | 0 | 0 |
| Other experts (voluntary) | 40 | 0 | 0 |
| **Total manpower cost** | **211** |  | **78 600** |

## Travel Costs

|  |  |
| --- | --- |
| **Description** | **Cost estimate** |
| Reference TB, Steering Group meetings (2 travels within Europe) | 2 000 € |
| Presentation at the ETSI User Conference on Advanced Automated Testing 2013 (1 travel within Europe) | 1 000 € |
| **Total cost** | **3 000 €** |

Part IV: STF performance evaluation criteria

# Key Performance Indicators

Interests of ETSI and non-ETSI stakeholders

* Voluntary work of experts directly involved in the STF or outside the STF
* Presentations to other ETSI TBs
* Contributions received from other ETSI TBs
* Contributions presented to TB MTS meetings (number, type, comments received)
* Presentations in workshops, conferences, stakeholder meetings (outside ETSI)
* Comments received on drafts (e.g. from personal communication, mailing lists, etc.)
* Potential interest of new members to join ETSI
* Liaison to identify requirements and raise awareness on ETSI deliverables

Quality of the STF results

* Availability of a TDL reference implementation featuring major TDL concepts
* Application of the ETSI drafting rules
* Approval of deliverables according to schedule
* Respect of time scale, with reference to start/end dates in the approved ToR

In the course of the project, the STF lead will collect the relevant data necessary to calculate the performance indicators used to evaluate the outcome of the STF. The results will be presented in the Final Report.

# Document history

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Date** | **Author** | **Status** | **Comments** |
| 0.1 | 10-Oct-2012 | A. Ulrich | initial | Creation of document |
| 0.6 | 17-Oct-2012 | A. Berrini | For MTS approval | Includes contributions in previous versions and an editorial clean-up. |