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| ***TTF T022 - Final Report for ETSI*** | | | | | |
| **Presented to ETSI meeting** |  |  | **Author:** | Martti Käärik | |
|  |  |  | **Date:** | 05 JUN 2023 | |
| **Doc ref** |  |  | **Version** | 0.1 | |
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|  |  |  |  |  |  |
| **TTF** | **T022** |  | **TTF leader** | Martti Käärik | |
| **TB/WG** | **MTS** |  | **TB responsible** | Philip Makedonski | |
|  |  |  | **Administrator** | Elodie Rouveroux | |
|  |  |  |  |  |  |
| **TTF title:** | TOP/TDL Enhancements for Better User Experience | | | | |
|  |  |  |  |  |  |
| **Milestone** | **C2** |  | **Status** | **Covers the period until (cut-off date)** | 30 JUN 23 |
| **Template** |
| **Objective** | Final drafts and final report approved by TC MTS  Third TOP tool feasibility demo | | | | |
| **Achieved** | Yes |  | | | |
|  | | | |
| **Remarks** |  | | | | |
|  |  |  |  |  |  |
| **Achieved dates** |  |  |  |  |  |
| **Template** | **Draft report** | **TB approval** | **ETSI approval** |  |  |
| 05 JUN 2023 | 27 JUN 2023 |  |  |  |  |
|  |  |  |  |  |  |
|  | | | | | |

# Executive summary

The present document provides an overview of the work process and results of TTF T022. After some delay and changes to the work plan, all the objectives of the TTF have been achieved and accepted by TC MTS.

The TTF work resulted in:

* user friendly and high-quality tooling for working with TDL test objectives and test descriptions,
* feasibility study of porting the existing tooling to online platforms and
* specification of test execution environment architecture for potential standardization in the future.

The tooling implementation is part of the TDL Open Source Project (TOP) that is publicly available in ETSI Labs platform. The outcome is described in more detail in clause 4.

The work was carried out by long-time contributors to TDL standardization and TOP tool development in close cooperation with the TDL steering group. Software development best practices were applied in planning and implementation phases. The requirements for the tooling (created by the TTF) are preserved and appended upon beyond the completion of the current TTF to ensure that user-centric view is kept in focus also for future work.

The TDL team aspires to move the TDL tooling to the case study phase in the near future. Potential projects within ETSI to apply the TDL tooling and methodology are proposed by ETSI CTI and pending acceptance.

Porting TDL tooling to an online platform is deemed feasible and further work in that direction is planned for upcoming TTFs. The test environment architecture description is expected to be distributed to test tool vendors (inside and outside ETSI) to gather feedback and motivate participation in upcoming standardization effort in that area.

# Introduction

## Scope, major aims of the TTF work

The focus in TDL roadmap for 2022 and beyond is the applicability of TDL in test execution. The aim is to provide an approach to map TDL specifications to any arbitrary general-purpose language as well as to clarify execution semantics for TDL test descriptions. TDL roadmap is available at <https://docbox.etsi.org/MTS/MTS/05-CONTRIBUTIONS/2020/MTS(20)080001_TDL_Roadmap.docx>

In addition to executability of TDL, the main objectives of the TTF were:

* implementation of TDL features in TOP to ensure coherent tool-support for a TDL-based test development process from requirements over test descriptions to test execution,
* complete test execution environment prototype for one protocol stack used in ETSI and
* provision of a first version of a web based TDL editor.

Terms of reference for the TTF is available at <https://docbox.etsi.org/C_Letter/CL2022/CL(22)_3847_CfE_TTF_T022_MTS_TOP_TDL.pdf>

## TTF activity and expected output

TC MTS created TDL to provide means for all ETSI groups to continuously develop test specifications (of various abstraction levels) using a structured and well-defined language. A missing piece until recently was user friendly tooling to support the development process. The TTF was expected to provide that tooling by extending existing (mostly prototypical) implementation by focusing on usability and code quality.

The output of TDL activity is the requirements specification describing the user scenarios and tool implementation that fulfils those requirements.

As the workflow is increasingly moving to web, the TTF was also expected to investigate the potential of providing web-based implementation of the same tooling that is being developed for the desktop. The description of prototyping results and guidelines for further development were to be documented.

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

The TC MTS was actively involved with the work process of the TTF by participating in requirements review and incremental demonstrations of the implemented features. This process has ensured good acceptance of the TTF outputs among the MTS delegates.

With the help of ETSI CTI, the TTF has initiated activities to involve an upcoming TTF of the ISG mWT in the first adoption of TDL tooling in the test specification process. While the start of that TTF has been delayed, the TDL team has analysed the needs of the mWT and adjusted the tooling to support their activities.

During the UCAAT of 2022, the TDL team made contacts with tool vendors who were interested in the design and potential standardization of test execution framework architecture and component interfaces. The relevant deliverables will be provided to those contacts for review after publication.

# Overview of the organization of the activity

## Team composition and experts’ qualification

|  |  |  |
| --- | --- | --- |
| Elvior | Martti Käärik | Deep understanding of TDL and testing of real-time systems, experienced with meta-modelling and model validation technologies (including Eclipse Modelling Framework and Object Constraint Language), software architecture and design, and various Eclipse frameworks (including graphical editing with Eclipse Sirius). |
| Institut für Informatik, Universität Göttingen | Philip Makedonski | Deep understanding of TDL and testing of real-time systems, experienced with meta-modelling and model validation technologies (including Eclipse Modelling Framework and Object Constraint Language), grammar design and compiler techniques for software languages, and various Eclipse frameworks (including domain specific language design with Eclipse Xtext). |
| Cinderella | Finn Kristoffersen | Deep understanding of TDL and testing of real-time systems, experienced with test description techniques (including TTCN-3 and Message Sequence Charts), ETSI specification process. |

## TTF teamwork, distribution of tasks, working methods

Martti Käärik was responsible for "Project management" as the TTF leader. "TOP requirements and validation" was carried out by Finn Kristoffersen. "TOP architecture and design" and "TOP features implementation" tasks were distributed evenly between Martti Käärik and Philip Makedonski with Finn Kristoffersen providing input regarding the architecture. The “Web-based TOP platform exploration" task was fulfilled by Philip Makedonski and Finn Kristoffersen worked on "Methodology and maintenance".

The experts collaborated using the Teams platform. Notes application was used to keep track of current activities and assignments as well as any decisions or open issues that were raised during the work. The meetings took place online using the Teams tool.

The working plan for the team was put in place in ETSI Labs platform. The tasks were divided into sprints according to agile methodology and used to monitor progress and report to governing groups.

Git version control tools were used to manage and review the source code.

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

The TDL steering group was actively involved, and monthly meetings were held to report progress, demonstrate the results and coordinate on the work plan. The requirements for the TOP implementation were reviewed and prioritized in close cooperation with the steering group. Several TC MTS members participated in the meetings and provided feedback.

Some of the task priorities were changed after the discussions among the steering group. This assured that all interested parties were satisfied with the process. However, the changes did not affect the objectives set forth in the terms of reference for the TTF.

## Meetings attended on behalf of the TTF with the reference TB and other ETSI TBs

TTF members participated in the following MTS meetings:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| MTS#87 | Tallinn | 2022-10-04 | All experts | Introduction of the TTF to the MTS delegates. |
| MTS#88 | Thessaloniki | 2023-01-24/25 | Philip Makedonski | Detailed TTF working plan was presented and changes to the milestones were agreed among the MTS. |
| MTS#89 | ETSI | 2023-06-01/02 | All experts | Final results of the "TOP features implementation" task were presented to the delegates and accepted by the MTS. Several participants expressed their satisfaction with the fast progress of the TTF work considering the initial delays. |

## TTF communications, presentations, promotion, inside and outside ETSI, WEB pages etc

The experts participated in the UCAAT conference in Munich, Germany that took place 13-15 of September 2022 (<https://www.etsi.org/events/2028-2022-09-9th-ucaat-user-conference-on-advanced-automated-testing>). A presentation highlighting the TDL was prepared for display in the ETSI MTS booth at the conference.­­

The goal of the participation was to promote TDL among participants and gather feedback as well as further ideas for advancement of the TDL and related methodologies. Among participants were representatives of the industry, test tool vendors and standardization bodies (including ETSI). Informal meetings were held to discuss their experiences with various testing frameworks and languages as well as modelling tools in general. TTF experts explained how TDL might be used in their respective domains or integrated with custom toolsets.

# Final status of the activity

## Overview of the TTF work

TTF has created a specification of functional requirements. The requirements were reviewed and prioritized by the TDL steering group and used as input for planning the work of TOP implementation. The requirements provide user centric view of the TDL toolset that helps stakeholders understand which features must be implemented and why. The work on the requirements specification will continue after the current TTF completes as new features were added to the specification that were not part of the original work plan for the TTF.

More than half of the TTF’s work was spent on the TOP features implementation task. The experts completed the implementation of all higher priority requirements that were specified previously (including all tasks specifically listed in the original work plan). Implemented tooling was demonstrated interactively during the MTS#89 meeting and was accepted without any issues raised.

Following major features were implemented in TOP:

* TDL meta-model and constraints,
* textual editor for standardized syntax,
* code templates for textual editor,
* diagram editor,
* TDL perspective and wizards,
* OpenAPI import,
* test code generator and runtime environment and
* test adapters for HTTP/JSON.

Overall, the implementation work resulted in the following:

* 57 completed tasks,
* around 250 Git commits and
* more than 12k lines of code.

The implementation work also included configuration of continuous integration pipeline (in ETSI Labs platform) to enable automated delivery of TOP tools to end-users.

The implementation project artifacts are available at the TTF’s ETSI Labs page <https://labs.etsi.org/rep/top/ttfs/ttf-022>

An artifact of implementation work was the description of TOP tooling architecture and the specification of execution environment runtime interfaces. The interface specifications are included in the source code (using Javadoc notation) and exported from the into the deliverable TR 103 119.

In parallel with the implementation work, the experts carried out rigorous functional and usability testing of the tooling which resulted in various corrections and improvements to the TDL constraints and textual syntax. Relevant updates were made to ES 203 119-1 and ES 203 119-8. No change requests were addressed during the work of the TTF.

The experts developed two different prototypical implementations of web based TDL tooling. The prototypes were demonstrated at the MTS#89 meeting. The implementation process and resulting recommendations for further development are described in TR 103 119. The TTF concluded that the state of the art of the model-based tooling for online platforms is sufficient to carry out further development work to make TDL tooling available on web browsers.

## Technical risk, difficulties encountered and corrective actions taken

It is increasingly common to use 3rd party components to develop software instead of developing all features from the ground up. The TOP implementation relies heavily on existing tooling provided by the Eclipse ecosystem. Over time, some of the components have had major backwards incompatible changes and some components have been dropped from the Eclipse release train.

Based on usage experience, TOP development team has dropped some experimental features and changed the use of underlying components to achieve more stable implementation. While this has not caused major problems for the work plan, it is something that should be considered when planning TTF resources.

In addition to stability and sustainability of the TOP implementation, TDL team has also started evaluating the performance of custom and 3rd party code by applying real-life examples for testing to assure that the tooling is usable also with bigger projects. This is another factor that requires attention when creating the work plan.

## Lessons learnt

The use of modern software project management tools has greatly improved the predictability and planning of TTF activities. The TTF expects further improvement and harmonization of such tools provided by ETSI.

## Recommendations for future activities in related domains

The TTF would like to see wider adoption of harmonized test specification techniques and methodologies among ETSI groups. While ETSI CTI has been invaluable in helping to approach other technical bodies and promote the activities of MTS, there still hasn’t been a major real use case for TDL. Continued efforts in that direction are required to help direct the efforts of the MTS to better serve the needs of ETSI members.

# ETSI deliverables

|  |  |
| --- | --- |
| Deliverable: RTS/TR 103 119  Current status: Final draft for approval  Methods for Testing and Specification (MTS); The Test Description Language (TDL); Reference Implementation and User Guidelines | **Achieved date** |
| Creation of WI by WG/TB | 2022-04-01 |
| TB adoption of WI | 2022-04-28 |
| Start of work | 2022-07-01 |
| Early draft |  |
| Stable draft |  |
| Final draft for approval | 2023-07-05 |
| TB approval |  |
| Draft receipt by ETSI Secretariat |  |
| Publication |  |
| Deliverable: RES/ES 203 119-1  Current status: Final draft for approval  Methods for Testing and Specification (MTS); The Test Description Language (TDL); Part 1: Abstract Syntax and Associated Semantics  TDL Meta-Model | **Achieved date** |
| Creation of WI by WG/TB | 2022-04-01 |
| TB adoption of WI | 2022-04-28 |
| Start of work | 2022-07-01 |
| Early draft |  |
| Stable draft |  |
| Final draft for approval | 2023-06-27 |
| TB approval |  |
| Draft receipt by ETSI Secretariat |  |
| Publication |  |
| Deliverable: RES/ES 203 119-8  Current status: Final draft for approval  Methods for Testing and Specification (MTS) The Test Description Language (TDL) Part 8: Textual Syntax | **Achieved date** |
| Creation of WI by WG/TB | 2022-04-01 |
| TB adoption of WI | 2022-04-28 |
| Start of work | 2022-07-01 |
| Early draft |  |
| Stable draft |  |
| Final draft for approval | 2023-07-05 |
| TB approval |  |
| Draft receipt by ETSI Secretariat |  |
| Publication |  |

1. Performance indicators
   1. Performance Indicators objectives achieved

|  |  |
| --- | --- |
| Contribution from ETSI Members to TTF work | |
| Steering Group meetings (number of meetings / participants / duration) | 6 / 7 / 2h |
| Number of delegates directly involved in the review of the deliverables | 2 |
| Contributions/comments received from the Reference Bodies | 4 |
| Contributions/comments received from other Reference Bodies | 0 |
|  |  |
| **Contribution from the TTF to ETSI work** | |
| Contributions to Reference Body meetings (number of documents / meetings / participants) | 3 / 3 / 10 |
| Presentations in workshops, conferences, stakeholder meetings | 2 |
|  |  |
| **Liaison with other stakeholders** | |
| Liaison to identify requirements and raise awareness on ETSI deliverables | 1 |
|  |  |
| **Quality of deliverables** | |
| Approval of deliverables according to schedule | schedule updated |
| Respect of time scale, with reference to start/end dates in the approved ToR | end date postponed |
| Comments from Quality review by Reference Body | 0 |
| Comments from Quality review by ETSI Secretariat |  |

* 1. Performance Indicators objectives not achieved

None.

1. Resources allocated and spent

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author:** | **ETSI - Funded Activities** |  |  |  |  |
| **Period covered:** | **From: 20 June 2022** | **To: 31 July 2023** |  |  |  |
| **Status:** | **Final** |  |  |  |  |
| **Status date:** | **05 June 2023** |  |  |  |  |

* 1. Summary of resources allocated and spent (real cost)

These have been divided into Manpower and travel budgets. The total expenses are summarized in the table below.

Table 1: Summary of resources spent

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Expertise Service Provision** | **Travel** | **Total** |
| Resource Available | | 119 500,00€ | 3 900,00€ | 123 400,00€ |
| Resource Usage | | 119 500,00€ | 3 900,00€**\*** | 123 400,00€**\*** |
| **Variance (Avail. - Usage)** | | **0,00€** | **0,00€\*** | **0,00€\*** |

**\*** Provisional costs. One travel expenses report has not been received yet.

This table provides a detailed view on the travels of the TTF.

Table 2: Travels

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Companies | Meetings | Places | Dates | Amounts |
| Cinderella ApS | UCAAT 2022 Conference | Munich, DE | 13-15 SEP 2022 | 567,86€ |
| Elvior OU | UCAAT 2022 Conference | Munich, DE | 13-15 SEP 2022 | 572,98€ |
| Georg August Universität Göttingen | UCAAT 2022 Conference | Munich, DE | 13-15 SEP 2022 | 502,24€ |
| Georg August Universität Göttingen | MTS#87 | Tallin, EE | 04-05 OCT 2022 | 745,83€ |
| Georg August Universität Göttingen | MTS#88 | Thessalaniki, GR | 24-25 JAN 2023 | 702,28€ |
| Cinderella ApS | MTS#89 | Sophia Antipolis, FR | 01-02 JUN 2023 | 269,60€ |
| Elvior OU | MTS#89 | Sophia Antipolis, FR | 01-02 JUN 2023 | 269,60€\* |
| Georg August Universität Göttingen | MTS#89 | Sophia Antipolis, FR | 01-02 JUN 2023 | 269,60€ |

Travels costs spent = 3 900,00€

**\*** Provisional cost. Waiting for the corresponding Travel expenses report.