OETCS/WP3/DescriptionOfWork

openETCS

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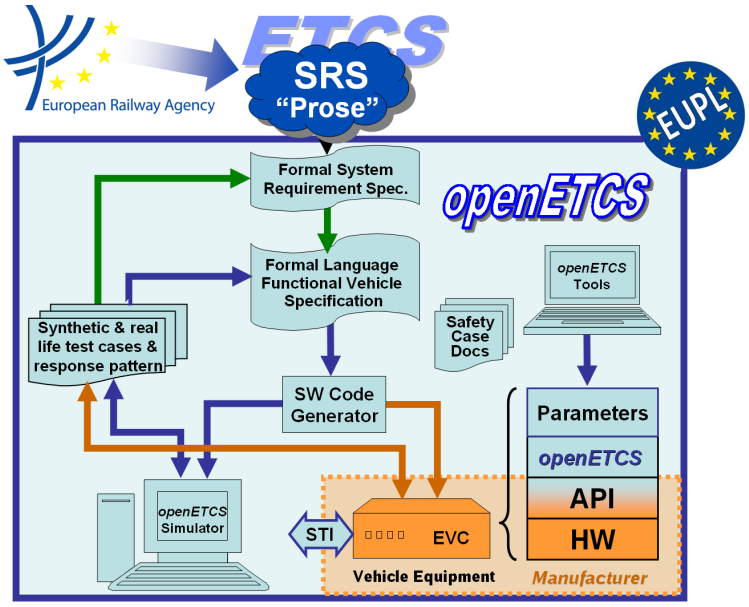
Work Package 3: “Modelling”

openETCS Modelling Work Package

Description of Work

openETCS WP3 SRS task force, Marielle Petit-Doche, Uwe Steinke and Bernd Hekele

January 2014



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openETCS WP3 SRS task force

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Description of work

Prepared for openETCS@ITEA2 Project

Abstract: This work package...

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1 Introduction

1.1 Motivation

The openETCS work package WP3 aims to provide the architecture and design of the openETCS OBU software as mainly specified in UNISIG Subset_026 version_3.3.0.

The appropriate functionality has been divided into a list of subfunctions of different complexity (see `https://github.com/openETCS/SRS-Analysis/blob/master/SystemAnalysis/List\_Functions.xlsx`).

All these functions are object of the openETCS project and have to be analyzed from their requirements and subsequently modelled and implemented. With limited manpower, a reasonable selection and order of these functions is required for the practical work that allows the distribution of the workload, more openETCS participants to join and leads to an executable– limited – kernel function as soon as possible.

While the first version of this document focuses on the first version of the limited kernel function, it is intended to grow in parallel to the growing openETCS software.

1.2 Objectives

The first objective of WP3 software shall be

- "Make the train run as soon as possible, with a very minimum functionality, and in the form of a rapid prototype."

This does not contradict the openETCS goal to provide conformance to EN50128.

- After a phase of prototyping, the openETCS software shall be implemented compliant to EN50128 for SIL4 systems.

Additional goals for this document are

- Identification of the functions required for a minimum OBU kernel
- Architecture overview regarding the minimum OBU kernel
- Technical approach: Description of the proceeding and methods to be used
- Road map of the minimum OBU kernel functions
- Road map thereafter

Note: This document will be extended according to the progress of WP3.

2 Goals of the openETCS Modelling Work

by Uwe

2.1 Functional Scope: The Minimum OBU Kernel Function

The objective "Make the train run with a very minimum functionality" shall be in terms of on ETCS OBU translated into

- The Train moves on a track equipped with balises and determines its position.

That means, for this very first step the train shall not supervise the maximum speed, shall not activate the brakes. Instead, the minimum function set shall be limited to (see https://github.com/openETCS/SRS-Analysis/issues/9)

- Receive, filter and manage balise information, received from track (see https://github.com/openETCS/SRS-Analysis/issues/12)
- Calculate the actual train position based on balise and odometry information (see https://github.com/openETCS/SRS-Analysis/issues/8)
- Calculate the distances between the actual train position to track elements in its front

A more detailed architectural breakdown of these functions is available in the form of a SysML model at (see https://github.com/openETCS/modeling/tree/master/model/sysml.

In addition, the work on this minimum functionality requires to be supported by

- The availability of the ETCS language as specified in Subset UNISIG Subset_026, chapter 7 and 8
- The abiltiy to link intermediate and final results with the requirements of the ETCS specification (subset_026, ..)
- The usability of a data dictionary (see https://github.com/openETCS/dataDictionary)

These supporting prerequisites are under construction and therefore not completely operable actually. How to deal with these restrictions, will be outlined in chapter ???

2.2 Actual Status

Some first analyis steps for the required minimum functionality have been gone as results from the SRS-Analysis task force. These results are available on https://github.com/openETCS/SRS-Analysis

2.3 Practical Approach

The architecture and design of the minimum OBU kernel shall be developed in consideration of the actual status, restricted prerequisites and limited resources as follows.

2.4 Organisation of the Work package

BH: Tasks, Repositories

3 Methodology

This section gives some information on how to proceed to achieve the objectives described in section 1.2. As decided previously in the project, the means chosen to design the WP3 software, compliant to SIL4 requirements of EN50128 are SysML on Papyrus and SCADE for the modelling part, C language for the executive software. The first versions of the OpenETCS toolchain already involve Papyrus.

Other tools can be involved to support the task of the workpackage (indeed to manage requirements, data, traceability,...) but will be defined latter depending of the needs and the propositions.

For further information on means selection and detailed description of the process, consider the deliverables [D7.1][1], [D7.2][2] and [D2.4][3].

3.1 Main step of the analysis

The figure 1 gives the main steps of the design approach and main used and produced artefacts. All is detailed in D2.4.

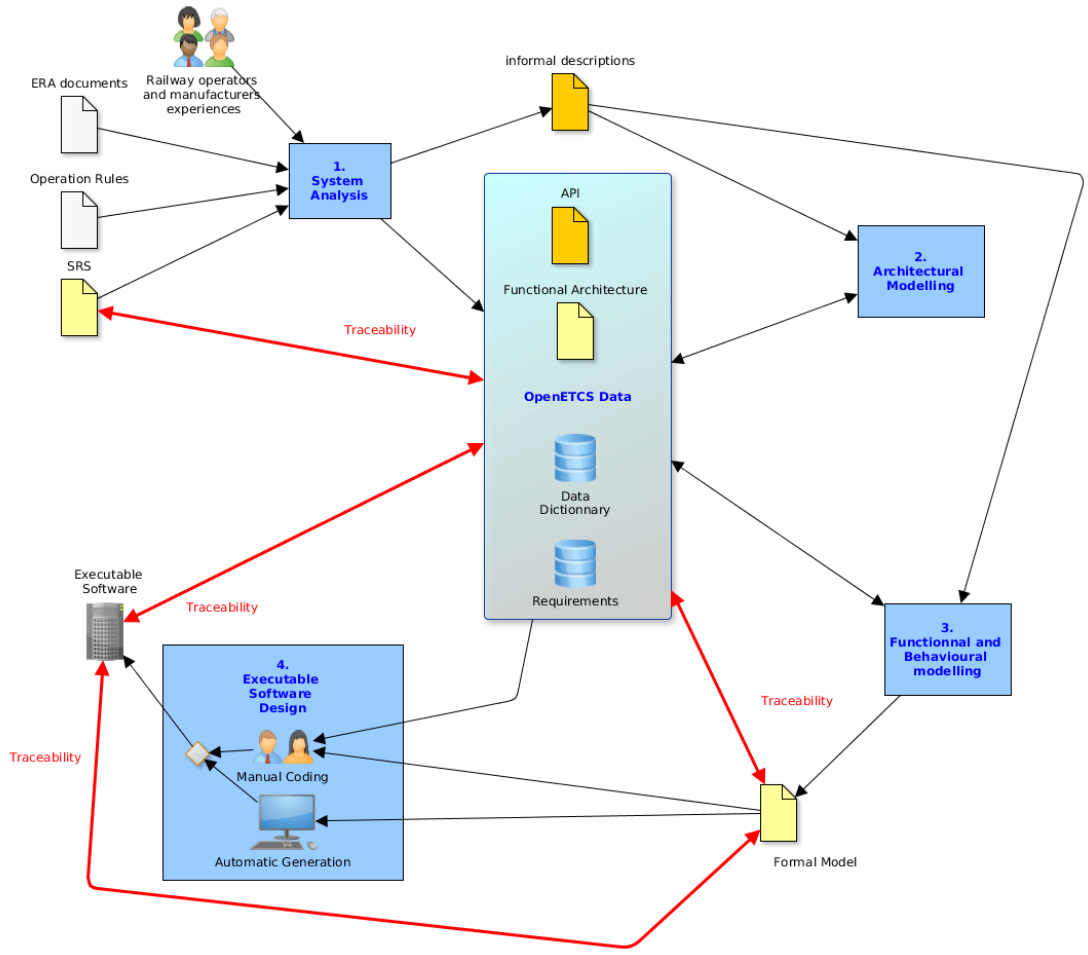

Figure 1. Main steps of the design approach

Four main steps are defined:

[1] https://github.com/openETCS/toolchain/blob/master/T7.1/D7.1/D7.1.pdf
[2] https://github.com/openETCS/toolchain/blob/master/T7.2/D7.2/D7_2.pdf
[3] https://github.com/openETCS/requirements/blob/master/D2.4/D2_4.pdf

System Analysis to identify the main functions and their interactions and to clarify the requirements allocated to them.

Architectural Modelling to specify the functional architecture of the system to design and internal and external interfaces. In parallel the main data exchanged between the functions shall be identified.

Functional and Behavioural Modelling to provide a formal model of each function.

Executable Software Design to provide executable part of software.

These steps are sharing common artifacts which going to be updated and completed during all the design phase. Some recommendations and guidelines are defined in D2.4 for naming of elements or specifing a model.

As the artifacts are shared, an iterative process can be easily applied at each level.

3.2 Shared artifacts

3.2.1 Functional architecture and API

API[4] is a document provided as input which can be updated according to the needs.

Functional architecture is specified as a SysML model, which can be automatically translated in a Scade model. An initial SysML model to cover the initial functional scope 2.1 is available on github: `https://github.com/openETCS/modeling/tree/master/model/sysml`

See D2.4 for how to use SysML to define the Functional Architecture.

3.2.2 Set of Requirements

The initial set of requirements is the contains of Subset_026 v3.3.0. These requirements are available as ReqIF format on github: `https://github.com/openETCS/modeling/tree/master/model/subset26` .

This set is going to be increased during the design with updated requirements and added requirements.

Data model of D2.4 gives the information to manage on the requirements.

For the moment, ProR is involved in the openETCS toolchain to define new requirements and links between them. It is still to clarify how to manage traceability.

3.2.3 Data Dictionary

The Data Dictionary is the set of all the types, constants and variables defined to describe the system. Data model of D2.4 describes how to define a data.

A preliminary task of the system analysis is to identified and specify the data structure which allow to describe the system.

[4] `https://github.com/openETCS/requirements/blob/master/D2.7-Technical_Appendix/OETCS_API\Requirements_v1.0Draft_130301.pdf`

Then the data structure and data definition shall be implemented in the data dictionary.

For the moment the mean to do this implementation is not clearly identified (UML library ? XML files ?)

3.2.4 Formal models

Two models are provided during this phase:

- a semi-formal model in SysML which gives the functional architecture of the system, including interaction between each function and definition of the data.
- a formal model in SCADE which follows and completes the same architecture and gives a behavioural description of each function. Then C code can be automatically generated from this model.

3.3 Function specification and design

For the specification and the design of a functional block, a set of subtasks can be defined:

1. Identify the function and the input document to describe it (requirements of subset 26 or other subsets, API,, functional architecture,...)
2. Specify its environment and its external interfaces with an ibd diagram in SysML
3. Define and specify its internal decomposition in subfunctions and its internal interfaces with ibd and bdd diagrams in SysML
4. Link and complete to the data dictionary
5. Allocate and manage the requirements
6. Clarify and specify the behavior of each elementary function in SCADE
7. Complete Data dictionary if necessary
8. Complete requirement sets and manage traceability
9. Provide for review

4 How to handle Findings in the SRS

5 How to Handle Findings in the SRS

by Bernd