

# THE TOPCASED PROJECT

## A TOOLKIT IN OPEN-SOURCE FOR CRITICAL APPLICATIONS AND SYSTEM DEVELOPMENT

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### ABSTRACT

In order to master the ever-growing complexity of systems embedded aboard airplanes, cars, satellites, etc. while reaching required quality levels and increasing the productivity of development phases (to avoid offshore developments), it is essential to improve systems engineering methods and tools and to establish their systematic use.

### INTRODUCTION

TOPCASED proposes an open-source toolkit (that is, deliverable, modifiable and usable freely) for systems engineering, whose goals are:

- To make durable methods and tools for the development of critical embedded systems, while minimising owning costs.
- To integrate as soon as possible advances in the academic world and methodological evolutions.
- To take certification regulatory constraints into account.

### TECHNICAL SECTION

The TOPCASED Project aims at:

- Developing editors for specification, design and implementation, supporting an integrated-development process from the systems specification

to the architecture and realisation of safe products (components, software, hardware included), possibly submitted to certification authorities (aeronautics, etc.).

- Developing and integrating formal-verification tools by contributing to improve existing techniques and theories.
- Developing business and industrial models for products (licenses, intellectual property, support, services, etc.).

Furthermore, the purpose is also:

- To support teaching (tools, small projects...).
- To strengthen the cooperation between industrial and academic worlds.
- To establish a maintenance process based upon contributions.

This being done in synergy with national or international research initiatives linked with this systems engineering topic.

TOPCASED proposes a cooperative approach of systems or equipment design between all actors of a project, whether they deal with hardware or software.

In order to reach these objectives, the TOPCASED Project is structured in work products (WPs), each of which focalising on a specific activity of the development process:

- WP2 is dedicated to modelling tools useful for product-definition upstream activities supporting the most adequate languages/methods (those who

are currently widely used in the industry, and those whose definition will be carried out during the present project). In order to optimise development costs and cycles for these modelling editors, the meta-tool solution is favoured by the TOPCASED project. In this setting, this WP2 will also study meta-modelling techniques in terms of tools and languages; and tight collaborations will be carried out with the IST ModelWare Project and the TopModL initiative.

- WP3 studies and implements model verification techniques. These techniques will be formal (synchronous or asynchronous) to get the proof that a given model satisfies functional or architectural properties. They will also feature simulation and exploration engines to analyse and validate finely the behaviour of user models, or will enable to analyse models statically to ensure modelling rules shall have been respected.
- WP4 focusses of the programming activity (whether is to produce software or hardware). The aim is to distribute software or hardware development environments in adequacy with industrial constraints. This includes language-edition tools, debugging tools and coding standard verification tools.
- WP5 studies and integrates techniques and tools essential for the whole TOPCASED process: model transformations. This is from these works that we will ensure the global coherence of the systems development

process. The studied transformations will enable to translate models from a modelling language to another, to generate code, documentation, test cases... here also, a tight collaboration with Modelware is expected.

- WP6 offers the necessary support to communication between tools through services. These works are a concrete application of some results of ModelWare. We will also study in WP6 the integration in TOPCASED of existing tools in industrial processes, and the transfer of information between these processes and tools developed in the project. The aim of these works is to organise the toolkit as a federation of interoperating tools, in order to spread out limited parts of the toolkit, depending on the needs and the context.
- At last, WP8 aims at analysing and specifying requirements for dependability aspects.

All the aforementioned works aim at providing an equipped solution to the various activities of an embedded-system development process. WP1 focusses on the global process from the definition of systems to the realisation of software and hardware, going through the equipment architecture, promoting an integrated MDA (Model-Driven Architecture) approach. The aim is to pilot (in terms of expression of requirements and evaluation of results) the other works in order for the tool set to form a coherent whole and to facilitate the fluidity of developments while applying and incremental approach. Through this piloting, it will be possible to give new

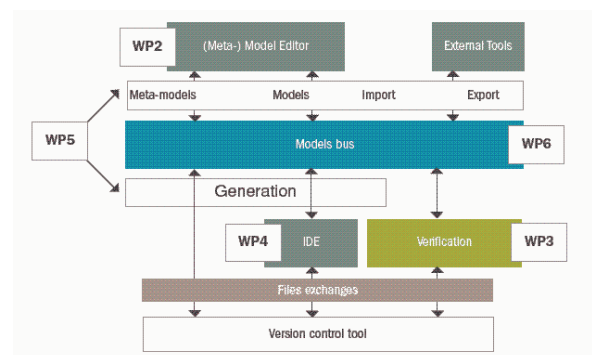
directions to the works from other WPs.

The validation of the results of the TOPCASED project on actual projects will be addressed in a complementary project.

Furthermore, one of the main threads of the TOPCASED Project being to release its results in **open source**, the success of the project goes necessarily through the setting of efficient means to distribute and maintain the results: which types of license, which maintenance structure, which development means, which “business model” will be necessary? This is the task of WP7 to address these questions.

We have identified 4 types of tasks:

- Platform tasks whose objective is an operational integration in the TOPCASED tool.
- Prosepective tasks whose results will be integrated later.
- Experimental tasks to carry out evaluations.
- Study tasks focussing on expression of requirements from experimental results.



**Figure 1: Architecture.**

## PARTNERSHIP SECTION

TOPCASED was retained very early as a project inside the Competitiveness Pole Aerospace Valley (Aeronautics, Space and Embedded Systems), selected itself as one of 6 “world-class” competitiveness poles by the French Government in July 2005. There are 4 types of stakeholders in the project:

- **Industrial** users of the Pole, using their experience in the development of critical systems bring their needs, participate in technical choices and developments and validate products: EADS Airbus, EADS Astrium, Atos-Origin, CNES, CS-Systèmes d’Information, Siemens VDO Automotive SAS, Sodifrance, Thalès Aerospace (member of Thales Group).
- **SMEs** bring their expertise in processes and/or technologies on value-added works: Anyware Technologies (Toulouse), Micouin Consulting (Marseille), Tectosages (Ariège).
- **Laboratories** bring their expertise on theoretical aspects of the hard points of the project: INRIA (Rennes and Rhône-Alpes Research Units) and IRIT-CNRS, LAAS-CNRS, ONERA-DTIM grouped inside the FÉRIA federation.
- **Universities and Schools** participate in the efforts of Research and Development, teach the knowledge associated to the tools developed and methods used, and host the project in its development phase thanks to their network infrastructure: ENSIETA in Brest, ENSEEIHT, ESO in Angers, UHA (Université de

Haute-Alsace), INSA Toulouse, Université Paul Sabatier in Toulouse Rangueil, UFSC (University of Florianopolis in Brasil).

## ECONOMICAL SECTION

An essential condition to the competitiveness of aeronautic, space and automotive industries lies in the improvement and the deployment of tools and methods for design, development, integration and verification of software-intensive systems.

The evolution of tools and methods for embedded-systems engineering is still an open field full of opportunities. In order to give an answer to durability constraints, development-costs control and come down constraints, the TOPCASED Project favours an open-source approach for these tools. This approach should generate jobs and services in maintenance, support and training.

The purpose is to reach in 10 years a generalised usage of these new methods and tools by all industrial partners from the Pole. The dispersion of these products to other applicative domains will also generate new activity (for instance: adapting to standards and practices from medical or nuclear industries).

## FUNDING AND PLANNING SECTION

The first two years are devoted to the definition and realisation of the targeted toolset framework as well as the elaboration of a standard development process for embedded systems. The third year has as a major objective to integrate verification tools and techniques in the available framework. The fourth year will finalise the integration of a chain supporting

the whole process and will prepare its global usage. The whole charge on these 4 years is currently estimated to 1745 men.monthes.

### **REGIONAL, NATIONAL AND INTERNATIONAL VISIBILITY**

Beyond its technical issues, TOPCASED aims clearly at being a synergy point for national and international works in the domain of Model Engineering.

National skills in this domain are scattered through the country, the TOPCASED Project has therefore settled tight collaborations with other major stakeholders. As an example, we may cite the creation of the common platform "OpenEmbedd", as part of the RNTL 2005 Call For Projects, with Competitivity Poles System@TIC (Paris Region), Images&Réseaux (Brittany) and Mnialogic (Rhônes-Alpes).

Other international collaborations towards standardisation are also on-going, for instance SAE/AADL (standardisation of an Architecture Description Language), AUTOSAR (European automotive consortium for open standards).

Furthermore, the project is fully adequate with the ambitions from the "High Level Group on Embedded Systems" from the European Commission for Enterprises and the Information Society. Naturally, the Project aims at being proposed as a project for the ARTEMIS Technological Platform for Embedded Systems.

### **REFERENCES**

<http://www.topcased.org>

