Project Results

PANORAMA

Supporting the shift to open source

The ITEA project PANORAMA (Boosting Design Efficiency for Heteregeneous³ Systems) has created an open-source meta-model and framework that promotes collaboration on software and hardware development using heterogenous tools and practices and without losing control of one's own data.

Project origins

Similar control units are used across the mobility sector, from automotive to avionics. However, different organisations typically utilise heterogenous functional domains, hardware and teams, presenting an issue when collaborating: how can data be exchanged without giving away intellectual property? While proprietary solutions exist, few wish to take over product usage from another company. The solution lies in an open-source model to abstract information for control unit optimisation in the early stages of development.

The PANORAMA project has enabled this through the creation of an enhanced meta-model and related tool framework to enable the design and development of heterogenous embedded hardware and software systems by heterogenous parties. Additionally, the project has provided best practices, novel analysis approaches and guidance for development with a focus on extending the scope and interoperability of current system-level analysis approaches. All of these innovations have been made available as open source, allowing for swift uptake by parties worldwide without the usual costs and effort associated with (collaborative) system development.

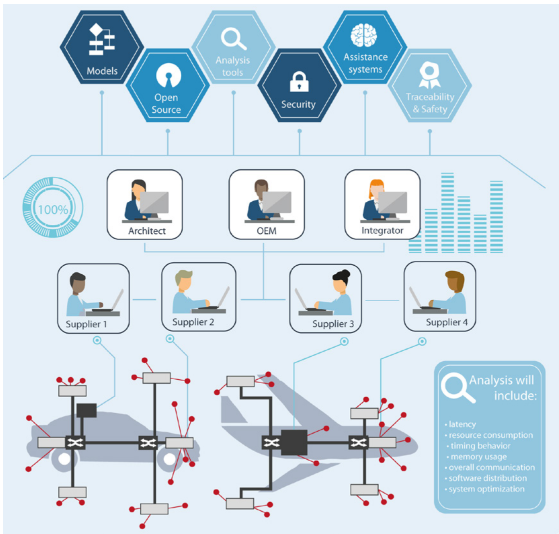
Technology applied

PANORAMA has developed a number of technological innovations centred around the meta-model and tool framework, which allows for the exchange of (meta)data between parties working on control unit optimisation. This is possible even before much is known about later functionalities as memory consumption, bandwidth and controller speed can be considered at an early development stage. At the core of this is a de-facto standardised data model to cover various heterogenous static and dynamic data analytics, a flexible operations support systems (OSS) framework to visualise and explore data sources, and a framework to transform the data model into different formats for further processing. Third-party tools can seamlessly be integrated into workflows using PANORAMA's service architecture, while data model extensions can be used for fault analysis and safety attributes.

An important aspect of the project is the capacity for parties to tailor the framework to their internal needs while still providing data to other parties. Elements of this include modular reference implementations to allow for the re-use of development artifacts outside of PANORAMA and data-driven artifact analysis visualisation using non-monolithic frameworks. A configurable Design-Space Exploration (DSE) service has also been developed for multi-objective optimisation and assessment. To further facilitate the uptake of these results, data security guidelines have been made publicly available alongside a dataset containing artifacts and trace links. This can serve as a foundation for future research in traceability and model-driven safety assessment by the PANORAMA community.

Making the difference

PANORAMA arrives at a time when 81% of companies are consuming open-source products or services and 44% are contributing to upstream open-source projects. For this reason, the project focuses on open-source collaboration in a business-friendly ecosystem. Using the open, vendor-neutral collaboration platform, companies can work with competitors for mutual benefit while exploiting their separate tool suites on top of this platform. Vector, for instance, has created an interface for loading and generating data which will serve as a starting point to attract new customers



Collaborative design in a heterogenous world of Hardware, Software and Teams

and collaborators. Bosch, meanwhile, has utilised PANORAMA for their PLAT4MC suite, which offers continuous project monitoring to around 500 internal users. Exploitation is also taking place via the Eclipse Foundation's networks, such as the OpenADx Working Group that organises a large number of projects and can introduce them to PANORAMA.

This approach to dissemination has seen the emergence of a global community: partners in Europe, Asia, Africa and the Americas are already making use of PANORAMA, including the huge automotive and avionics markets of Germany, China and the USA. Clear benefits can be seen in maintainability, reliability and efficiency. For maintainability, the project has reduced the time taken to rework, adapt and test tools from 57 days to 12 days and, for reliability, has received an A grade for code quality from the industry standard SonarQube. Regarding efficiency, the local set-up of individual toolchains (the installation and integration of several tools) typically took eight hours prior to PANORAMA; this is now possible in 0.8 hours using the service-based architecture and encompasses validation, migration, transformation, simulation, tracing, optimisation, analysis and visualisation. This allows the influence of new functionalities to quickly be seen by all parties.

In terms of standardisation, the PANORAMA consortium is now working on combining the physical simulation of the FMI/FMU standard with the project's performance simulation to create more realistic simulation environments that account for timing within the hardware or environment. This is being pursued in close collaboration with VDA, the association that coordinates the structure of the German automotive industry and provides guidance on it. This will possibly lead to future European projects expanding on PANORAMA's successes. Having already built up a large open-source community worldwide, the project has a strong foundation to continue reducing the costs and increasing the quality of software development both now and in the future.

Major project outcomes

Dissemination

- 49 achievements & publications, 18 presentation on fairs, 6 workshops & 11 trainings

Exploitation (so far)

- Eclipse APP4MC open source framework (https://www.eclipse.org/app4mc/):
  - Several application within framework, e.g.:
  - APP4MC transformation; APP4MC cloud; APP4MC simulation; APP4MC tools (https://projects.eclipse.org/projects/automotive.app4mc/developer)
- Eclipse Capra (https://projects.eclipse.org/projects/modeling.capra):
  - Traceability management tool
- ForSyDe (https://forsyde.github.io/):
  - A Methodology for "correct-by-construction" Formal System Design
- Open-Source Data traceability:
  - The MobSTr dataset: Model-Based Safety Assurance and Traceability (https://github.com/panorama-research/mobstr-dataset)
- Enhanced products (supporting tools): Embedded Multicore tooling - PLAT4MC; INCHRON Toolsuite; VECTOR Toolsuite; Polarion (PLM System)

Standardisation

- VDA recommendation (https://webshop.vda.de/VDA/en/vda-710-072022)
- BTF enhancements (Best Trace Format) (https://www.eclipse.org/app4mc/documentation/)
- ASAM-MDX support (https://www.asam.net/standards/detail/mdx/)
- ODE open dependability exchange Meta-Model (https://deis-project.eu/)
- FMI interfacing for simulation (https://fmi-standard.org/)

Submitted patents

- 'Verfahren zur Simulation einer Hardwareeinheit in einer Recheneinheit'
- 'Verfahren und Vorrichtung zum Verarbeiten von Daten'
- 'Method for criticality level aware deep learning in collaborative engineering of intelligent dependable embedded systems'
- 'Evaluating machine learning algorithms by definition of evaluation framework for an objective quality measure
- 'Simulation-based Generation of Component Fault Trees for Software Components'

PANORAMA

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Partners

Finland

- TactoTek

Germany

- Dortmund University of Applied Sciences and Arts
- Eclipse Foundation Europe GmbH
- Fraunhofer
- INCHRON
- OFFIS
- Regensburg University of Applied Science
- Robert Bosch GmbH
- Siemens AG
- University of Rostock
- Vector Informatik GmbH

Portugal

- Critical Software S.A.
- Instituto Superior de Engenharia do Porto (ISEP)

Sweden

- Alten
- Arcticus Systems AB
- KTH (Royal Institute of Technology)
- Mälardalen University
- Qamcom Research & Technology AB
- Saab AB
- University of Gothenburg

Turkey

- AVL Research and Engineering
- Mantis Software
- UNIT Information Technologies R&D

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April 2019

Project end

September 2022

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