



PROJECT RESULTS

Cutting costs in complex design

Ensuring fast verification of mission-critical embedded systems



The SPICES project developed tools for fast verification of software designs in mission-critical applications such as avionics and communications. The project made use of two standards: the architecture analysis and design language (AADL), which offers a precise modelling language for embedded real-time systems, and Object Management Group (OMG) component technology. The resulting approach enables early analysis of systems and ensures consistency between software architecture and implementation thanks to component technology.

Overall engineering efforts for embedded software have risen markedly with the increasing complexity of mission-critical systems. And design costs are significantly higher for systems with certification constraints – such as in avionics to meet DO178B Airborne Systems and Equipment Certification criteria. When developing and integrating such systems, the cost of fixing design problems found late on is very high.

Model-driven engineering

There is a lot of room when developing such applications to cut costs by making integration more

predictable. However, this demands technically very challenging technological developments. SPICES set out to verify design decisions as soon as they are made, and guarantee consistency between design decisions and the actual system.

The project brought together experts in analysis, verification and software engineering of real-time and embedded systems from the avionics and communications to reduce the costs and efforts of building mission-critical systems. It developed use of model-driven engineering based on AADL, making it possible to conduct verification and analyses early in the design process, and to provide support for integrating software subsystems of critical software-intensive embedded capabilities.

Building on established standards

SPICES built on AADL and the CCM standard component-based technology from the OMG to set up a spectrum of innovative tools covering several types of activities. These included: verifying real-time constraints; state exploration; estimating performance; power consumption analysis based on high-level designs; and determining

SPICES (ITEA 05015)



Partners

- Airbus
- Axlog Ingenierie (during part of project)
- Barco
- CEA-List
- Cetic
- Féria
- KU Leuven DistriNet
- Uni Bretagne-Sud Lab-STICC
- SQS
- TCP/SI
- THALES Avionics
- THALES Communications
- University of Cantabria
- Verimag

Countries involved

- Belgium
- France
- Spain

Start of the project

September 2006

End of the project

November 2009



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worst-case execution time. It also extended the capabilities of advanced component-based technologies towards new targets – such as reconfigurable hardware and partitioning kernels used in avionics or secure systems.

The technological developments were validated in a series of demonstrators that provided an ideal framework to gain experience in the use of tools early in the development cycle. These demonstrators included:

- Software radio;
- Avionics flight warning system;
- Mars Rover prototype (space domain);
- Avionics software in an air traffic control application;
- Modelling of a direct memory access (DMA) subset in avionics hardware.

High level of confidence required

The markets targeted initially are avionics, aerospace and radio communications. Such domains require a high level of confidence in the final system. In addition, with the increased use of software in all areas of industry, there is a significant trend to being able to support high-integrity developments in other domains – such as healthcare systems. The main challenge lies in the ability to provide adequate cross-industry solutions.

Today's market for tools in the area covered by SPICES is quite

fragmented. A key shift from the current market offer is the perspective of open-source for a substantial number of tools, which will contribute to democratisation of use of the techniques promoted by the project.

Initial applications through consultancy and support

While the topic of the ITEA project is strategic, the appropriate business model is more delicate. The traditional software-tool vendor model may be difficult to sustain in the medium term. SPICES is following a long-term trend: adopting such technologies for mission-critical systems in a generalised way will still necessitate time. This is due to the inherently intricate development process for mission-critical systems and the peculiarities of each product line candidate.

The short-term business opportunities are in the area of consultancy and support to industries to introduce such techniques, and identify with them the technologies integration path. Further opportunities will be at the level of tool evolution and integration into industrial developments at large.

A major outcome of this ITEA project has been support for a proactive European stance in worldwide standardisation efforts in the field of embedded software engineering.

Major project outcomes

Dissemination

- 30 publications
- Demonstrators during multiple events: e.g. AADL User's day, June 2009, Brest & ITEA Symposiums 2007, 2008, 2009.

Exploitation

New products:

- Open-source set of tools for Eclipse/Topcased for AADL. Further maturation through OPEES initiative
- Pathcrawler, worst-case execution time estimation tool (CEA)
- Component-based framework for mission-critical systems (THALES)

Standardisation

- AADL behavioural annex
- Proposals to OMG of adaptation of Component model to reconfigurable hardware.

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