



PROJECT RESULTS

Designing for digital convergence

Model and tool interoperability through a common meta-model

The main focus of MARTES was on how to use the standard unified modelling (UML) and SystemC hardware description languages efficiently in combination for systematic model-based development of real-time embedded systems in an era of digital convergence. The project adopted ideas from model-driven architecture (MDA), particularly the separation of application functionality and platform. A common meta-model was defined as the basis for both the MARTES UML profile and the semantically sound integration of a number of tools. Several case studies were carried out to assess the applicability of the methodology and tools.

Digital convergence leads to new products created by combining and integrating existing and new technologies in innovative ways. However, these developments often leave the embedded systems developers struggling with unprecedented complexity and scalability caused by an explosion of new content. Unfortunately, the traditional programming craftsmanship approach cannot

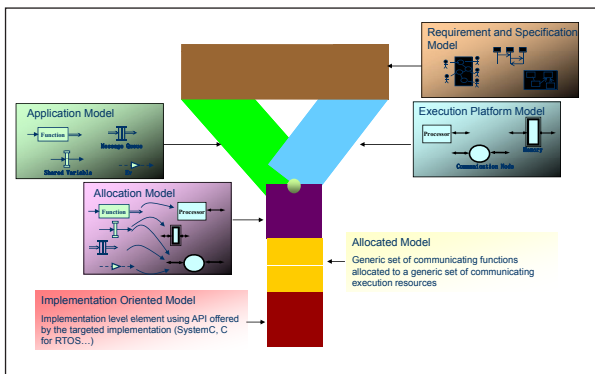
deal with all these problems, so a real engineering methodology is needed.

MARTES therefore aimed to define, construct, validate and deploy a new model-based methodology and an interoperable toolset for real-time embedded systems development. The co-modelling approach of UML and SystemC provides an innovative integrated process that helps reduce cost and time to deployment, while enhancing performance and other life-cycle aspects of embedded systems development.

Meeting dual needs

The project was driven by the needs of the two main types of actors:

1. **System companies** urgently needed the co-modelling methodology and supporting tools for efficient development of embedded systems products targeting increasingly diverse markets. They identified this capability as the key to maintaining and advancing the leading position of European companies.
2. **Tool providers** saw a consistent, widely accepted methodology and tool interoperability as prerequisites to the creation of a large market for systems-level design tools. UML and MDA had already gained widespread acceptance in the information technology (IT) industry. Complemented by appropriate profiles, these concepts can form a basis for an industry-standard embedded systems design methodology. This opens up a market for a new category of UML-based



MARTES model overview

MARTES (ITEA 04006)

Partners

- Barco
- CoFluent Design
- GMV
- INRIA
- Katholieke Universiteit Leuven
- Lund University
- Nokia
- NXP Semiconductors
- Softteam
- Sweco PIC
- Tampere University of Technology
- Telefónica I+D
- Telelogic
- Thales Communications
- Thales Research & Technology
- Universidad Carlos III de Madrid
- University of Cantabria
- VTT Technical Research Centre of Finland

Countries involved

- Belgium
- Finland
- France
- The Netherlands
- Spain
- Sweden

Start of the project

January 2005

End of the project

December 2007



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tools – and, thanks to tool interoperability, increases the market for many existing tools

Model-based approach

As a starting point, the consortium used standard modelling languages, especially UML and SystemC, and employed existing methods around them, notably model-driven architecture and model-driven engineering (MDE). In addition, the analysis of current practices in the participating companies, together with relevant university research results, led to identification of the modelling concepts needed for the development of real-time embedded systems.

Based on these two sources, the partners defined appropriate meta-models and language profiles for the MARTES methodology. Existing tools were adapted and new ones developed to support and automate the process. Finally, the participating companies undertook a number of design case studies to validate the overall approach.

Real-time embedded systems

Considering the diversity of the consortium, a major achievement of the project was the convergence to a common understanding on model-based real-time embedded systems (RTES) development. At the core of the methodology is the MARTES meta-model that forms the basis of a new way to use UML and SystemC for RTES development together with the MARTES UML profile. A strength of the approach is that it enables architectural

exploration and dealing with non-functional properties, such as real-time performance and power, better than any previous UML approaches. The UML profile has been fed into Object Management Group (OMG) standardisation. All aspects of the MARTES methodology are documented in publicly available deliverables.

The MARTES meta-model enables semantically-sound tool integration. Several tools were integrated using Eclipse Modelling Framework (EMF) ecore implementation of the meta-model. New features were developed for commercial, in-house and university tools to support the methodology. All tool enhancements were tested in industrial case studies with encouraging results.

Focus on early phases

MARTES methodology is in principle applicable to the development to any kind of RTES and focuses on early phases of the process, such as requirements specification and architecture definition. It has been evaluated by industrial partners in the domains of mobile communications, telecommunications, consumer multimedia, avionics command and control and displays, defence and aerospace.

The MARTES meta-model provides the semantic basis for the integration of architecture development, analysis and deployment tools, such as UML tools, performance analysis tools, code generation and synthesis tools.

Major project outcomes

Dissemination

- More than 90 international publications, most available on the project website – these include journal, conference, forum and workshop papers
- Organisation of or participation in several national and international workshops
- An exhibition theatre panel at DATE'07 and a stand at DATE'08 (planned).

Exploitation

- Enhancements in three commercial toolsets.

Standardisation

- Contributions by several individual partners to the on-going definition of the OMG UML MARTE profile inside the ProMARTE consortium. Their contributions are direct outcomes of the MARTES methodology work.
- Participation in Do-178C standardisation committee by one partner.

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