



IST-004527 ARTIST2
Network of Excellence
on Embedded Systems Design

Activity Progress Report for Year 4

JPRA-Cluster Integration
**Development of UML for
Real-time Embedded Systems**

Clusters:

Real Time Components

Activity Leader:

Dr. Sébastien Gérard (CEA LIST)

Policy Objective (abstract)

To develop a framework for handling central aspects of Real time Systems in UML-based notations, and in UML-based system development. This will influence standardization and allow European UML-based tool providers to have a larger impact.

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1. Overview of the Activity

1.1 ARTIST Participants and Roles

Dr. Sébastien Gérard – CEA (Fr)

Areas of his team's expertise: standard modelling and RT/E (Real-Time/Embedded) domains.

Dr. Susanne Graf – VERIMAG (Fr)

Areas of his team's expertise: modelling of real-time components.

Dr. Julio Medina - Cantabria university (Sp)

Areas of his team's expertise: model-based schedulability analysis.

1.2 Affiliated Participants and Roles

Pr. Ivica Crnkovic – MdH (Se)

Areas of his team's expertise: component models.

Dr. Stefan van Baelen - K.U. Leuven (Be)

Areas of his team's expertise: QoS specification.

Dr. Bernhard Josko – OFFIS (Ge)

Areas of his team's expertise: real-time UML.

Gilbert Edelin and Dr. Laurent Rioux – Thalès Research and Technology (Fr)

Areas of his team's expertise: Real-time and embedded case study from the aerospace or telecommunication domain and standardization.

Dr. Matthias Grochtmann – DaimlerChrysler (Ge)

Areas of his team's expertise: specification, design and implementation of automotive systems.

Dr Henrik Lönn – Volvo (SE)

Areas of his team's expertise: specification, design and implementation of automotive systems.

1.3 Starting Date, and Expected Ending Date

Starting date: September 1st, 2004.

Expected ending date: End of the project.

In fact, the expected ending date is setup to the end of the project but this activity will probably continue after because of its OMG expected lifecycle. Indeed, the MARTE standard is now voted and accepted in its Beta1 version. The first Finalization Task Force for MARTE has also been finished last june, and a second Finalization Task Force has been launched in order to conclude some remaining work it was not possible to achieve within the first period. This activity will last for one year (its expected deadline is July 2009). After that, it is also expected for a revision of the MARTE standard in order to deal with the issues that it was not possible to handle within the Finalization Task Force. These issues and other possible improvements of the MARTE standard will then have to be taken into account within the expected next step of the OMG standardization process, i.e. the Revision Task Force. This latter activity will provide the version 1.1 of MARTE.

1.4 Baseline

Since the adoption of the UML standard and its new advanced release UML2, this modelling language has been used for development of a large number of time-critical and resource-critical systems. Based on this experience, a consensus has emerged that, while a useful tool, UML is lacking in some key areas that are of particular concern to real-time and embedded system designers and developers. In particular, it was noticed that first the lack of quantifiable notions of time and resources was an impediment to its broader use in the real-time and embedded domain. Second, the need for rigorous semantics definition is also a mandatory requirement for a widespread usage of the UML for RT/E systems development. And third, specific constructs were required to build models using artefacts related the real-time operating system level such as task and semaphore.

Fortunately, and contrary to an often expressed opinion, it was discovered that UML had all the requisite mechanisms for addressing these issues, in particular through its extensibility facilities. This made the job much easier, since it was unnecessary to add new fundamental modelling concepts to UML – so-called “heavyweight” extensions. Consequently, the job consisted in defining a standard way of using these capabilities to represent concepts and practices from the real-time and embedded domain.

Hence, this specification of a UML™ profile adds capabilities on the one hand for modelling Real Time and Embedded Systems (RT/ES), and on the other hand for analyzing schedulability and performance properties of UML specifications. This new profile is intended to replace the existing UML Profile for Schedulability, Performance and Time [UML profile for Schedulability, Performance, and Time, version 1.1., formal/05-01-02, 2005]. This extension, called the MARTE profile, should address specification, design, and verification stages of the development cycle of RT/ES. It wants to address the two branches of the V cycle, i.e. design and validation& verification. Modelling capabilities have to ensure both hardware and software aspects of RT/ES in order to improve communication/exchange between developers. It has also to foster the construction of models that may be used to make quantitative analysis regarding hardware and software characteristics. Finally, it should enable interoperability between developments tools used all along the development process.

1.5 Problem Tackled in Year 4

Work performed within year 4 is a continuation of year3, in a sens that we continued to review and suggest changes to the Object Management Group (OMG - responsible for defining the UML standard) by providing inputs on standardization of UML profiles specific to real-time systems: the UML profile for MARTE. Specially, we have raised a certain number of issues w.r.t. to the MARTE specification, and we have then participated actively to their resolution by providing and discussing resolutions. Let's notice that, CEA and Thales were co-chairs of the OMG's task force in charge of the MARTE finalization task force, and that INRIA were also active member of this group.

Finally, experiments on the usage of MARTE have also been continued in order to assess the technical soundness of the MARTE proposal and first tools to exploit UML models annotated by MARTE extensions have been prototyped.

1.6 Comments From Year 3 Review

1.6.1 Reviewers' Comments

ACCEPTED

The document is of good quality. It clearly shows the progress of the group over the last 3 past years and project plans for years 4. The document is concise, clear and provides the necessary information. However the two figures would have benefited from some explanations (at least acronyms of second picture). In section 2.2 the difficulty presented is not clear. The OMG does not preclude members to provide specification to non-member, it just does not want to endorse document which have not been finalized. The disseminations aspects and relationship with industry appear to be a bit weak.

1.6.2 How These Have Been Addressed

- Acronyms of the second picture have been added.
- Disseminations and relationship with industry have been improved in Year 4. Specially, a dedicated FP7 project has been set-up for that purpose, the ADAMS project (www.adams-project.org).

2. Summary of Activity Progress

2.1 *Previous Work in Year 1*

The first year of this activity has been dedicated to firstly influence on the writing of the request for proposal (RFP) of the new UML profile for real-time and embedded systems. This RFP expresses all the requirements the new standard will have to satisfy. The RFP, document referenced at OMG web server as realtime/05-02-06 (UML Profile for Modelling and Analysis of Real-Time and Embedded systems (MARTE) RFP)) has been voted and accepted in the context of the Real-time, Embedded, and Specialized Systems (RTESS) Platform Task Force in February 2005: UML Profile for Modelling and Analysis of Real-Time and Embedded systems (MARTE) RFP , realtime/05-02-06, <http://www.omg.org/cgi-bin/doc?realtime/05-02-06>.

Within the second half year period, the job consisted in both following action (main part of this work has been performed within the French CARROLL-Protes project):

- To setup an OMG submitter team in order to answer to the RFP. The team that has been organized is called the ProMARTE team: www.promarte.org. This team consists of the main companies (end users and tool providers) involved in this aspect at the OMG. It is composed of: Artisan, Carlton university, CEA, IBM, I-Logix, INRIA, Looked-Martin, Thales, Tri-Pacific.

- To write the initial submission of the ProMARTE team that has been delivered in November 2005: Joint UML Profile for MARTE Initial Submission, realtime/05-11-01, <http://www.omg.org/cgi-bin/doc?realtime/2005-11-01>

Within this first year, in the context of the Omega project, Verimag aimed at the definition of an UML profile appropriate for real-time embedded systems based on the existing SPT profile. The extension done in Omega introduces a notion of "observer" and emphasizes the importance of capturing the relevant events which make reference to the system at execution and is used to capture its dynamic properties.

2.2 *Previous Work in Year 2*

A consolidated architecture for the MARTE profile

The MARTE profile architecture model consists of three main packages:

- The Time and Concurrent Resource Modelling package (TCRM); it defines basic model constructs for time and resource, especially concurrent resources. These foundational concepts are then refined in both of the following package in order to fit with both modelling and analyzing concerns.

- The Real-Time and Embedded application Modelling package (RTEAM); it enables modelling of RT/E application. It concerns mainly defining high-level model constructs to depict real-time and embedded features of application, and to enable the description of execution platforms, software as well as hardware.

- The Real-Time and Embedded application Analysis; it provides a generic support for analyzing annotated models. This generic framework is also refined in order to cope with schedulability and performance analysis. It is also expected that the generic framework for analysis will be specialized/extended to support other kind of quantitative analysis, such as power consumption, memory use or reliability.

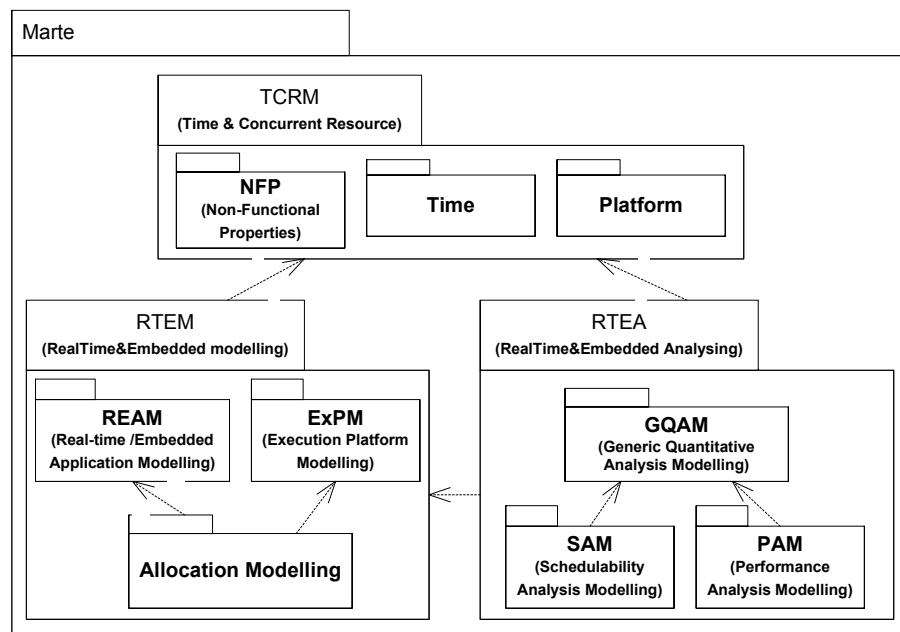


Figure 1. Architecture of the MARTE profile at the end of year 2.

Difficulty: Dissemination issue due to privacy rule of an ongoing work at OMG

Actually, OMG ongoing work performed in OMG consortium such as the ProMarte one is considered to be private until final vote. So, the only available documents related to MARTE in the year 2 were the initial submission that provides only an outline of the proposal; it does not go into the details of the proposed concepts. So, only members of the ProMarte consortium can access the full information of the standard, i.e. CEA (the leader of the activity), INRIA, Thales and Cantabria University.

2.3 Previous Work in Year 3

Harmonization of the MARTE standard (CEA, Cantabria University and Thalès Research and Technology)

Work performed within this activity consisted in making consistent the whole specification which is made of several dependant parts. The main goal was then to harmonize/align all sub-profiles contained within the MARTE specification. As for example, both following specific profiles dedicated to platform modelling, the Hardware Resource Model (HRM) and the Software Resource Model (SRM) have been aligned with the more generic profile contains in the MARTE foundation package, the Generic Resource Platform (GRM) subprofile. This latter defines a set of standard concepts dedicated to model system-level computing platform. All the jobs performed within this activity led to a new MARTE architecture as shown on the following figure.

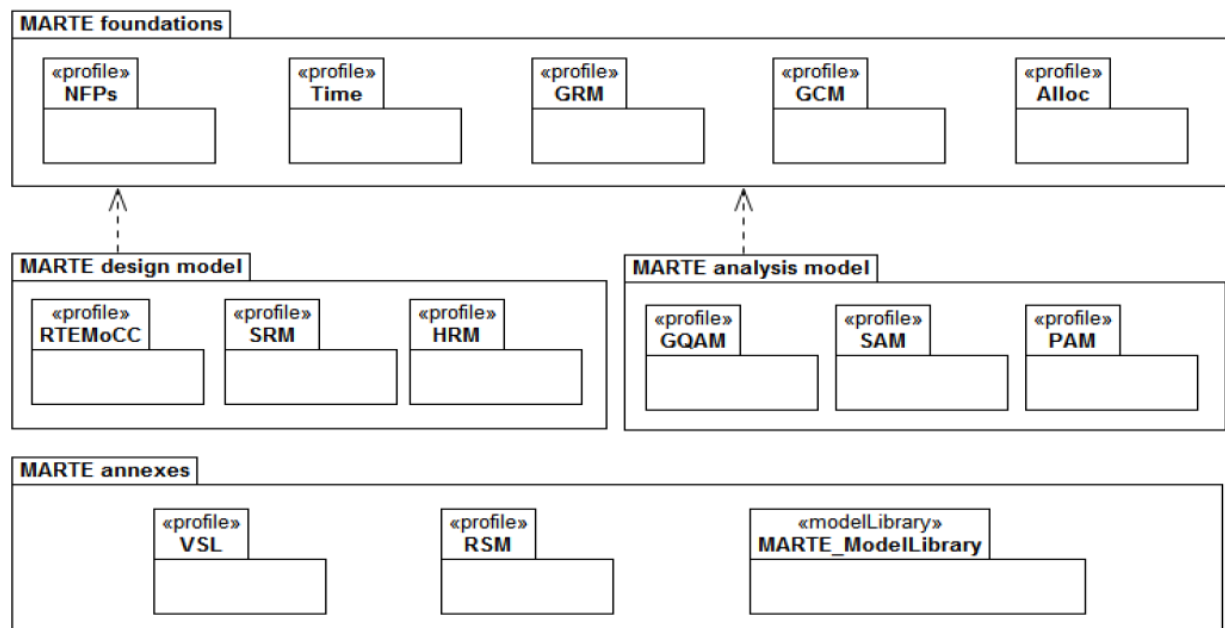


Figure 2. Architecture of the MARTE profile at the end of year 3 (NFPs=Non-Functional Properties, GRM=Generic Resource Modeling, GCM=Generic Component Model, Alloc=Allocation Modeling, RTEMoCC=Real-Time Embedded Model of Communication and Computation, SRM=Software Resource Modeling, HRM=Hardware Resource Modeling, GQAM=Generic Quantitative Analysis Modeling, SAM=Schedulability Analysis Modeling, PAM=Performance Analysis Modeling, VSL=Value Specification language and RSM=Repetitive Structure Modeling)

Debugging of the MARTE standard (CEA, Cantabria University and Thalès Research and Technology)

Within this period, we have continued to experiment with MARTE in different case studies. All these experiments were used to debug MARTE and hence have contributed a lot to improve its quality and soundness.

Dissemination (CEA, Cantabria University and Thalès Research and Technology)

The end of this period was also dedicated to build the first materials needed to disseminate MARTE among industry and academics. A web site (hosted by the OMG consortium) has been set up. Among other, this web site gathers all the papers and events related to MARTE, and a very detailed tutorial: <http://www.omgmarTE.org>. Within this web site, you may also have information about current implementation of this specification.

2.4 Final Results

2.4.1 Technical Achievements

Experiments of the MARTE standard (CEA and Thalès Research and Technology)

Within this period, we have continued to experiment the usage of MARTE in two ways. Firstly, we have used MARTE to build examples of systems in order to assess the usage of MARTE for modelling real-time and embedded features. Within this period, we have implemented the profile within two UML2 tools. CEA did it for the Papyrus open-source tool and Thales did it for the RSA (from IBM) tool. This latter implementation is also available in open-source and maybe downloaded on the OMG's web site for MARTE. In addition, both CEA and Thales have also started to experiment the usage of MARTE for annotating UML models in order to performed schedulability analysis. CEA has then implement first prototype of gateway between papyrus

and both schedulability analysis tools, SymTA/S and MAST. And Thales has implemented two other gateways between RSA for the UML modeling aspect and RapidRMA and Cheddar for the schedulability analysis aspect.

www.omgmarTE.org and www.papyrusuml.org

Raising issues and proposition of resolutions (CEA, Cantabria University and Thalès Research and Technology)

In consequence of the previous activity, we have discovered issues within the MARTE specification. Firstly, we have then raised officially all these issues using the OMG issue web service. Secondly, as we were also directly involved in the OMG's finalization task force dedicated to MARTE, we have also proposed the adequate resolutions to solve all of these issues. Let's notice that OMG has accepted in June 2008 the finalization task force report we have contributed to. Finally, following figures illustrate the final architecture of the MARTE profile.

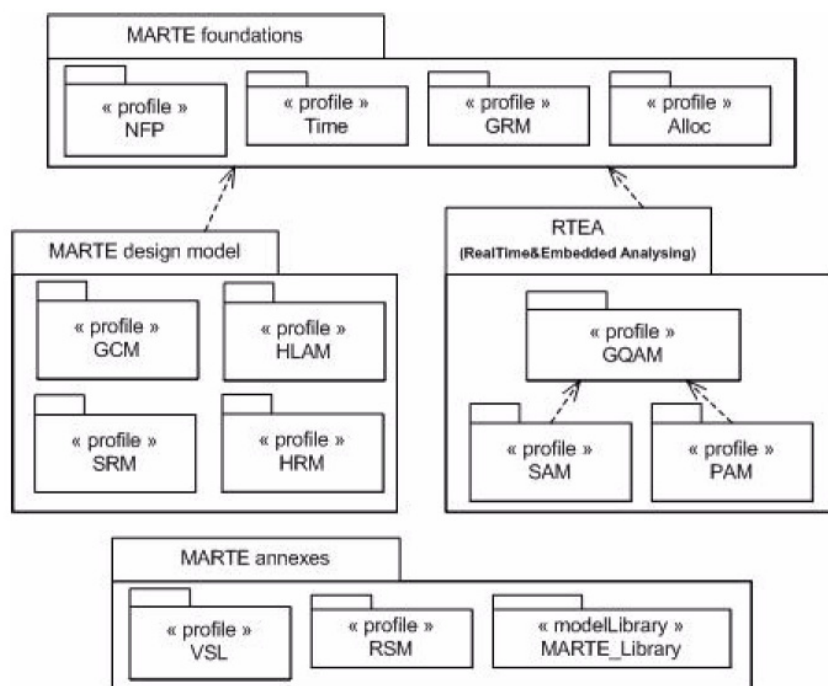


Figure 3. Final architecture of the MARTE profile (**NFP** = Non-Functional Properties, **GRM** = Generic Resource Modeling, **GCM** = Generic Component Model, **Alloc** = Allocation Modeling, **HLAM** = High-Level Application Modeling, **SRM** = Software Resource Modeling, **HRM** = Hardware Resource Modeling, **GQAM** = Generic Quantitative Analysis Modeling, **SAM** = Schedulability Analysis Modeling, **PAM** = Performance Analysis Modeling, **VSL** = Value Specification language and **RSM** = Repetitive Structure Modeling)

Disseminations and relationship with industry (CEA, Cantabria University, Thalès Research and Technology and Volvo)

From its adoption by the OMG in June 2007, in addition to previous activities that consists firstly in elaborating examples to prove the validity of the specification and find possible issues, and secondly in improving the quality of the specification by solving the raised issues, one important task has been to promote as much as possible this new standard through production of tutorials and tools supporting the specification. This specific effort of dissemination of MARTE is specially concretized through the new FP 7 project ADAMS. It aims at promoting the usage of the MARTE standard for the development of real-time and

embedded systems using both model and component design paradigms. www.adams-project.org.

In the Persiform project, Verimag and FTRD had defined a UML profile for modelling for performance adopting performance concepts from a major performance analysis tool (Hyperformix workbench) [CWG08]. In the OpenEmBeDD project, Verimag and Thales work on an adaptation of the developed tool chain to a subset of MARTE. A complete adaptation however would need enriching MARTE which should be envisaged for a later point of time.

2.4.2 Individual Publications Resulting from these Achievements

CEA

[DDG08] Hung Le Dang, Hubert Dubois and Sébastien Gérard, "Towards a Traceability Model in a MARTE-based Methodology for Real-Time Embedded Systems", First IEEE International workshop UML and Formal Methods, in conjunction with the 10th International Conference on Formal Engineering Methods, ICFEM 2008. Kitakyushu-City, Japan, October 2008.

[ESG08] Huascar Espinoza, David Servat, and Sébastien Gérard, "Leveraging Analysis-Aided Design Decision Knowledge in UML-Based Development of Embedded Systems", SHARK Workshop, p.55-62, ISBN:978-1-60558-038-8, at ICSE 2008, Leipzig, Germany, 10 - 18 May 2008.

[GS08] Sébastien Gérard and Bran Selic, "The UML – MARTE Standardized Profile", The 17th IFAC World Congress, Seoul, Korea, July 6-11, 2008.

[T08] Safouan Taha, "Modélisation conjointe logiciel/matériel de systèmes temps réel", PhD report, Université de Lille, France, Mai 2008.

[ERG08] H. Espinoza, K. Richter, S. Gérard, "Evaluating MARTE in an Industry-Driven Environment: TIMMO's Challenges for AUTOSAR Timing Modeling", Design, Automation, and Test in Europe (DATE - 2008), Munich, Allemagne, 2008.

[MTJTG08] Chokri Mraidha, Yann Tanguy, Christophe Jouvray, François Terrier, Sébastien Gérard, "An execution framework for MARTE-based models", Joint 13th IEEE ICECCS & 15th IEEE ECBS (UML&AADL - 2008), Belfast, Irlande, 2008.

Cantabria

[MMP08] Patricia López Martínez, José María Drake Moyano, Julio Medina Pasaje. "Real-Time Extensions to Deployment and Configuration of Component-based Distributed Applications". Proceedings of the OMG Workshop on Distributed Object Computing for Real-time and Embedded Systems, July 14 – 16, 2008, Washington, DC, USA

[MDPM08] Patricia López Martínez, José M. Drake, Pablo Pacheco, and Julio L. Medina. "An Ada 2005 Technology for Distributed and Real-Time Component-based Applications". In Proceedings of the 13th International Conference on Reliable Software Technologies, Ada-Europe, Venice (Italy), in Lecture Notes on Computer Science, Springer, LNCS 5026, June, 2008, ISBN: 3-540-68621-7, pp. 254-267.

Verimag

[Gra08] Susanne Graf, "Omega -- Correct development of Real Time Embedded Systems", in *SoSyM int. Journal on Software & Systems Modelling* vol. 7 (2) 2008.

2.4.3 Interaction and Building Excellence between Partners

CEA, Cantabria University, INRIA and Thales:

- Members of the ProMARTE team who have proposed MARTE to OMG
- Members of the OMG Finalization Task Force for MARTE

- Members of the second OMG Finalization Task Force for MARTE
- Coordinated presentations in the OMG information day in Ottawa in June 2008
- Co-writing of a Tutorial for MARTE (www.omgmarte.org)

CEA and Thales:

- Ongoing experiments on the usage of MARTE for Thales Business Units
- Dissemination of MARTE inside Thales Business Units
- Open source mplementation of an VSL/NFP MARTE editor for RSA/PapyrusUML

CEA and Cantabria University:

- Joint work focussed on the usage of MARTE for performing schedulability analysis in a model-driven process (ACCORD)
- Common participation to Tutotials on MARTE (e.g. ECRTS 2007 and FDL2007)
- Common proposition of an ITEA project on model-based analysis with MARTE.

CEA, Volvo and KTH:

- Within the ATESSST project (www.atesst.org) dissemination to automotive industries including Volvo (ARTIST2 affiliated partner) and KTH (ARTIST2 core partner) has been carried out. CEA, Volvo and KTH continue this cooperation within the follow-up of Atesst withint Atesst2.

CEA, Cantabria University, Thales and Vovlo:

- Work together withitn a new FP7 project, ADAMS, for promoting the usage of MARTE within both domains, avionics and automotives domains.

CEA and Volvo

- Work together in the TIMMO project, where timing issues are addressed in the AUTOSAR and EAST-ADL2 context.

2.4.4 Joint Publications Resulting from these Achievements

[R08] Sébastien Revol, "Profil UML pour TLM SystemC: Contribution à l'automatisation du flot de conception et vérification des System on Chip", PhD report, Université Joseph Fournier, Grenoble, France, Juin 2008.

[RTRGT08] S.Revol, S.Taha, A.Radermacher, S.Gerard, F.Terrier, "Unifying HW analysis and SoC design flows by bridging two key standards: UML and IP-XACT", DIPES, Milan, Italie, Sept. 2008

[SCCFJLST07] Carl-Johan Sjöstedt, DeJiu Chen, Phillipe Cuenot, Patrick Frey, Rolf Johansson, Henrik Lönn, David Servat, Martin Törngren. Developing Dependable Automotive Embedded Systems using the EAST-ADL; representing continuous time systems in SysML. In Proc. of EOOLT'2007. 1st Int. Workshop on Equation-Based Object-Oriented Languages and Tools.

[STSSCL07] Jianlin Shi, Martin Törngren, David Servat, Carl-Johan Sjöstedt, DeJiu Chen, Henrik Lönn. Combined usage of UML and Simulink in the Design of Embedded Systems: Investigating Scenarios and Structural and Behavioral Mapping. In Proc. of OMER 4 workshop on Object-oriented modeling of embedded real-time systems, Oct. 30-31, 2007.

[CFJLRSKC08] P. Cuenot, P. Frey, R. Johansson, H. Lönn, M-O Reiser, D. Servat, R. Tavakoli Koligari, D.J. Chen. Developing automotive products using the EAST-ADL2, and Autosar compliant architecture description language. Proc. of ERTS 2008, Toulouse, France.

[TCJLT08] Fredrik Törner, De-Jiu Chen, Rolf Johansson, Henrik Lönn, Martin Törngren, "Supporting an Automotive Safety Case through Systematic Model Based Development - the EAST-ADL2 Approach", SAE World Congress, 2008, SAE paper number 2008-01-0127.

[SSTSCAL08] Carl-Johan Sjöstedt, Jianlin Shi, Martin Törngren, David Servat, DeJiu Chen, Viktor Ahlsten, Henrik Lönn, "Mapping Simulink to UML in the Design of Embedded Systems: Investigating Scenarios and Structural and Behavioral Mapping", invited paper, OMER 4 Post Workshop Proceedings - April 2008.

[FJLT08] Patrik Frey, Rolf Johansson, Henrik Lönn, Martin Törngren, "Engineering Support for Automotive Embedded Systems - Beyond AUTOSAR", FISITA world automotive congress, Sept. 14-19, 2008, Munich.

[ELEC08] Sébastien Demathieu, Sébastien Gérard, Frédéric Mallet, « Marte, le nouveau standard UML pour les systèmes temps réel embarqués », Electronique mensuel, 189:2-6, Mars 2008.

[ISORC08] Sébastien Demathieu, Frédéric Thomas, Charles André, Sébastien Gérard François Terrier, "First Experiments Using the UML Profile for MARTE", 2008 11th IEEE Symposium on Object Oriented Real-Time Distributed Computing (ISORC), pp. 50-57, 2008.

[CWG08] Olivier Constant, Wei Monin, Susanne Graf, "A model transformation tool for performance simulation of complex UML models", ICSE Companion 2008.

2.4.5 Keynotes, Workshops, Tutorials

Workshop : UML&AADL'2008

13th IEEE International Conference on Engineering of Complex Computer Systems

Belfast, Northern Ireland – April 2nd, 2008

New real-time systems have increasingly complex architectures because of the intricacy of the multiple interdependent features they have to manage. They must meet new requirements of reusability, interoperability, flexibility and portability. These new dimensions favour the use of an architecture description language that offers a global vision of the system, and which is particularly suitable for handling real-time characteristics. Due to the even more increased complexity of distributed, real-time and embedded systems (DRE), the need for a model-driven approach is more obvious in this domain than in monolithic RT systems. The purpose of this workshop is to provide an opportunity to gather researchers and industrial practitioners to survey existing efforts related to behaviour modelling and model-based analysis of DRE systems. This workshop sought contribution from researchers and practitioners interested in all aspects of the representation, analysis, and implementation of DRE system behaviour and/or architecture models.

<http://www.artist-embedded.org/artist/Topics,1199.html>

Workshop : ACES^{MB} 2008, 1st International Workshop on Model Based Architecting and Construction of Embedded SystemsUML&AADL'2008

ACM/IEEE 11th International Conference on Model Driven Engineering Languages and Systems

Toulouse, France – September 29th, 2008

New real-time systems have increasingly complex architectures because of the intricacy of the multiple interdependent features they have to manage. They must meet new requirements of reusability, interoperability, flexibility and portability. These new dimensions favour the use of an architecture description language that offers a global vision of the system, and which is particularly suitable for handling real-time characteristics. Due to the even more increased complexity of distributed, real-time and embedded systems (DRE), the need for a model-driven approach is more obvious in this domain than in monolithic RT systems. The purpose of this

workshop is to provide an opportunity to gather researchers and industrial practitioners to survey existing efforts related to behaviour modelling and model-based analysis of DRE systems. This workshop sought contribution from researchers and practitioners interested in all aspects of the representation, analysis, and implementation of DRE system behaviour and/or architecture models.

<http://www.artist-embedded.org/artist/ACES-MB-08.html>

Workshop : ATESSST Open Workshop 2008

Brussels March 2008

A dissemination activity where the results of the ATESSST project was presented to an invited audience from the automotive industry and the ARTIST2 NoE.

www.attest.org

Workshop: EAST-ADL, AADL, MARTE, Autosar harmonization workshop

Paris -- Oct. 25, 2007

The workshop provided useful information exchange between the standardization initiatives and ATESSST. Approximately 25 participants from the automotive industry (apart from ATESSST partners, VW, Audi and Continental attended), CMU/SEI and research universities/institutes were represented. Also invited were representatives from the recently started TIMMO project. It was agreed to maintain contacts, and to organize follow up meetings. Identified topics of common interest include Timing, Error modeling and Methodology. A common email list will be set up.

3. Milestones, and Future Evolution Beyond the NoE

3.1 Milestones

- Year 1: preliminary work for standardizing an OMG profile for real-time and embedded systems.
 - Vote the MARTE RFP (realtime/05-02-06) *achieved in February 2005.*
 - MARTE initial submission (realtime/05-11-01) *achieved in November 2005.*
- Year 2: Revised version of the standard. The official revised version of the standard documents was initially due to Q4 2006, but has been postponed to Q1 2007.
- Year 3: Follow-up of the revised version of the standard.
 - Vote of the MARTE revised version scheduled for March 2007. *The vote of the standard has been shift for one OMG cycle meeting (i.e. 3 months) in order to be able to finalize some minor sections and to make sub profiles of MARTE more consistent together. The vote has then be done in June 2007.*
 - Milestone 4 (scheduled within Q4 2007): Artist feedback report on MARTE. *The work for this milestone still needs to start. This action did not yet start because of the delay of the MARTE vote. Now as MARTE has been accepted (Beta1 version) and because its finalization task force has been launched, this work should be started as soon as possible. It is scheduled to start this activity in October 2007.*
- Year 4: MARTE Finalization Task Force.
 - Milestone 5 (scheduled for Decembre 22nd, 2007), MARTE Issues. *The purpose of the work to perform to achieve this milestone was to continue to review the MARTE standard documents and to experiments its concepts in order to detect remaining errors/missing in the specification. A set of issues have detected and raised using the standard OMG issues reporting system.*
 - Milestone 6 (scheduled for June 2nd, 2008), MARTE Finalization. *This task has been done in time, and we have reported our finalization work on the MARTE specification through a specific OMG report called the MARTE FTF report (ptc/2008-06-05). Due to some lack of time, the first MARTE FTF (Finalization Task Force) has been continued by a second FTF. This latter will require us to provide recommendations and report in April, 3rd 2009.*

3.2 Indicators for Integration

Joint work of members of this cluster on requirement analysis of RT/E domains for modelling has contributed to the success of the standardization of the Request for Proposal of the UML profile for MARTE.

Workshop organizations related to this subject as for example the MARTES workshop series held within the Models conference series is another indicator of integration: first edition was collocated with Models2005 in Montego Bay (Jamaica) and the second edition will be held within the Models2006 in Geneva (Italy). Let's notice the new workshop, ACESMB 2008, hold in conjunction with the ACM/IEEE 11th International Conference on Model Driven Engineering Languages and Systems.

Participations of Artist members have been, either active organizers, or lecturers, of the summer school MDD for DRES held in Brest (France) in September 2006 and will also participate to its new edition scheduled in April 2009.

Common work of Artist members that are also OMG members (i.e., CEA, Thales, INRIA and Cantabria University) has been a major input and driver of the MARTE standard. Moreover, these partners will continue to work together on the MARTE standard within the OMG Finalization Task Force. Let's also note that CEA is still the chair of the second MARTE OMG FTF group and Thales was co-chair of the first FTF.

CEA and Cantabria continue to work together on MARTE and MDD, specially working on the ability to connect the CEA toolbox (ACCORD) for designing RTE systems and the Cantabria Toolbox (MAST) for schedulability analysis.

CEA and Thales have also closed collaboration on the usage of MARTE within an MDD process for designing their RTE systems.

Finally, let's notice firstly that there are several projects promoting the use of MARTE. The French project OpenEmBeDD with ARTIST partners CEA, FTRD, INRIA and VERIMAG and affiliated partners Airbus and Thales promotes MARTE as one of the user level formats besides AADL and SDL [CWG08]. Secondly, CEA, Cantabria Thales, and Volvo are partners in a new FP7 project, ADAMS (www.adams-project.org) where they are working on promoting the usage of MARTE in both domains, aeronautics and automotive.

3.3 Main Funding

The activity has been mainly funded by the CARROLL initiative, a common research programme between Thalès, CEA and INRIA. In particular, by the PROTES and CORTESS projects of CARROLL which aims to initiate within the OMG an RFP (Request For Proposals) and submit a proposal for a UML profile for embedded systems.

IST projects ATESSST and ATESSST2 (<http://www.atesst.org/>) contribute to fund this activity for CEA and Volvo. French projects Usine Logicielle (from "Pole de compétitivité Sysm@tic") and OpenEmBeDD contribute to fund this activity for CEA.

Finally, the ADAMS project is a final source of funding for this activity for CEA, Cantabria, Thales and Volvo.

3.4 Future Evolution Beyond the Artist2 NoE

Firstly, as the main output of this activity has been a standard, some of the partners of this activity will continue their effort for dealing with maintaining and evolutions of the MARTE standard.

Secondly, once a standard is delivered it is time to disseminate its usage in order to make usefull this standard. This purpose may be achieved within the ARTIST Design NoE where all partners of the activity are involved, but also in other projects such as ATESSST2 and ADAMS.

For the automotive domain, a clear identification of the role of MARTE in the AUTOSAR and EAST-ADL2 context is necessary and expected from the future progress of the established collaborations.

The SPEEDS project, with Artist partners INRIA, OFFIS, Parades, Verimag and affiliated partners Airbus, EADS, and Esterel Technologies promotes the HRC profile addressing in the first place the notion of contracts attached to components which is an orthogonal issue to MARTE. The HRC meta-model is presently being formulated as a SysML profile for the

structural concepts. And in the future it is likely to converge with MARTE on the expression of non functional requirements.

4. Internal Reviewers for this Deliverable

Martin Törngren (KTH, Se)

Ileana Ober (IRIT, Fr)