



MAENAD



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Model-based Analysis & Engineering of Novel Architectures for Dependable Electric Vehicles

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Revision chart and history log

Version	Date	Reason
1.0	2011-08-31	First intermediate release
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1 Introduction

This deliverable provides a description of the presentation material that is developed within the MAENAD project and provides references to this material.

The project presentation material includes:

- Newsletters
- Concept presentations that describe the various conceptual parts of the EAST-ADL language
- Public project deliverables
- IGI Encyclopedia article
- White-paper on EAST-ADL
- Published papers
- The www.maenad.eu web site, providing the above material as well as more information about the MAENAD project.
- Poster, presenting MAENAD
- Wikipedia article on EAST-ADL

Before describing the actual presentation material, let us take a brief look at how dissemination activities are being organized and monitored within the MAENAD project:

The presentation material is closely related to the dissemination actions that take place in the project. Dissemination activities are monitored in the global action list Excel document, which includes four sheets dedicated to dissemination:

Newsletters: Includes planning of newsletters, including timing and responsible persons per section

Publication ideas: Includes publications under development, or topics that could lead to publications.

Disseminations: Performed dissemination activities, e.g. papers, presentations.

Dissemination venues: Identified venues where we should submit publications.

2 Presentation material

In this section, an overview of the project presentation material is given.

2.1 Newsletters

During the predecessor projects, ATESSST, and ATESSST2, an e-mail list (sig-adl) was set up, and during ATESSST2, 8 newsletters were distributed. Based on feedback from the development and reception of these newsletters, the following conclusions were made:

- The newsletters should avoid pictures, since they have a tendency to get trapped by anti-virus programs.
- The newsletters should be short and concise, and encourage further reading.
- We need results to publish newsletters, but to avoid that all newsletters are sent out at the end of the project, when all results are finished, they should be synchronized with project milestones and deliverables, as partial results will be available then.

Based on these conclusions the newsletters are planned as follows:

- After each milestone a newsletter is produced, based on results from this milestone. This includes deliverables that are released in this milestone.
- A draft of the newsletter should be available at the Milestone meeting, and the newsletter released when all deliverables are finished.
- The intention is to synchronize the newsletter issues with the related project Timmo-2-use (ITEA2).

So far, five newsletters have been published, they are available on the maenad.eu website “News Page”.

1. Information on project start, press release (sent 2010-12-01)
2. Initial phase: Requirements and needs, EAST-ADL language refinement (2010-02-04)
3. Demonstrators, New language concepts in discussion, methodology (2011-05-06)
4. Language and profile update, methodology, engineering scenarios, modeling platform update, enhancement of Language Support for Analysis, V&V (2011-10-24)
5. Language and profile update, EATOP, Analysis and synthesis algorithms for fully electric vehicles, Methodology (2012-04-02)

A sixth newsletter will be released after MS6, and then two more newsletters are planned for MS7 and MS8 (end of project).

2.2 Concept presentations

So called concept presentations were initiated in the ATESS2 project. They consist of a number of PowerPoint presentations, of various EAST-ADL concepts. The purpose is to provide an easily accessible overview and introduction to EAST-ADL. The concept presentations holds also, EAST-ADL implementations, where the purpose of the implementations is to set up the EAST-ADL meta model with tools used in projects of the market today. These presentations are continuously maintained and updated throughout the MAENAD project; one major revision was made just before Milestone 4, where some presentations also were added. The following presentations are currently available:

- Overview and Structure
- The relation between EAST-ADL and AUTOSAR
- The Behavior support of EAST-ADL
- The tools and meta-modeling aspects and support of EAST-ADL
- The Methodology of EAST-ADL
- The Variability support of EAST-ADL
- The Requirements support of EAST-ADL
- FEV Analysis
- Timing Analysis
- ASIL decomposition
- Dependability analysis
- Optimization
- Behavior: External tools for behavior
- Behavior: Native behavior
- Behavior: Simulation
- MetaEdit+ implementation of EAST-ADL
- SystemWeaver implementation of EAST-ADL

The following concept presentations are planned:

- MAENAD Modeling Workbench
- MAENAD Analysis Workbench
- EATOP implementation of EAST-ADL
- Case study overviews: Range and mode control, regenerative braking, propulsion

2.3 Project deliverables

In the description of work, the public deliverables in Table 1 are defined. The intention is to publish these deliverables on the www.maenad.eu web site, as they are released. This includes deliverable D4.1.1, which is the EAST-ADL language specification.

Table 1. List of public deliverables

Del. no.	Deliverable name	Delivery (proj. month)
D2.1.1	Engineering Scenarios and Requirements for FEV	12
D2.2.1	Design Methodology	16, 26, 36
D3.1.1	Language Concepts Supporting Engineering Scenarios	6, 15, 24
D3.2.1	Analysis and Synthesis Concepts Supporting Engineering Scenarios	9, 18, 27
D4.1.1	EAST-ADL Language Specification	9, 21, 33
D4.2.1	EAST-ADL profile for MARTE	12, 36
D4.3.1	EAST-ADL XML Schema	9, 21, 33
D5.1.1	MAENAD Modelling Workbench	12, 36
D5.2.1	MEANAD Analysis Workbench	9, 24, 30
D5.3.1	Tool adaptations for EAST-ADL	12, 24, 30
D6.1.1	Preliminary Case study Definition and metrics	6
D6.1.3	Case study analysis and safety assessment	12, 24, 34
D7.1.1	Project presentation material	12, 24, 36
D7.2.2	Standardization plan and activities	6, 36

2.4 White paper of EAST-ADL

During the ATESS2 project, a gap was identified for stakeholders interested in EAST-ADL at a more detailed level than the concept presentations (compare section 2.2), but without having to go through the language specification (compare section 2.3). A solution in terms of a *white paper* has been proposed within MAENAD, a document that describes e.g. the general benefits of using of EAST-ADL, why the language is designed the way it is, and how the different language extensions work.

A first draft version has been released internally, which is partly based on the IGI Encyclopedia article, as described in the following section.

2.5 The IGI Encyclopedia Article

IGI Global is a publisher of journals, books, encyclopedias, and teaching cases on information science and IT management. MAENAD got invited to write an article about EAST-ADL. This is a 13-page document describing EAST-ADL in overview, background, modeling concepts (Functional Abstraction, Timing Modeling, Requirements Modeling, Functional Safety Modeling, Variability Modeling and Behavior Constraint Modeling), methodology and related concepts. The article was prepared in April 2012, and updated based on feedback August 2012.

2.6 The MAENAD web-site

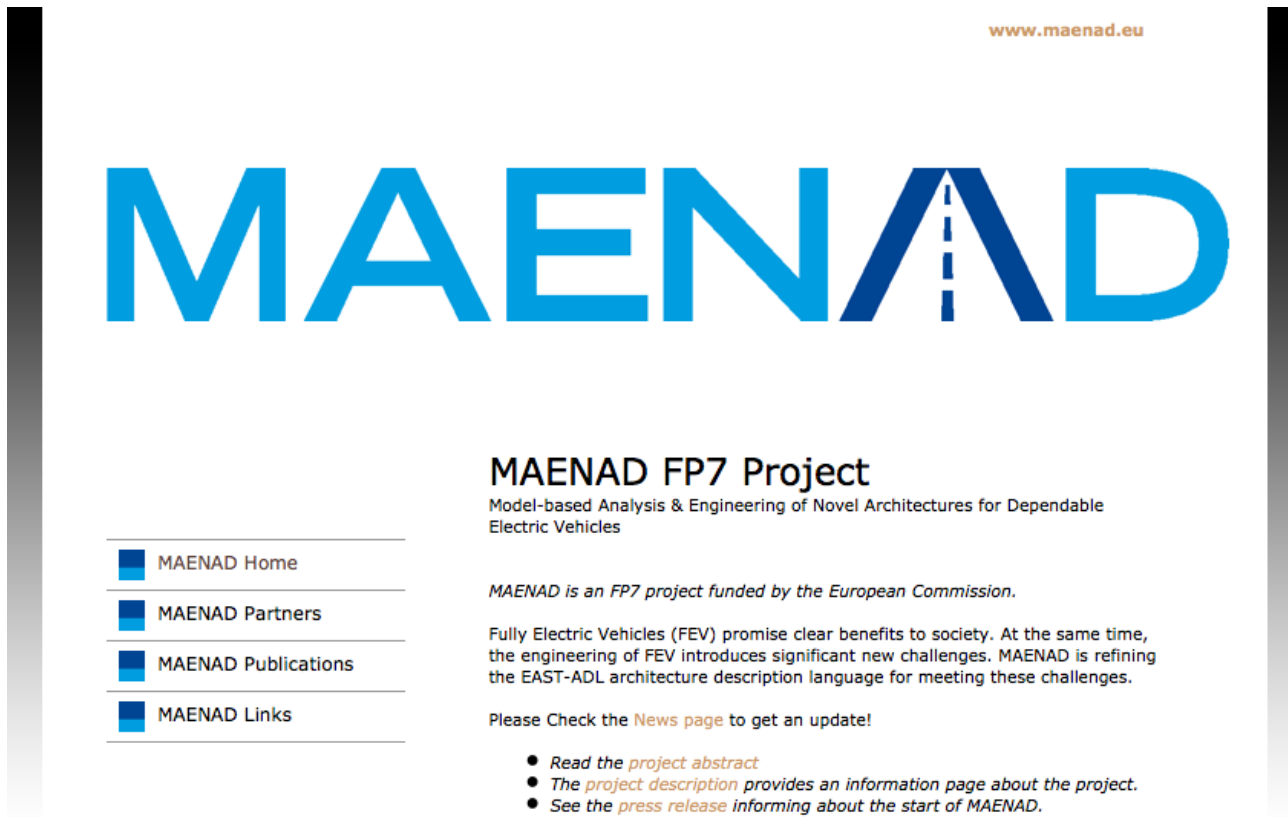


Figure 1: The maenad.eu website

The www.maenad.eu website was opened shortly after the project start, and contains information about the project. The objective is to have all the public dissemination material described in this deliverable available here.

2.7 Poster

A poster has been developed and shown in various contexts relevant for MAENAD. The first occasion was at the TIMMO-2-USE workshop.

The first poster shows project administrative information and overall project approach. The second poster goes more into technical details through a basic EAST-ADL model with relevant concepts.

MAENAD
Model-based Analysis & Engineering of Novel Architectures
for Dependable Electric Vehicles

Motivation and Objectives

Rely Electrical Vehicles pose new challenges to the engineering of the electrical and embedded systems. Charge and powertrain systems will have more autonomy, share control resources, and rely less on mechanical structure. Control power management and optimization algorithms are needed to ensure durability of components, high performance, range of travel and low energy consumption. To succeed in meeting these challenges, appropriate engineering support is required.

The objective of MAENAD is to:

- Assist the safety process defined in the ISO 26262 automotive safety standard
- Provide effective prediction of quality attributes (reliability and performance)
- Provide tool support for the automated exposition of design spaces (feasibility, performance and cost optimization).

Project Plan, Milestones, and Deliverables

The project will define the modeling concepts and tooling, based on identified engineering needs and a methodology defined in the project. An electrical vehicle will be used to assess and provide feedback on project results.

Project Plan, Milestones, and Deliverables

- Identifying engineers' needs regarding development, verification and validation of FCV systems.
- Definition of a methodology for using EAST-ADL in the context of FCV.
- Refining EAST-ADL to meet identified engineering needs and methodology.
- Definition of an EAST-ADL domain language metamodel according to AUTOSAR.
- Definition of an EAST-ADL UML profile and AUTOSAR compliant XML exchange format.
- Development and refinement of tools for supporting EAST-ADL.
- Validation of concepts and tools on priority electric vehicle.

Achievements

- Identification of requirements for modeling support for ISO26262 and relevant FCV standards
- Identification of methodology elements supporting ISO26262 in an EAST-ADL context
- Tool development for EAST-ADL, based on Papyrus UML, SystemWorx and ModelSight
- Analysis and software testing including FTA, FMEA, LSA, decomposition and AUTOSAR generation
- Modeling examples illustrating FCV and safety concerns

Organizational Information

Budget	4 M€	Partners:	Vehicle Manufacturers,
Duration	28 months	Vehicle Technology, Centre-Research-IT	Automotive Suppliers/Consultants,
DSU / coordinator	INRSU / CEE	Continental, Delphi/Alveo, 4E Group	Third Vendors
Coordinator	Hervé Léves, Volvo Technology	Metacore, Pivotal, SAP, Systemix	Research Institute and Universities:
Starting	3 M€	Third Vendors	CEA, MIT, RWTH Aachen, TU Berlin, University of Hull
Start	December 2010		
Contact n°	FP7-2010-240087		
Contact	herve.leves@volvo.com		
Website:	www.maenad.eu		

MAENAD
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EAST-ADL Model Organization

On Vehicle Level, the feature model represents the assembly visible properties of the vehicle.

On Analysis Level, the abstract functional definition of the vehicle systems is applied, to allow analysis of vehicle system independency of detailed design.

On Design Level, the design architecture represents the detailed design of the functional context and hardware.

The Implementation Level is based on AUTOSAR, and thus contains the software architecture and target hardware.

The Environment Model captures the surrounding environment including vehicle mechanics and external systems. This model is common to all abstraction levels, as the external environment is the same, regardless of representation of the EE architecture. Sensors and actuators on the respective abstraction level serve as interfaces to the environment model.

1 Defines on a lower abstraction level low multiplicity of entities on the higher level. This is modeled.

2 Requirements can be identified to any entity in the model. Requirements can be defined to more detailed requirements or refined to sub-entities or nodes.

3 Algorithms and functionality as well as interactions with the environment are represented in a hardware-independent way on Analysis Level.

4 Transfer functions and abstract aspects of middleware and platform and hardware components are represented by E2eSoft- and E2eHardware- and E2eMechanics- (respectively) Design-Units and Component-Instances representing application functionality for regular applications and sensor/actuator interfacing respectively.

5 Functional elements of the FunctionalDesign-architecture are associated to components on the hardwareDesignArchitecture. For example, a hardwareFunction may be associated to a sensor and a LoadController/brake to an axle.

6 Software architecture is represented using AUTOSAR elements.

7 The EE system model on the respective abstraction level is contained in a shared environment model using ComponentInstances that can go beyond the component boundaries.

Orthogonal aspects like requirements, variability, V&V, and traceability information are associated to any entity, including AUTOSAR entities.



Figure 2. MAENAD Posters

2.8 Wikipedia article on EAST-ADL

Although Wikipedia is not considered to be a very reliable source, since anyone could update anything, many people use Wikipedia as a first place to get an overview of a subject and find references to further reading. Hence, it is important to keep this information correct. A general update on the Wikipedia article of EAST-ADL was made, including information about MAENAD. The article was reviewed within MAENAD before being published. The page is available at:

<http://en.wikipedia.org/wiki/EAST-ADL>

For a snapshot, see Figure 3.

Overview
[\[edit\]](#)

EAST-ADL is an [Architecture Description Language](#) (ADL) for automotive embedded systems, developed in several European research projects. It is designed to complement [AUTOSAR](#) with descriptions at higher level of abstractions. Aspects covered by EAST-ADL include vehicle features, functions, requirements, variability, software components, hardware components and communication^[1]. Currently, it is maintained by the [EAST-ADL Association](#)^[2] in cooperation with the European FP7 MAENAD^[3] project.

EAST-ADL contains several abstraction levels. The software- and electronics-based functionality of the vehicle are described at different levels of abstraction. The proposed abstraction levels and the contained elements provide a separation of concerns and an implicit style for using the modeling elements. The embedded system is complete on each abstraction level, and parts of the model are linked with various traceability relations. This makes it possible to trace an entity from feature down to components in hardware and software.

EAST-ADL is defined with the development of safety-related embedded control systems as a benchmark. The EAST-ADL scope comprises support for the main phases of software development, from early analysis via functional design to the implementation and back to integration and validation on vehicle level. The main role of EAST-ADL is that of providing an integrated system model. On this basis, several concerns are addressed:

- Documentation, in terms of an integrated system model.
- Communication between engineers, by providing predefined views as well as related information.
- Analysis, through the description of system structure and properties.

Behavioural models for simulation or code generation are supported as references from EAST-ADL functions to external models, such as a subsystem in [MATLAB/Simulink](#)^[4].

Organisation of EAST-ADL Meta-Model [\[edit\]](#)

The diagram illustrates the EAST-ADL meta-model organized into four abstraction levels: Vehicle Level, Analysis Level, Design Level, and Implementation Level. These levels are contained within an EnvironmentModel. The Vehicle Level includes TechnicalFeatureModel. The Analysis Level includes FunctionalAnalysisArchitecture. The Design Level includes FunctionalDesignArchitecture and HardwareDesignArchitecture. The Implementation Level includes AUTOSAR Application SW, AUTOSAR Basic SW, and AUTOSAR HW. To the right, Extensions ... are shown as vertical bars for Requirements, Variability, Timing, and Dependability. Arrows indicate 'Data exchange over ports' between levels and 'Allocation' from Design to Implementation levels.

EAST-ADL Spotlight [\[edit\]](#)

EAST-ADL is a domain-specific language using meta-modeling constructs such as classes, attributes, and relationships. It is based on concepts from UML, SysML and AADL, but adapted for automotive needs and compliance with AUTOSAR. There is an EAST-ADL UML2 profile which is used in UML2 tools for user modeling. The EAST-ADL definition also serves as the specification for implementation in domain-specific tools.

The EAST-ADL meta-model is organized according to 4 abstraction levels:

- Vehicle level contains modeling elements to represent intended functionality in a solution-independent way
- Analysis level represents the abstract functional decomposition of the vehicle with the principal internal and external interfaces.
- Design level has the detailed functional definition, a hardware architecture and allocations of functions to hardware.
- Implementation level relies on AUTOSAR elements and does not have EAST-ADL-specific constructs for the core structure.

Figure 3: The EAST-ADL Article on Wikipedia snapshot

2.9 Workshops

A joint workshop with the TIMMO-2-USE project was planned during spring, but due to difficulties in finding time for a physical meeting, two joint telcos were held instead.

Another workshop, including the project AMALTHEA and SAFE will be held in Berlin in the hotel: Angleterre Hotel 2012-09-24-2012-09-25. The goal of the workshop is to present results and plans from the projects to an interested audience. The projects will explain the challenges addressed and the solutions provided in the areas of methodology, representation and tooling. At the end of the workshop the views of the projects should be aligned and possible cooperation's be defined.

2012-03-22: Workshop #1 with TIMMO-2-USE project, telco meeting

2012-05-03: Workshop #2 with TIMMO-2-USE project, telco meeting

2012-09-24 – 2012-09-25: Joint workshop in Berlin with AMALTHEA, MAENAD, SAFE and TIMMO-2-USE

2.10 Publications

Main results from the project will be disseminated through scientific publications. The goal is to produce 5 collaborative journal papers, 15 collaborative conference papers within the project.

In section 2.10.1 to 2.9 are the publications that until now have been issued:

2.10.1 Journal papers

Chen, DeJiu; Johansson, Rolf; Lönn, Henrik; Blom, Hans; Walker, Martin; Papadopoulos, Yiannis; Torchiaro, Sandra; Tagliabo, Fulvio; Sandberg, Anders: Integrated Safety and Architecture Modeling for Automotive Embedded Systems. A special issue of the journal e&i – elektrotechnik und informationstechnik, Springer, on the topic automotive embedded systems

Papadopoulos Y., Walker M., Parker D., Rude E., Hamann R., Uhlig A., Grätz U., Lien R. (2011) Engineering Failure Analysis & Design Optimisation with HiP-HOPS, Journal of Engineering Failure Analysis, 18 (2): 590-608, Elsevier Science, ISSN: 1350-6307

Adachi M., Papadopoulos Y., Sharvia S., Parker D., Tohdo T. (2011) An approach to optimization of fault tolerant architectures using HiP-HOPS, Software Practice and Experience, 41: n/a DOI: 10.1002/spe.1044, 36 pages, Wiley .

2.10.2 Conference papers

Tagliabo, Fulvio; Torchiaro, Sandra; Lönn, Henrik; Johansson, Rolf; Chen, De-Jiu; Papadopoulos, Yiannis; Walker, Martin; Sandberg, Anders: Modelling Support for the Automotive Functional Safety Standard, Sixth International Conference on Dependability and Computer Systems DepCoS-RELCOMEX June 27- July 1 2011

Qureshi, Tahir Naseer; Chen, DeJiu; Lönn, Henrik ; Törngren, Martin: From EAST-ADL to AUTOSAR Software Architecture: A Mapping Scheme, the 5th European Conference on Software Architecture (ECSA 2011), Essen, Germany, 13-16 September 2011.

Papadopoulos, Yiannis; Walker, Martin; Lönn, Henrik: Automatic allocation of system safety requirements to components of a system architecture using HiP-HOPS, Model Based Safety Assessment Workshop, Toulouse France 14-17/03/2011

Sharvia S., Papadopoulos Y. (2011), Integrated Application of Compositional and Behavioural Safety Analysis, IEEE Dependable Computing Systems (DEPCOS'11), Advances in Intelligent and Soft Computing, AISC 97: 179-192, DOI: 10.1007, ISBN 978-3-642-21393-9, Springer.

Mahmud N., Walker M., Papadopoulos Y. (2011) Compositional synthesis of Temporal Fault Trees from State Machines, 6th Annual IEEE Conference Availability, Reliability and Security (ARES 2011), DYADEM workshop, Vienna, Austria, DOI 10.1109/ARES.2011.89, p.p. 429-435, ISBN: 978-0-7695-4485-4, IEEE publications

Sharvia S., Papadopoulos Y. (2011), IACoB-SA: an Approach towards Integrated Safety Assessment, 7th Annual IEEE Conference on Automation Science and Engineering (CASE 2011), Trieste, Italy, proceedings in electronic volume with ISBN 978-1-4577-1732-1/11/, IEEE publications

Papadopoulos Y., Adachi M., Sharvia S., Parker D., Tohdo T., Walker M. (2011) Optimization of fault tolerance using model transformations, 7th International Conference On Computer Science & Information Systems, Athens, June 2011, 10 pages, to be published as book chapter.

Nggada S.H., Parker D. J., Papadopoulos Y. (2010) Dynamic Effect of Perfect Preventive Maintenance on System Reliability and Cost Using HiP-HOPS, IFAC-MCPL 2010, 5th Conference

On Management And Control Of Production And Logistics, September 2010, Coimbra – Portugal, published in ifac-papersonline.net.

Eric Armengaud, Markus Zoier, Andreas Baumgart, Matthias Biehl, DeJiu Chen, Gerhard Griessnig, Christian Hein, Tom Ritter, Ramin T. Kolagari Model-based Toolchain for the Efficient Development of Safety-Relevant Automotive Embedded Systems SAE 2011 World Congress & Exhibition, April 2011, Detroit, USA

Qureshi Tahir Naseer, Chen, De-Jiu, Persson Magnus and Törngren Martin, Towards the Integration of EAST-ADL and UPPAAL for Formal Verification of Embedded System Architectures, in Worskhop on ime Analysis and Model-Based Design, from Functional Models to Distributed Deployments (TiMoBD). Taipei, Taiwan, October 9, 2011.

Qureshi Tahir Naseer, Chen, De-Jiu and Törngren Martin, A timed automata-based method to analyze EAST-ADL timing constraint specifications, ECMFA 2012

Oscar Ljungkrantz, Henrik Lönn, Hans Blom, Cecilia Ekelin and Daniel Karlsson: Modelling of Safety-Related Timing Constraints for Automotive Embedded Systems. ASCoMS – Workshop on Architecting Safety in Collaborative Mobile Systems, Safecomp 2012

Carl Bergenhem, Rolf Johansson and Henrik Lönn: A novel modelling pattern for establishing failure models and assisting architectural exploration in an automotive context, ASCoMS – Workshop on Architecting Safety in Collaborative Mobile Systems, Safecomp 2012

2.10.3 Book chapters

Nggada, S., Parker, D., Papadopoulos, Y., (2010) Extending HiP-HOPS with Capabilities of Planning Preventative Maintenance, Strategic Advantage of Computing Information Systems in Enterprise Management, (eds) Sarrafzadeh and Petratos, pp. 231-245, ISBN: 978-960-6672-93-4

Sharvia S., Papadopoulos Y. (2010), Integrating Compositional Safety Analysis and Formal Verification, Strategic Advantage of Computing Information Systems in Enterprise Management, (eds) Sarrafzadeh and Petratos, pp. 181-201, ISBN: 978-960-6672-93-4

2.10.4 Dissertations

Matthias Biehl, Licentiate thesis, November 2010. Supporting Model Evolution in Model-Driven Development of Automotive Embedded Systems. ISBN 978-91-7415-723-9, KTH - Royal Institute of Technology, Stockholm, Sweden.

Matthias Biehl and Tahir Naseer Qureshi will both defend their PhD-theses during the upcoming period, which both are partially based on results from MAENAD.

2.10.5 Presentations

Lönn, Henrik: Supporting the Engineering of Electrical Vehicle Systems, Electric Vehicle ICT-Infrastructure, Berlin 23rd March 2011

Lönn, Henrik: Timing Modelling and Analysis in an Automotive Context, DaNES Timing Analysis Workshop, Copenhagen February 2011

Lönn, Henrik, European Green Cars Initiative “Portfolio of European Green Cars Projects” Workshop, Workshop Poster and the Brochure presented, 31th May 2011

Lönn Henrik and Rolf Johansson: Supporting ISO26262 with EAST-ADL, SAFE project Seminar, February 2012

Lönn, Henrik: Support for ISO 26262 in the EAST-ADL/AUTOSAR context. BeSafe Seminar, Gothenburg, May 2012

Lönn, Henrik: Support for ISO 26262 in the EAST-ADL/AUTOSAR context, IQPC Conference Experiences with ISO 26262, 2012

Lönn, Henrik: MAENAD Project status for EUCAR Integrated Safety Board, 17th Sept 2012

Chen, De-Jiu: Dagstuhl Seminar 12272: Architecture-Driven Semantic Analysis of Embedded Systems, 2012

Henrik Lönn: Model-based Analysis & Engineering of Novel Architectures for Dependable Electric Vehicles, 3rd European Green Cars Initiative Clustering Event, July 2012

Lönn, Henrik: Models Meeting Automotive Design Challenges, ECMFA, July 2012

Ernest Wozniak: MAENAD: Model-based Analysis & Engineering of Novel Architectures for Dependable Electric Vehicles, First Workshop on European Industrial & Academic Collaborations on Real Time and Embedded Systems Modeling and Analysis (EIAC-RTESMA), July 2012

Lönn, Henrik: MAENAD Project status for EUCAR Integrated Safety Board, May 2012

DeJiu Chen, Dagstuhl Seminar 12272: Architecture-Driven Semantic Analysis of Embedded Systems, 2012

Yiannis Papadopoulos, EAST-ADL and HIP-HOPS: Model-based design and evaluation, Seminar, ITI GmbH office, Dresden, January 2012

Yiannis Papadopoulos, EAST-ADL and HIP-HOPS: Model-based design and evaluation, Seminar, Flemish Mechatronics institute, Leuven, December 2011

3 Summary

There are various artifacts channels for project dissemination, and dissemination of EAST-ADL identified, targeted at slightly different audiences, e.g.: academic (Publications), industry managers (Concept presentations, White paper), Engineers, EAST-ADL tool developers (specifications, EAXML schema), other projects (Newsletters, website, workshops) or general public (IGI Encyclopedia, Wikipedia,). We believe these all are relevant, but they might be adjusted throughout the project, based on feedback.

The concept presentation material is reviewed internally in the project. The general idea is that new project members, not too familiar with EAST-ADL should review the presentations, to find things that need improvement. External reviewers are also considered for reviewing the concept presentations; this could also be seen as a dissemination activity itself.