



**An Open Source Development Platform
For Embedded Multi- and Many-Core Systems**

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APP4MC – Applications for MultiCore

- Timeline and current project(s)
- Challenges for embedded multi- and many-core systems
- The AMALTHEA Platform
- Project activities: releases, next steps

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Eclipse Project

<http://projects.eclipse.org/proposals/app4mc>



Project information

Project name 09013 AMALTHEA
Status Completed
Period Jul 2011 - Apr 2014
Call ITEA 2 Call 4
Challenge Engineering
Website www.amalthea-project.org
Partners 15
Countries  Finland
 Germany
 Turkey

<https://itea3.org/project/amalthea.html>



Project information

Project name 13017
 AMALTHEA4public
Status Running
Period Sep 2014 - Aug 2017
Call ITEA 2 Call 8
Challenge Engineering
Website www.amalthea-project.org
Partners 22
Countries  Germany
 Spain
 Sweden
 Turkey

<https://itea3.org/project/amalthea4public.html>

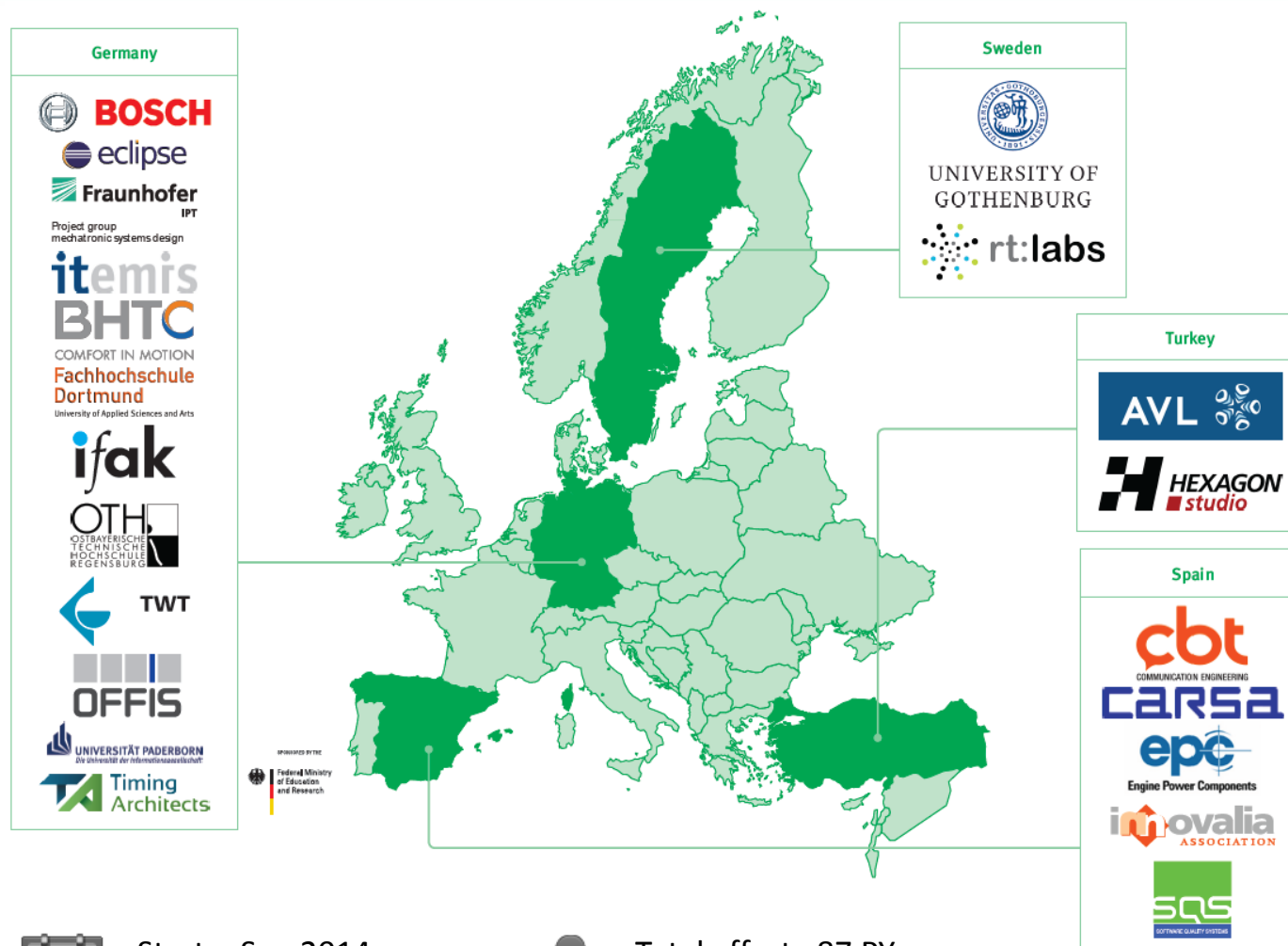


Community



ITEA2 Project AMALTHEA4public

Project Consortium



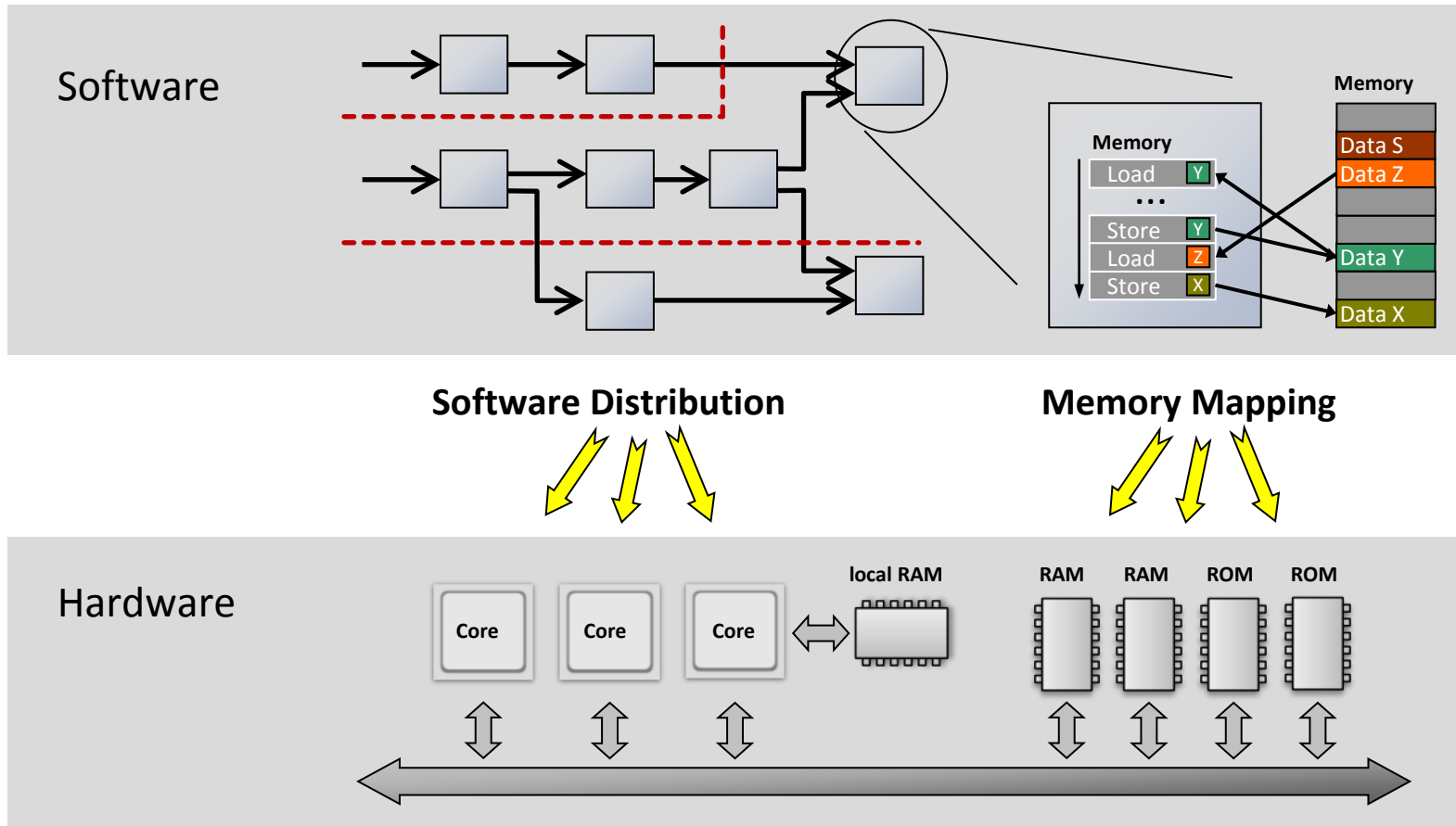
Start: Sep 2014
End: Aug 2017



Total effort: 87 PY
Project leader: Robert Bosch GmbH

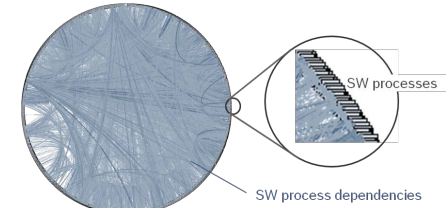
APP4MC – Applications for MultiCore

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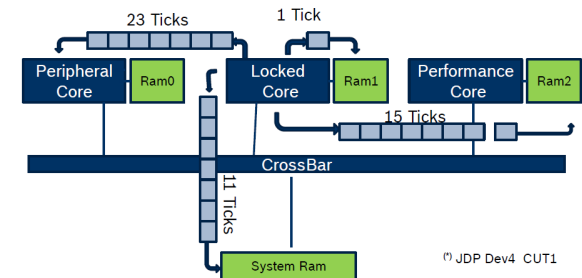
▪ Typical Paradigm of Single-Core Software

- Blackboard Architecture: Memory access is for “free”
- Integration challenge: scheduling of computation



▪ Paradigm Change for Multi-/Many-Core

- Cross-Core Communication is expensive
- Synchronization leads to high overheads
- Memory location matters
- Integration challenge: scheduling of computation and communication

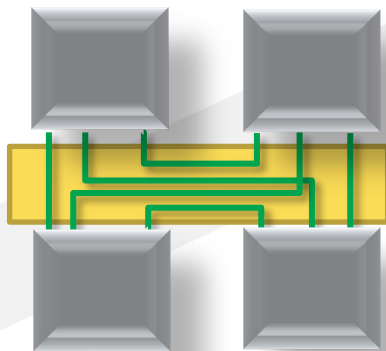


- Sophisticated new tooling required for task distribution, memory location optimization and performance analysis

Cross-core communication is a new resource bottleneck

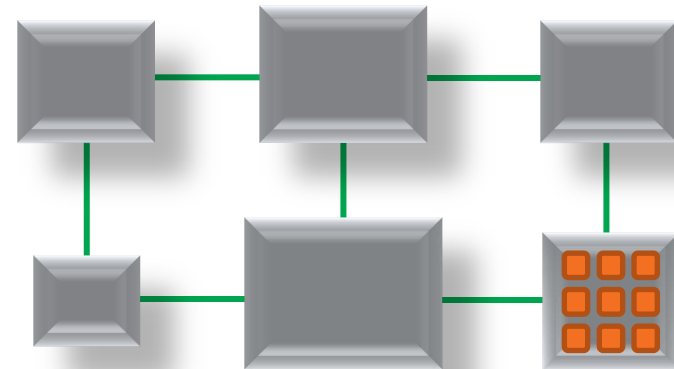
Multi-Core

- Small number of homogenous cores with shared memory
- Mostly symmetric connectivity (e.g. crossbar)
- Limited impact on SW distribution



Many-Core

- Larger number of **heterogeneous** cores with distributed memories
- Increasingly **heterogeneous connectivity** (Non-uniform Memory Access)
- High impact on SW distribution



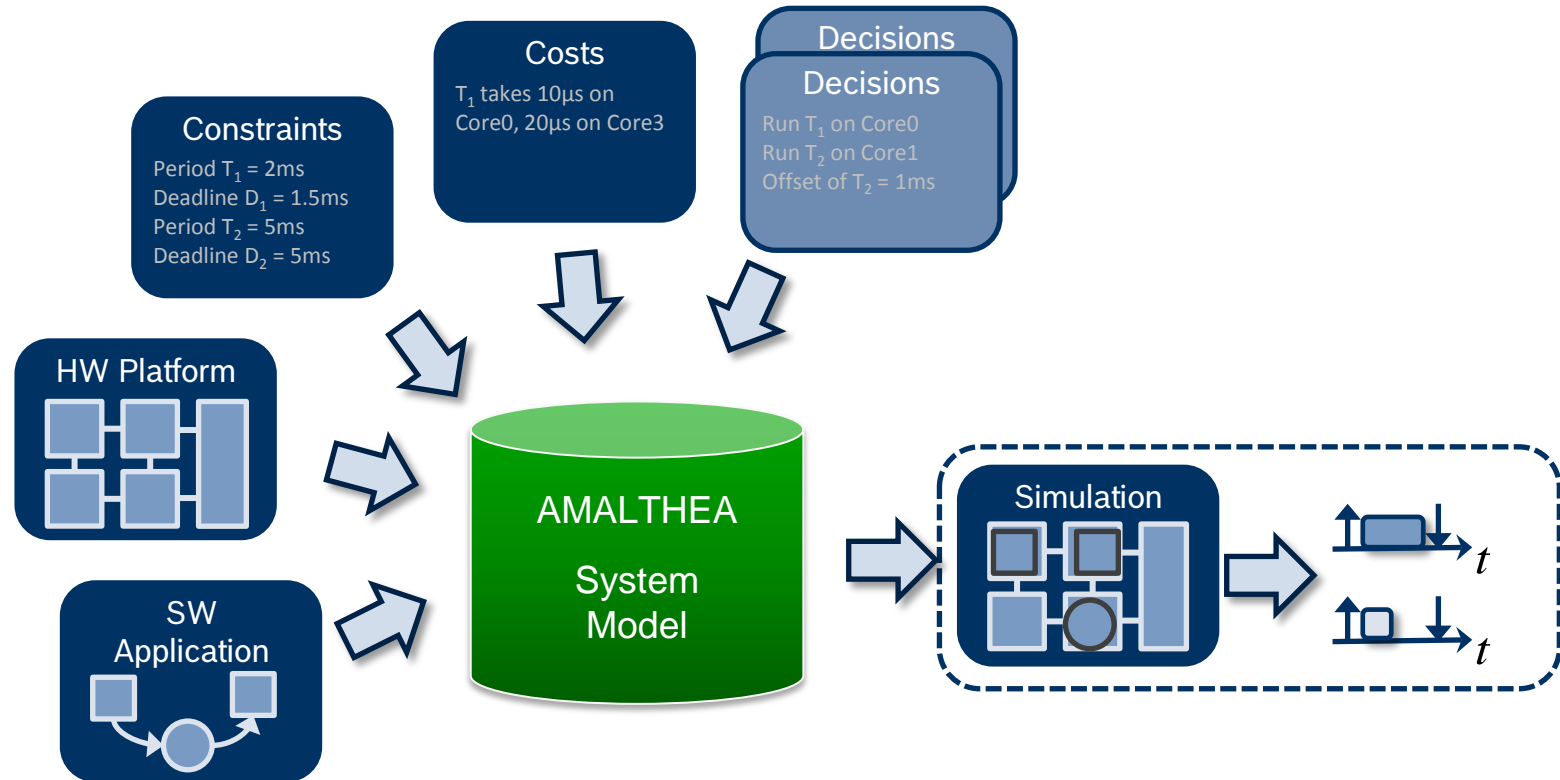
Today's automotive Multi-Cores already have Many-Core characteristics

APP4MC – Applications for MultiCore

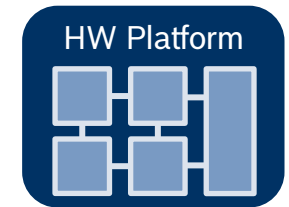
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Tool platform AMALTHEA

Processing, Simulation and Analysis

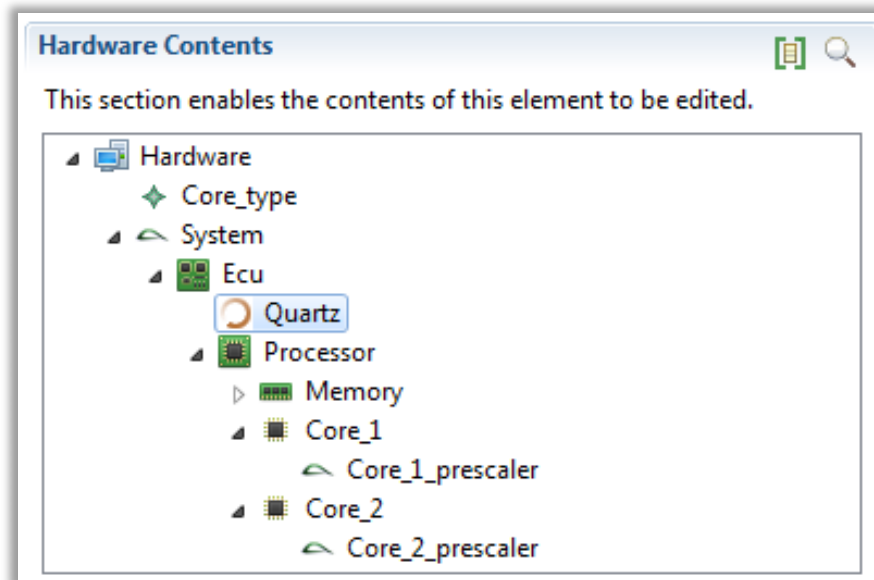


Hardware Characteristics



■ Hardware Elements

- ECU
- Microcontroller
- Core
- Memory
- Network



Software Behavior

Costs

T_1 takes $10\mu s$ on Core0, $20\mu s$ on Core3

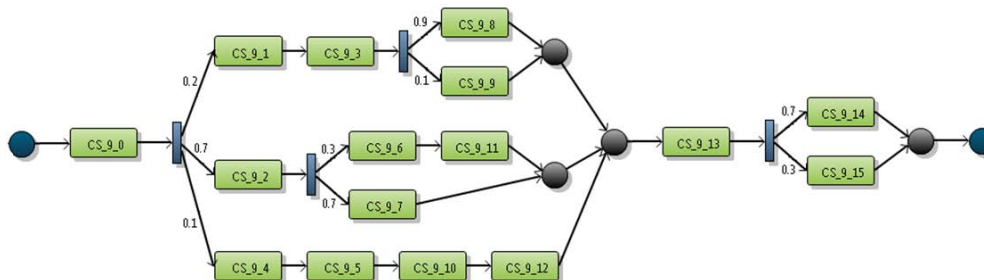
SW

Application



Description on different levels of abstraction

- Considering time consumption only
- Including communication statistics
- Adding detailed call sequences (with probability)



Timing Constraints

Constraints

Period $T_1 = 2\text{ms}$
Deadline $D_1 = 1.5\text{ms}$
Period $T_2 = 5\text{ms}$
Deadline $D_2 = 5\text{ms}$

▪ Runnable Sequencing Constraints

▪ Timing Constraints

- Order Constraint
- Synchronisation Constraint
- Repetition Constraint
- Delay Constraint
- Age Constraint
- Reaction Constraint

based on Events

based on Event Chains

▪ Data Age Constraints

Mapping Constraints

Constraints

Period $T_1 = 2\text{ms}$
Deadline $D_1 = 1.5\text{ms}$
Period $T_2 = 5\text{ms}$
Deadline $D_2 = 5\text{ms}$

■ Affinity Constraints

- Pairing Constraints
- Separation Constraints

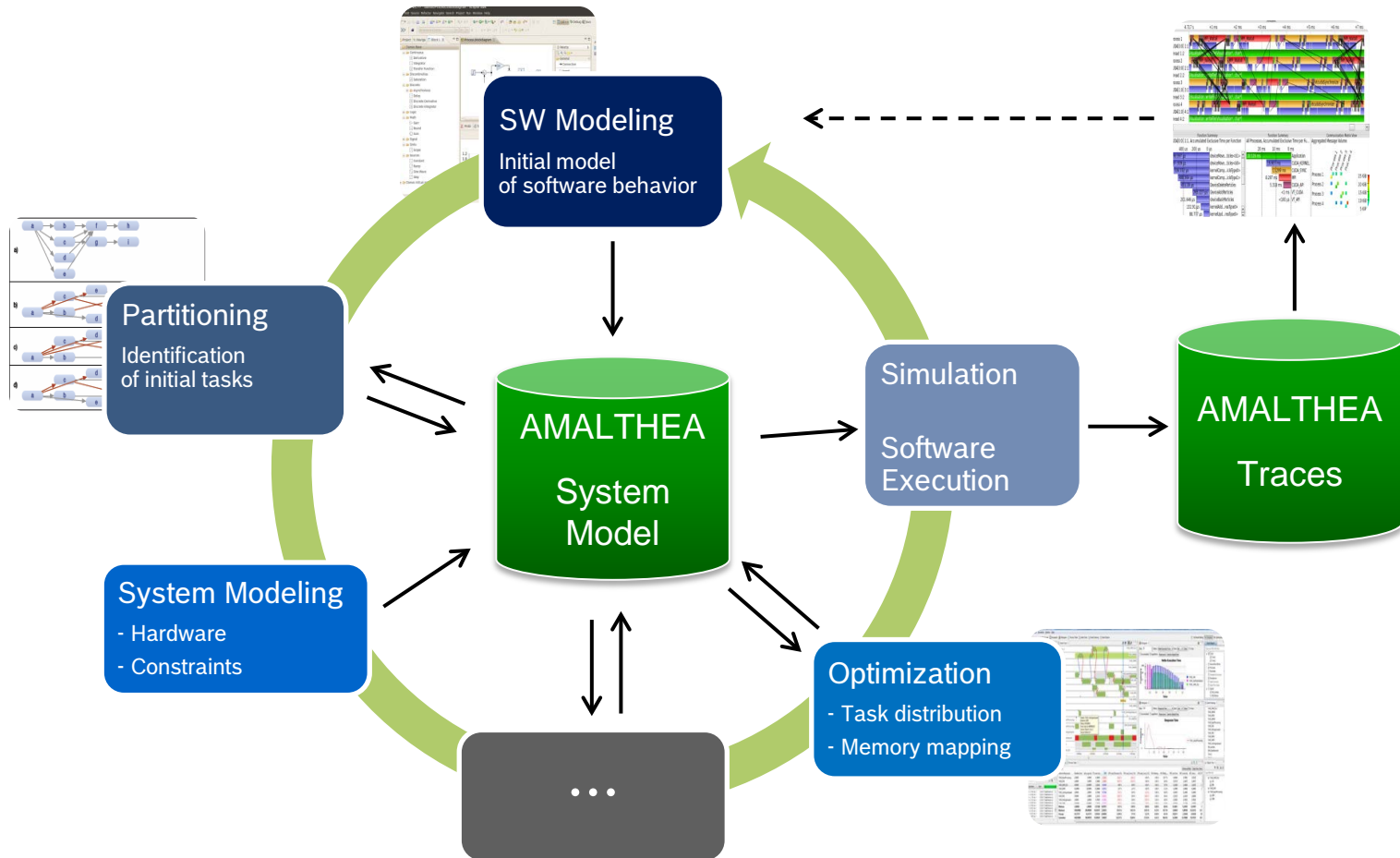


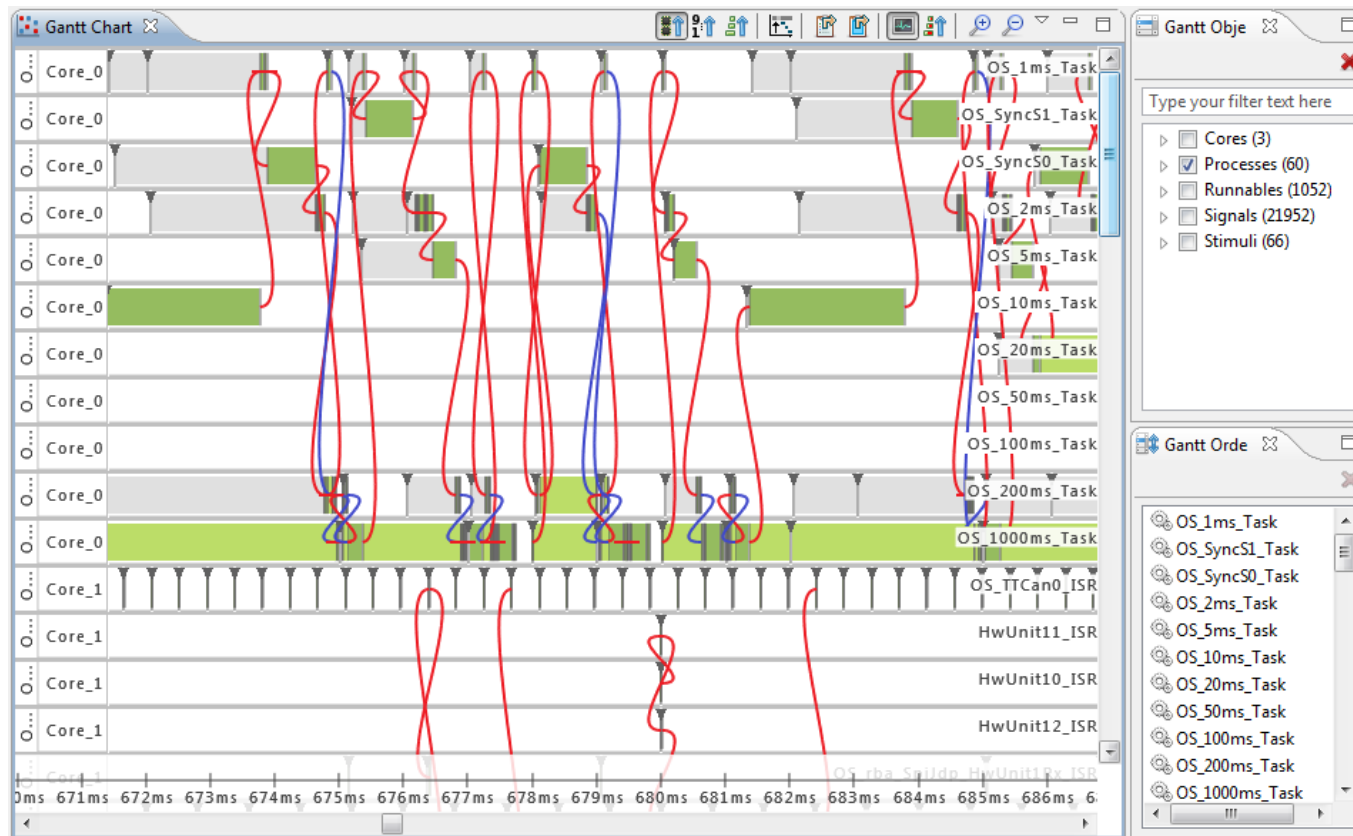
- Runnables
- Processes (Task or ISR)
- Schedulers

■ Property Constraints

Tool platform AMALTHEA

Processing, Simulation and Analysis



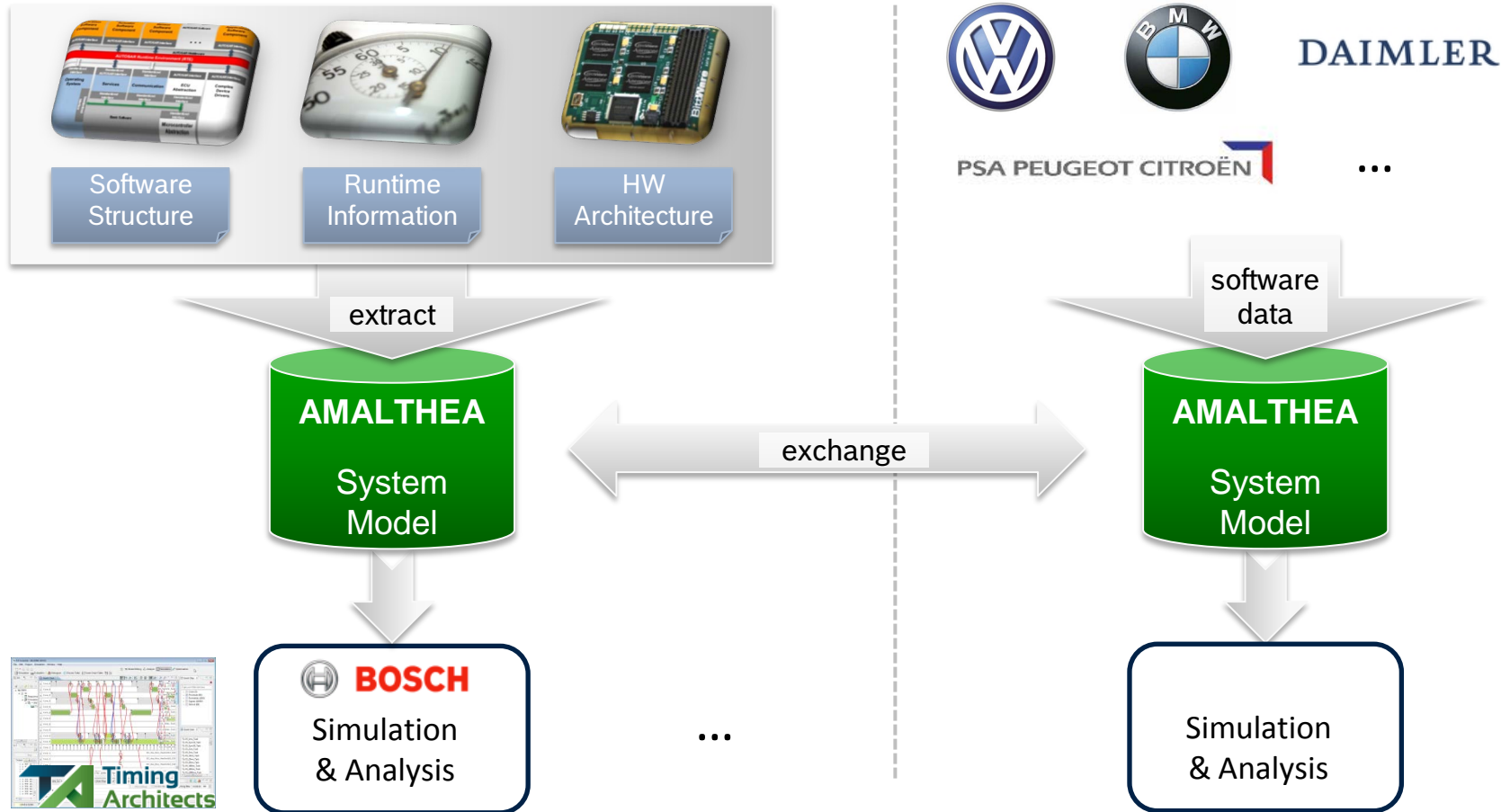


Example of a timing / scheduling simulation*

*Commercial tool – not part of the open source project

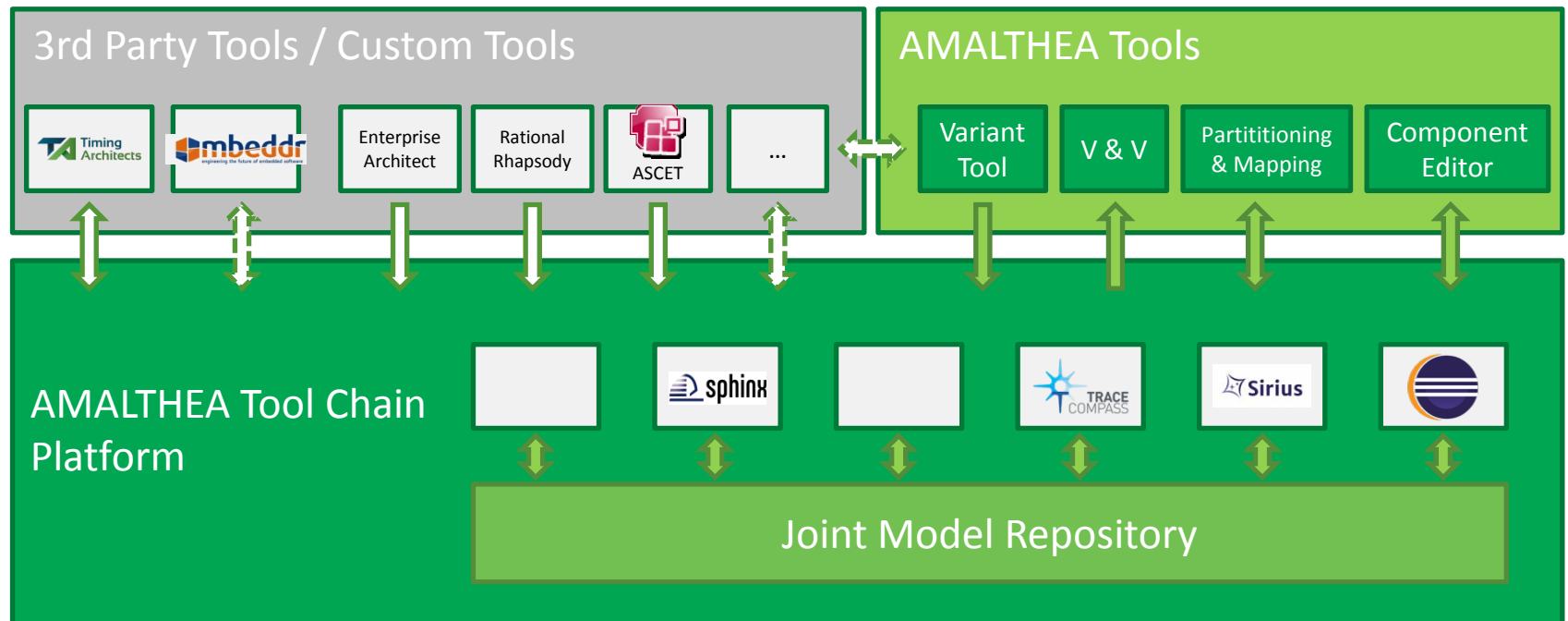
Tool platform AMALTHEA

Use cases @ BOSCH



Tool platform AMALTHEA

Platform Architecture



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AMALTHEA

The Open Source Platform





AMALTHEA
An Open Platform Project for Embedded Multicore Systems



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Downloads

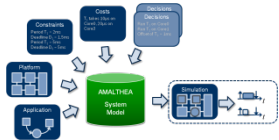
Name	Version	Size	Hits
org.itea2.amalthea.platform.product-win32.win32.x86_64-1.0.3.201406160730	AMALTHEA Tool Platform for Windows (64 Bit)	299.43 MB	538
org.itea2.amalthea.platform.product-win32.win32.x86-1.0.3.201406160730	AMALTHEA Tool Platform for Windows (32 Bit)	299.29 MB	185
org.itea2.amalthea.platform.product-linux.gtk.x86_64-1.0.3.201406160730	AMALTHEA Tool Platform for Linux (64 Bit)	299.04 MB	129
org.itea2.amalthea.platform.product-macosx.cocoa.x86_64-1.0.3.201406160730	AMALTHEA Tool Platform for OSX (64 Bit)	298.94 MB	41

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The official update site for the AMALTHEA platform is located at <http://platform.amalthea-project.org/update/>

Open Source
Release
in May 2014

<http://www.amalthea-project.org>



- Enhancements / analysis of **system model** underway to support new requirements (e.g. Many-Core)

Release 1.1.0

June 2015

Model Extension

- + Arrival Curves
- + OS Overheads
- + Data Age Constraints
- + Custom Attributes generalized
- + Event Sets
- + ...

Release 1.1.1

Sept 2015

Maintenance Release

- + Modes
- + Extended Hardware Description
- + Improved Model Handling
(scope, named references, ...)

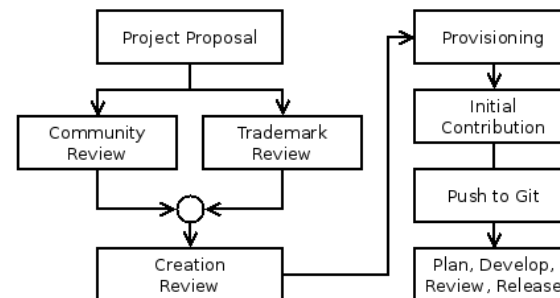
Project Activities

Eclipse Project Proposal



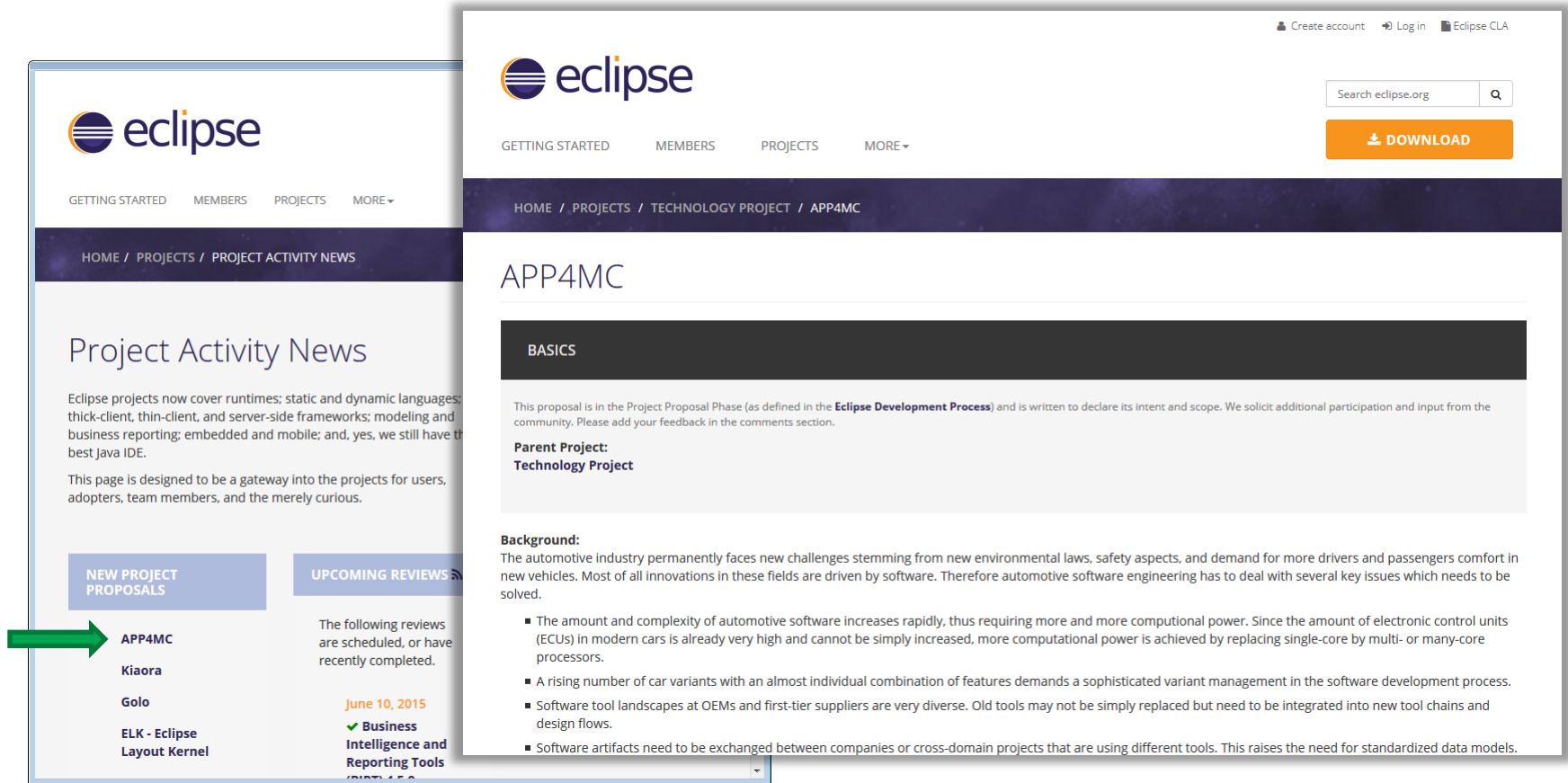
- Process for creation of Open Source **Eclipse project** started

Overview of the Project Creation Process



Project Activities

Eclipse Project Proposal



The screenshot displays the Eclipse Project Proposal page for APP4MC. The page is divided into two main sections: 'Project Activity News' and 'APP4MC'. The 'Project Activity News' section includes a description of Eclipse projects and a list of new project proposals. The 'APP4MC' section provides details about the project, including its parent project (Technology Project) and background information. A green arrow points to the 'APP4MC' link in the 'NEW PROJECT PROPOSALS' section.

Project Activity News

Eclipse projects now cover runtimes; static and dynamic languages; thick-client, thin-client, and server-side frameworks; modeling and business reporting; embedded and mobile; and, yes, we still have the best Java IDE.

This page is designed to be a gateway into the projects for users, adopters, team members, and the merely curious.

NEW PROJECT PROPOSALS

- APP4MC**
- Kiaora
- Golo
- ELK - Eclipse Layout Kernel

UPCOMING REVIEWS

The following reviews are scheduled, or have recently completed.

June 10, 2015

- ✓ Business Intelligence and Reporting Tools

APP4MC

BASICS

This proposal is in the Project Proposal Phase (as defined in the **Eclipse Development Process**) and is written to declare its intent and scope. We solicit additional participation and input from the community. Please add your feedback in the comments section.

Parent Project:
Technology Project

Background:

The automotive industry permanently faces new challenges stemming from new environmental laws, safety aspects, and demand for more drivers and passengers comfort in new vehicles. Most of all innovations in these fields are driven by software. Therefore automotive software engineering has to deal with several key issues which need to be solved.

- The amount and complexity of automotive software increases rapidly, thus requiring more and more computational power. Since the amount of electronic control units (ECUs) in modern cars is already very high and cannot be simply increased, more computational power is achieved by replacing single-core by multi- or many-core processors.
- A rising number of car variants with an almost individual combination of features demands a sophisticated variant management in the software development process.
- Software tool landscapes at OEMs and first-tier suppliers are very diverse. Old tools may not be simply replaced but need to be integrated into new tool chains and design flows.
- Software artifacts need to be exchanged between companies or cross-domain projects that are using different tools. This raises the need for standardized data models.

Source: <http://projects.eclipse.org/proposals/app4mc>

Project Activities

Eclipse Project Proposal

SOURCE CODE

Initial Contribution:

The initial codebase of APP4MC is the result of the publicly funded project **AMALTHEA** and is currently extended and maintained by the **AMALTHEA4public** project. A first release - available under the EPL - was published in June 2014 and can be downloaded from amalthea-project.org. The code that will be contributed to the APP4MC project is separated into multiple components that are described in more detail.

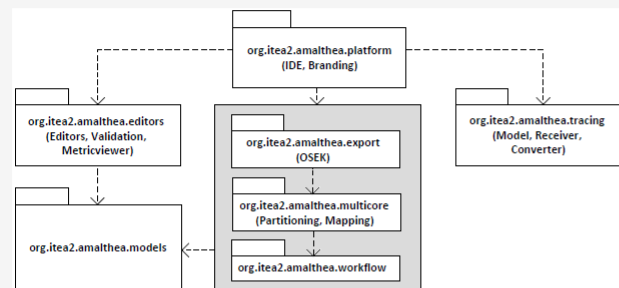


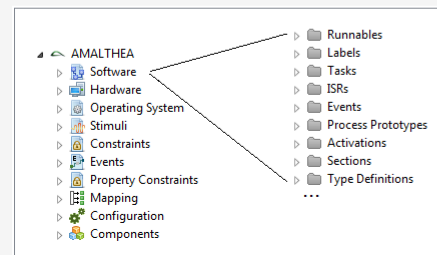
Figure: AMALTHEA Tool Platform components and their dependencies (simplified)

Models

The EMF models are specified with Xcore. The parts of the overall model (see left column in the editors figure)

Editors

This component contains editors for all AMALTHEA models. The editors are Sphinx tree editors based on ge nodes and new labels and icons.



PEOPLE

Project Leads:
Harald Mackamul

Committers:
Harald Mackamul
Lothar Wendehals
Daniel Kunz
Jan Jatzkowski
Christopher Brink
Lukas Krawczyk
Robert Hottger
Susan Iwai

Mentors:
Cedric Brun
Bernd Kolb

Interested Parties:

- Robert Bosch GmbH
- itemis AG
- Timing Architects
- Behr Hella Thermocontrol
- Dortmund University of Applied Sciences and Arts

You can support
the proposal !

Source: <http://projects.eclipse.org/proposals/app4mc>

Project Activities

Timeline & future activities

