Eclipse DemoCamps Mars 2015 / Stuttgart

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

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Agenda

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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AMALTHEA
Timeline

APP4MC

Eclipse Project

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

AMALTHEA

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

4public AMALTHEA

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

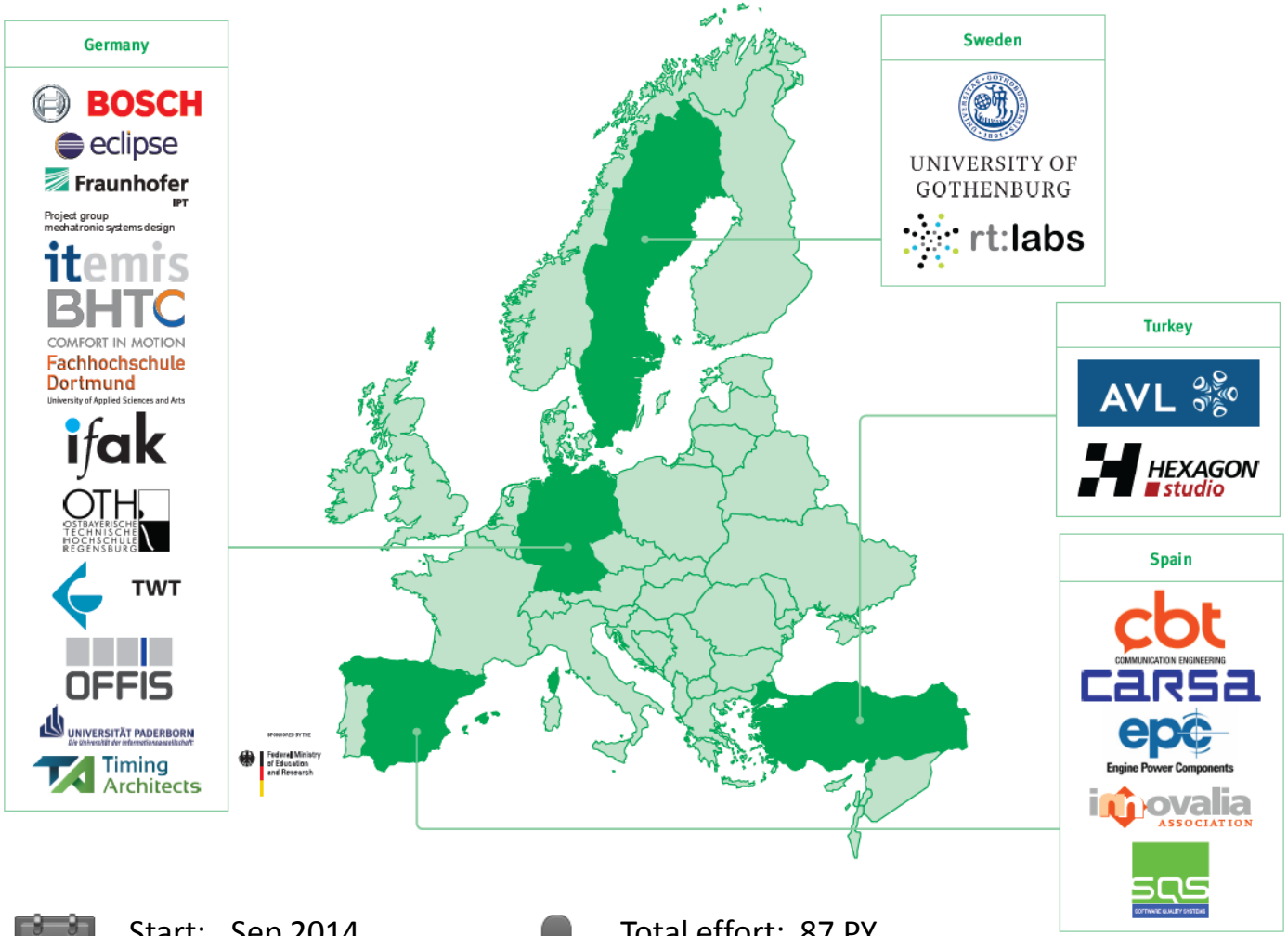
Community

2011 → 2012 → 2013 → 2014 → 2015 → 2016 → 2017 → ...

4public AMALTHEA

ITEA2 Project AMALTHEA4public

Project Consortium



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Start: Sep 2014
End: Aug 2017

Total effort: 87 PY
Project leader: Robert Bosch GmbH

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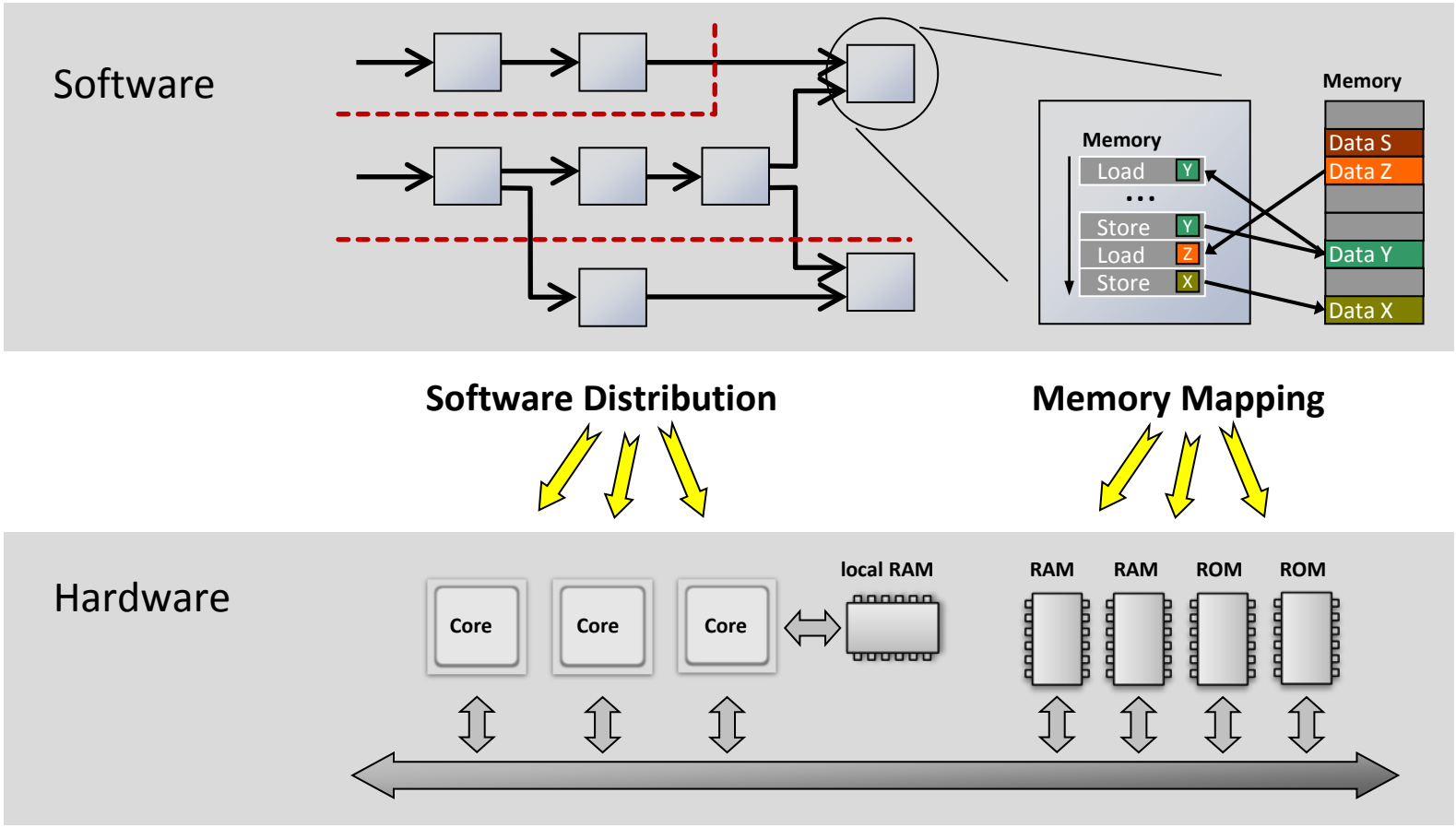
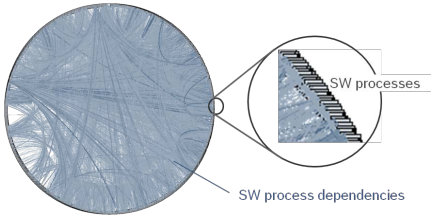
Challenges of Embedded Multi-Core

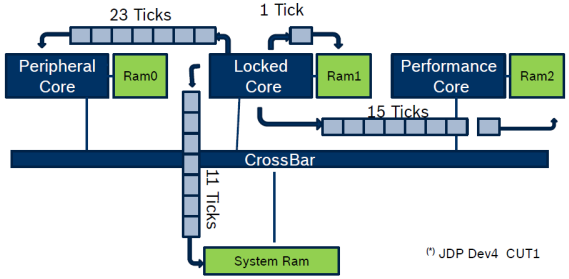


Challenges of Embedded Multi-Core

- **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

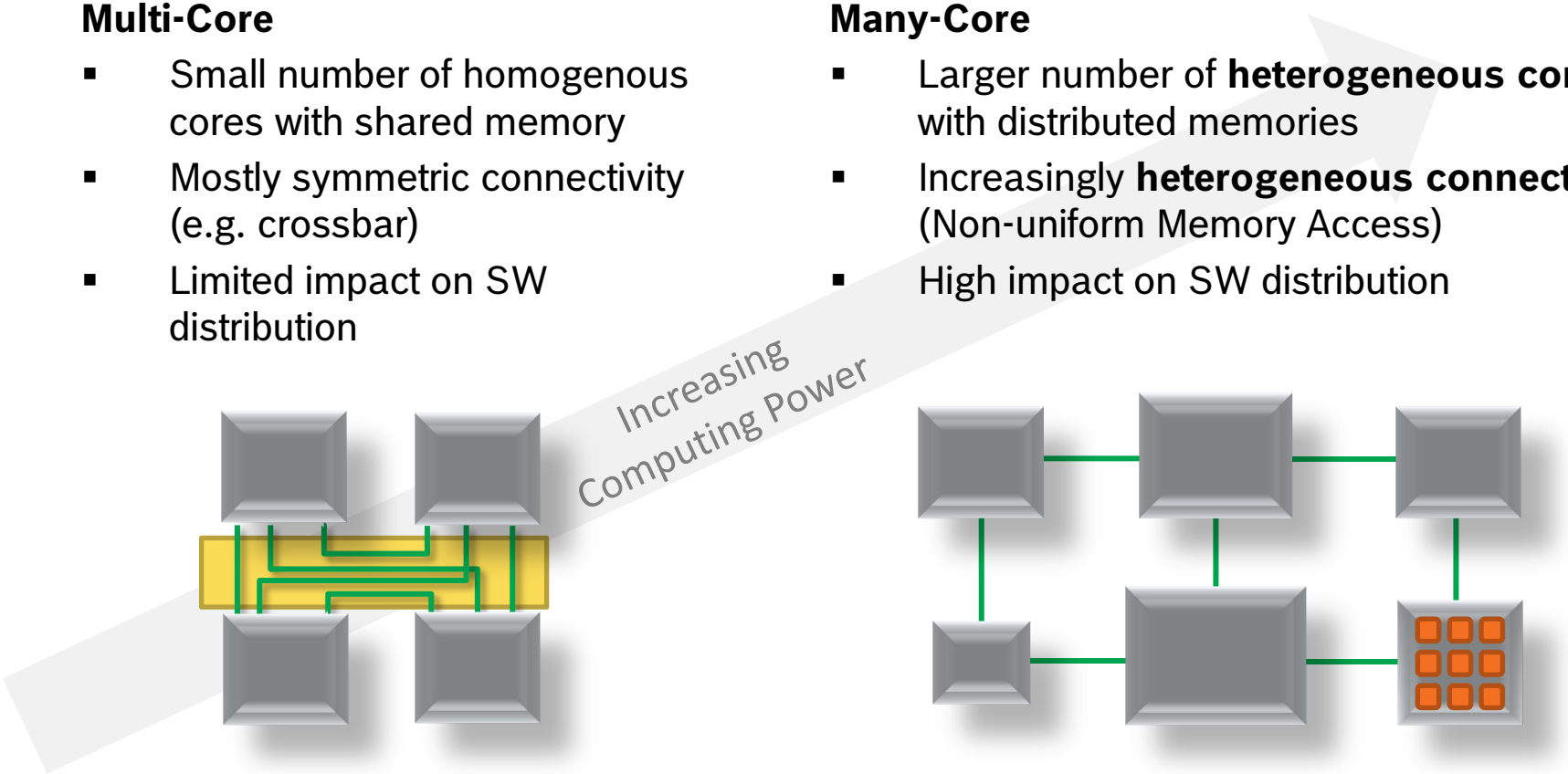
From Multi- to Many-Core

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

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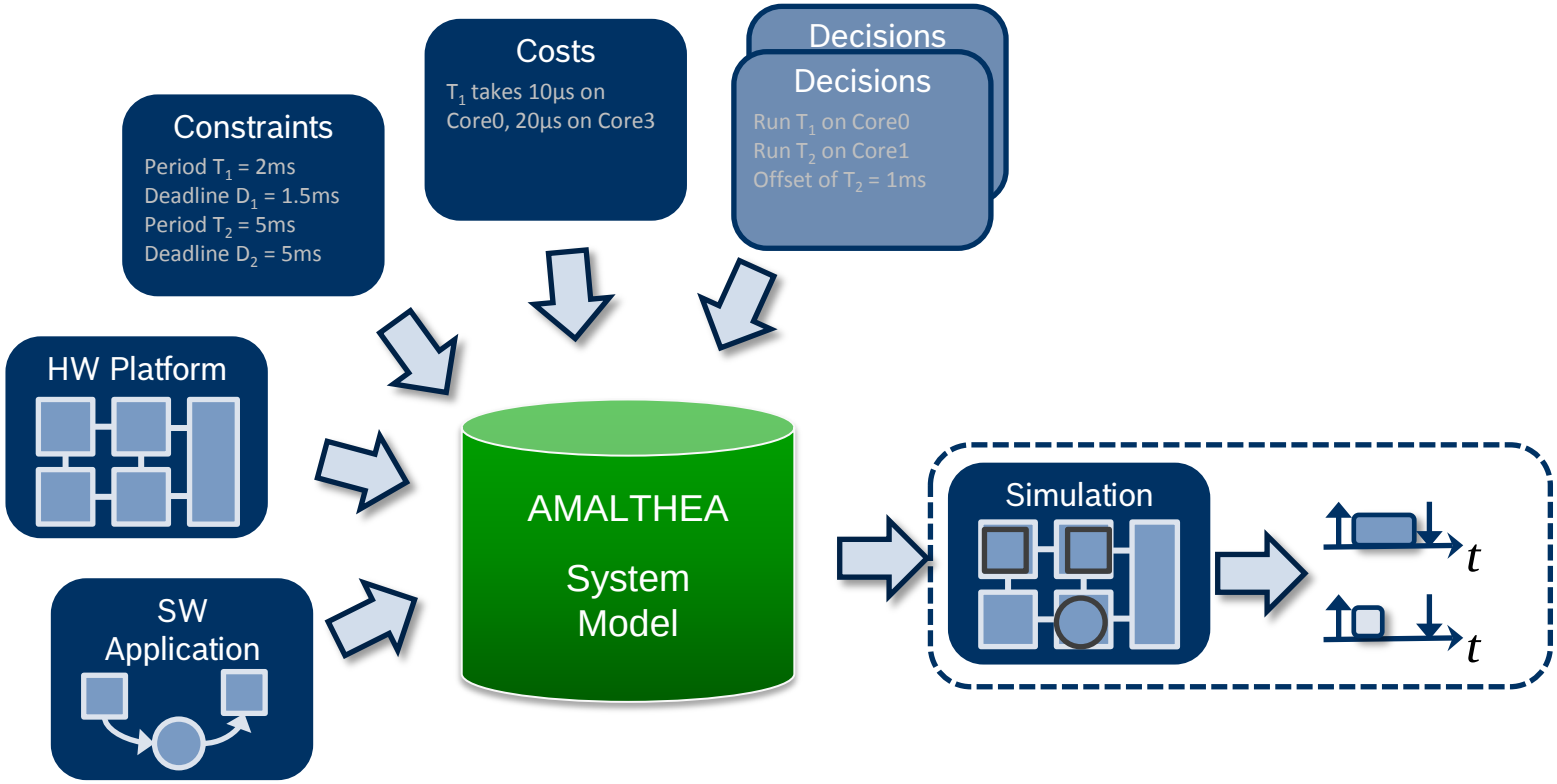
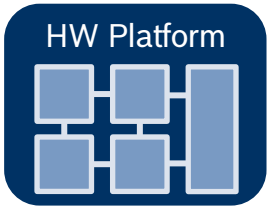
- Project activities: releases, next steps

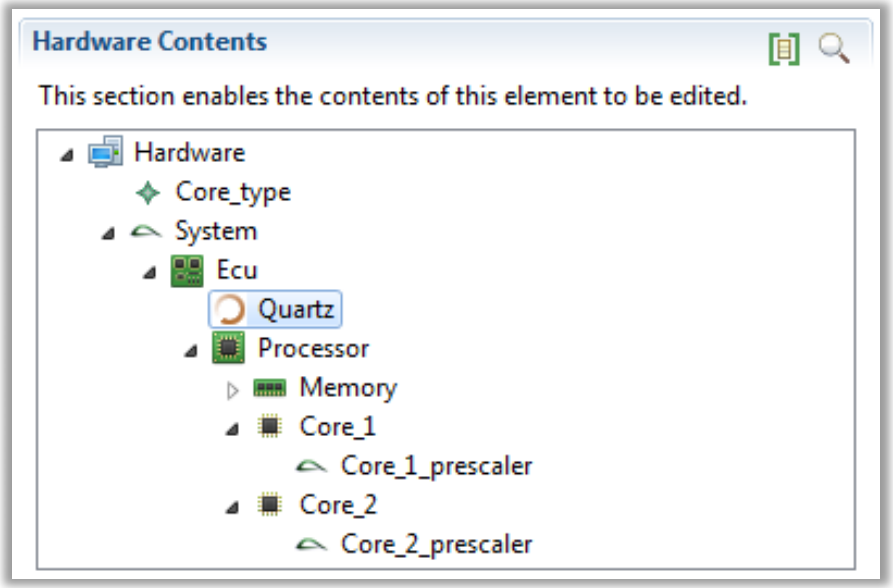
Tool platform AMALTHEA
Processing, Simulation and Analysis



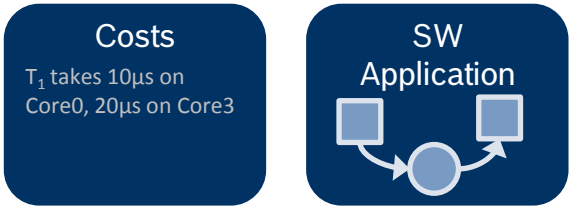
Hardware Characteristics



- **Hardware Elements**
  - ECU
  - Microcontroller
  - Core
  - Memory
  - Network

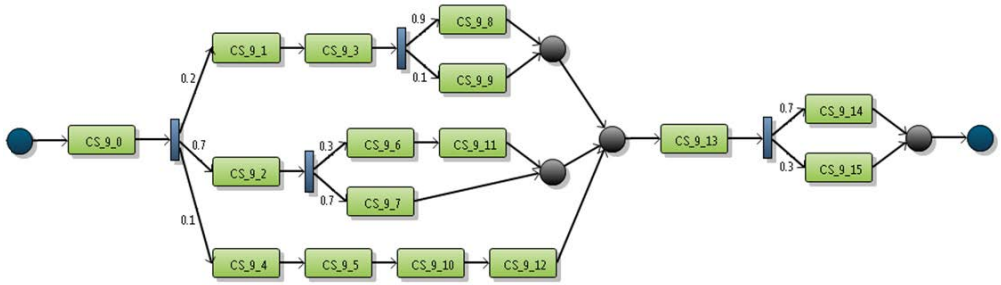


Software Behavior



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 = 2ms
Deadline D_1 = 1.5ms
Period T_2 = 5ms
Deadline D_2 = 5ms

- **Runnable Sequencing Constraints**
- **Timing Constraints**
  - Order Constraint
  - Synchronisation Constraint
  - Repetition Constraint
  - Delay Constraint

  } based on Events

  - Age Constraint
  - Reaction Constraint

  } based on Event Chains

- **Data Age Constraints**

Mapping Constraints

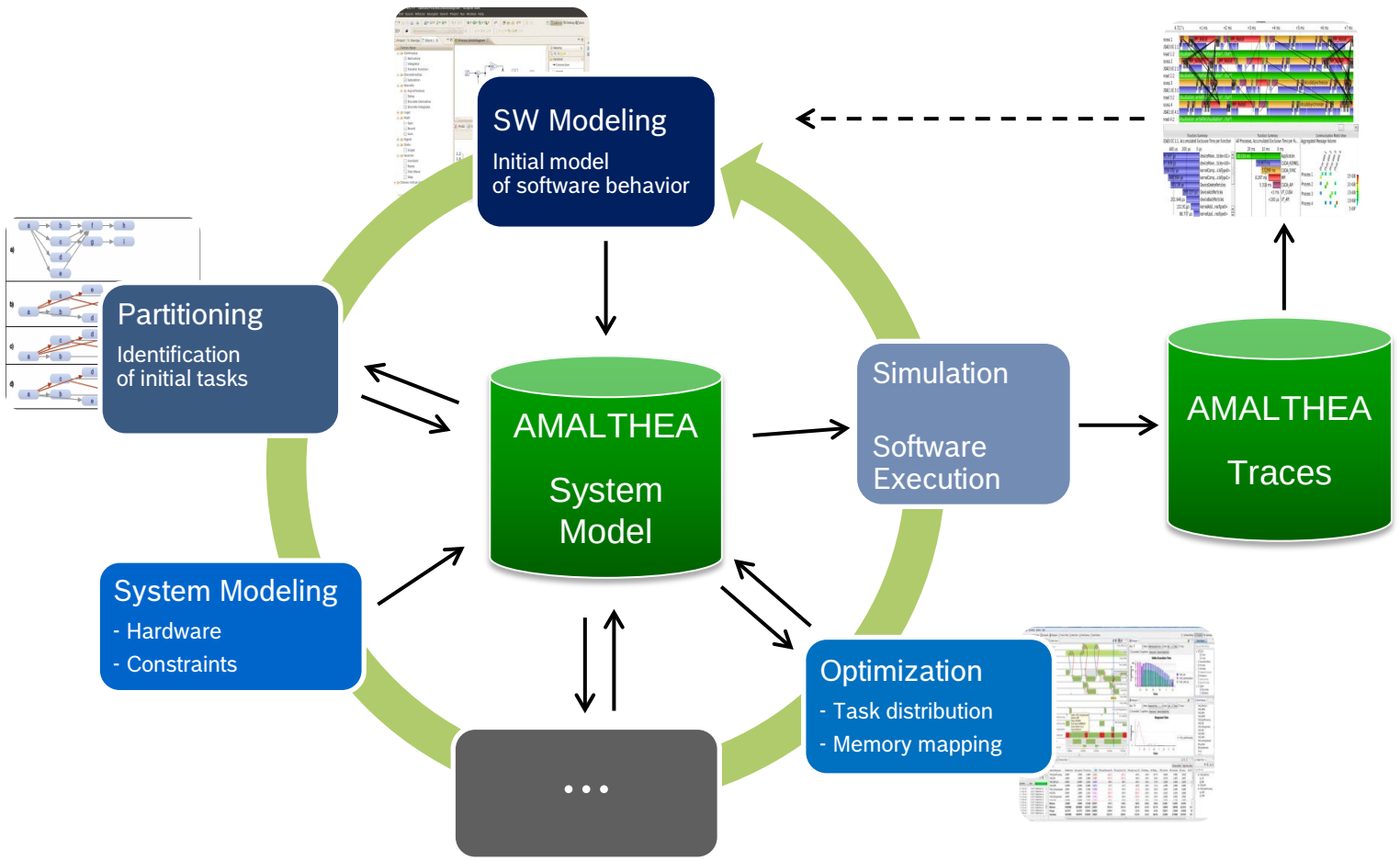
Constraints
Period T_1 = 2ms
Deadline D_1 = 1.5ms
Period T_2 = 5ms
Deadline D_2 = 5ms

- **Affinity Constraints**
  - Pairing Constraints
  - Separation Constraints

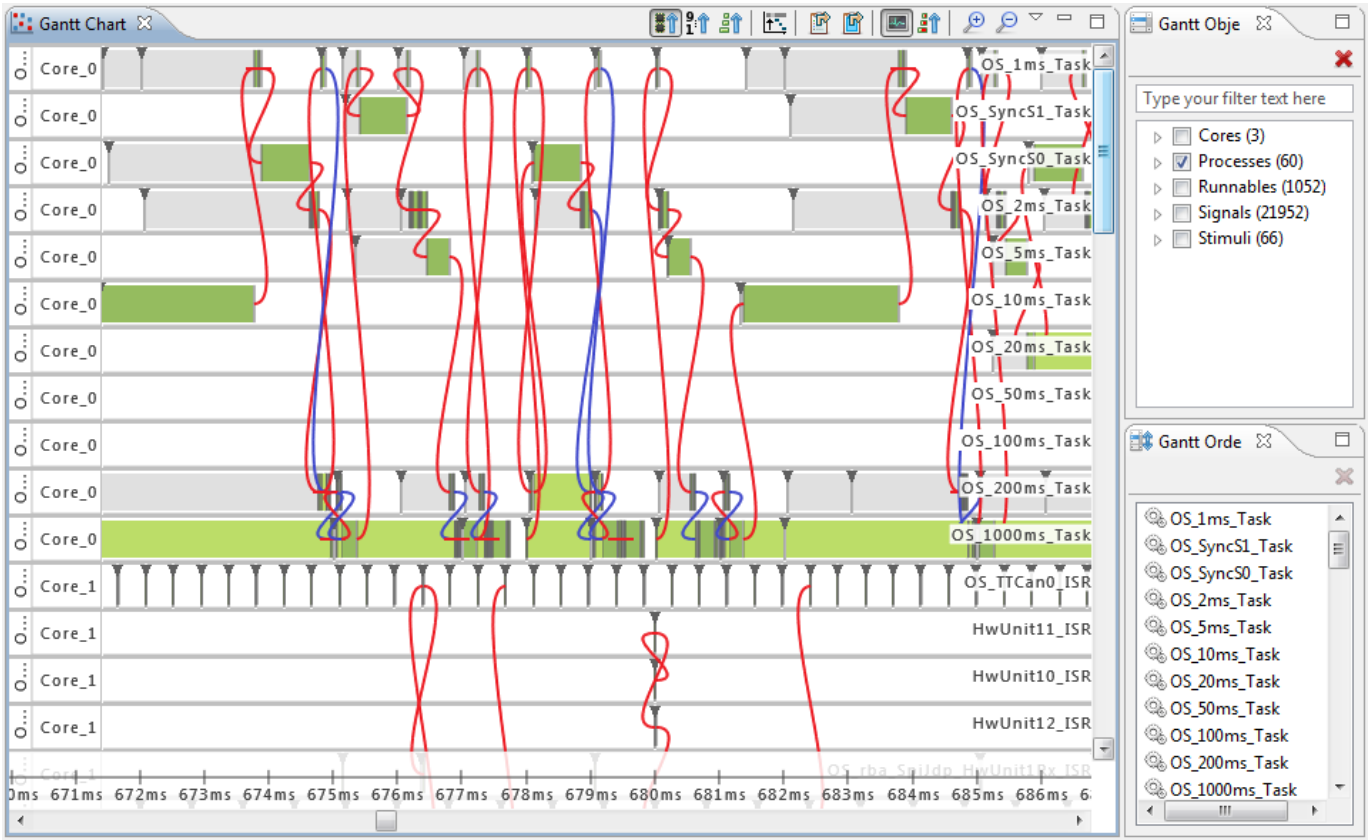
  }
  - Runnables
  - Processes (Task or ISR)
  - Schedulers

- **Property Constraints**

Tool platform AMALTHEA
Processing, Simulation and Analysis



Performance Simulation



Example of a timing / scheduling simulation*

*Commercial tool – not part of the open source project

Tool platform AMALTHEA
Use cases @ BOSCH

PSA PEUGEOT CITROËN ...

DAIMLER

extract

software data

AMALTHEA System Model

exchange

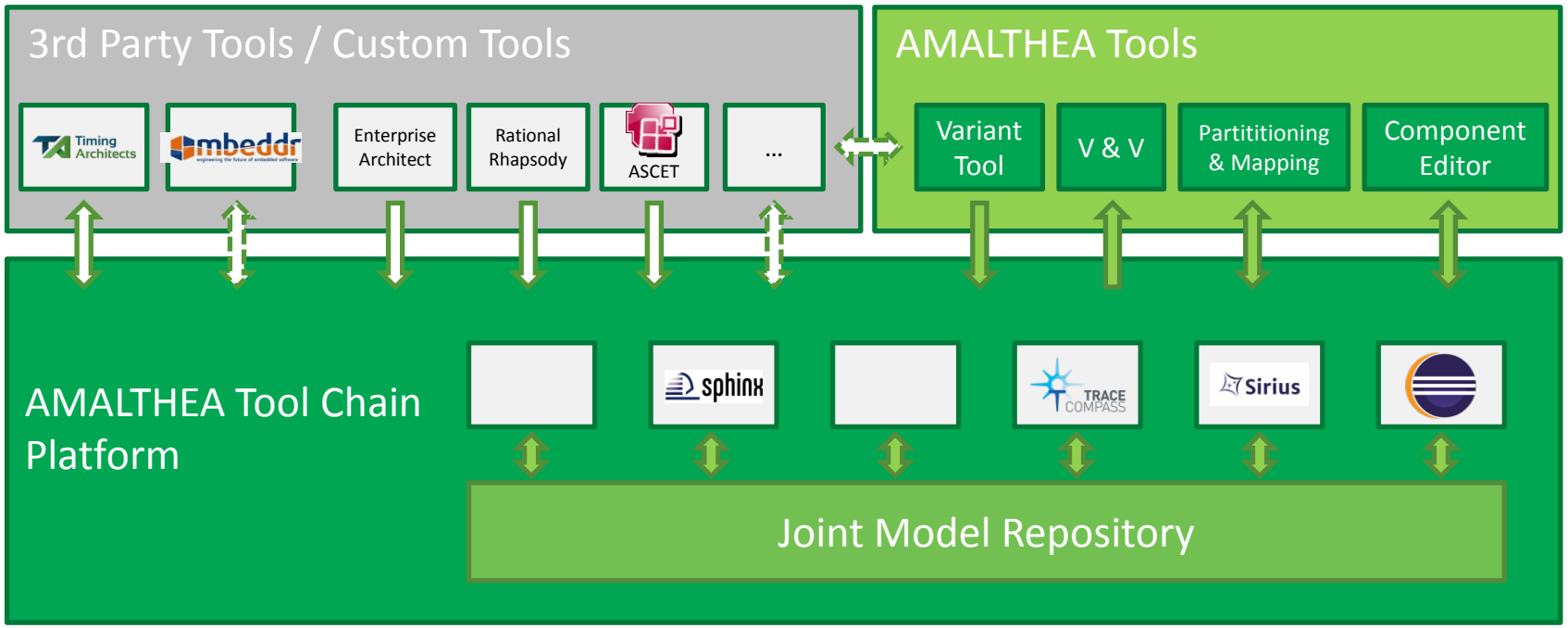
AMALTHEA System Model

BOSCH Simulation & Analysis

...

Simulation & Analysis

Tool platform AMALTHEA
Platform Architecture



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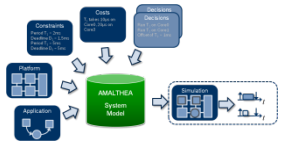
AMALTHEA
The Open Source Platform

Open Source Release in May 2014

http://www.amalthea-project.org

Project Activities
Next Releases



- 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

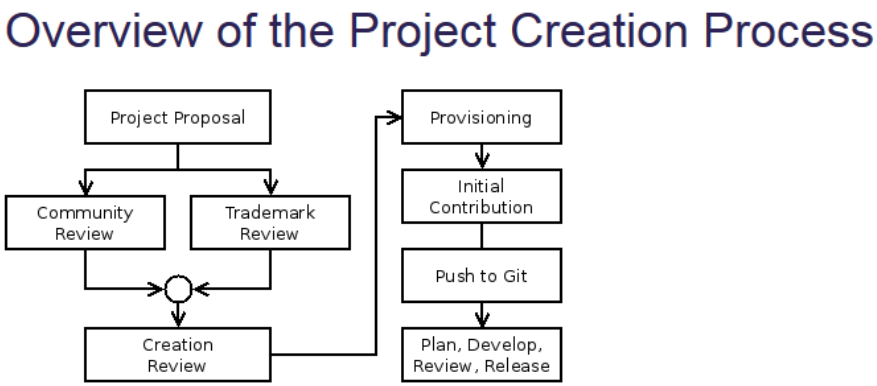
Maintenance Release

+ Modes
+ Extended Hardware Description

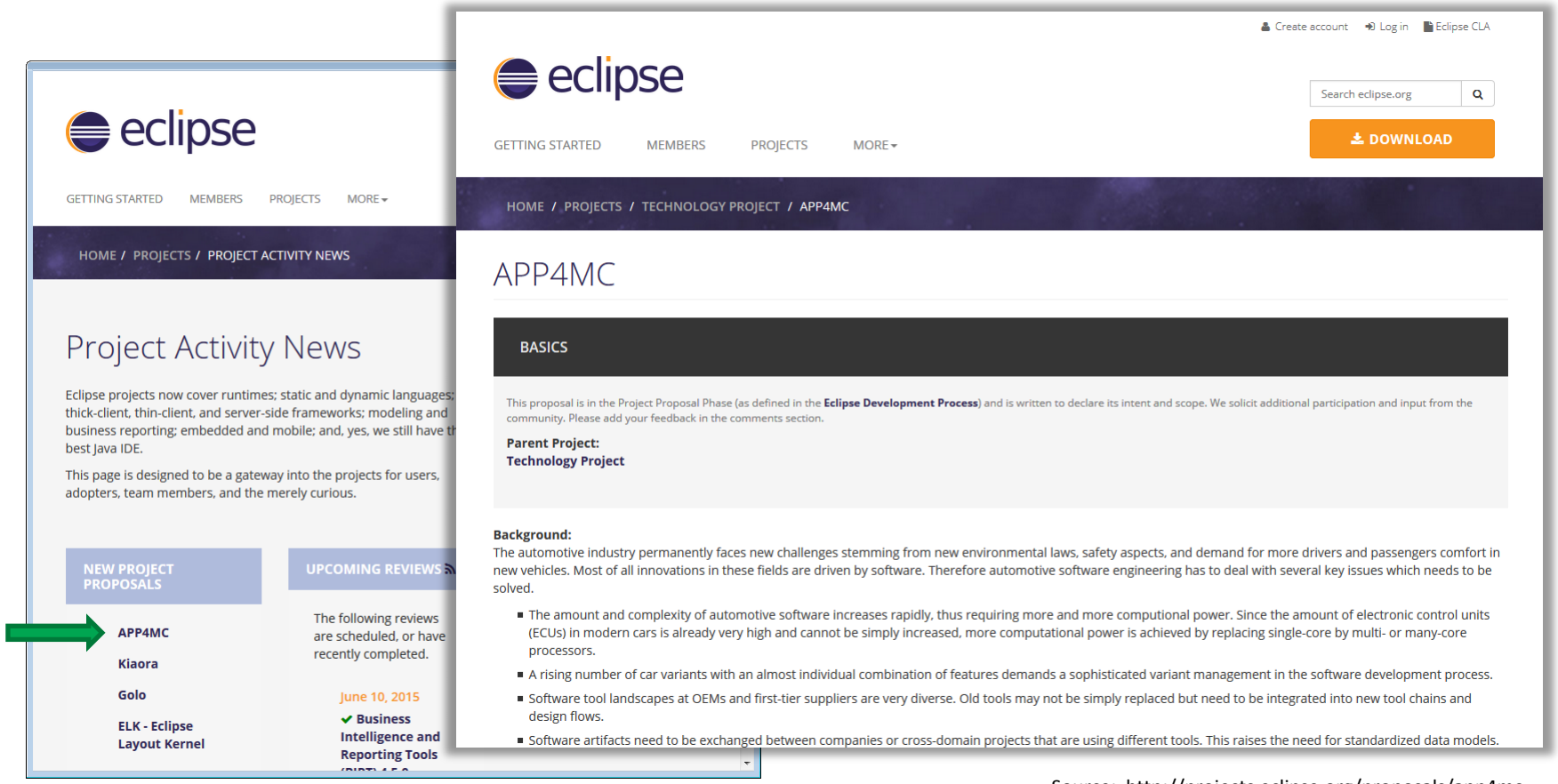
+ Improved Model Handling
  (scope, named references, …)

Project Activities
Eclipse Project Proposal

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



Project Activities
Eclipse Project Proposal



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.

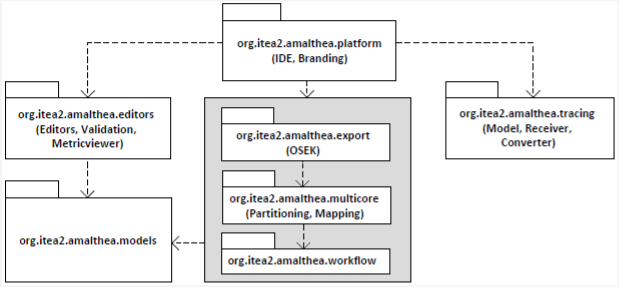


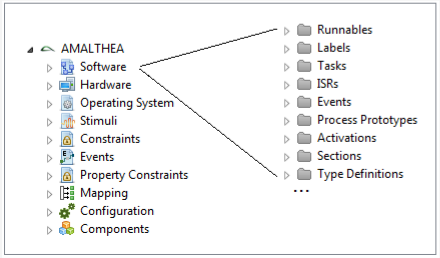
Figure: AMALTHEA Tool Platform components and their dependencies (simplified)

Models

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

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 Höttger
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