EclipseCon Europe 2017

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

Harald Mackamul, Robert Bosch GmbH
Robert Höttger, FH Dortmund
Eclipse APP4MC

APP4MC

is an open source tool platform for engineering embedded multi- and many-core software systems. The platform enables the creation and management of complex tool chains based on a common data model, including simulation and validation. As an open platform, it supports interoperability and extensibility and unifies data exchange in cross-organizational projects.

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Eclipse APP4MC Application
Data exchange and collaboration

Source: EMBEDDED REAL TIME SOFTWARE AND SYSTEMS 2016
http://web1.see.asso.fr/erts2016/
Agenda

Eclipse APP4MC Status
Project Status
Official Releases in 2017

Open Source Platform

Eclipse projects and community

Publicly funded projects and collaboration


www.amalthea-project.org/ www.eclipse.org/app4mc/

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Project Creation
The Official Proposal Process

- 2015-07-28 – trademark approved
- 2015-08-12 – creation review successful
- 2016-03-31 – initial contribution
- 2016-04-20 – source code cleared for checkin
- 2016-07-07 – code moved to Eclipse repository
- 2016-07-28 – Milestone 0.7.0 published
- 2016-09-19 – full IP review for APP4MC Platform completed
## Project Creation

**IP Clearance**

---

### Third-Party Libraries

<table>
<thead>
<tr>
<th>ID</th>
<th>State</th>
<th>Pri</th>
<th>OS</th>
<th>Assignee</th>
<th>Status</th>
<th>Resolution</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>11157</td>
<td>approved</td>
<td>P3</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>org-xerial-sqlite Version: 3.7.2 (PB CQ901)</td>
</tr>
<tr>
<td>11150</td>
<td>approved</td>
<td>P3</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>xalan 2.7.1 top level jar Version: 2.7.1 (PB Orbit CQ2213)</td>
</tr>
<tr>
<td>11161</td>
<td>approved</td>
<td>P3</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>Xerces Version: 2.9.0 (PB Orbit CQ2095)</td>
</tr>
<tr>
<td>11312</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>resolver.jar Version: 1.2 (PB Orbit CQ2136)</td>
</tr>
<tr>
<td>11313</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>serializer.jar Version: 2.7.1 (PB Orbit CQ2134)</td>
</tr>
<tr>
<td>11314</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>xml-apis jar Version: 1.3.04 (PB Orbit CQ2168)</td>
</tr>
<tr>
<td>11316</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>java_cup runtime Version: 10k (PB Orbit CQ1950)</td>
</tr>
<tr>
<td>11316</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>BCEJ Jar Version: 5.2 (PB Orbit CQ1933)</td>
</tr>
<tr>
<td>11518</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>Google Guava Version: 15.0.0 (PB Orbit CQ7768)</td>
</tr>
<tr>
<td>11520</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>Apache Commons Lang Version: 2.6 (PB Orbit CQ6450)</td>
</tr>
<tr>
<td>11522</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>JUnit Version: 4.12 (PB Orbit CQ9298)</td>
</tr>
<tr>
<td>11521</td>
<td>approved</td>
<td>P2</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>log4j Version: 2.12.6 (Subset - see all comments) (PB Orbit CQ3660)</td>
</tr>
<tr>
<td>11554</td>
<td>approved</td>
<td>P3</td>
<td>awai</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>javassist Version: 3.19.0-GA (PB CQ8727)</td>
</tr>
<tr>
<td>11553</td>
<td>approved</td>
<td>P3</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>easymock Version: 3.3.1</td>
</tr>
<tr>
<td>11560</td>
<td>approved</td>
<td>P3</td>
<td>awai</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>jdom Version: 2.0.6 (Subset, Custom)</td>
</tr>
<tr>
<td>11603</td>
<td>approved</td>
<td>P3</td>
<td>new</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>PlantUML EPL Version: 8000 (PB CQ8178)</td>
</tr>
<tr>
<td>11214</td>
<td>approved</td>
<td>P3</td>
<td>awai</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>jgraph Version: 0.9.0 <em>Custom</em></td>
</tr>
<tr>
<td>11102</td>
<td>approved</td>
<td>P3</td>
<td>awai</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>ojalu Version: 39.0</td>
</tr>
<tr>
<td>11159</td>
<td>approved</td>
<td>P3</td>
<td>awai</td>
<td>emo-ip-...</td>
<td>RESO</td>
<td>FXE</td>
<td>jaxen Version: 1.1.6</td>
</tr>
<tr>
<td>11213</td>
<td>awaiting_analysis</td>
<td>P3</td>
<td>awai</td>
<td>emo-ip-...</td>
<td>NEW</td>
<td>FXE</td>
<td>jenetics Version: 3.0.1</td>
</tr>
<tr>
<td>11156</td>
<td>approved</td>
<td>P2</td>
<td>unde</td>
<td>sharon...</td>
<td>RESO</td>
<td>FXE</td>
<td>APP4MC Platform</td>
</tr>
</tbody>
</table>

### Source Code

---

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Project Evolution
The Build Infrastructure

Repositories

- app4mc.web
  - git
  - build and publish website
  - provide downloads

Websites

- app4mc
  - git
  - build and test products

Build & Test Automation

- Hudson
  - hudson.eclipse.org/app4mc

Websites

- www.eclipse.org/app4mc
- projects.eclipse.org/projects/technology.app4mc

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Project Community
Contributions

APP4MC

Contribution Activity:
Commits on this project (last 12 months).

Individual Contribution Activity:
Commits on this project by individuals over the last three months.

Organization Contribution Activity:
Commits on this project by supporting organization over the last three months.

projects.eclipse.org/projects/technology.app4mc

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Project Community
Contributions via Gerrit
Agenda

Project Promotion
Project Promotion
Articles, Conferences, Trade Fairs

para//el 2016

WATERS

para//el 2017

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Project Promotion
Academic Challenges

WATERS industrial challenge

WATERS
7th International Workshop on Analysis Tools and Methodologies for Embedded and Real-time Systems
5th July 2016, Toulouse, France

In conjunction with ECRTS

Important dates
Submission deadline: 26th May 2016
Acceptance notification: 7th June 2016
Final version deadline: 17th June 2016
Workshop: 5th July 2016

Verification challenge

About the FMTV Challenge
The purpose of the Formal Methods for Timing Verification (FMTV) challenge is to share ideas, experiences and solutions to a concrete timing verification issue from real industrial case studies. It aims at promoting discussions, cross-fertilization of ideas and synergies across the real-time research community, as well as attracting industrial participation from different domains having a specific interest in timing verification.

The 2016 FMTV Challenge
We are glad to announce that the 2016 challenge is proposed by Arne Hamann, Simon Kramer, Martin Lukasiewycz and Dirk Ziegenbein from Bosch GmbH.

A general presentation and a full model of the challenge are available on the WATERS community forum. Potential participants are invited to post questions, e.g., for clarification, and follow on-going discussions about the challenge. For questions which are not of general interest, feel free to contact Sophie Quinton (sophie.dot.quinton@inria.fr).

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Static Code Analysis

- Static Code Analysis

  - SCA AMALTHEA Exporter
  - Intermediate Representation (EMF)
    - Filling the Intermediate Representation with supplementary information to categorize SCA result i.e., which function is Task or Runnable

  - AMALTHEA Merger
    - AMALTHEA Analysis
    - Validations
    - Filtering
    - Partitioning

  - Clang/LLVM AST
  - .... AST

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Meta Model Explorer
Project Promotion

Demonstrators

Rover Demonstrator

© APP4MC - All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Rover Demonstrator

Rover Documentation
Browser-based Camera Stream & Drive Control

Version  May 31, 2017
Implementation Mustafa Özcelikörs moceliks@gmail.com
Supervision & revision Robert Hötger robert.hoetger@fhi-dortmund.de

University of Applied Sciences and Arts Dortmund
IDiAL Institute, Project AMAIHEA4public
BMBF Fund.Nb. 01—S14029K

APP4MC Rover Parts
The following parts are designed with FreeCAD and can be printed in a standard 3D printer. The archives contain the FreeCAD file (*.PC3) and the STL file.

Front with fixed camera holder

Rover Documentation
Tracing with Perf, Conversion to CTF, and analysis with TraceCompass

Version  June 17, 2017
Implementation Mustafa Özcelikörs moceliks@gmail.com
Supervision & revision Robert Hötger robert.hoetger@fhi-dortmund.de

University of Applied Sciences and Arts Dortmund
IDiAL Institute, Project AMAIHEA4public
BMBF Fund.Nb. 01—S14029K
Project Promotion
Rover Demonstrator

APP4MC

Common Platform Model
- Components
- Events
- Hardware
- Mapping
- Stimuli
- Constraints
- Operating System
- Software
- Trace
- Your contribution...

Basic Tools
- Timing Analysis
- Compiler
- Partitioning
- Task Generator
- Mapping
- Visualisation
- Trace Converter
- Your contribution...

Your Tools
- ...
Project Promotion
Rover Demonstrator

Modeling (via AMALTHEA tool)

Multicore Wizard configuration

Code Generation

Enhanced Model

Mapping Model

Create CPP out of Mapping Model
Project Promotion
Task Visualizer
Perf Tracing, CTF Conversion, and Import to TraceCompass
Project Promotion
Community and Dissemination

Best Paper Awards:
- “Challenges of Establishing Traceability in the Automotive Domain”, Software Quality Days 2017
- “Automated Distribution of Software to Multi-Core Hardware in Model Based Embedded Systems Development”, ICIST 2015

Total of 31 scientific publications at a broad range of international journals, conferences and workshops, e.g.:
- 2017: DATE, ICIST (submitted), IDAACS (t.a.), IT Journal (submitted)
- 2016: ARCS, ASE, FMTV, JSEP, parallel, RE, REFSQ, SANER, SysInt
- 2015: ICIST, IDAACS, IESS, ISCPMBC (Riga), Kando, PMTEES, Scopes, SEAA, WinTeSys

- Contributions at DIF, EIW, Hackathons, EW, Cebit, Co-Summit, EclipseCon
- Google Summer of Code (GSOC) Project A4MCar
Project Promotion
Demonstrators

- Available at https://git.eclipse.org/r/app4mc/org.eclipse.app4mc.examples
- Rover source code and documentation
- Software distributed with APP4MC
- A4MCAR is further part of GSoC
- APP4MC software distribution improved automatic OS distribution at the A4MCAR regarding timing by 12%
Project Promotion

APPSTACLE

- Hono setup (Web FE, DB / Cloud BE)
- Visualizing raw data
- *Platform / Runtimes* → RT aspects
- *In-vehicle connectivity*
- *Monitoring / Diagnostics*
Project Promotion
Rover Demonstrator

- OLED display + buttons (shutdown, menu)
- Buzzer
- Eclipse Hono (cloud) interaction, raw data transmission
- [http://eclipse.org/cF](http://eclipse.org/cF) (public Git repo)
- Android App control via Bluetooth

Planned
- Hackathon 02.2018 planned (100+ participants)
- AGL layers development + image build system + SDK cross compilation
- Eclipse technology integration
  - HawkBit, MosQuitto, Ditto, Leshan, Keti, Kapua, Sumo, …
Project Promotion
Rover Demonstrator – Eclipse technologies

Eclipse TraceCompass
Trace visualization

Eclipse SUMO
Traffic simulation

Eclipse Ditto
Digital twins, Abstraction API

Eclipse Leshan
LM2M

Eclipse MosQuito
MQTT

Eclipse Kapua
Device management

Eclipse Keti
Security

Rover

curl -X PUT -i -H 'Content-Type: application/json' --data-binary '{"IR_FrontL": 7, "IR_FrontR": 10}' http://idial.institute:8080/telemetry/DEFAULT_TENANT/4711
Evaluate the Sessions

Sign in and vote at eclipsecon.org