Embedded Software Development with AUTOSAR

An Engineering Partner's Perspective
Tobias Lorenz, Gothenburg, September 2016
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IAV Group
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IAV Group

IAV’s company facts
Your Strong Engineering Partner

What we develop moves you.

- Engineering expertise in the entire vehicle from detail to overall system
- At your side from concept to start of production and beyond
- Over 30 years of experience in automotive developing to the level of manufacturing readiness
- Excellent developers and first-class technical outfit
- Integrated approach comprising methodology, technology and application
- Close liaison with universities and research institutes
- Over 6,500 dedicated members of staff close to you wherever you are in the world
Vehicle Development

2,950 members of staff

- Vehicle and mobility concepts
- Derivative development
- Sub-systems and overall systems
- Requirement and design specifications
- Interfaces
- Layout, computation, design, simulation, testing
- Software and hardware development
- Analysis, diagnostics, measurement
- Calibration, validation, testing, integration and verification
- Fleet support

Headcount planned for 2016
Proximity to Customers Worldwide

- Paris
- Seoul
- London
- Moscow / Kaluga
- Modena
- Beijing
- Shanghai
- Tokyo
- Detroit
- Sao Paulo
- Mexico City
- Palo Alto
- Stockholm
- Germany
- Beijing
- Shanghai
Scope of Presentation
Scope of Presentation

Outline of some experiences made with AUTOSAR using three exemplary scenarios

ECU Integrator
The role of the ECU Integrator in the AUTOSAR development workflow (AUTOSAR 3.x + 4.x)

SW Component Designer
SW Component Developer
Prototypical composition based function development (AUTOSAR 4.x)

Toolchain Developer
Tool interoperability and feature support (AUTOSAR 4.x)

→ Focus on activities at Application Layer and RTE-Layer
Introduction
AUTOSAR Development Workflow

VFB
- System Engineer

ASW
- SW Component Designer
- SW Component Developer

RTE
- ECU Integrator

BSW
- Basic SW Configurator
- Basic SW Module Developer

RTE Contract-Phase

RTE-Generation Phase

Toolchain Developer (not in AUTOSAR standard)
# IAV’s AUTOSAR Projects and Roles

**Strict Top-Down projects covering the roles of**

- ECU Integrator
- Basic Software Configurator
- Basic Software Module Developer
- Toolchain developer

## Application Layer

<table>
<thead>
<tr>
<th>Runtime Environment (RTE)</th>
<th>System Services</th>
<th>Memory Services</th>
<th>Communication Services</th>
<th>I/O Hardware Abstraction</th>
<th>Complex Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onboard Device Abstraction</td>
<td>Memory Hardware Abstraction</td>
<td>Communication Hardware Abstraction</td>
<td>I/O Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microcontroller Drivers</td>
<td>Memory Drivers</td>
<td>Communication Drivers</td>
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</tbody>
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## Microcontroller

![Diagram of microcontroller](image-url)
### IAV's AUTOSAR Projects and Roles

#### Application Layer

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**Strict Top-Down projects covering the roles of**

- Software Component Developer
  - Object code delivery only
- Toolchain developer
IAV’s AUTOSAR Projects and Roles

Strict Bottom-Up projects with high flexibility covering the roles of

- Software Component Developer
  - Object code delivery only
- Software Component Designer
- Basic Software Configurator (partly)
- ECU Integrator (partly)
- Toolchain developer
IAV’s Project Experiences
ECU Integrator in AUTOSAR Workflow

ECU Integrator (Top-Down with object code and more than one supplier)

- ECU software can only be generated if
  - Architecture is agreed with all suppliers
  - RTE is generated and RTE-Header are delivered to suppliers
  - Object-Files are delivered from all suppliers

- Issues related to the role
  - Source of project delay if only one supplier is not on schedule
  - Needs to be functional knowledge carrier or needs to have functional information (often shared using proprietary formats)

→ Ease workflow (Composition-RTE)
Prototypical Function Development

**SWC Developer (Bottom-Up)**
- Currently this scenario only works if:
  - RTE Contract-Phase is used
    - Not possible for projects that need RTE optimizations
  - RTE-Generation Phase with build-server is used
    - Not possible on e.g. test drives where no internet access is available
    - Security risks
- Reasons for limitation
  - Freely chosen variable names in RTE
  - Setup of parameter reference tables

→ Improve prototyping (Composition-RTE)

**BSW Configurator**
- BSW Module Developer
- Fixed BSW as object code

**ECU Integrator**
- RTE-Generation

**SWC Designer**
- SWC Developer
- dynamic

→ Architecture
A common toolchain uses an equal AUTOSAR XML description format to generate RTE with generators from different vendors

Currently only possible with restrictions

- Different vendors support different features
- Sometimes different vendors need different ARXML artifact combinations for some features
- The quality of the generated RTE differs extremely in terms of runtime behaviour, feature support, safety mechanisms and readability of the generated code

→ Limited tool interoperability
Summary
The defined workflows and common architectural description formats in AUTOSAR are very helpful to unify software development in the automotive domain

There are still existing gaps and hurdles in daily work using this workflows

Three use cases were outlined
  – Difficult role of ECU Integrator
  – Limited support of prototypical bottom-up projects
    → Possible solution could be Composition-RTE
  – Interoperability of tools using the RTE generators from different vendors as an example
Thank You

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