Global Automotive E/E Standard

Rick Flores, General Motors, AUTOSAR Steering Committee
Open Architecture Summit
Washington, D.C. November 4, 2014
E/E innovations in vehicle development increases

90% of all innovations are fully based on E/E

Major innovations:
- 1970: Mechanics
- 1980: Electronic support
- 1990: Infotainment
- 2000: Linked networks
- 2010: 90% of all innovations
- 2020: E/E

AUTOSAR – The Global Automotive E/E Standard
2003 – 10 companies found AUTOSAR
AUTOSAR has Become a Global Standard

Europe: 91 Partners
America: 27 Partners
Africa: 1 Partner
Asia: 67 Partners
Overview

1. AUTOSAR Motivation and Partnership
2. AUTOSAR Organization and Processes
3. AUTOSAR Worldwide and other Standards
4. AUTOSAR Outlook
Overview

1. AUTOSAR Motivation and Partnership
2. AUTOSAR Organization and Processes
3. AUTOSAR Worldwide and other Standards
4. AUTOSAR Outlook

Vision and Objectives

Cooperation and Partner Status
**AUTOSAR**

**Main Working Topics**

- **Architecture:**
  Software architecture including a complete basic software stack for ECUs – the so called AUTOSAR Basic Software – as an integration platform for hardware independent software applications.

- **Methodology:**
  Defines exchange formats and description templates to enable a seamless configuration process of the basic software stack and the integration of application software in ECUs. It includes even the methodology how to use this framework.

- **Application Interfaces:**
  Specification of interfaces of typical automotive applications from all domains in terms of syntax and semantics, which should serve as a standard for application software.
Running the AUTOSAR partnership: Three tier partnership structure

Core Partners
- Organizational control
- Administrative control

Premium Partners
- Leadership of Working Groups
- Involvement in Working Groups

Associate Partners
- Users of the AUTOSAR standard

Development Partners
- Dedicate expertise contributions
- Involvement in Working Groups
AUTOSAR Vision

AUTOSAR aims to improve complexity management of integrated E/E architectures through increased reuse and exchangeability of SW modules between OEMs and suppliers.
The Principles of the Development Cooperation

- Core-, Premium- and Development Partners jointly develop a common automotive standard

- AUTOSAR Partners grant each other a non-exclusive, non-transferable license under its essential intellectual property rights

- AUTOSAR Partners do not assert against each other when commercially exploiting the AUTOSAR standard

- As part of their exploitation of AUTOSAR, AUTOSAR Partners developed AUTOSAR compliant products

- AUTOSAR Partners commit for product conformance to AUTOSAR specifications to ensure interoperability

Cooperate on standards, compete on implementation.
Running the AUTOSAR partnership:
Exploitation license valid for automotive applications

“Automotive Applications means applications related to engine powered, land-based, non-railed vehicles, such vehicles intended for primary transportation purposes.”
Running the AUTOSAR partnership:
Exploitation license valid for derived applications

Civil machineries

YES

Ultra hazardous activities

NO

Marine including military marine transportation vessels, railway powertrain, agriculture and forest machinery, construction and mining machinery, compressors and pumps, or power generators.

aerospace and aviation, nuclear power, chemical and/or biological reactors, petrochemical, or military (except for military marine transportation vessels).
Overview

1. AUTOSAR Motivation and Partnership

2. AUTOSAR Processes and Organization

3. AUTOSAR Worldwide and other Standards

4. AUTOSAR Outlook

Life cycle model and concept handling process

Release Phases

Management boards and work packages
AUTOSAR Release Management:
Decoupled Concept Development Process

AUTOSAR Guided Tour (Part 1)
Organization and Processes

Concept Assessment
- Evaluate concept (initial technical assessment, dependencies to other concepts)
- Agree on use cases and features
- Refine concept request

Concept Elaboration
- Agree on refined use cases and features, concept elements and concept parts
- Identify affected specifications, new specifications to be created
- Investigate different solutions, and select the most suitable
- Prepare project plan and propose validation strategy

Validation
- Prove maturity of concept
- Identify inconsistencies & incompleteness

Detailing
- Prepare “copy-and-paste” ready solution based on expert discussions
- Agree on final technical solution with owner of affected documents

Incorporation
- Add technical solution to the AUTOSAR documents
Achievements – new concepts in release 4.2.1

For the AUTOSAR Basic Software and Methodology Release 4.2.1 new concepts were developed and integrated:

- **Communication**
  - Enhanced Ethernet Support
    - Switch Configuration
    - Sender Receiver Serialization
  - CAN FD

- **Safety & Security**
  - E2E Extension
  - ASIL QM Protection
  - Secure On Board Communication

- **Basic Software**
  - NV Data Handling RTE
  - EcuM Fixed MC

- **Methodology**
  - Safety Extensions
  - Decentralized Configuration
AUTOSAR Organization
Overview

Project Organization

- Executive Board
- Steering Committee
- Project Leader Team
- Communication Team
- Legal Team

Support Functions
- Technical Manager
- Quality Manager
- Change Manager
- Quality Assurance
- Release Manager
- Technical Office

- Core Partner
- Lead WP and WP
- Subcontractor
- Regional WPs

Work Packages
Work Package structure from 2015 on

WP-A
Software Architecture
WP-A-LIB Libraries
WP-A-PRODERR Production Errors

WP-A1
VFB and RTE

WP-A2
COM Stack

WP-A3
Functional Safety

WP-A4
Diagnostics

WP-A5
MCAL

WP-M
Methodology and Templates
WP-M-METH Methodology
WP-M-GST Generic Structure Template
WP-M-SWCT Software Component Template
WP-M-SYST System Template ECU Configuration
WP-M-TIMEX Timing Extensions

WP-M1
Timing Analysis

WP-I
Application Interfaces
WP-I-BODY Body and Comfort
WP-I-ENGINE Powertrain Engine
WP-I-TRSM Powertrain Transmission
WP-I-CHASSIS Chassis Control
WP-I-OCSAFE Occupant and Pedestrian Safety

WP-I-VAL
Acceptance Test

WP-T

WP-R-JP
Japan

WP-X-SEC
Security

WP-X-VAL
Validation

Legend:
Lead Work Package
Subgroups

Work Package
Subgroups

Cross-product concerns
Overview

1. AUTOSAR Motivation and Partnership
2. AUTOSAR Organization and Processes
3. AUTOSAR Worldwide and other Standards
4. AUTOSAR Achievements and Outlook

- Globalization - motivation and activities
- Regional co-operations
- Other Standards
Motivation to Globalize the AUTOSAR Organization

- Foster AUTOSAR as a global standard
- Make the participation for partners in the regions China, India, Japan and US more attractive. That means:
  - Make F2F-Meetings easier
  - Cover local / regional requirements (e.g. provide specific configuration, translations …)
  - Motivate our regional partners to join and support the standardization process
- Avoid the creation of variants of the standard in the regions

AUTOSAR started to introduce regional work packages and user groups
AUTOSAR Worldwide: Open to Connect Others ...

First activities started
At least to be considered …
Overview

1. AUTOSAR Motivation and Partnership
2. AUTOSAR Organization and Processes
3. AUTOSAR Worldwide and other Standards
4. AUTOSAR Outlook

Future of AUTOSAR
Future of AUTOSAR – objectives and challenges

- Maintain stability and compatibility of existing standard.
- Main directions of the Future of AUTOSAR:
  - Reflect new use cases of today’s and future market needs.
  - Adapt to upcoming market needs.
  - Support new technologies.

Anticipate the future – identification of technological trends, key features and next challenges for AUTOSAR

Stabilize the standard – maintain the standard, reduce complexity and increase usability, improve job sharing
Starting point – selected main drivers

Main drivers for new automotive software systems have been determined.

Highly automated driving

Car-2-X applications

Open access to vehicle

Stronger interaction
Summary

Challenges of a living standard:
- Improve stability and keep compatibility with existing releases
- Reflect new use cases of today's and future market needs

Main directions of the Future of AUTOSAR:
- Improve existing standard
- Adapt to upcoming market needs
- Support new technologies: Car2X, enhanced security, dynamic architectures, …
Thank you for your attention!

More Information about AUTOSAR:
http://www.autosar.org

Become a partner and get exploitation rights for the AUTOSAR standard
request@autosar.org

Published Releases
GM SYSTEM/ SOFTWARE PRODUCT LINES BACKUP
GM NEXT GENERATION TOOLS

PROBLEM STATEMENT

How do we create a tool set that allows:

• Full explicit traceability across the development lifecycle in a high reuse, multi-deployment Product Line

• Modern Architecture Management Methods
  • Information hiding, component based software engineering, generated middleware, ...

• Global large scale multi-user collaboration (~3000 users)
  • Ease of use
  • Minimization of CM version conflict (avoid merges)
WHAT IS A PRODUCT LINE

A Product Line is a set of systems sharing a common, managed set of features that are developed from a common set of core assets in a prescribed way.

Why Product Line over Products – Our Experience

• As much as an 85% reduction in effort for a second application
• As much as a 70% reduction in field claims
THE SPL LIFECYCLE FRAMEWORK

Feature-based Abstraction

Product Line Management

Profile A

Feature Profiles

Requirements Engineers

Architects

Developers

Quality Assurance

Shared SPL Assets

Gears Product Configurator

Design Models

Source Code

Test Cases

Simplicity of a Single Automated Production Line

“Horizontal” Shared Asset Perspective

Key
Variation Points

GENERAL MOTORS
SYNCHRONOUS CONCERNS IN A SPL SOLUTION

- **Multi-product.** Feature-based variation management and automated production line
- **Multi-phase.** Product line lifecycle assets, architecture and traceability
- **Multi-baseline.** Product line change management and baseline management
PLE LIFECYCLE BASED ON A CONFIGURABLE BILL OF FEATURES
Exploring AUTOSAR: Hardware independent architecture

Yesterday

Software

Hardware

Today

Application Software

AUTOSAR

Hardware

Customized

Standardized
Exploring AUTOSAR: Software architecture

<table>
<thead>
<tr>
<th>SW Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle Ware</td>
</tr>
<tr>
<td>Basic Software</td>
</tr>
<tr>
<td>ECU Resources</td>
</tr>
</tbody>
</table>

Application Layer

Runtime Environment

- System Services
- Memory Services
- Communication Services
- I/O Hardware Abstraction
- Complex Drivers

Onboard Device Abstraction
Memory Hardware Abstraction
Communication Hardware Abstraction
Microcontroller Drivers
Memory Drivers
Communication Drivers
I/O Drivers
Exploring AUTOSAR: Basic Software Abstraction inside the Infrastructure Architecture

Example: Communication Stack – CAN
Exploring AUTOSAR: Application interfaces

- Ports implement the interface according to the communication paradigm.
- Ports are the interaction points of software components.
- The communication is channeled via the RTE.
- The communication layer in the basic software is not visible at the application layer.
Exploring AUTOSAR: Application interfaces – Example engine speed

Port „Engine Speed“
The actual rotational speed of the engine crankshaft.

Interface „Engine Speed 1“
Connection to transfer a rotational speed of type N1.

Data type „N1“ [rpm]: Uint16 value with resolution 0.5
Exploring AUTOSAR: Methodology – Basic approach

Virtual Integration

```
<table>
<thead>
<tr>
<th>System Constraint Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECU Descriptions</td>
</tr>
<tr>
<td>SW-C 1</td>
</tr>
<tr>
<td>SW-C 2</td>
</tr>
<tr>
<td>SW-C 3</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>SW-C n</td>
</tr>
</tbody>
</table>
```

Introduction of HW Attributes

```
<table>
<thead>
<tr>
<th>ECU Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECU Description</td>
</tr>
</tbody>
</table>
```

ECU Configuration

```
<table>
<thead>
<tr>
<th>ECU Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECU I</td>
</tr>
<tr>
<td>SW-C 1</td>
</tr>
<tr>
<td>SW-C 2</td>
</tr>
<tr>
<td>RTE</td>
</tr>
<tr>
<td>BSW</td>
</tr>
</tbody>
</table>

| ECU II            |
| SW-C 3            |
| RTE               |
| BSW               |

| ECU n             |
| SW-C n            |
| RTE               |
| BSW               |

```

System Constraint Description

```
<table>
<thead>
<tr>
<th>System Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flex Ray</td>
</tr>
<tr>
<td>Gateway</td>
</tr>
</tbody>
</table>
```

```
| CAN               |
```

Tools supporting development of software components
Exploring AUTOSAR: Methodology – AUTOSAR description templates

AUTOSAR description templates
- **SWC description:** application software
- **ECU description:** ECU characteristics and configuration
- **System description:** network and assignment of SWCs to ECUs

Tool-based deployment of SWCs to ECUs