Why AUTOSAR
Agenda

- **Motivation for AUTOSAR**
  - AUTOSAR roadmap and history
  - Vector and AUTOSAR
  - Advantages of MICROSAR
Growing E/E Complexity

Motivation for AUTOSAR

- Electronic Injection control
- Cruise Control
- Gearbox Control
- Traction Control
- Anti Lock Breaks
- Electronic Stability Control
- Active Body Control
- Adaptive Cruise Control
- Emergency Call
- Airbags
- Electronic Stability Control
- Active Body Control
- Adaptive Cruise Control
- Emergency Call
- Airbags
- Electronic Stability Control
- Active Body Control
- Adaptive Cruise Control
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- Active Body Control
- Adaptive Cruise Control
- Emergency Call
- Airbags
- Electronic Stability Control
- Active Body Control
- Adaptive Cruise Control
- Emergency Call
- Adaptive headlights
- Active steering
- Curve warning
- Stop and Go
- Lane Keeping assistance
- Automated Parking
- Collision mitigation
- Electronic Break Control
- Car 2 Car communication
- Tele-diagnostics
- Software updates over the air
Motivation for AUTOSAR

Quantity of Software rising very steeply

- Single Electronic Control Unit
- Multiple Electronic Control Units
- Domain Control Units
- HPC (High Performance Computing)

1990 | 2000 | 2015 | 2020
---|---|---|---
CAN | MOST | LIN | FLEXRAY | ETHERNET
8 Bit → 16 bit → 32 bit → 64 bit → Multicore

*In 2010, some vehicles had about 10 million SLOC and by 2016 this expanded by a factor of 15, to roughly 150 million lines

*McKinsey&Company Report Feb’18
'Rethinking car software and electronic architecture'
Many different hardware platforms are used
- Embedded systems traditionally do not support full hardware abstraction
- Limited modularity of the software

Poor reusability: Software must often be rewritten from scratch when hardware (processor type) is changed

Variability: Suppliers have to support a large variety of OEMs and vehicle platform variants with their software
Two different AUTOSAR statements:

“Cooperate on standards – compete on implementation”
Objectives

- **Serviceability** over the entire product life cycle
  - Software updates and upgrades over the entire life of a vehicle
- **Abstraction** of hardware from software, making development more flexible.
  - Shift development activities from implementation to configuration
- Improvement in **software quality** by standardized BSW
- **Competition** is focused onto OEM-relevant features
- **Reusability** of functions across vehicle networks and across OEM boundaries.
Motivation for AUTOSAR

Objective

AUTOSAR

AUTOmotive Open System ARchitecture

- Improve software quality and reduce costs by RE-USE
  - Re-use of functions across carlines and across OEM boundaries
  - Re-use of development methods and tools
  - Re-use of basic software
Motivation for AUTOSAR

Standardization

Interfaces

Exchange Formats

Methodology
Motivation for AUTOSAR

Layered View: Simplified

- Application Layer
- Run Time Environment
- Service Layer
- ECU Abstraction Layer
- Microcontroller Abstraction Layer
- Complex (Device) Drivers/ CDD
- Microcontroller
Layered View: Detailed

Motivation for AUTOSAR

AUTOSAR Runtime Environment (RTE)

Application

- System Service
- Memory Services
- Comm. Services
- I/O Hardware Abstraction
- Complex Device Drivers

Microcontroller

- Onboard Device Abstraction
- Memory Hardware Abstraction
- Comm. Hardware Abstraction
- Microcontroller Drivers
- Memory Drivers
- Comm. Drivers
- I/O Drivers

Microcontroller Abstraction Layer

ECU Abstraction Layer

Service Layer
Motivation for AUTOSAR

Standardization of Interfaces

Source: http://www.autosar.org
Motivation for AUTOSAR

Standardization of Exchange Formats

BUS Protocols

- LIN
- CAN
- FlexRay™
- CAN FD
- Automotive Ethernet

System Description / ECU Extract

(AUTOSAR XML format)

ECUC Configuration

(AUTOSAR XML format)
Motivation for AUTOSAR

Standardization of Methodology

SW functionality of the vehicle is defined as a system of SWCs...

Software Component Description

An extract is created for each ECU...

Extract of System Description

The ECU is configured in detail

System Description

... and mapped to ECUs

ECU Configuration Description (ECUC)

Basic Software (BSW)

RTE
Motivation for AUTOSAR

AUTOSAR Workflow with OEM and TIER1

- Interface between OEM* and TIER1*: ECU Extract of System Description (ECUEX)
- OEM creates ECUEX based on vehicle system design
- TIER1 configures AUTOSAR ECU based on ECUEX

*Note: "OEM" and "TIER1" may also be organizational units within one company ("System Responsible" vs. "ECU responsible")
Objectives - Achieved

- **Reusability** of functions over different vehicles.

**Motivation for AUTOSAR**

**Function Library**
- Seat Adjustment A
- Seat Adjustment B
- Lighting
- Seat Heating
- Air Conditioning

**Vehicle A**
- Hardware Topology
- Software Configuration
- Distributed System
- Code Generation

**Vehicle B**
- Hardware Topology
- Software Configuration
- Distributed System
- Code Generation
Motivation for AUTOSAR

- **AUTOSAR roadmap and history**
  - Vector and AUTOSAR
  - Advantages of MICROSAR
(AUTomotive Open System ARchitecture)

is a worldwide development partnership of car manufacturers, suppliers and other companies from the electronics, semiconductor and software industry.
AUTOSAR Partnership

Core Partners

- BMW GROUP
- Bosch
- Continental
- Daimler
- Ford
- GM
- PSA Peugeot Citroën
- Toyota
- Volkswagen

Development Partners

- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November

Associate Partners

- Premium Partners

- Attendees

- Tools and Services

- Standard Software

- Generic TIER 1

- Tools and Services

- Semi-conductor

- Vector Informatik GmbH
AUTOSAR Partnership

9 Core Partners
- BMW Group
- CONTINENTAL
- DAIMLER
- FORD
- PSA PEUGEOT CITROEN
- TOYOTA
- GM
- VOLKSWAGEN AG

48 Premium Members
- DELPHI
- TTEKT
- DENSO
- HONDA
- MAGNA
- HYUNDAI-KIA MOTORS
- RENAULT
- MAZDA
- VOLVO
- MAGNIFICENT
- ETAS

11 Development Members
- Itemis
- SGS
- C&S
- FUSE
- TUV NORD
- VALIDAS

65 Associate Members
6 Attendees

General
OEM
Generic
Tier 1
Standard
Software
Tools and
Services
Semi-
conductors

2010.10.19: up-to-date status see www.autosar.org
AUTOSAR roadmap and history

**History**

- **AUTOSAR 2.0**
  - specifications on components (BSW and RTE)

- **AUTOSAR 2.1**
  - includes specifications on development methodology and templates
  - first descriptions for application interfaces (body and interior electronics)

- **AUTOSAR 3.0**
  - > 20 compositions from the body, powertrain, and chassis domain
  - Specifications of standardized application interfaces (powertrain, chassis domain)
  - harmonized the concept for wakeup of ECUs and startup of networks
  - state managers for the bus systems CAN, LIN, and FlexRay added

- **AUTOSAR 3.1**
  - OBDII (new revisions of the DCM, DEM, FIM specifications,...)
AUTOSAR roadmap and history

History

- **AUTOSAR 4.0 Rev1 (2009-12)**
  - Functional Safety (Memory Partitioning, Time Determinism, Program Flow Monitoring, E2E, BSWM Defensive Behavior, Dual µC, E-Gas Monitoring)
  - Architectural Improvements (Error Handling, Multi Core, Boot loader Interaction)
  - RTE enhancement (Triggered Events, Integrity and Scaling at Ports, API Enhancement)
  - COM (LIN 2.1 Spec, FR 3.0 Spec, FlexRay ISO TP, XCP for ASR, Large Data Types, TCP/IP + DoIp, J1939Tp, TTCAN)
  - Functional (NM coordination, ASR Scheduler)
  - Conformance Test specifications (CT Specs, only Rev1 and Rev2, but not >Rev2)

- **AUTOSAR 3.2 Rev1 (2011-05)**
  - Partial Networking
  - Robustness Features (state manager modules)
  - Improvement of error handling (e.g. production vs. development errors)
  - Back-porting of AUTOSAR 4.0 features into AUTOSAR 3.2
    - Parts of the Safety Concept (E2E communication protection)
    - Extended CDD Concept
    - BSW Mode Manager
    - FlexRay ISO TP
Agenda

Motivation for AUTOSAR
AUTOSAR roadmap and history

- **Vector and AUTOSAR**
  - Advantages of MICROSAR
History/Facts

- **History**
  - AUTOSAR Premium Member since 2004
  - Support AUTOSAR 3 solution since 2008
  - Support AUTOSAR 4 solution since 2013

- **Facts**
  - Contribution in 16 work packages
  - More than 1500 person years of engineering invested
  - 1st delivery of AUTOSAR 3 BSW in Mar.2008 and 1st SOP in 2010
  - > 500 serial production projects
  - Most used solution in the world
  - More than 250 engineers are working on Vector AUTOSAR solution
Agenda

Motivation for AUTOSAR
AUTOSAR roadmap and history
Vector and AUTOSAR

» **Advantages of MICROSAR**
Advantages of MICROSAR

MICROSAR – The Vector Solution for AUTOSAR ECU Software

- MICROSAR Consists of RTE and Basic Software Modules
- Covers all aspects of the AUTOSAR Standard
- Many Extensions and Add-Ons.
Advantages of MICRO SAR

MICRO SAR Basic Software at a glance

Vector Standard Software

Available extensions for AUTOSAR
Advantages of MICROSAR

MICROSAR Basic Software at a glance

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<th>OS</th>
<th>SYS</th>
<th>DIAG</th>
<th>MEM</th>
<th>COM</th>
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<th>HSM</th>
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<td>vHm</td>
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1 Includes Adc, Eep, Fis, EthSw, Eth, LIn and Wdg
2 Functionality represented in EthTsyM and StdM
3 Different variants available
Advantages of MICROSAR

MICROSAR Basic Software Packages

<table>
<thead>
<tr>
<th>The MICROSAR Solution consists of packages that contain the BSW Modules</th>
<th>Content</th>
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<tbody>
<tr>
<td>MICROSAR MCAL</td>
<td>Driver for driving the microcontroller periphery</td>
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<tr>
<td>MICROSAR CAN</td>
<td>Basic software modules for CAN communication</td>
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<tr>
<td>MICROSAR COM</td>
<td>Basic software modules for network-independent communication and gateways</td>
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<tr>
<td>MICROSAR EXT</td>
<td>Driver for driving external chips</td>
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<tr>
<td>MICROSAR FR</td>
<td>Basic software modules for FlexRay communication</td>
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<td>MICROSAR DIAG</td>
<td>Basic software modules for diagnostics</td>
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<tr>
<td>MICROSAR IO</td>
<td>Interface between the microcontroller periphery and the application</td>
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<tr>
<td>MICROSAR AVB</td>
<td>Basic software modules for Audio/Video communication via Ethernet</td>
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<tr>
<td>MICROSAR AMD</td>
<td>Monitoring and debugging of application and MICROSAR BSW</td>
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</table>
Advantages of MICROSAR

Vector Product for Classic AUTOSAR

- Full range of AUTOSAR BSW modules
- Available for production use
- Available for AUTOSAR 4.x and 3.x
- Safety-relevant projects up to ASIL-D
- With security features according to AUTOSAR 4.3
- User-selectable configuration (pre-compile, link-time or post-build)
- Supports multiple ECUs for many platforms incl. multicore microcontrollers
Advantages of MICROSAR

Features Recently Developed

**MICROSAR4**

- BSW-Split Option
  - Allows Ethernet Stack to be mapped to a dedicated core
- Software Download (Over-the-air)
  - Allows flash image download at application runtime
  - Interaction with the Vector Bootloader for image activation
  - Solution available for several OEMs
- Security
  - AUTOSAR 4.3 Security Solution (incl. CSM, SECOC, CRYIF, CRYPTO)
  - Key- and Freshness Value Management available for all relevant OEMs
  - vHSM: execution of algorithm on a dedicated crypto core
- SOME/IP Transport Protocol
- Smart Charging
  - Protocol ISO15118 BPT (Bi-directional Power Transfer)
  - Protocol ISO15118 WPT (Wireless Power Transfer)
- ETH
  - support of QBV according IEEE802.1
  - support of RTP (Realtime Transport Protocol)
Features Under Development

MICROSAR4
- vHSM Firmware Update
- Mirroring according to AUTOSAR 4.4
  - CAN-CAN
  - CAN-LIN
- ETH: SJA1105Q SRP Brige (Stream Reservation Protocol)
- Optimized message routing in PduR
Advantages of MICROSAR

Features Coming Next

MICROSAR 4

- Secure communication using IPSec and IKIv2
- ECU authentication according to IEEE802.1x
- AUTOSAR 4.4 KeyM (certificate parsing)
Advantages of MICROsAR

AUTOSAR Workflow

Complete SW functionality of the vehicle is defined as a system of SWCs...

An extract is created for each ECU...

The ECU is configured based on the ECU Extract.
Advantages of MICROSAR

Complete tool chain for all phases of the development

System Design
- Architecture and Communication Design: PREEvision
- Diagnostics Design: CANdelaStudio

Application Software Development
- SWC Design: PREEvision, DaVinci Developer
- SWC Execution and Test: vVIRTUALtarget pro

ECU SW Integration
- BSW/RTE Configuration: DaVinci Configurator Pro
- Virtual Integration: vVIRTUALtarget basic

AUTOSAR ECU/System
- System Design
- Application Software Development
- ECU SW Integration
- System Verification

System Verification
- ECU Calibration: CANape
- Verification of Network Communication and Diagnostic Behavior: CANoe & CANoe.DiVa

Application Software Verification
- SWC Verification within Real ECU: CANoe & VT System
- SWC Verification in Virtual Environment: vVIRTUALtarget pro

AUTOSAR ECU
- Basic Software (BSW)
- RTE

ECU SW Verification
- ECU Monitoring and Debugging: CANoe.AMD
Advantages of MICROSAR

Workflow for ECU development

- **DaVinci Configurator Pro**
- **BSW/RTE Configuration, SWC Integration**
- **ECU-EX**
- **SWC Design, SWC Integration**
- **SYS-EX**
- **ECU-C**
- **GEN. Code Files**
- **Report Files**
- **Static Code Files**
- **MICROSAR or custom modules**
- **bswmd**
- **Code Generation**
- **da Vinci Tools**
- **Input Files**
  - **PREE vision**
  - **CANdel Studio**
  - **Legacy Files**
  - **arxml**
- **Project Setup and Update**
- **Output Files**
  - **Report Files**

For more information about Vector and our products please visit

www.vector.com

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