AUTOSAR Introduction
The vision, the partnership and current features in a nutshell

09 Apr 2020
Agenda

- Introduction of the AUTOSAR Partnership
- Challenges in the automotive industry
- Architecture and recent features
- Smart solutions based on AUTOSAR
- Processes and quality
- Outlook
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AUTOSAR Introduction

(AUTomotive Open System ARchitecture)

is a worldwide development partnership of car manufacturers, suppliers and other companies from the electronics, semiconductor and software industry.
AUTOSAR aims to improve complexity management of integrated E/E architectures through increased reuse and exchangeability of SW modules between OEMs and suppliers.
Aims and benefits of using AUTOSAR

AUTOSAR aims to standardize the software architecture of Electronic Control Units (ECUs). AUTOSAR paves the way for innovative electronic systems that further improve performance, safety and security.

- Hardware and software – widely independent of each other.
- Development can be decoupled (through abstraction) by horizontal layers, reducing development time and costs.
- Reuse of software enhances quality and efficiency
Exploitation of the standard provides significant benefits

- Establish development distribution among suppliers
- Compete on innovative functions with increased design flexibility
- Simplify software and system integration
- Reduce overall software development costs

An industry standard is established.
Exploitation of the standard provides significant benefits

An industry standard is established.

- Enable more efficient variant handling
- Reuse software modules across OEMs
- Increase efficiency of application development
- Invent new business models
Exploitation of the standard provides significant benefits

- Interface with development processes
- Embed tools into an overall tool environment

An industry standard is established.

- OEM
- Supplier
- Tool provider
- New market entrant
Exploitation of the standard provides significant benefits

- Enable new business models by means of standardized interfaces
- Easily understand how automotive software is developed

An industry standard is established.

- OEM
- Supplier
- Tool provider
- New market entrant
### The 283 AUTOSAR Partners

<table>
<thead>
<tr>
<th>Category</th>
<th>Partners</th>
</tr>
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<tbody>
<tr>
<td><strong>2 Strategic Partners</strong></td>
<td></td>
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<tr>
<td>BMW Group</td>
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<td>BOSCH</td>
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<td>Continental</td>
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<td>Ford</td>
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<td>DAIMLER</td>
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<td>PSA</td>
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<td>GM</td>
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<td>TOYOTA</td>
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<td>VOLKSWAGEN AG</td>
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<tr>
<td><strong>9 Core Partners</strong></td>
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<tr>
<td><strong>58 Premium Partners</strong></td>
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<td>General OEM</td>
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<td>VOLVO</td>
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<td>HONDA</td>
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<td>TATA MOTORS</td>
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<td>RENAULT</td>
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<td>HYUNDAI</td>
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<td>GREAT WALL</td>
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<td><strong>Generic Tier 1</strong></td>
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<td>Autoliv</td>
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<tr>
<td>Continental</td>
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<td>HELLA</td>
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<td>dSPACE</td>
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<tr>
<td>JTEKT</td>
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<tr>
<td>LEAR</td>
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<td>items</td>
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<td><strong>Standard Software</strong></td>
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<td>Mentor</td>
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<td>MathWorks</td>
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<td>KIT</td>
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<td>SOL</td>
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<td>VECTOR</td>
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<td>LUXSOFT</td>
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<td>wind</td>
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<tr>
<td><strong>Tools and Services</strong></td>
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<td>ETRI</td>
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<td>Fraunhofer</td>
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<td><strong>Semiconductors</strong></td>
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<td>IBM</td>
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<td>VECTOR</td>
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<td>LUXSOFT</td>
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<td>wind</td>
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</tr>
<tr>
<td><strong>134 Associate Partners</strong></td>
<td></td>
</tr>
<tr>
<td><strong>49 Development Partners</strong></td>
<td></td>
</tr>
<tr>
<td><strong>12 of 64</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>09 Apr 2020</strong></td>
</tr>
<tr>
<td>AUTOSAR Introduction</td>
<td></td>
</tr>
</tbody>
</table>

**134 Associate Partners**

**28 Attendees**
History and current state – Total: 283
Geographical distribution of partners

Europe: 137
- Core: 6
- Strategic: 0
- Premium: 26
- Development: 30
- Associate: 56
- Attendee: 19

North America: 35
- Core: 2
- Strategic: 0
- Premium: 6
- Development: 4
- Associate: 23
- Attendee: 0

Asia: 109
- Core: 1
- Strategic: 2
- Premium: 22
- Development: 15
- Associate: 67
- Attendee: 2

Africa: 2
- Core: 0
- Strategic: 0
- Premium: 0
- Development: 2
- Associate: 0
- Attendee: 0
User Group Structure

- **UG-CN (China)**
  - Demonstrator development
  - BSW integration

- **UG-NA (North America)**
  - Common Training: OEM-Tier1 Workflows/ Security
  - Safety
  - Ethernet

- **UG-IE (Improved Exploitation)**
  - 6 thesis on optimizing the use of AUTOSAR
  - Establishment of Adaptive Platform

09 Apr 2020
# Groups, Boards and Task Forces

<table>
<thead>
<tr>
<th>Group</th>
<th>Type</th>
<th>Initiated by</th>
<th>Main Tasks</th>
<th>Coaching</th>
<th>Contact person</th>
<th>Reporting to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead WG</td>
<td>Permanent</td>
<td>PL Team</td>
<td>- Technical supervision of WGs and concept groups</td>
<td>PL Coach</td>
<td>WG Speaker</td>
<td>PL Team</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Harmonization of technical content</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Assignment of concepts to WGs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WG</td>
<td>Permanent</td>
<td>PL Team</td>
<td>- Expert statements</td>
<td>PL Coach</td>
<td>WG Speaker</td>
<td>PL Team</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Responsibility for documents and code development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Assessment of concepts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subgroup</td>
<td>Permanent</td>
<td>WG</td>
<td>WG substructure for a dedicated branch of WG content</td>
<td>-</td>
<td>Subgroup Speaker</td>
<td>WG</td>
</tr>
<tr>
<td>Control Board</td>
<td>Permanent</td>
<td>PL Team</td>
<td>Controlling task within AUTOSAR processes (e.g., CM, QM, SDE or RM) such</td>
<td>PL Team</td>
<td>CM, QM or RM</td>
<td>CM, QM or RM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>as CCB, CF-CBB and OSS-CB</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Concept Group</td>
<td>On demand</td>
<td>CP/SP/PP/DP</td>
<td>Creation and processing of a concept or a set of concepts according to concept process</td>
<td>-</td>
<td>Concept Owner(s)</td>
<td>Lead WG, WG, PL Team; cf. concept handling process</td>
</tr>
<tr>
<td></td>
<td>(project-based)</td>
<td></td>
<td>Responsibility for concept validation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Force</td>
<td>On demand</td>
<td>WG or PL Team</td>
<td>Dedicated task with defined due date</td>
<td>-</td>
<td>TF Speaker</td>
<td>WG or PL Team</td>
</tr>
<tr>
<td></td>
<td>(project-based)</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>UG</td>
<td>On demand</td>
<td>PP/DP/AP</td>
<td>Creation of documents or implementations based on existing releases</td>
<td>PL or SC Team</td>
<td>UG Speaker</td>
<td>PL-Team</td>
</tr>
<tr>
<td></td>
<td>(project-based)</td>
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</tbody>
</table>
AUTOSAR Deliverables

Legend
- Released as an own standard
- Released as part of the standard it is extending
- A extends B
- A planned to extend B
Challenges – selected main drivers

- Highly automated driving
Challenges – selected main drivers

- Car-2-X applications
- Internet of Things and cloud services
Challenges – selected main drivers

- Increasing data rates
Challenges – selected main drivers

- New processor technologies
Challenges – selected main drivers

- Trust
Challenges – Driving changes in E/E Architectures

New types of in vehicle computers are required to fulfill the needs of
• performance,
• flexibility and
• connectivity

But
• backwards compatibility with existing solutions,
• fulfillment of increasing requirements for safety and security
is a must as well.
AUTOSAR’s answer to the upcoming challenges

<table>
<thead>
<tr>
<th>Real time Requirements</th>
<th>High, in the range of micro-sec</th>
<th>Mid, in the range of milli-sec</th>
<th>Low, in the range of sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Criticality</td>
<td>High, up to ASIL-D</td>
<td>High, at least ASIL-B</td>
<td>Low, QM</td>
</tr>
<tr>
<td>Computing power</td>
<td>Low, ~ 1000 DMIPs</td>
<td>High, &gt; 20,000 DMIPs</td>
<td>High, ~ 10,000 DMIPs</td>
</tr>
</tbody>
</table>
AUTOAR Adaptive Platform

The 3 Pillars of the Adaptive Platform …

I – Safe & Secure

- external communication
- in-vehicle communication
- platform services
  - SecOC
  - IPsec
  - process separation
  - crypto
  - IAM
  - failure handling
  - safe data storage
  - supervision
  - exception-less APIs
  - resource budgeting

II – Connected

- Service-Oriented Communication
  - SOM/IP
  - ComM
  - REST

III – Dynamic & Updateable

- Cloud
- App Development

... are the prerequisite for ADAS applications
Strengthen and Extend Pillars of AUTOSAR

**AUTOSAR USP**

Strengthen Safety & Security
- Support standard failure and attack scenarios
- Extend test and verification
- Improve processes

Strengthen connectivity
- Extend standard cloud services
- Think about AUTOSAR App store
- Enable connectivity to smart phones and zone ECU's

Develop flexible updates during life time
- Improve modularity e.g. define cluster interfaces
- Provide means for system description
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AUTOSAR in a Vehicle Network
AUTOSAR Foundation
Common Features

The Foundation **assures compatibility** of the different AUTOSAR standards and therefore **contains** all **common artifacts** such as …
AUTOSAR Foundation
The Methodology, derived out of the Meta Model, ...

... provides means to describe the AUTOSAR architecture with all its interfaces
... defines exchange formats and description templates (e.g. manifest) to enable
  • a seamless integration of the complete vehicle E/E architecture,
  • the automatized configuration of the µC- and µP-software stacks and
  • the seamless integration of application software
... supports means to ensure safety and security of the system
... provides templates to document the standard
The layered architecture of the classic platform basically supports:

- Hardware abstraction
- Scheduling of runnables and tasks (OS)
- Communication between applications on the same hardware and over the network
- Diagnosis and diagnostic services
- Safety- and Security Services
<table>
<thead>
<tr>
<th>Microcontroller</th>
<th>System Services</th>
<th>Memory Services</th>
<th>Crypto Services</th>
<th>Off-board Communication Services</th>
<th>Communication Services</th>
<th>I/O HW Abstraction</th>
<th>Complex Drivers</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Onboard Device Abstraction</td>
<td>Memory HW Abstraction</td>
<td>Crypto HW Abstraction</td>
<td>Wireless Communication HW Abstraction</td>
<td>Communication HW Abstraction</td>
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<tr>
<td></td>
<td>Microcontroller Drivers</td>
<td>Memory Drivers</td>
<td>Crypto Drivers</td>
<td>Wireless Communication Drivers</td>
<td>Communication Services</td>
<td></td>
<td>I/O Drivers</td>
</tr>
</tbody>
</table>
AUTOSAR Adaptive Platform

Logical view

User Applications

- Adaptive Application
- Adaptive Application
- Adaptive Application
- Adaptive Application
- ASW::XYZ Non-PF Service
- ASW::XYZ Non-PF Service

Legend

- SERVICE Non-PF Service
- SERVICE Func. Cluster
- API Func. Cluster

- IPC (local)
- DDS
- POSIX / C++ STL

- ara::com
  Communication Mgmt.
- ara::rest
  RESTful
- ara::per
  Persistency
- ara::core
  Core Types

- ara::exec
  Execution Mgmt.
- ara::iam
  Identity Access Mgmt.
- POSIX / C++ STL
  Operating System

- ara::crypto
  Cryptography
- ara::adi
  Automated Driving Interfaces
- ara::nm
  Network Management
- ara::ucm
  Update and Configuration Management

- ara::time
  Time Synchronization
- ara::phm
  Platform Health Mgmt.
- ara::state
  State Management
- ara::diag
  Diagnostics

- ara::s2s
  Signal to Service Mapping
- ara::nm
  Network Management

- (Virtual) Machine / Container / Hardware
AUTOSAR AP and CP Features

Release R18-10
26 Nov 2018

Release R19-03
29 Mar 2019
Stabilization

Release R19-11
29 Nov 2019

Demo Release R19-11
27 Mar 2020

Release R20-11
27 Nov 2020

Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
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**Software Architecture – AUTOSAR Defined Interfaces**

**Use Case ‘Front Light Management’: Exchange Type of Front Light**
Use Case ‘Front Light Management’: Exchange Type of Front Light

Software Architecture – AUTOSAR Defined Interfaces

- SwitchEvent check_switch()
- Switch_event (event)

- LightRequest
  - switch_event (event)
  - request_light (type, mode)

- Front-Light Manager
  - request_light (type, mode)
  - get_keyposition()
  - set_light (type, mode)
  - set_dboard(type, mode)

- Xenonlight
  - set_light (type, mode)
  - set_current (…)

- AUTOSAR Interface
- Standardized Interface
- Operating System
- Std. AUTOSAR Interface
- Services
- Std. Interface

- ECU Abstraction
- Std. Interface

- Microcontroller Abstraction
- DIO

- CAN Driver

- Silicon Vendor A
- Supplier A
- ECU-Hardware
- Supplier B
- OEM
- AUTOSAR Interface

- AUTOSAR PTF
- Integrator
- Supplier B
- AUTOSAR Interface

- AUTOSAR Introduction | 09 Apr 2020 | 50 of 64
## Distribution ECUs

<table>
<thead>
<tr>
<th>SwitchEvent</th>
<th>LightRequest</th>
<th>Front-Light Manager</th>
<th>Xenonlight</th>
</tr>
</thead>
<tbody>
<tr>
<td>switch_event(event)</td>
<td>request_light(type, mode)</td>
<td>request_light(type, mode)</td>
<td>set_light(type, mode)</td>
</tr>
<tr>
<td>AUTOSAR Int.</td>
<td>AUTOSAR Interface</td>
<td>AUTOSAR Interface</td>
<td>AUTOSAR Interface</td>
</tr>
</tbody>
</table>
Distribution on ECUs – ‘Front-Light Management’

SwitchEvent
check_switch()
switch_event(event)

LightRequest
switch_event(event)
request_light(type, mode)

Front-Light Manager
request_light(type, mode)
get_keyposition()
set_light(type, mode)

Xenonlight
set_light(type, mode)
set_current(…)

CAN Bus

AUTOSAR Interface

AUTOSAR Int.
AUTOSAR Platform Application
Continuous improvement cycle for ADAS systems

On Board
- Scene Understanding
- Sensor Fusion
- Perception

Mission and Trajectory Planning

Plan Execution, Motion Control

Off Board

Secure data exchange on top of
DDS
SOME/IP or
REST

Labeling of trained data

Evolution by training

Simulation and sign-off

ara:adi

ara:com

✓
AUTOSAR Platform Application

User Applications

- ara::exec: Execution Mgmt.
  - ara::com: Communication Mgmt.
  - ara::rest: RESTful
  - ara::time: Time Synchronization
  - ara::per: Persistency
  - ara::plm: Platform Health Mgmt.
  - ara::core: Core Types
  - ara::idm: Identity Access Mgmt.
  - ara::log: Logging & Tracing
  - ara::crypto: Cryptography

(a) Run Execution Manager

```
ara::exec > start { Vehicle Manager }
The operation completed successfully

ara::exec > start { HMI }
The operation completed successfully

ara::exec > start { Distance Radar }
The operation completed successfully
```

(Virtual) Machine / Container / Hardware
Adaptive Cruise Control (ACC) install

User Applications

- ara::com Communication Mgmt.
- ara::rest RESTful
- ara::time Time Synchronization
- ara::per Persistency
- ara::exec Execution Mgmt.
- ara::iam Identity Access Mgmt.
- ara::log Logging & Tracing

- ara::sat service State Management
- ara::diag service Diagnostics
- ara::ad service Automated Driving Interfaces

Key-Value Database:
- Vehicle Manager
- HMI
- Distance Radar
- ACC

AROS Runtime for Adaptive Applications (ARA)

(Virtual) Machine / Container / Hardware

>> Run Persistency
... ...
... ...
... ara:: per > install new application software from ara:: ucm service (ACC)
Ara:: per > deploy persistent data to Key-Value Database:
> Vehicle Manager
> HMI
> Distance Radar
> ACC
User Applications

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ara::com</td>
<td>Communication Mgmt.</td>
</tr>
<tr>
<td>ara::rest</td>
<td>RESTful</td>
</tr>
<tr>
<td>ara::time</td>
<td>Time Synchronization</td>
</tr>
<tr>
<td>ara::pm</td>
<td>Platform Health Mgmt.</td>
</tr>
<tr>
<td>ara::exec</td>
<td>Execution Mgmt.</td>
</tr>
<tr>
<td>ara::core</td>
<td>Core Types</td>
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<tr>
<td>ara::iam</td>
<td>Identity Access Mgmt.</td>
</tr>
<tr>
<td>ara::log</td>
<td>Logging &amp; Tracing</td>
</tr>
<tr>
<td>ara::crypto</td>
<td>Cryptography</td>
</tr>
<tr>
<td>ara::ucm</td>
<td>Update and Configuration Management</td>
</tr>
</tbody>
</table>

Run Execution Manager

- `ara::exec start { Vehicle Manager }`
  The operation completed successfully
- `ara::exec start { HMI }`
  The operation completed successfully
- `ara::exec start { Distance Radar }`
  The operation completed successfully
- `ara::exec start { ACC }`
  The operation completed successfully

(Virtual) Machine / Container / Hardware

User Applications

- HMI
- Vehicle Manager
- ACC
- Distance Radar

AUTOSAR Runtime for Applications (ARA)
### Vehicle Manager
- **Communication Mgmt.**
  - `ara::com`

### HMI
- **RESTful**
- **Time Synchronization**
- **Persistency**
- **Platform Health Mgmt.**
- **Execution Mgmt.**
- **Identity Access Mgmt.**
- **Logging & Tracing**

### Distance Radar
- **State Management**
- **Diagnostics**
- **Service Network Management**
- **Signal to Service Mapping**

### ACC
- **Update and Configuration Management**

The AUTOSAR Runtime for Adaptive Applications (ARA) provides a framework for developing and deploying vehicle software applications.

**Operating System**
- POSIX PSE51 / C++ STL

**Cryptography**
- `ara::crypto`

**Virtual Machine / Container / Hardware**
- **ACC**
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AUTOSAR Adaptive Platform development approach

**Specification**

Identify needs & use-cases:
1) Concepts
2) Features
3) Requirements

**Implementation**

Gain speed:
1) Spec validation
2) Reduce room for spec interpretation
3) Training / dissemination of AP

Attracting environment for coders:
- Appealing technology (C++, Yocto, Git, …)
- Modern use case (ADAS EBA)
- Handy documentation (Wiki)
- Peer programming sessions

**Demonstration**

Gain trust:
1) Advertises the progress
2) Highlights some specific features

Show AUTOSAR interoperability
- of classic and adaptive platforms
- but also with others

Best tradeoff between commercial cooperation & compatibility between different vendors
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Timeline to full automation

AUTOSAR – a faithful ADAS companion

Automated Driving

Level 5: full automation

Level 4: highly automated driving

Level 3: Conditional automation

New Features, planning in progress

2018 2019 2020 2021 2022 2023 2024 2025 2026