Using the AUTOSAR and Functional Mockup Standard in the Development Process
Agenda

- Company
- Virtualization in the Development Process
- AUTOSAR and FMI (Functional Mockup Interface) Standard
- Solution Examples for AUTOSAR and FMI
- Summary
“With our solutions and services, we increase quality and efficiency for the development and maintenance of embedded systems.”

ETAS – Driving Embedded Excellence

- Founded 1994
- Shareholder 100 % Robert Bosch GmbH
- Headquarters Stuttgart, Germany
  18 additional offices worldwide

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<th>Asia-Pacific</th>
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<td>505 employees</td>
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ETAS solutions support all steps of ECU software development
Portfolio Examples

Accelerate your calibration, e.g. with INCA for ECU development, test, and calibration of electronic control systems in the vehicle, on the test bench, or on the PC.

Provide a production real-time operating system RTA and an AUTOSAR-RTE suitable for applications in all areas of automotive ECU design.

With the acquisition of ESCRYP, ETAS offers a unique combination of embedded security and embedded software safety competencies.
Motivation: cross-domain system design

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- **virtual prototyping of cross-domain functions**
- **verification & validation of behavior**
- **parameterization & calibration**

Drivers: Electrification, Driver Assistance, ...
Motivation: combine system and component design

- Shorter learning cycles between design & validation require integrated support from virtual systems until target ECU validation
- Lower integration, validation & calibration cost
- System understanding for all developers

Source: GM
Virtualization in the Development Process

Virtualization means the execution of development steps within a partially or completely simulated environment.

Core to virtualization are

- *models* (functions, plant, driver, environment) and

- their *management*, e.g. variants, IP protection, traceability

Virtualization has to master the combination of modeling, integration, and simulation based on standards.
Relevant standards:

1. **AUTOSAR**
   - Software components and their communication (≈ “controller”) in and between ECUs (Electronic Control Units)

2. **Functional Mockup Interface (FMI)**
   - Embedding controls in the system

AUTOSAR and FMI are
   - independent from each other
   - complement each other

➔ Avoid coupling of plant and controls via AUTOSAR
Characteristics of the AUTOSAR Integration ETAS Virtual ECU (EVE)

- Generation of AUTOSAR SW components
- Configuration of virtual ECUs
- Test of the Implementation and behavior validation of the virtual ECU
- Fast round-trip engineering
Solution Examples
Solution Examples

**Functional Mockup Interface Standard (FMI)**

- Exchange and co-simulation of models
- Validation via several "proof of concept" applications
- Supported by different tool vendors
- Free access to the specification, including examples

→ FMI is the only open accessable interface to connect plant and control

Modelica Association Project

[www.fmi-standard.org](http://www.fmi-standard.org)
- Import ETAS ASCET models into DS 3D Experience *Smart Safe & Connected*, using the FMI standard, run a system simulation with 3D visualization

- Traceability of ETAS Requirements over Requirements – Functionality – Logic – Physical (RFLP) stages – and tests

- Next step: Access 3D Experience models from the ETAS Functional Mockup integrator and run a system simulation using virtual ECUs (ISOLAR-EVE)
Solution Examples

Multi I/O FMUs

Dymola FMUs

ISOLAR-EVE FMU*)

Generators  Integration  Simulation  Visualization

Access 3D Experience from ETAS Multi-Domain Mockup Integrator

*) FMU: Functional Mockup Unit

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Controller Optimization

MiL
- Parameterization
- Time-triggered
- Event-triggered
- FMUs from different tools (ASCET, Dymola)
- Variable and fixed-step solvers

SiL
- Closed-loop validation: ECU SW and plant models
- Virtual calibration
- Test and validation of production code
- Test and validation of AUTOSAR-specific configurations
Solution Examples

Characteristics

- Scaling from single to multi ECUs
- Across MiL, SiL, HiL
- Repository access, e.g. PLM
- Access from many clients
- Standards
- Data Analytics

Standard-based integration platform for complex systems

- System-(Co-)-Design
- Parameterization
- Test & Validation
Virtualization shortens the learning cycles and increases the productivity in the development of embedded systems.

ETAS offers integrated products and services from virtual system simulation and validation towards embedded SW testing and calibration.

Both FMI and AUTOSAR standards are actively supported by ETAS.

- Seamless transitions between systems and embedded software engineering.
- Agile development processes, allowing shorter learning cycles.
- Lower integration, validation & calibration cost.
- Better system resource utilization & performance.
Stay real, start virtual