Development of Chassis Software Components with Virtual Prototypes
QTronic User Conference 2019, Berlin, December 2, 2019

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Agenda

› Motivation & Project Goals
› Simulation Environment
  › E/E Architecture
  › Virtual ECUs
› Vehicle Model
› Features of the Co-Simulation Setup
› Summary
Challenges in the New EV Project at AUDI

Vehicle Project

› Drastic Reduction of Prototype Vehicles
› New E/E Architecture
› Collaboration with Tier-1 Suppliers
› Tight Schedule
Challenges in the New EV Project at AUDI

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→ Demand for more „Virtual Development“

Challenges for Simulation Architecture
› Integration of several vECU into the simulation environment
› Availability throughout the entire development process

Challenges for Simulation Usability
› Many new users that didn’t use simulations before
› Simulations on Office PC Hardware
The existing Tool Chain didn’t meet the requirements

Attempts to build an entire vECU failed ❌
› Too many signals in the bus
› Long build time

Usability for “normal” developers not attractive ❌
› Considered too specialized for common use
› Parametrization with standard MCD file formats not possible

CarMaker Vehicle Model considered fit for further use ✔
› Large model library already available
› CM Models in use on HIL test beds
› Simulation environment easy to use

Demand for a new SiL Tool Chain
Goals for the New SiL Tool Chain

- Flexible Simulation Environment
- Standards for Modelling and Validation
- Synchronization with Vehicle Milestones
- Synergies between Simulation Use Cases
Requirements to the Tool Chain from the E/E Architecture

Chassis Components are „smart actuators“ coordinated by central ECU (HCP)
› Simulation of several vECU necessary
› Distributed functions require consideration of timing

Extensive vECU Interface
› Many Busses (e.g. Flexray, CAN_FD, Ethernet, ...)
› Electric I/O (Damper Control, Sensors, ...)
› Physical properties (acceleration,...)

vECU provided by Suppliers
› Cooperation with suppliers and QTronic support to create Silver vECU
› Integration of FMU
Build of the vECU with SILVER

Integration of ASW and BSW Functions
› SWC provided as x86 libs from different Volkswagen brands and suppliers
› Generation of RTE with Silver RTE-Gen
› Generation of FlexRay and CAN_FD bus interface

Custom Additions (provided as C-Code)
› Mapping of Ethernet signals
› Simple hardware abstraction

Process Integration of vECU Build
› Generation of vECU for every SW release
› Automation of the vECU build via Jenkins
Integration of the Vehicle Components with IPG CarMaker

- The vehicle model must provide all sensors signals and actors
- Modelling process is linked to the vehicle development process
- Extensive validation is required to ensure sufficient quality

→ Usage of the Carmaker vehicle model with custom plugins
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→ Usage of the Carmaker vehicle model with custom plugins
Overview of the Co-Simulation Tool Chain

- Co-Simulation easy to set up

Vehicle Model
IPG CarMaker / CarMaker 4 Simulink

- Parametrization of Vehicle Model
- Definition of scenario and driver
- Integration of plug-ins

HCP vECU
QTronic SILVER

- HCP vECU
- Rest-Bus Model
- Supplier vECU (FMU, Silver)
Overview of the Co-Simulation Tool Chain

- Co-Simulation easy to set up
- Bypass very useful, saves time

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**Model-Based Function Development**
Matlab/Simulink

- Development of functions in Targetlink
- No need for building of a new vECU

**Bypass**
Co-Sim. TCP/IP
Overview of the Co-Simulation Tool Chain

- Co-Simulation easy to set up
- Bypass very useful, saves time
- Possibility to use existing file formats and layouts
- Tool Chain accepted by “non-simulation engineers"

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**Measurement & Calibration**
e.g. Canape
- Re-use of existing measurement layouts for calibration
- Direct access to calibration parameters via A2L

**Co-Sim.**
TCP/IP

**Bypass**

**Master**

**XCP-SimTime**

**.mdf**

**.dcm**
The Silver / CarMaker Tool Chain meets (most of) the User’s Requirements...

› The new E/E architecture required a new SIL environment for SW development and testing
› The vECU Build is integrated in the SW build process to minimize effort
› The process to parametrize the IPG Carmaker Vehicle model has been successfully validated and is integrated in the virtual development process at Audi
› The good usability of the tool chain enables “normal” developers to use simulation as a tool → Usage of “virtual development” methods in many use cases
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...so everything is perfect?

- The Co-Simulation Environment has some performance issues, that need to be worked on
- For full synergies, vECU should be usable on HIL test beds (currently not possible)
Thank you for your attention!

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