Development of Chassis Software Components with Virtual Prototypes

QTronic User Conference 2019, Berlin, December 2, 2019

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AUDI AG

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Agenda

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

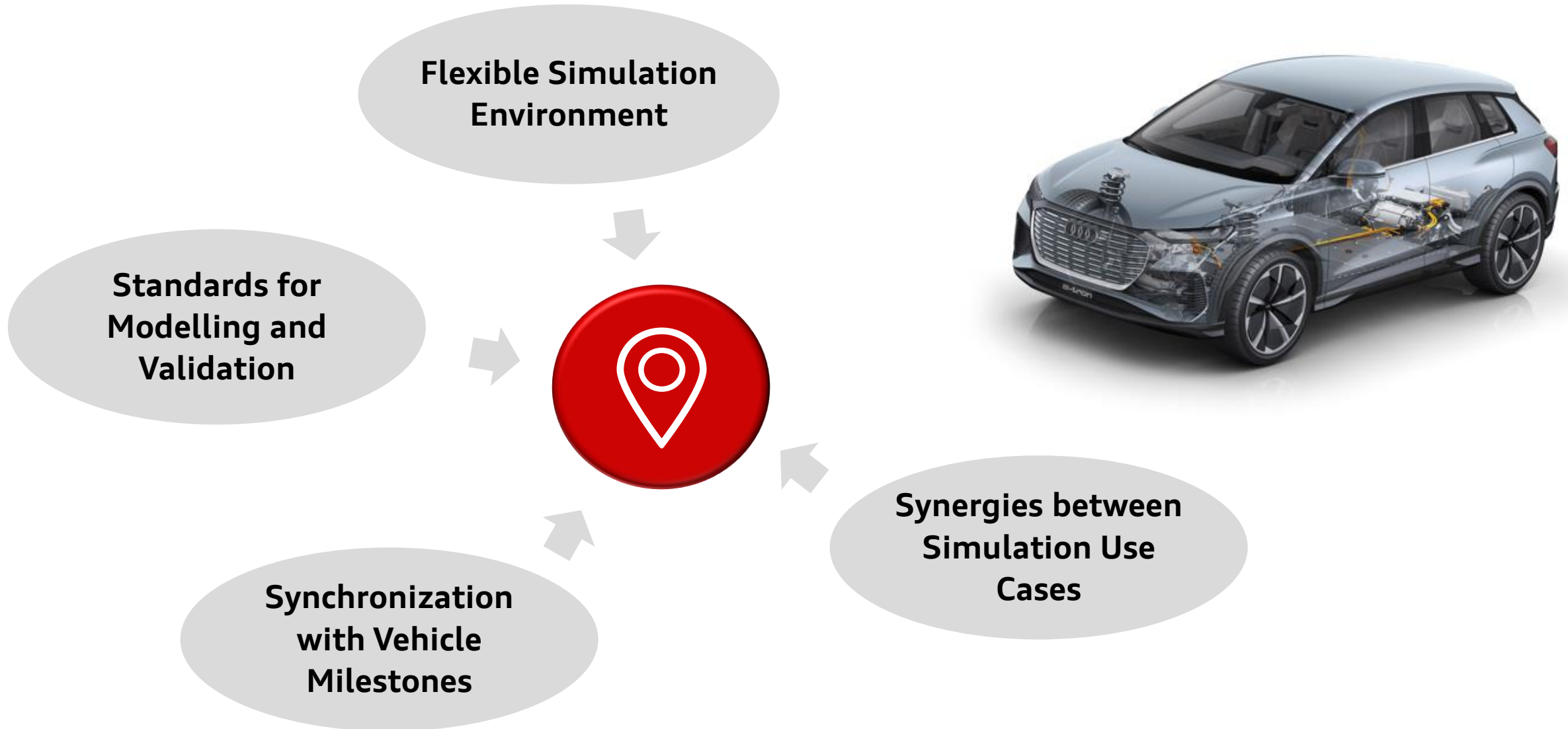› Parametrization with standard MCD file formats not possible

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

Synergies between Simulation Use Cases

Synchronization with Vehicle Milestones

Requirements to the Tool Chain from the E/E Architecture

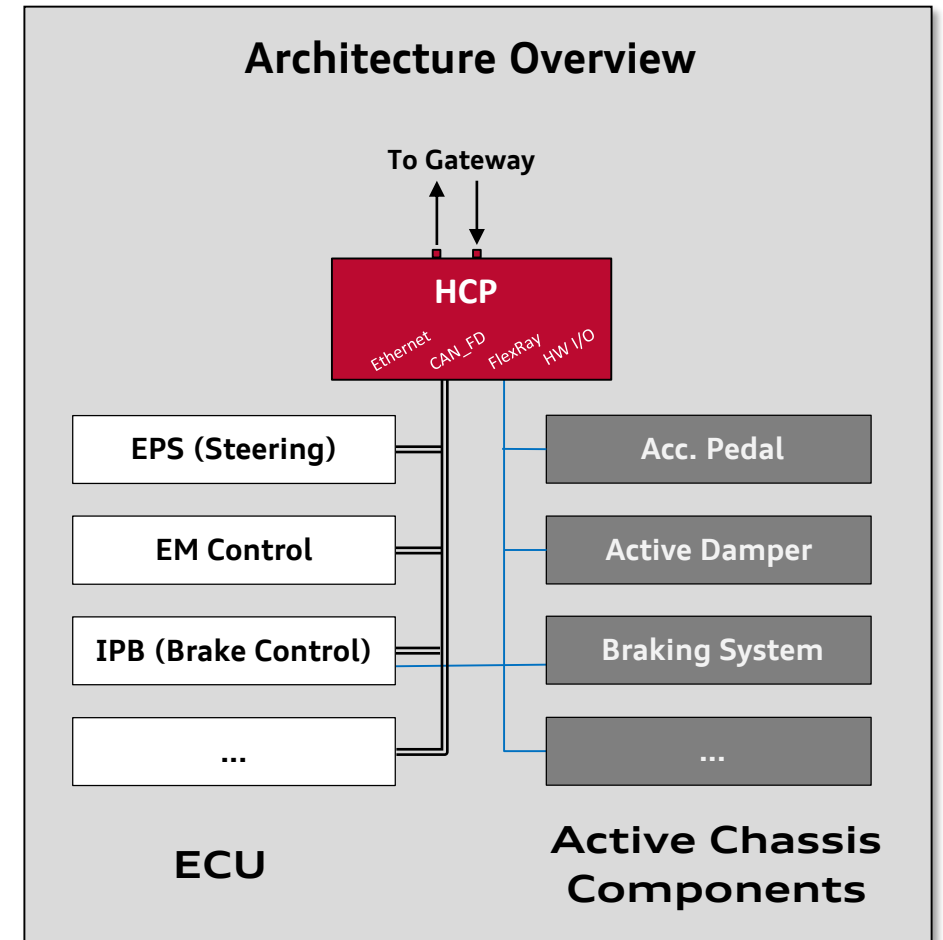**Chassis Components are „smart actuators" coordinated by central ECU (HCP)**

› 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

Architecture Overview

To Gateway

HCP

Ethernet   CAN_FD   FlexRay   HW I/O

EPS (Steering)

EM Control

IPB (Brake Control)

…

Acc. Pedal

Active Damper

Braking System

…

ECU

Active Chassis Components

# 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)

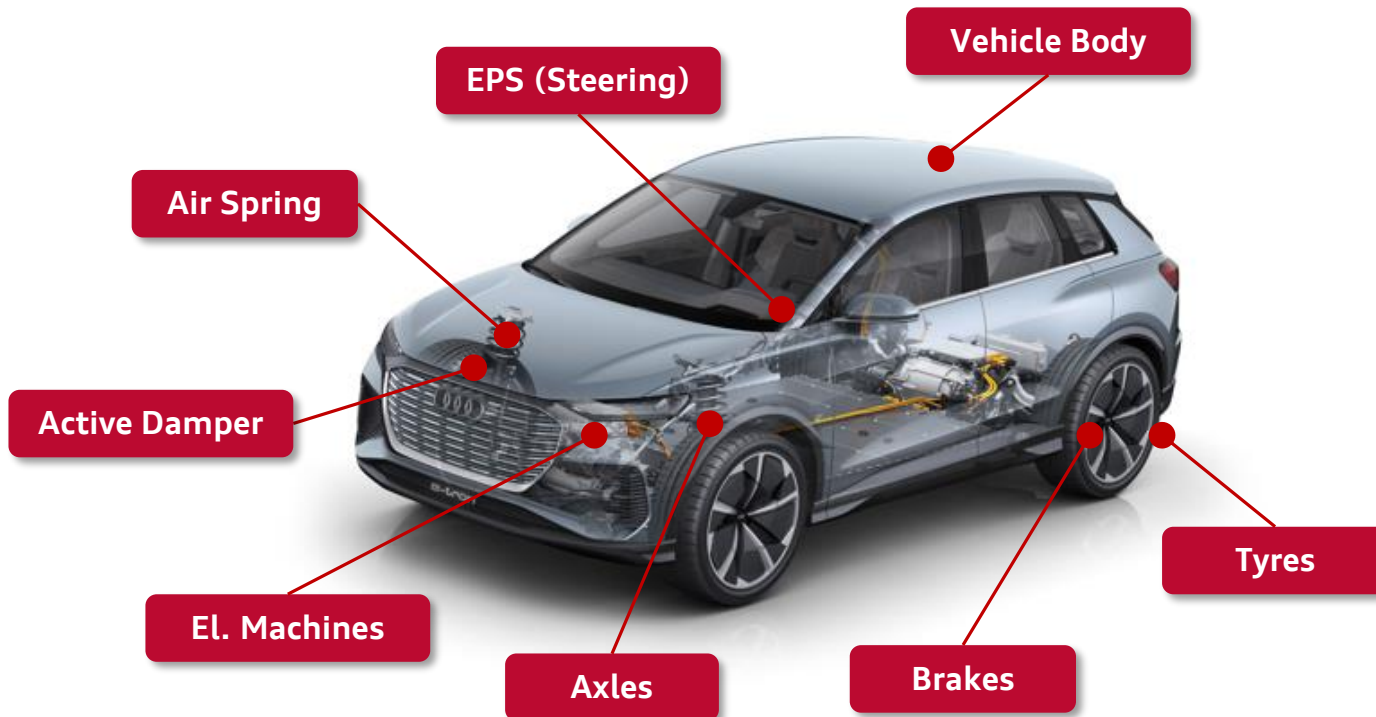› Mapping of Ethernet signals

› Simple hardware abstraction

Process Integration of vECU Build

› Generation of vECU for every SW release

› Automation of the vECU build via Jenkins
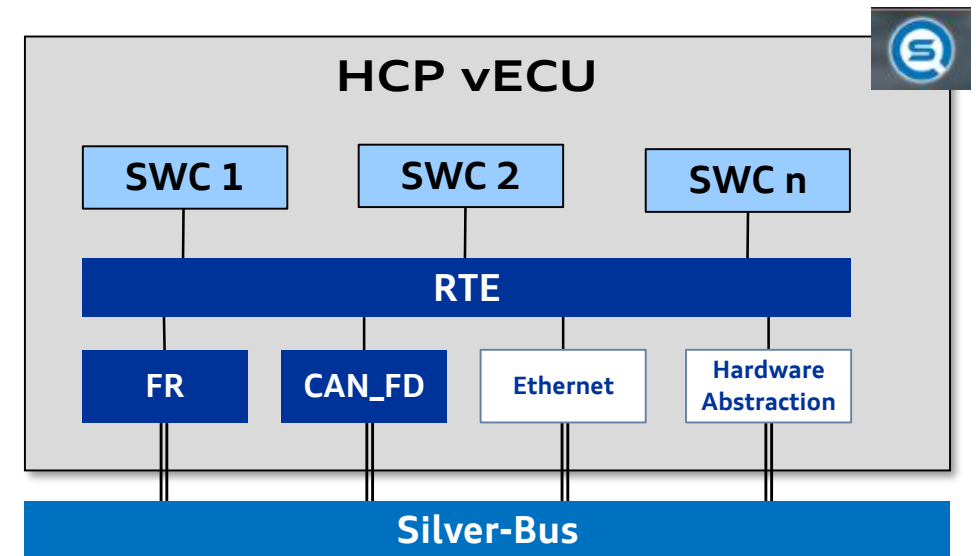
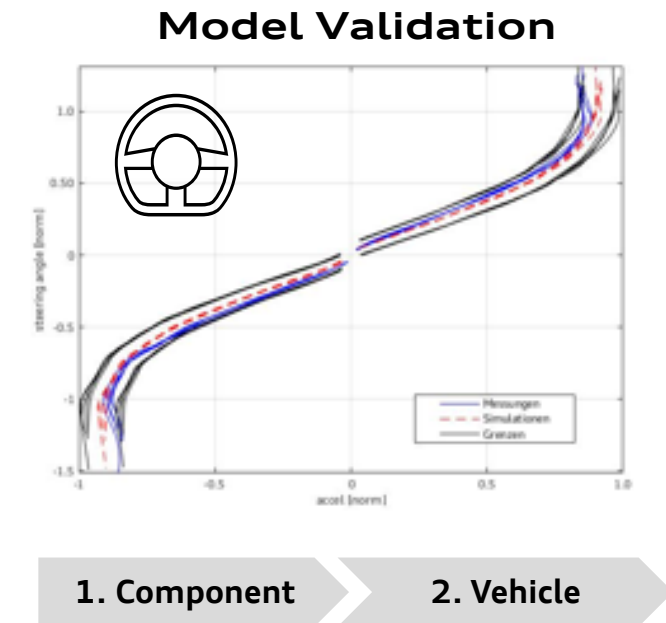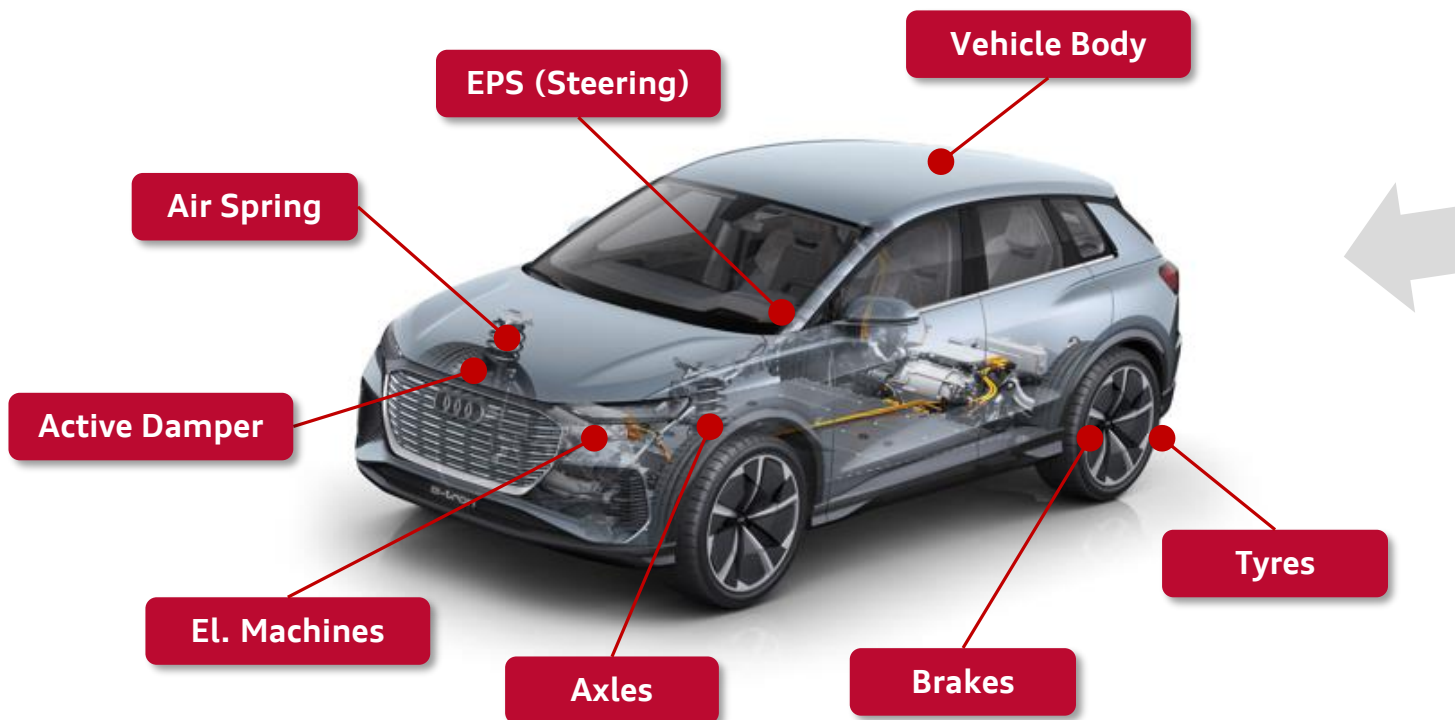# Integration of the Vehicle Components with IPG CarMaker

› 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**

Integration of the Vehicle Components with IPG CarMaker

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→ **Usage of the Carmaker vehicle model with custom plugins**

EPS (Steering)

Vehicle Body

Air Spring

Active Damper

El. Machines

Axles

Brakes

Tyres
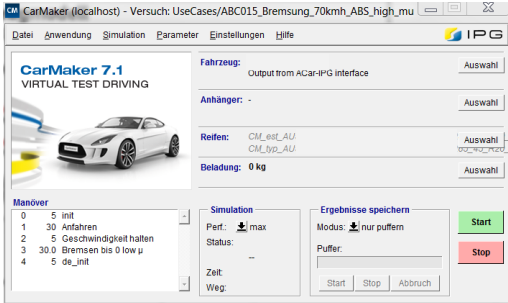
Model Validation

1. Component   2. Vehicle

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

Master

HCP vECU
QTronic SILVER

› HCP vECU
› Rest-Bus Model
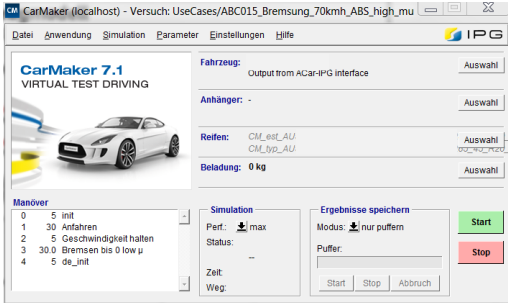› Supplier vECU (FMU, Silver)

Co.-Sim.
TCP/IP

Overview of the Co-Simulation Tool Chain

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› Bypass very useful, saves time

Model-Based Function Development
Matlab/Simulink

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

Bypass

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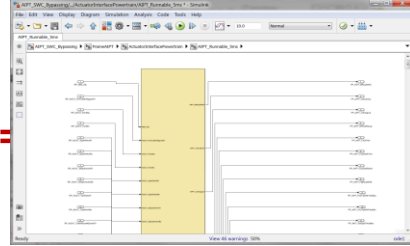**Master**

HCP vECU
QTronic SILVER

› HCP vECU
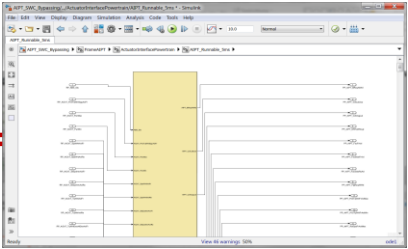› Rest-Bus Model
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Overview of the Co-Simulation Tool Chain

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> Possibility to use existing file formats and layouts

→ **Tool Chain accepted by "non-simulation engineers**
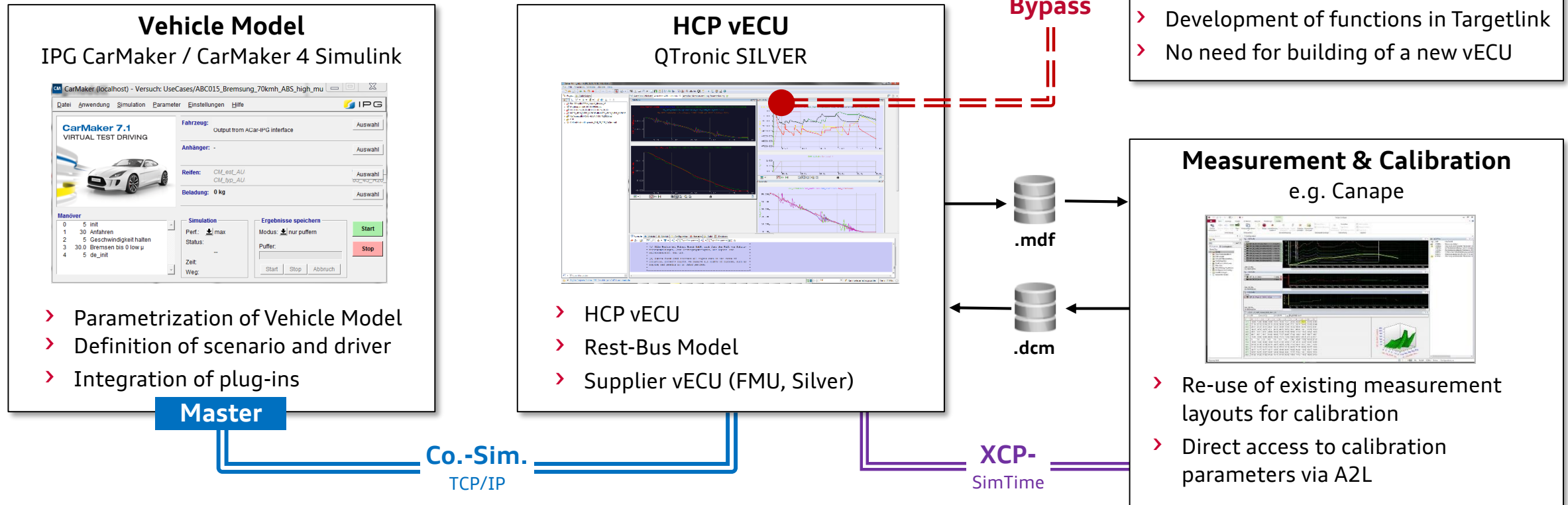
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HCP vECU
QTronic SILVER

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> Rest-Bus Model
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.mdf

.dcm

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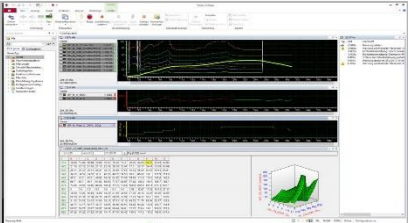
> Re-use of existing measurement layouts for calibration
> Direct access to calibration parameters via A2L

Co.-Sim.
TCP/IP

XCP-
SimTime

Summary

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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  → Usage of "virtual development" methods in many use cases

...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)
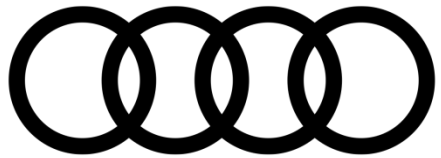
Thank you for your attention!

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