

Digital transformation of RDE calibration environments

The quest for networked virtual ECUs and agile processes

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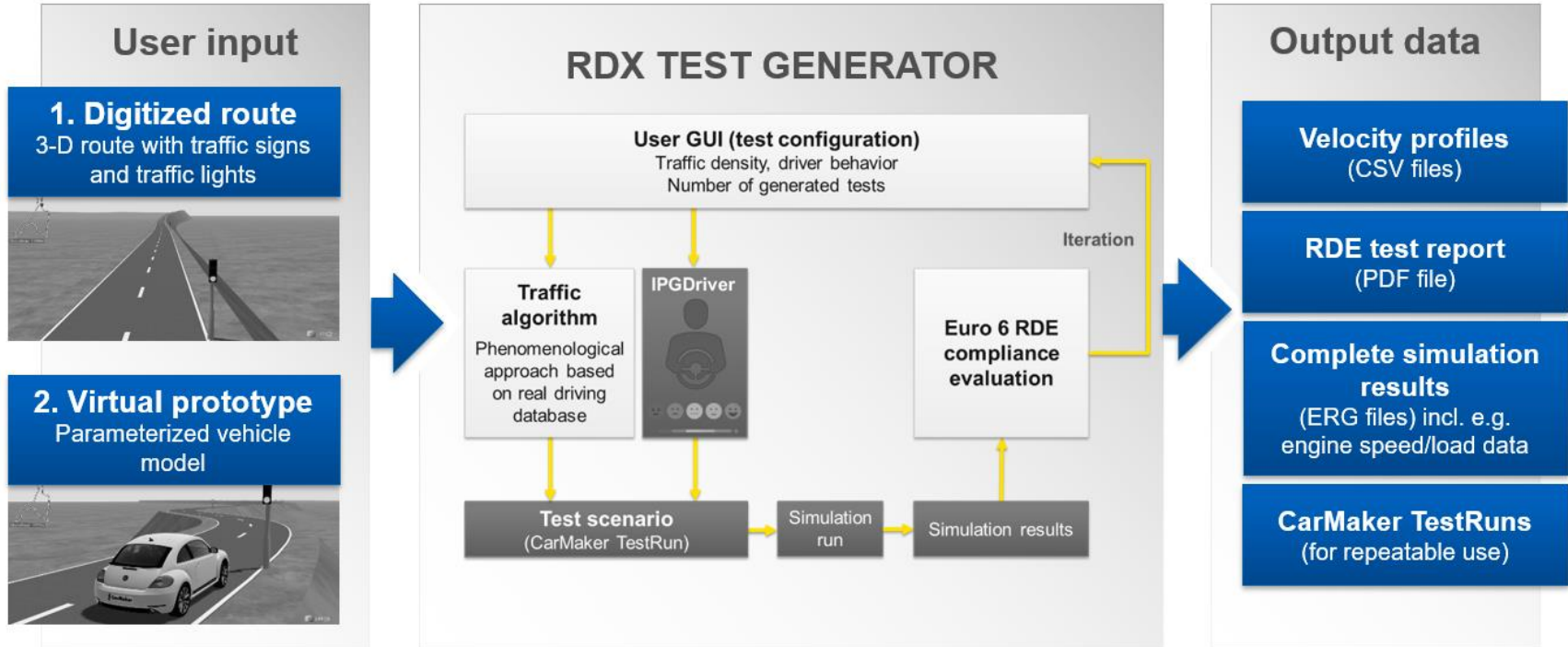
Digital transformation of RDE calibration environments

Idea: Save time and money by moving selected work steps to PC

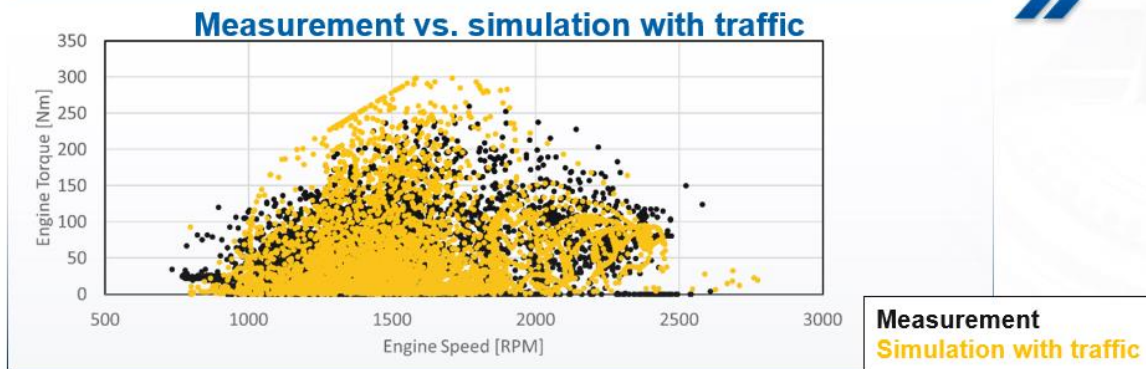
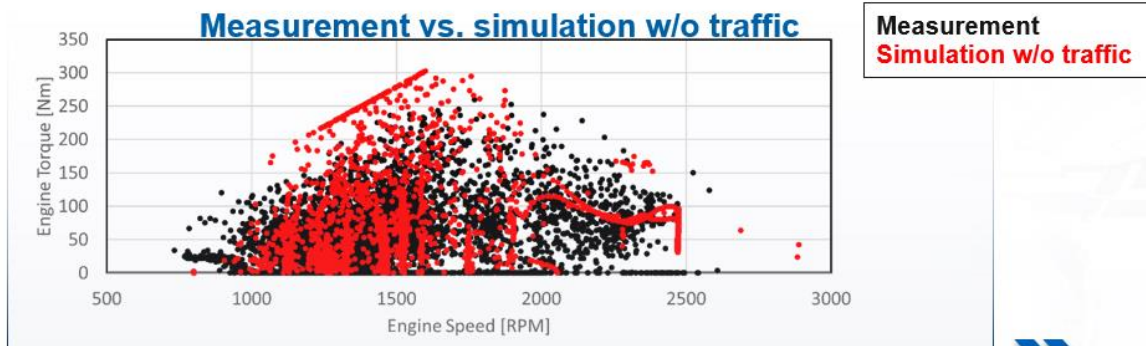
Outline

- Digitization of RDE proving ground, driver and vehicle
- Virtualization of the networked ECUs of the powertrain
- PC-based tool chain for RDE calibration
- Conclusion

Digitization of RDE proving ground, driver and vehicle



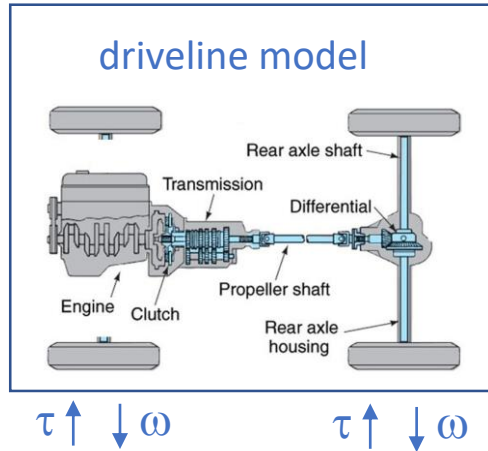
RDX Test Generator: Assessment of state coverage



Good coverage of operating points with total vehicle simulation combined with phenomenological traffic simulation!
→ Realistic load behaviour

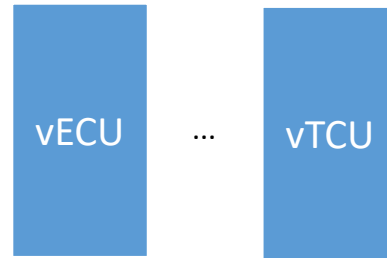
Virtualization of networked ECUs of the powertrain

use e.g.: MATLAB/Simulink, Dymola, AMESim, GT-Power, WAVE, axisuite, ...



Work flow

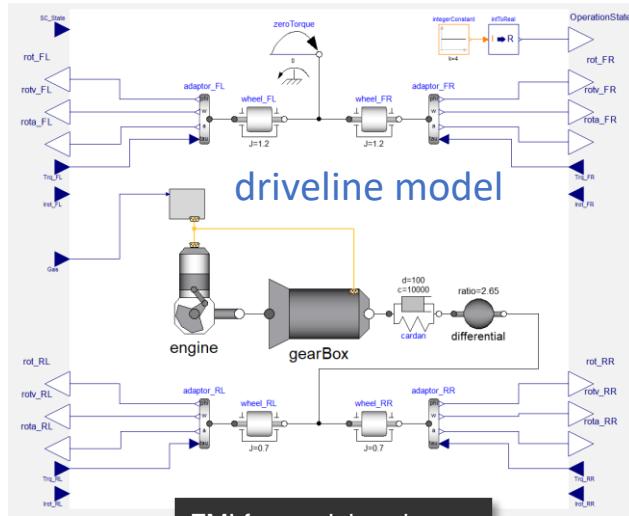
- implement CarMaker's plugin interface "PowerTrain" in Silver
- export the Silver setup as FMU 2.0
- import FMU into CarMaker. At runtime, CarMaker runs Silver
- networked vECUs control the virtual vehicle.



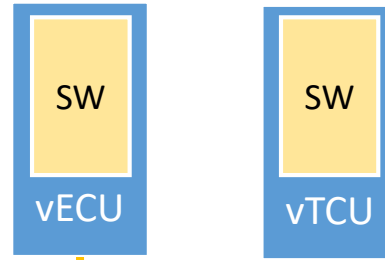
Virtualization of networked ECUs of the powertrain

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FMI for model exchange



Silver

virtual CAN

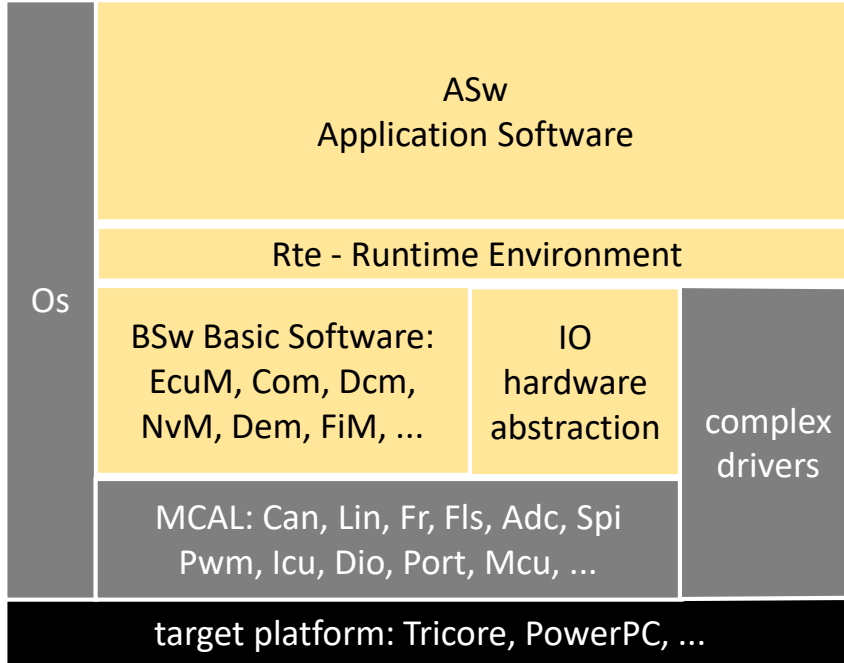
FMI for cosim



CarMaker

Building a virtual ECU with Silver

Example: AUTOSAR ECU

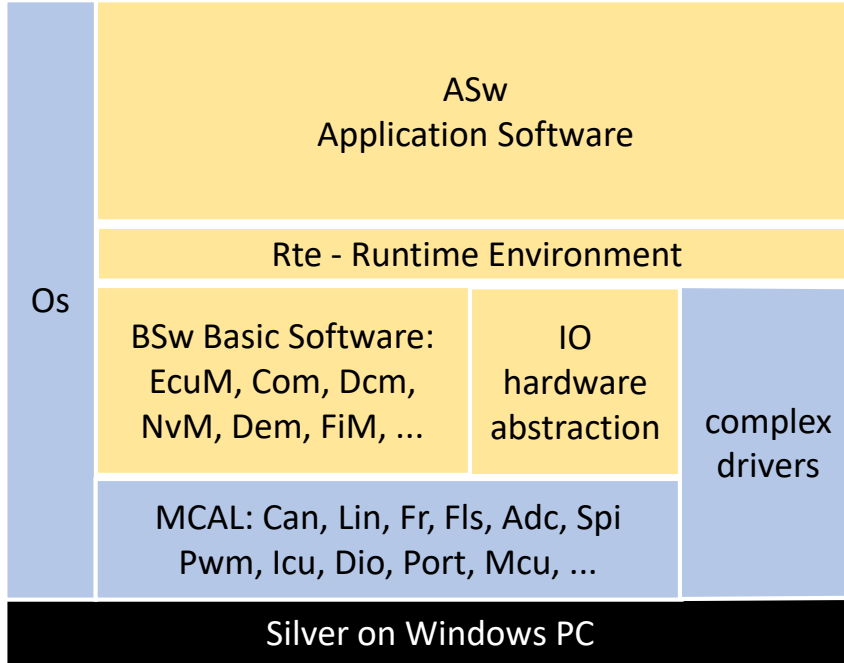


to build a virtual ECU for Windows PC

- replace platform dependent SW by Silver compliant counterparts implemented using the Silver Basic Software (sbs) library
- compile platform independent SW for Windows or run via chip simulation

Building a virtual ECU with Silver

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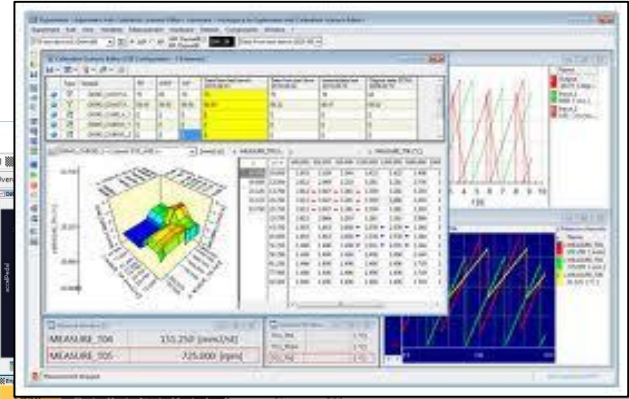
PC-based tool chain for RDE



load



RDX Test Generator



- **RDX Test Generator** drives CarMaker
- **CarMaker** runs a PowerTrain plugin implemented with Silver
- **Silver** runs networked vECUs and driveline model
- **INCA** connects to vECU via XCP over TCP/IP

Summary

Achievement

- tool chain for PC based engine calibration
- runs in soft realtime: interactive use
- driven by RDE scenarios
- low cost solution for pre-calibration
- complements calibration on real hardware

Limitations

- tool chain limited by accuracy of the powertrain plugin, e.g. model of combustion and exhaust aftertreatment

Demonstration

- available at the QTronic booth