University of Stuttgart
Institute of Automotive Engineering

EVS35
OSL2022

Concept of a Service-oriented Vehicle Energy Management and Evaluation of the Data Quality of Related Services

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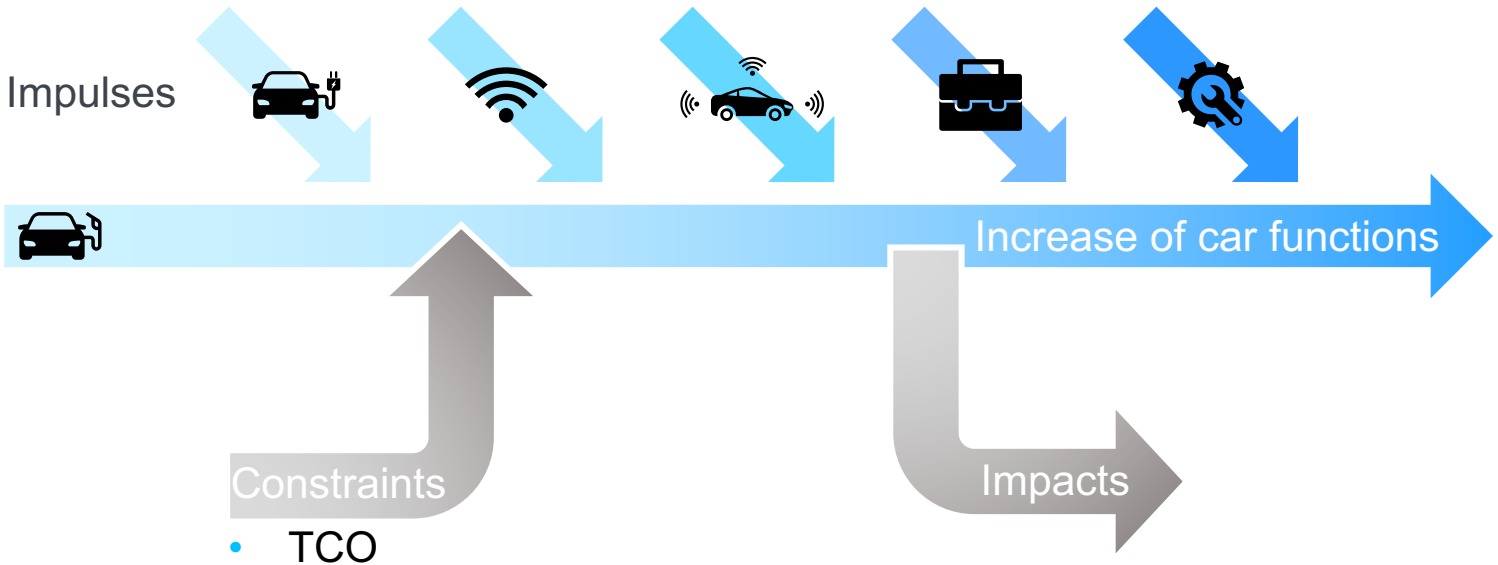
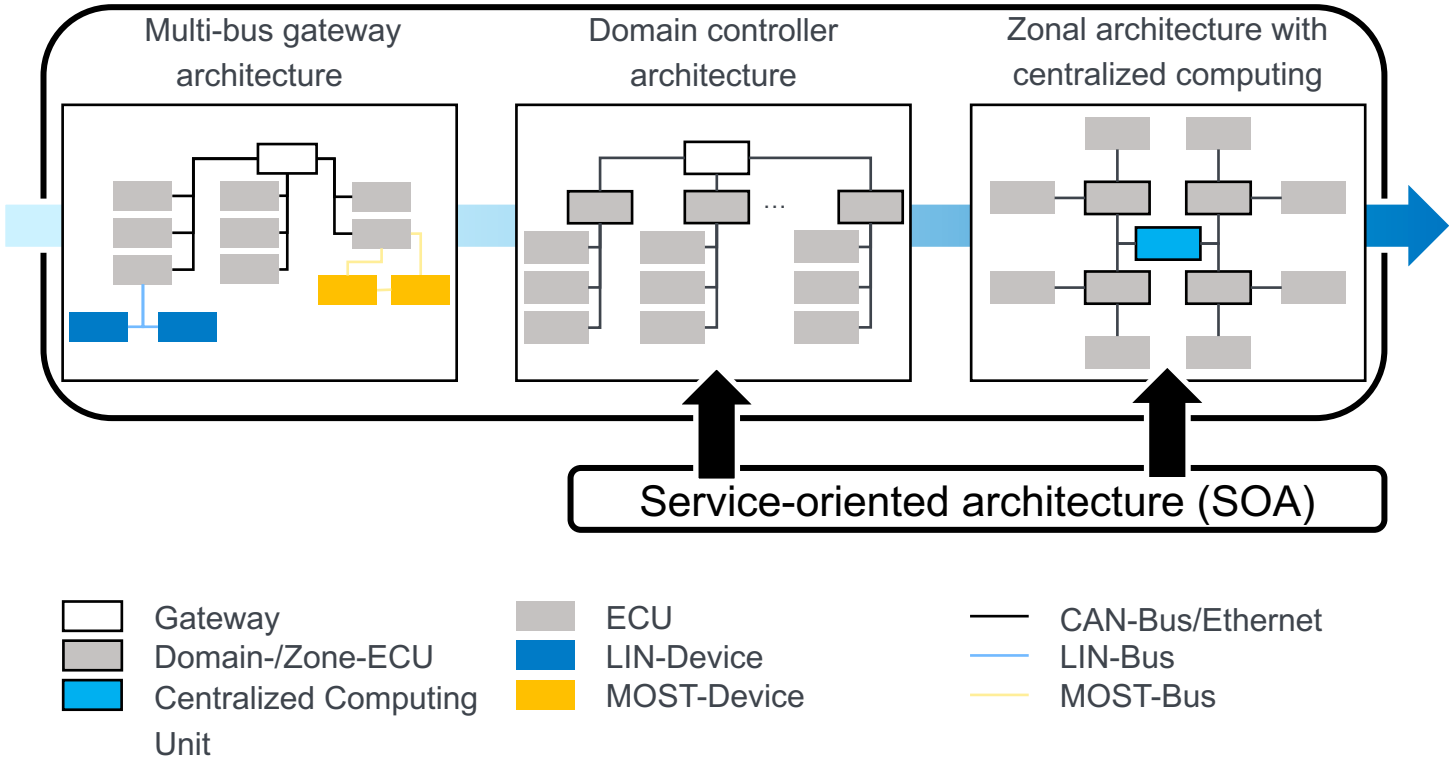
Development of E/E architectures
Impulses for the increase of Car Functions



- TCO
- Development time
- Emissions

- Rising complexity
- Higher coordination effort

Development of E/E Architectures
Change in Hardware Architecture to meet the Functional Requirements



Development of E/E Architectures
Service-oriented Architecture in Serial and Development Vehicles

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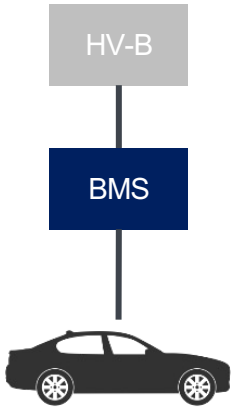
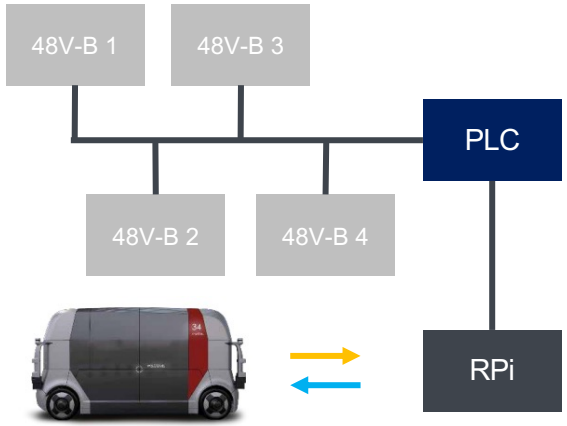
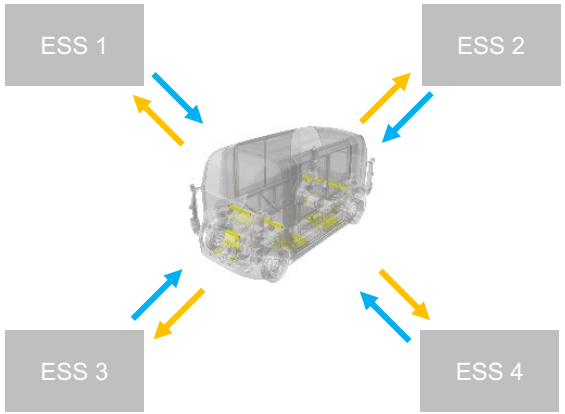
a) State of the art



b) Project UNICAR*agil*



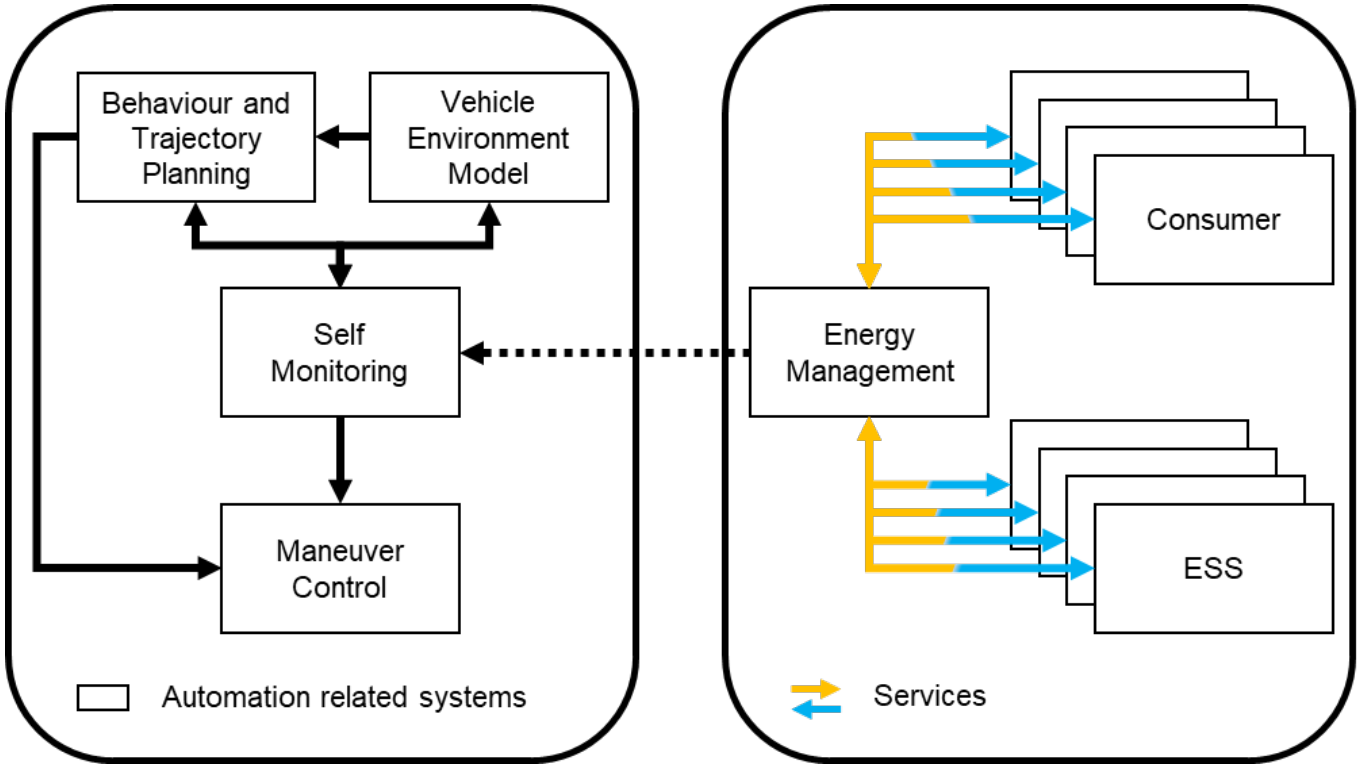
c) Future projects



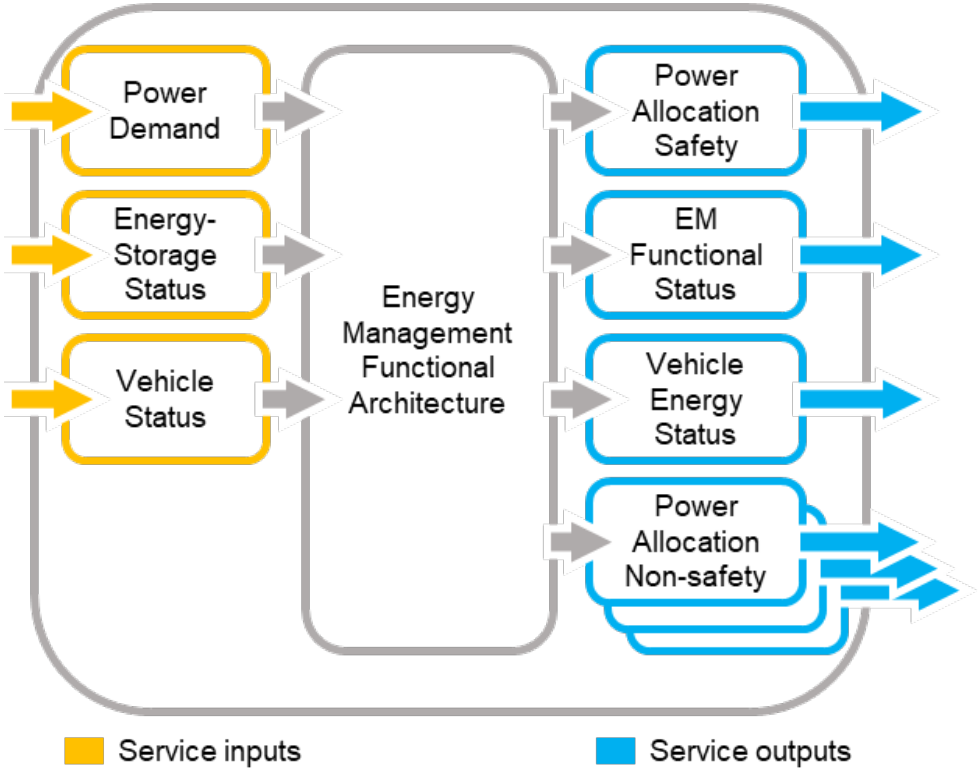
HV-B	High-Voltage battery
48V-B	48V battery
BMS	Battery management system
ESS	Energy storage system

RPi	Raspberry Pi
PLC	Programmable logic controller
	Communication via CAN-Bus
	Services

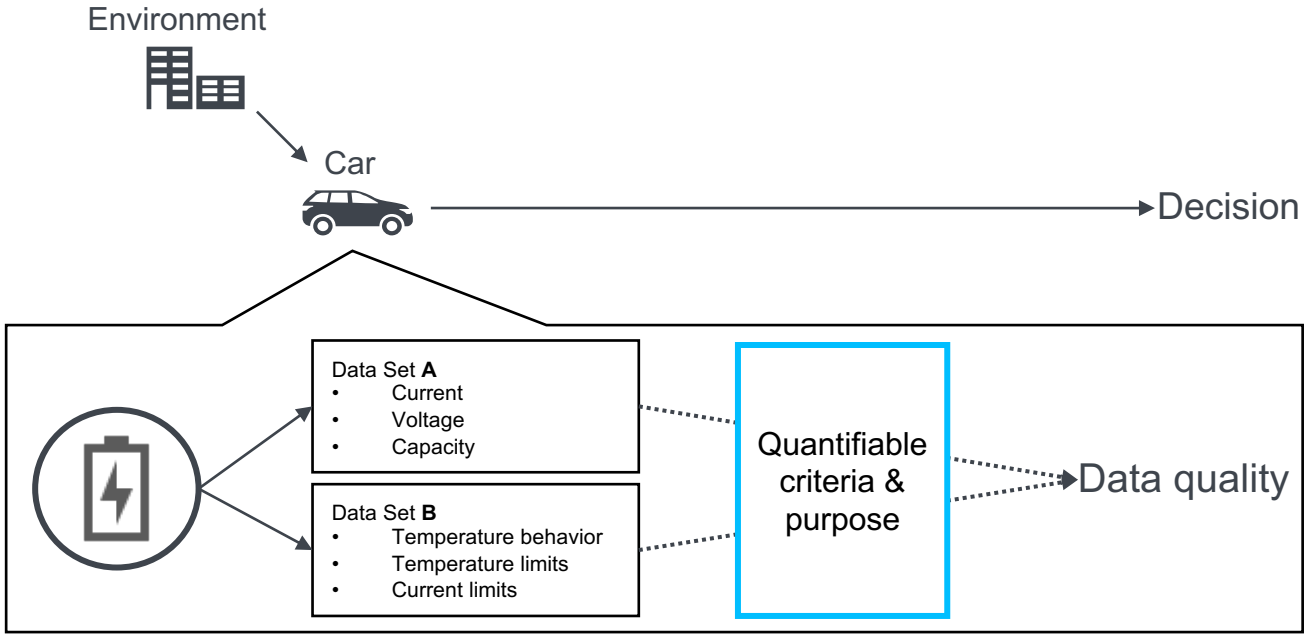
Service-oriented Vehicle Energy Management
Role of the Energy Management in Autonomous Vehicles



Service-oriented Vehicle Energy Management
Service Structure of an Energy Management

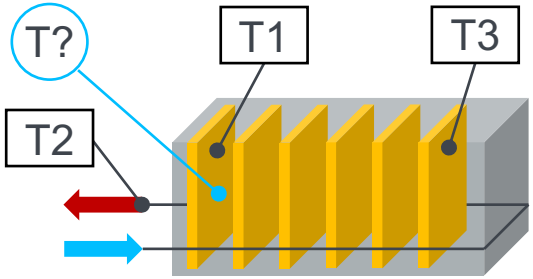


Data Quality
Decision Process in Autonomous Vehicles



Data evaluation by the vehicle based on quantifiable criteria and according to the purpose of use.

Data Quality
Example of Battery Temperature Measurment



Battery modul
Battery cell
Cooling channel

T1 Temperature sensor battery surface cell 1
T2 Temperature sensor battery cooling outlet
T3 Temperature sensor battery surface cell 6

Which data source should be chosen?

Plausibility

Reliability

$$\epsilon_{DQ} = P \cdot \frac{S \cdot \tau_{Min}}{\tau_{Sensor}}$$

Data	Quality	Cell surface sensor T1	Cooling outlet sensor T2	Cell surface sensor T3
P	(-)	1	1	1
R	(-)	1	0.06	0.16
ϵ_{DQ}	**(-)**	**1**	**0.06**	**0.16**
Δ_S	(K)	0.3	0.5	0.3
Δ_{Age}	(K)	0-8.79 (0-30 sec)		
Δ_{ACC}	**(K)**	**0.3-9.1**	**0.5-9.3**	**0.3-9.1**

How much can we trust the data from this source?

Sensor inaccuracies

Signal ageing

$$\Delta_{ACC} = \Delta_S + \Delta_{Age} = \Delta_S + \frac{\dot{Q}_{max} \cdot \Delta t}{C_{Th}}$$

Conclusion
Findings & next Steps

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- ✓ A concept of the service interfaces for an energy management in an SOA has been developed.
- ✓ An approach to assess data quality through an energy management has been formulated.
- ❑ Implementation of the service interfaces into a SOA of an entire vehicle and assessment of the modularity and compatibility with other interfaces and systems.
- ❑ Determine meaningful parameters for the data quality evaluation by combining them with vehicle functions and driving scenarios.

Thank you!

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