University of Stuttgart
Institute of Automotive Engineering

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An Approach to Implement Service-Oriented Software Architecture on Energy Management Systems of Autonomous Electric Vehicles

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Outline

- Motivation
- Evolution of Vehicle E/E Architectures
- Service-Oriented Architecture (SOA)
- UNICARagil Project
  - Introduction to ASOA
  - EPS in the UNICARagil
- Proposed approach
- Conclusion and outlook

Motivation

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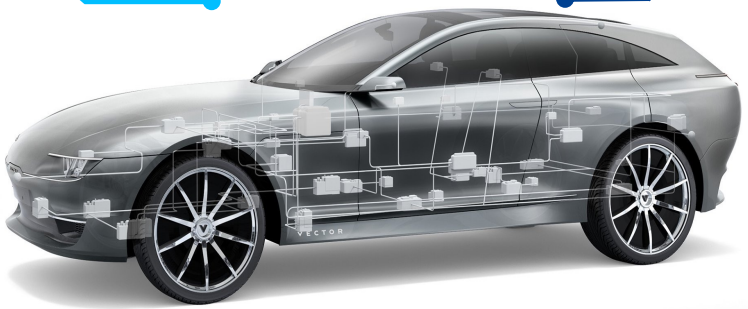
Automotive Trends

- ADAS[1]
- Infotainment
- Connectivity
- Electrification
- Automated driving



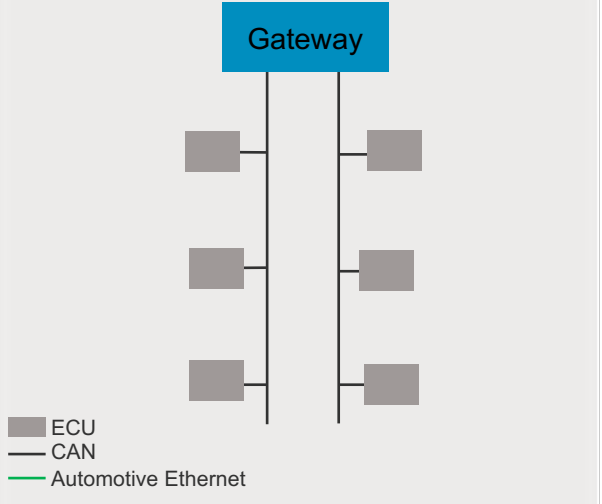
Required Enablers

- Supercomputers on Board
- Intelligent high bandwidth networks
- New approach to E/E and software architectures

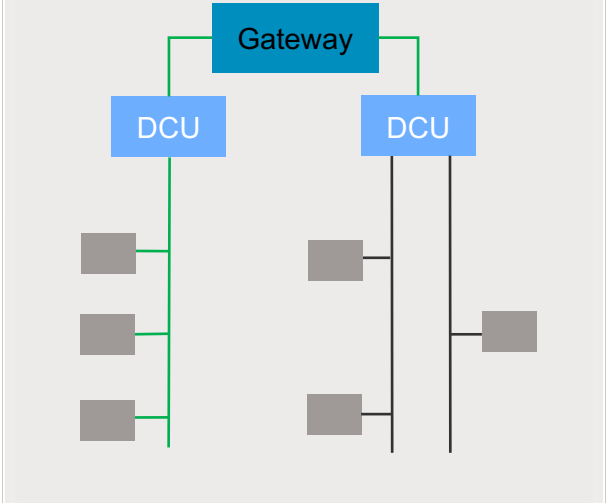
[1]Advanced Driver Assistance Systems

Image: vector.com/news/esg-mobility-and-vector

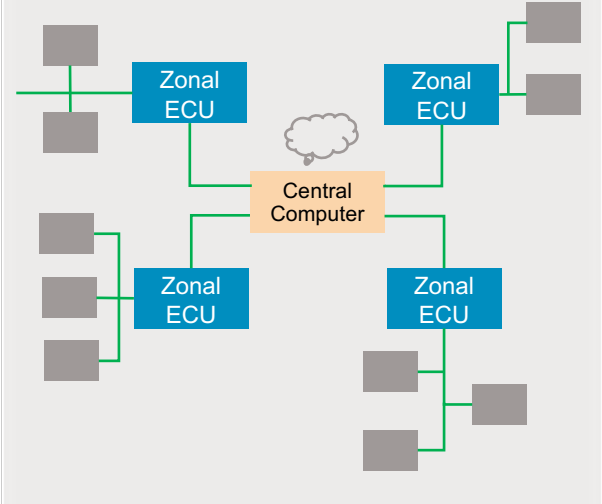
Evolution of Vehicle E/E Architectures



- One function per ECU
- Heavy and long wiring



- Central domain controllers
- Gateways and networks



- Functions excecuted in high performance computers
- Highspeed Ethernet

Today
Distributed architecture

Tomorrow
Domain centralized architecture

Future
Zone architecture

SOA – What‘s it all about?

- SOA is an architectural pattern, which provides flexible integration of components at runtime
- SOA encapsulates different functions into services
- SOA provides flexibility in adding new features, remove or update components

Key Challenges:

- Compatibillity
- Security and reliability
- Reuse of existing expertise, workflows and software assets

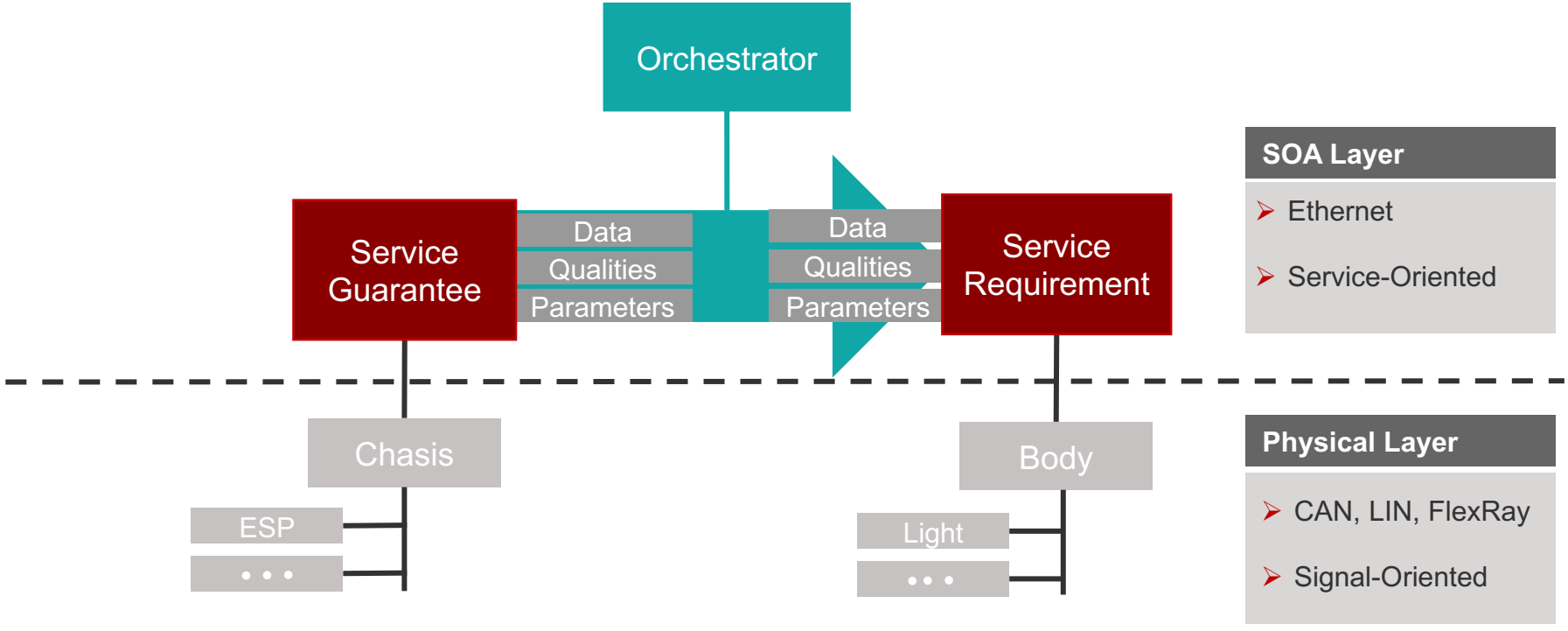
Image: automotiveworld.com/articles/car-smartphone-wheels

OBJECTIVE

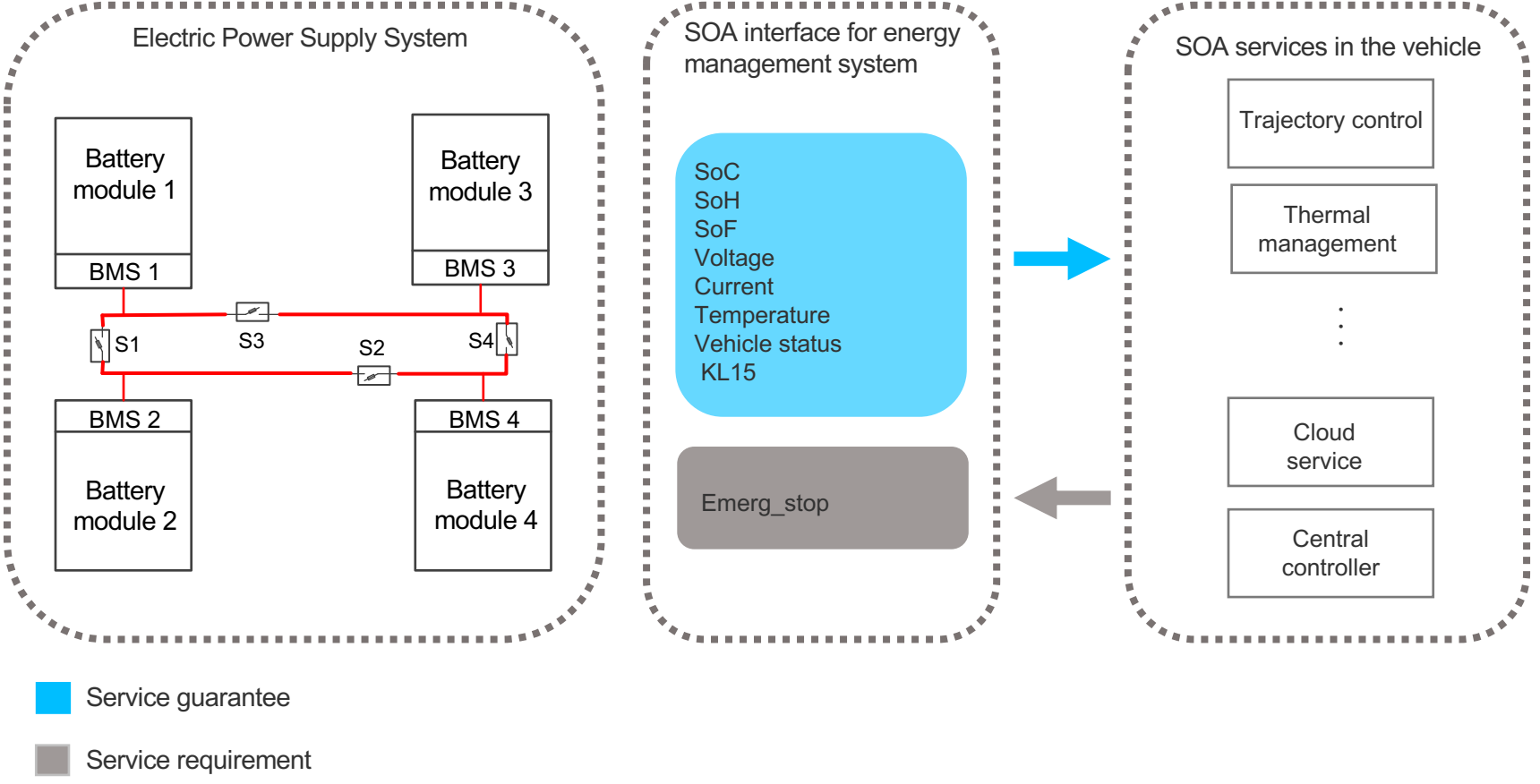
1. Modular structures for agile, automated vehicle concepts
2. Disruptive concepts in hardware and software architecture
3. Fully automated and driverless vehicles
4. Four prototypes of different characteristics

Automotive Service-Oriented Architecture (ASOA)

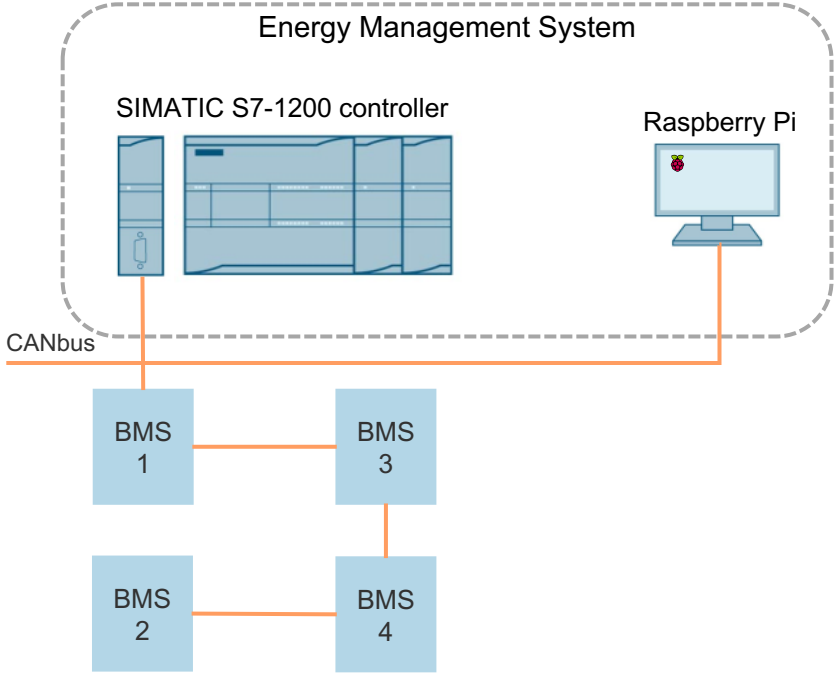
The interfaces between services in ASOA are established at design time and are realized in the forms of requirements and guarantees



The Electric Power Supply (EPS) in the UNICARagil



Concept of presented approach

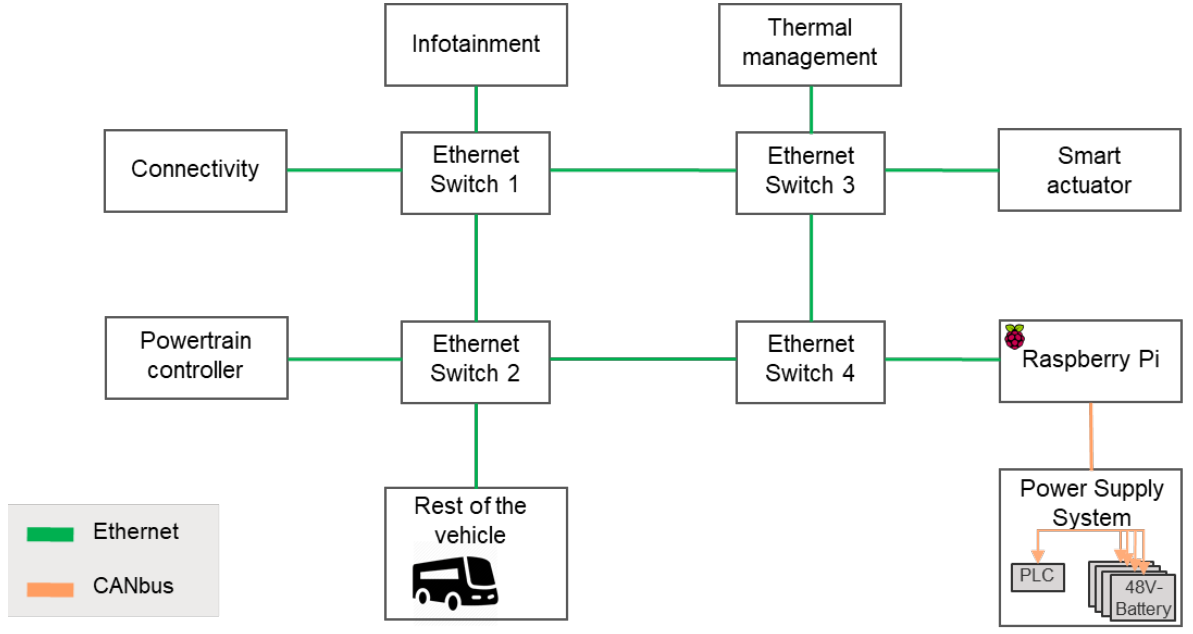


Message 1								
CAN ID	Value							
0x85	02	64	00	17	00	00	00	00
Battery information								
	Status	SoF	SoH	SoC				
	Driving	100%	0%	23 %	-	-	-	-

Message 2								
CAN ID	Value							
0x86	00	00	00	41	0A	F0	01	CD
Battery information								
				Temperature	Current		Voltage	
	-	-	-	25 °C	0 A		46,1 V	

Data Transmission → Data Processing → Receving Data in Raspberry Pi → Integration into ASOA → Publishing service via Ethernet

Concept of presented approach



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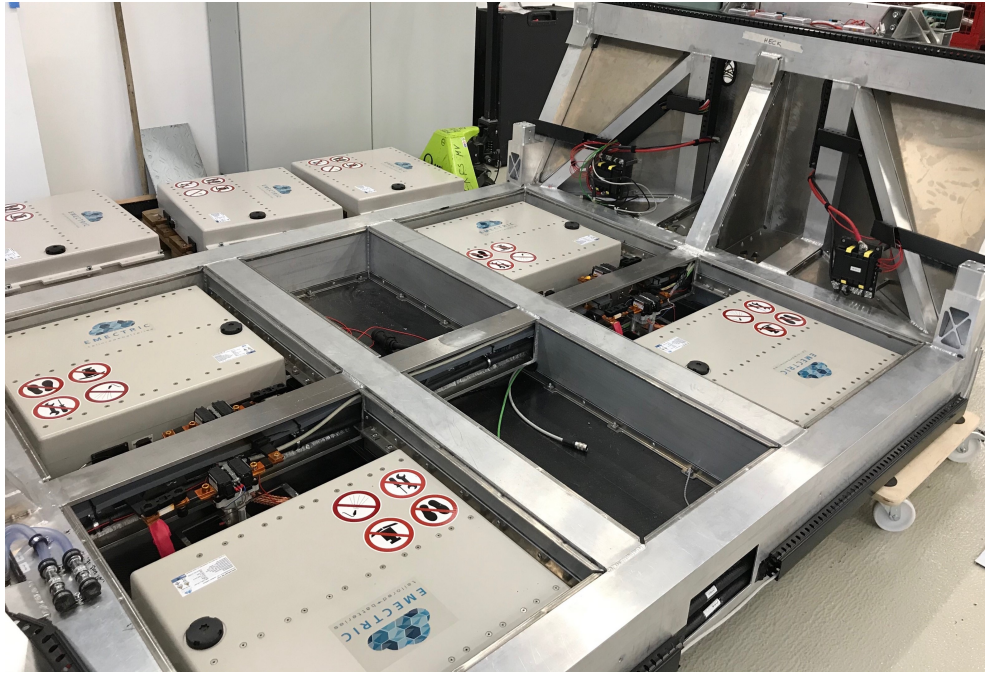
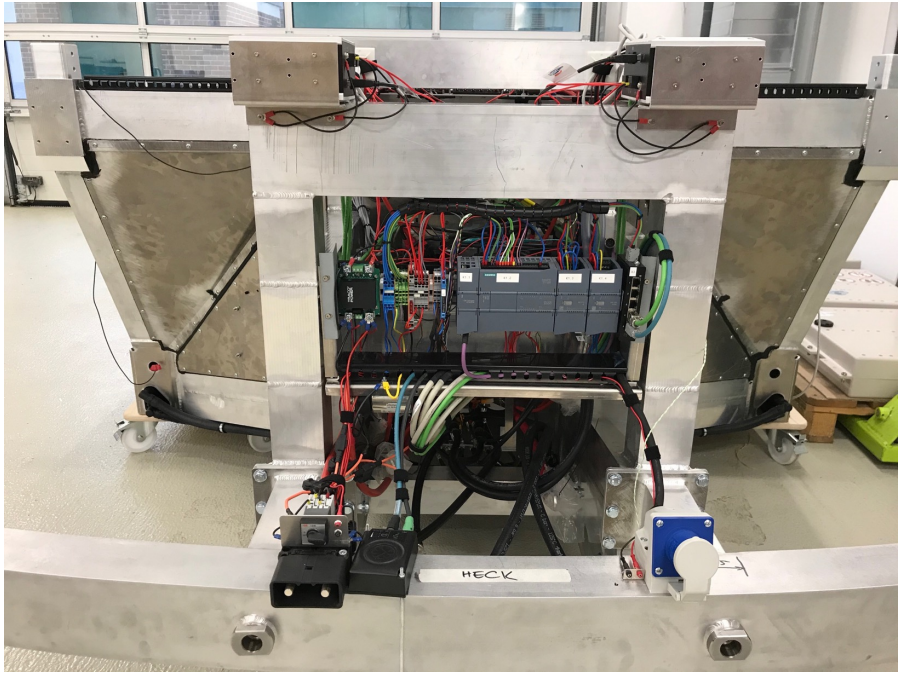


48V- Li-ion Batteries



PLC wiring front view

Conclusion and outlook

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- ✓ We proposed a cost-effective approach to integrate the EMS of an automated vehicle into SOA
- ✓ Based on ASOA, a service for energy management system is designed that provides battery information to other software functions in the vehicle
- ✓ The suggested architecture consists of a Raspberry Pi and an embeded platform
- ✓ The developed service is implemented in C++
- ✓ This approach is used in the UNICARagil project
- ✓ Our results show the successful integration of EMS into ASOA while maintaining upgrade and updatability

As a next step, we will:

- Calculate the accuracy of the data and integrate it into ASOA

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Thank you!

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