

CODE4EV: Collaborative Development Framework for Electric Software-defined vehicles

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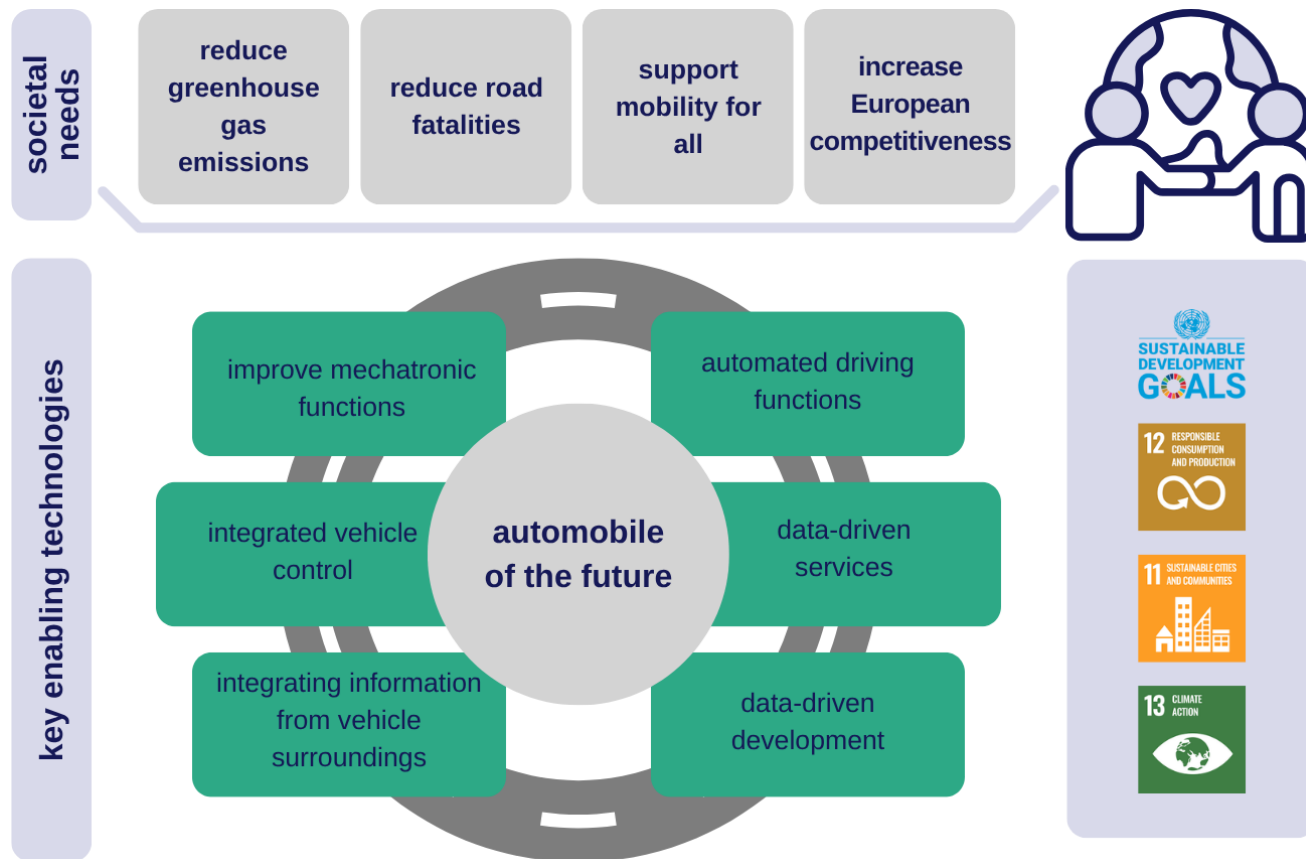
European SDV Ecosystem Summit 2025, 2025|05|20



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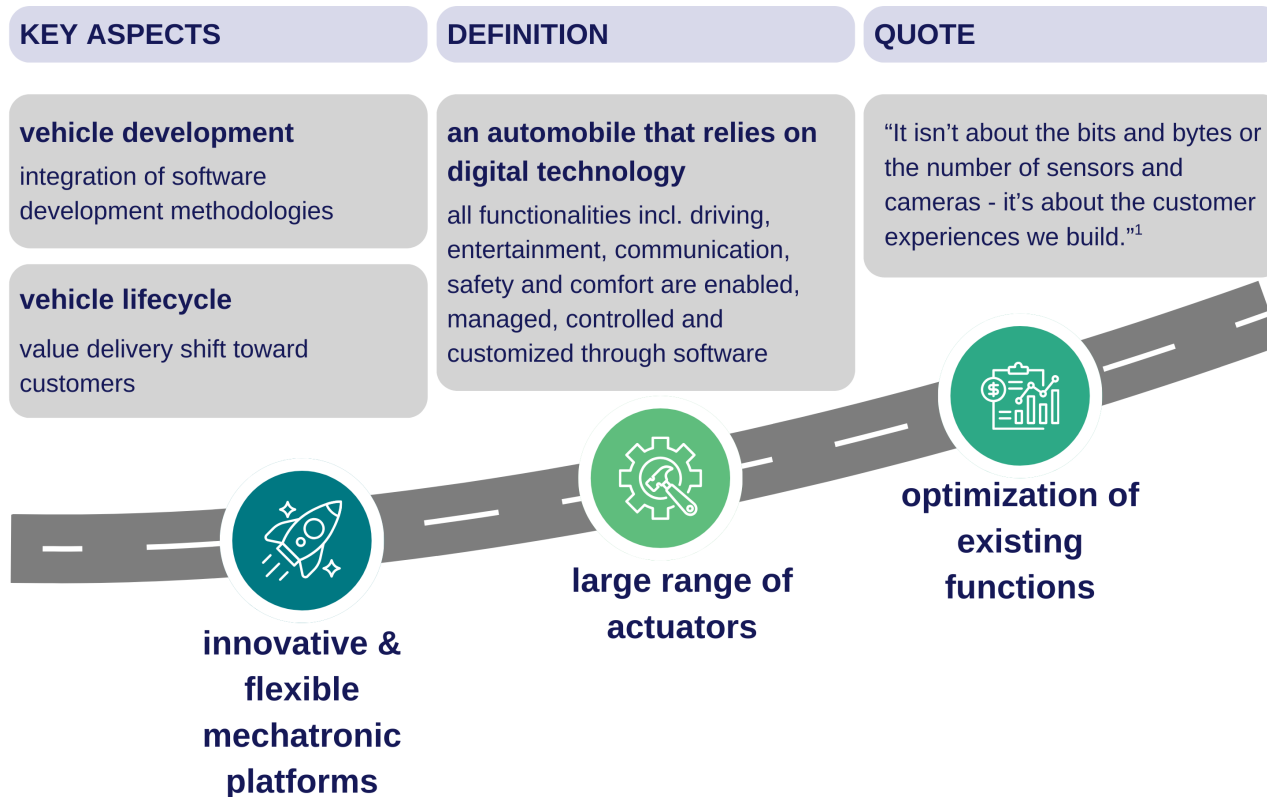


Evolution of the automotive industry



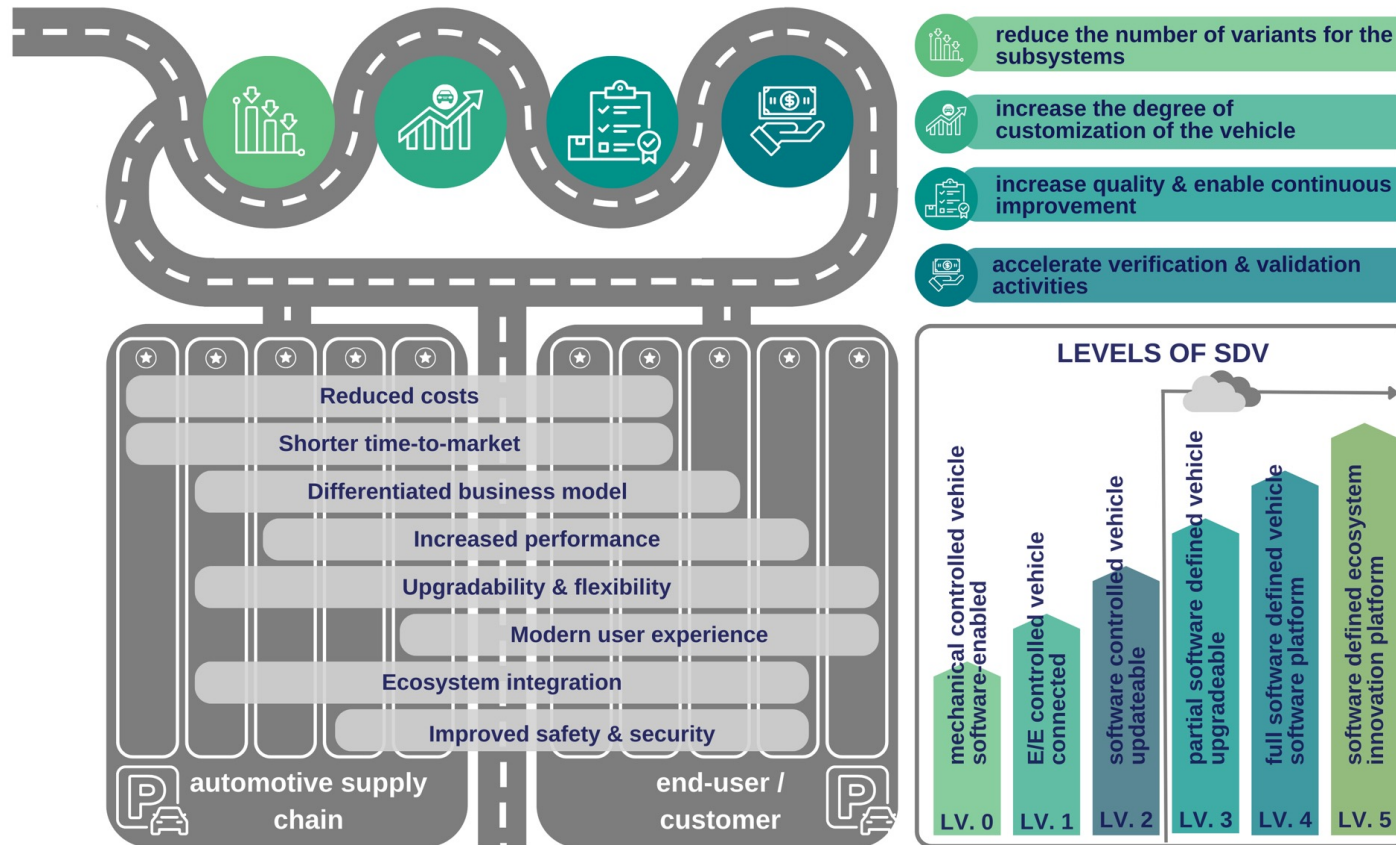
Sources: [1] CINEA, 2022; [2] UNFCCC, 2015; [3] EC, 2019; [4] EU, 2025; [5] EC, 2021; [6] EC, 2020; [7] EC, 2016 / © Armengaud Innovate

Software defined vehicle



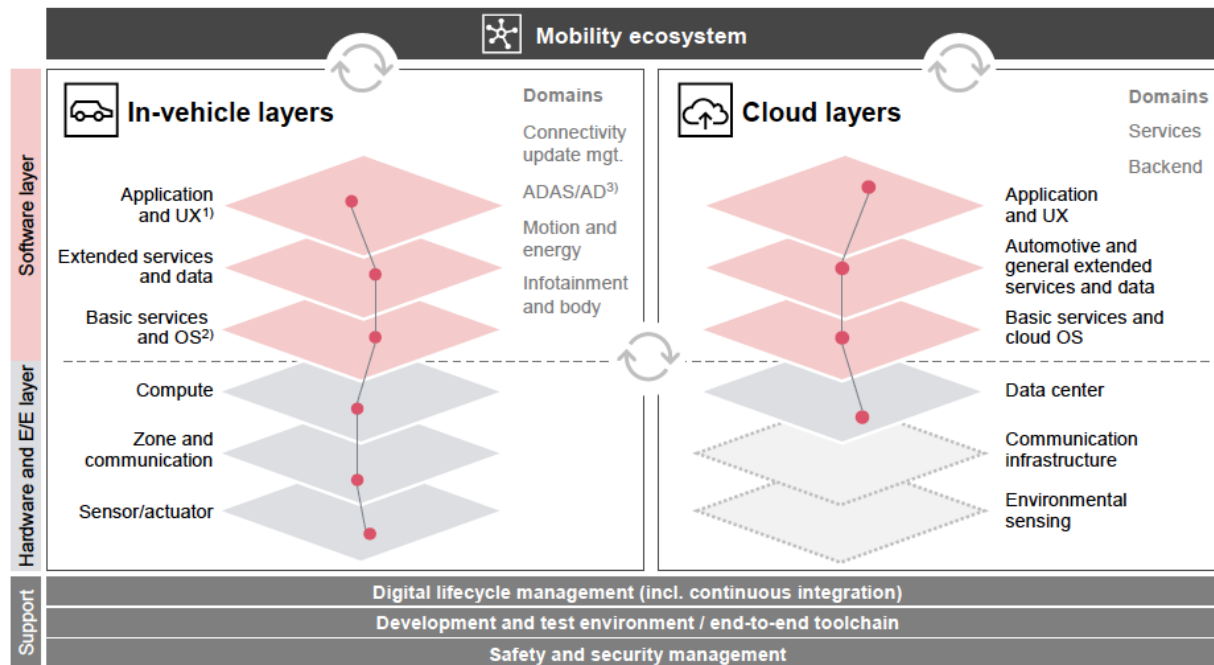
Sources: [8] O'Reilly Media, Inc., 2023; [9] Strategy & PwC, 2024 / © Armengaud Innovate

Benefits of SDV



Sources: [10] O'Reilly Media, Inc., 2023; [11] Strategy & PwC, 2024 / © Armengaud Innovate

Vehicle architecture



Software-defined vehicles – revolutionizing the automotive industry Strategy&

● Access via standardized interfaces 1) UX = User experience 2) OS = Operating system 3) ADAS/AD = Advanced driver-assistance system 4) API = Application programming interface

SDV architecture highlights

- Includes **in-vehicle** and **cloud components**
- **Separation of hardware and software** for **rapid updates** and **hardware-independent software operations**
- Separation is achieved through a **layered architecture** akin to those used by hyperscalers
- Enables **modular development of software**, together with **other players**
- **Applications and functionalities** are created by **combining** underlying **services across layers**
- **Services** are used across and within layers via **standardized APIs⁴⁾**

November 2024
6

PwC, 2024, What is an SDV (Software Defined Vehicle)? Defining SDVs beyond just vehicles, Shinichiro Watanabe and Shuhei Itoda, available at <https://www.pwc.com/jp/en/knowledge/column/definition-of-sdv.html>

CODE4EV: key facts



software-defined vehicles (SDVs) play a crucial role in the automotive landscape of the future



Development of digital design tools and a reliable methodology for electric SDVs in 3 use cases:

- Collaborative Development Framework
- Tailored Electric SDV architecture
- Optimal Powertrain Design & Control
- EV Health Monitoring & Predictive Maintenance
- Smart motion control

CODE4EV: key facts



Started in January 2025
Project duration 36 months
Coordinated by TU Ilmenau, Germany
Costs of the project amount € 4.995.981,25



14 partners from eight European countries



Project consortium

Technical University of Ilmenau
AGH University of Krakow
Armengaud Innovate
Aptiv Services
Austrian Standards International
BET Motors
Elektrobit Automotive
Elaphe Propulsion Technologies
FAE Technology
Heron Sports
Instituto Tecnológico de Aragón
Siemens
TTTech Auto
Université de Lille

Industrial Advisory Board

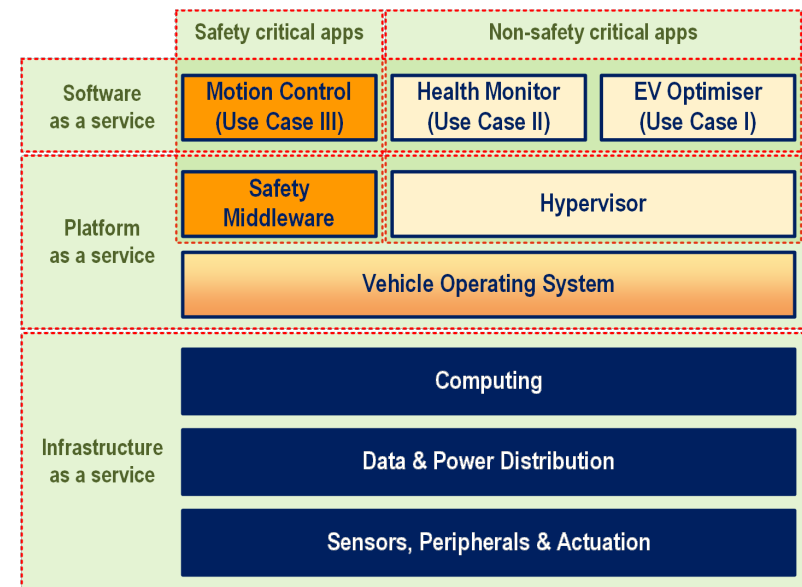
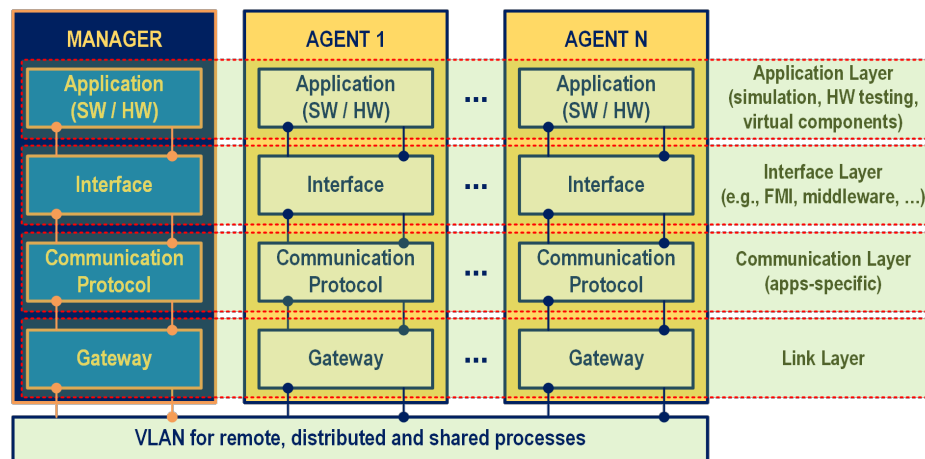
AUDI
HONDA
ZF-TRW
FEDERATE
Sarolea Motorcycles

CODE4EV: objectives

Not New SDV but Design Process



CODE4EV: CoDe-Framework - Concept

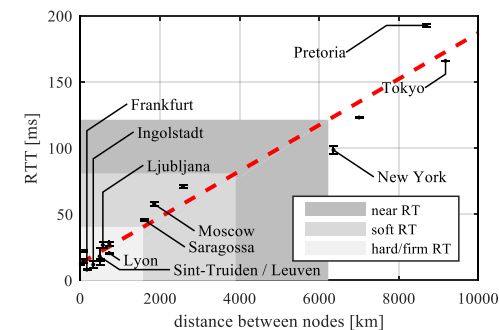


- (Real-time) connection of labs, testing facilities, and developers in **different geographical locations**
- **Manager** - cloud-based hub with global vehicle model and emulated on-board software (VehicleOS, middleware, apps et al.)
- **Agents** – local hosts that can (i) replace a system in the global vehicle model with real hardware on the test setup, or (ii) replace components of emulated SW with own blocks / apps

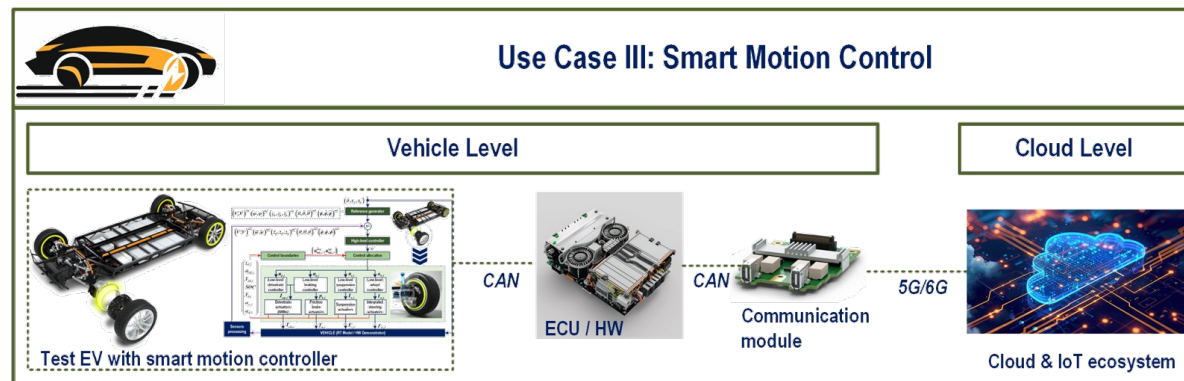
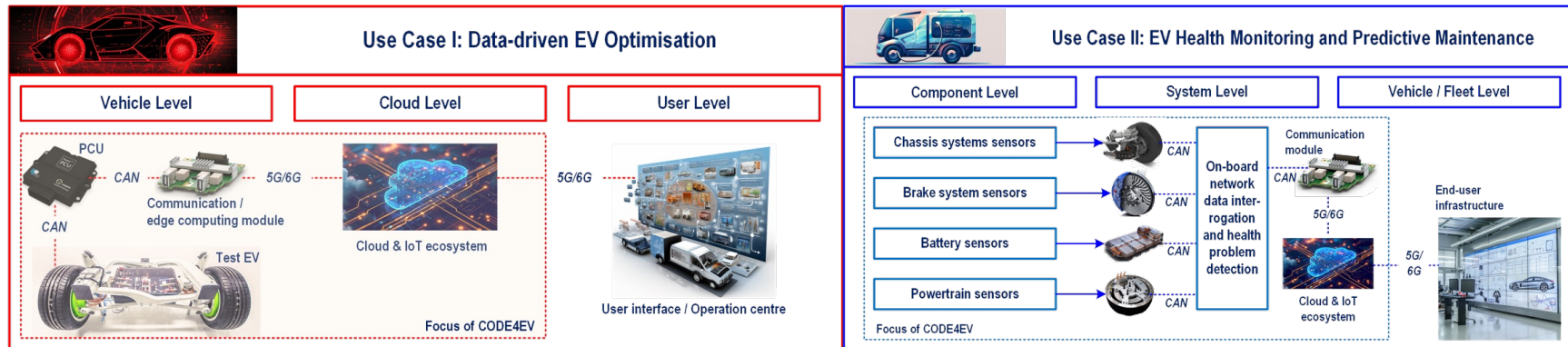
CODE4EV: CoDe-Framework - Realisation



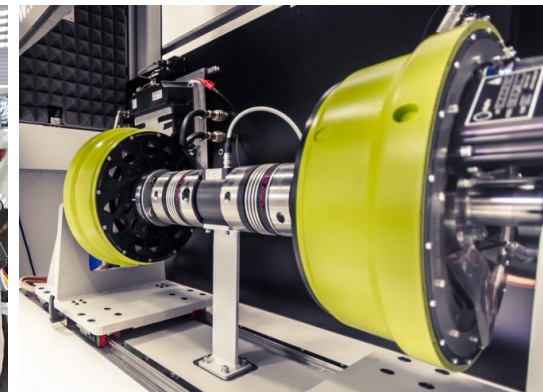
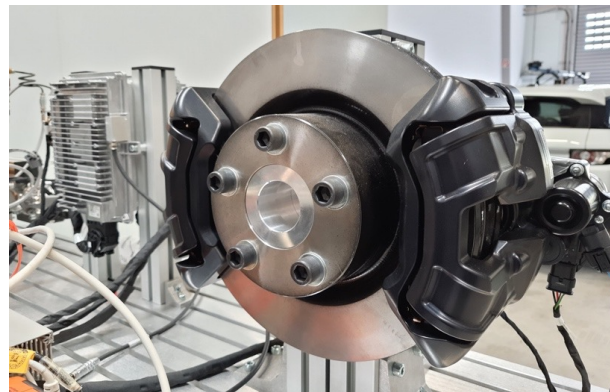
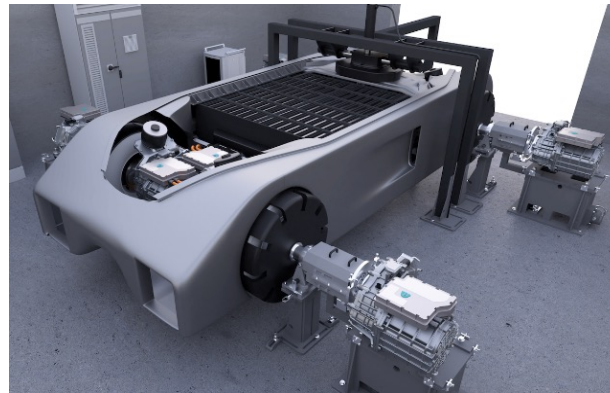
- Preliminary **five** connected hosts
 - Ilmenau as “manager”
 - Ljubljana, Graz und Saragossa as Use Case owners (incl. hardware components)
 - Lille as digital twinning of Use Cases
- Performance of available **Internet-based communications** confirmed in previous studies, e.g. round-trip time for soft-RT applications (< 80 ms)



CODE4EV: Use Cases



CODE4V: Hardware for Data Collection and Demonstration





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CODE4EV

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