Elektrobit

Scalable and Flexible Software Platform for High-Performance ECUs

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Agenda

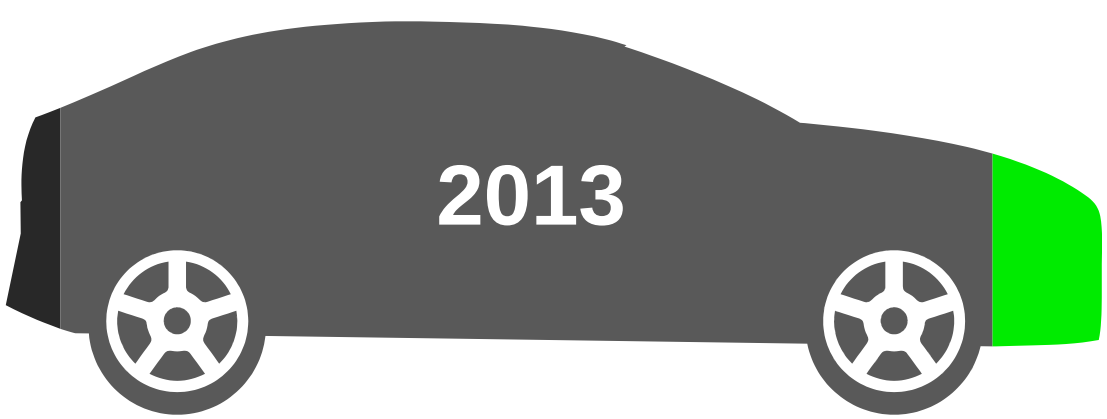
A **New E/E Architectures and High-Performance ECUs**

B **Non-Functional Aspects: Safety | Security | Cloud**

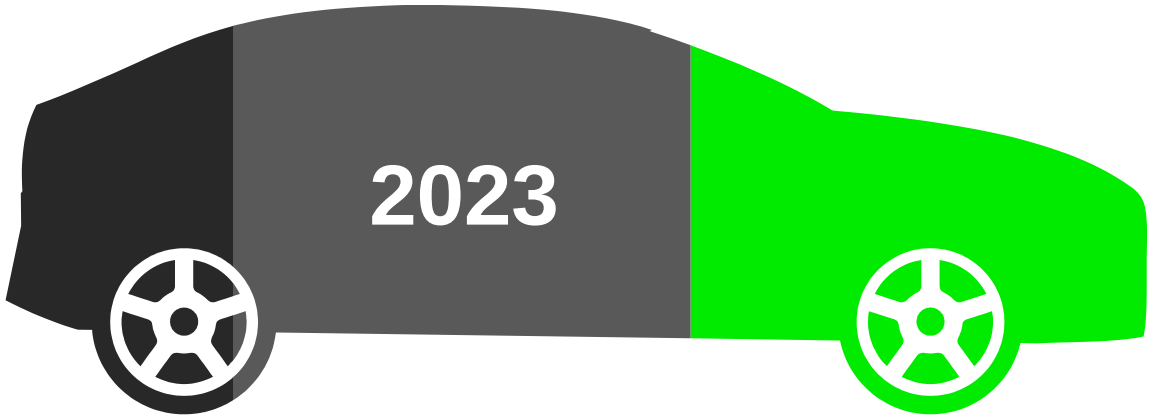
C **Handling Software Development Complexity of High-Performance ECUs**

Future Value - Created through Software

Value of a car: yesterday vs. tomorrow



5 % Content 85 % Hardware 10 % Software

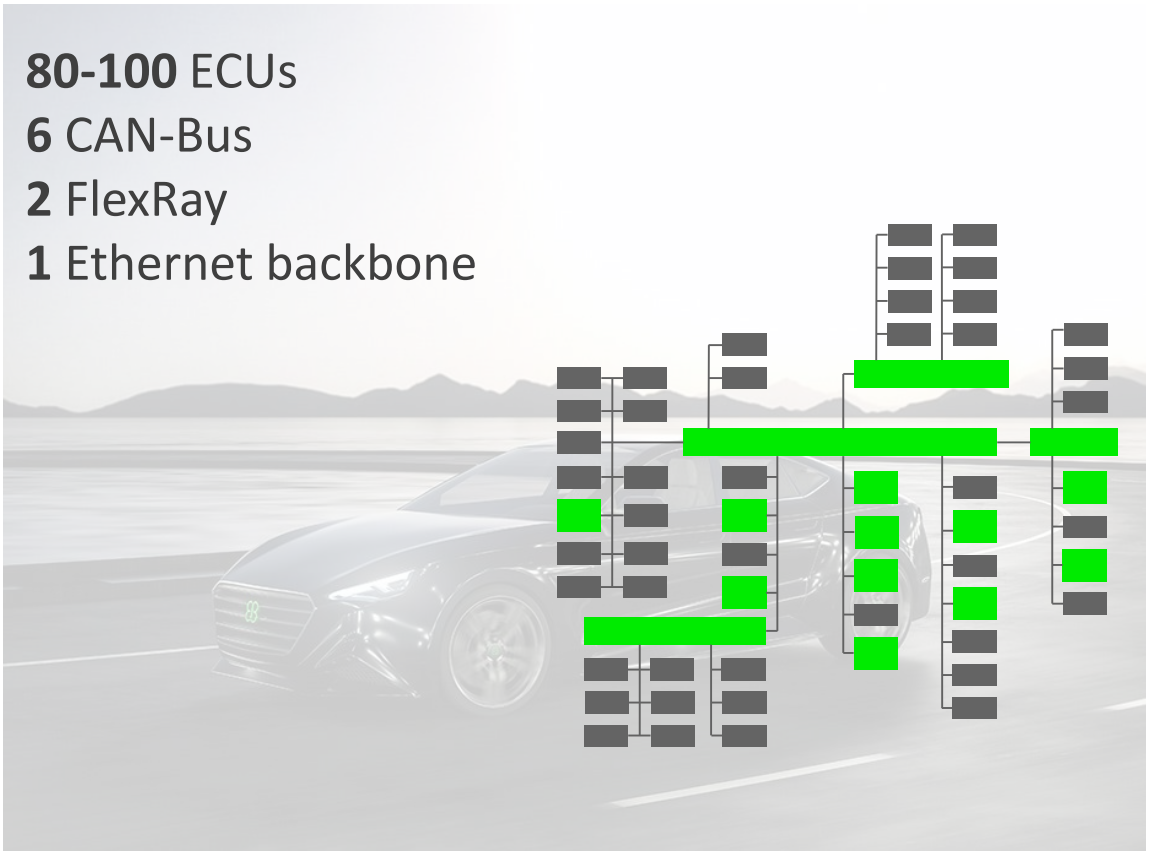


20 % Content 40 % Hardware 40 % Software

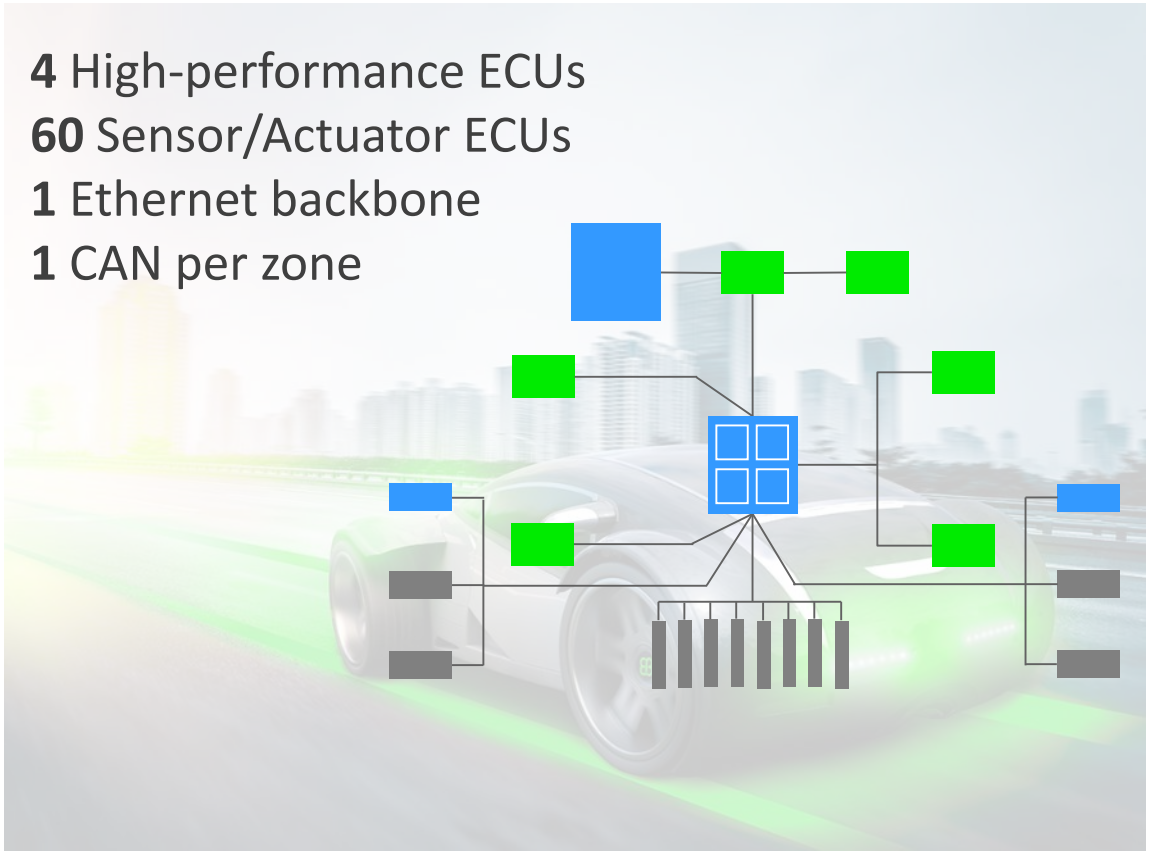
Source: Morgan Stanley Research

E/E Architectures with HPC seem Clean and Simple

80-100 ECUs
6 CAN-Bus
2 FlexRay
1 Ethernet backbone



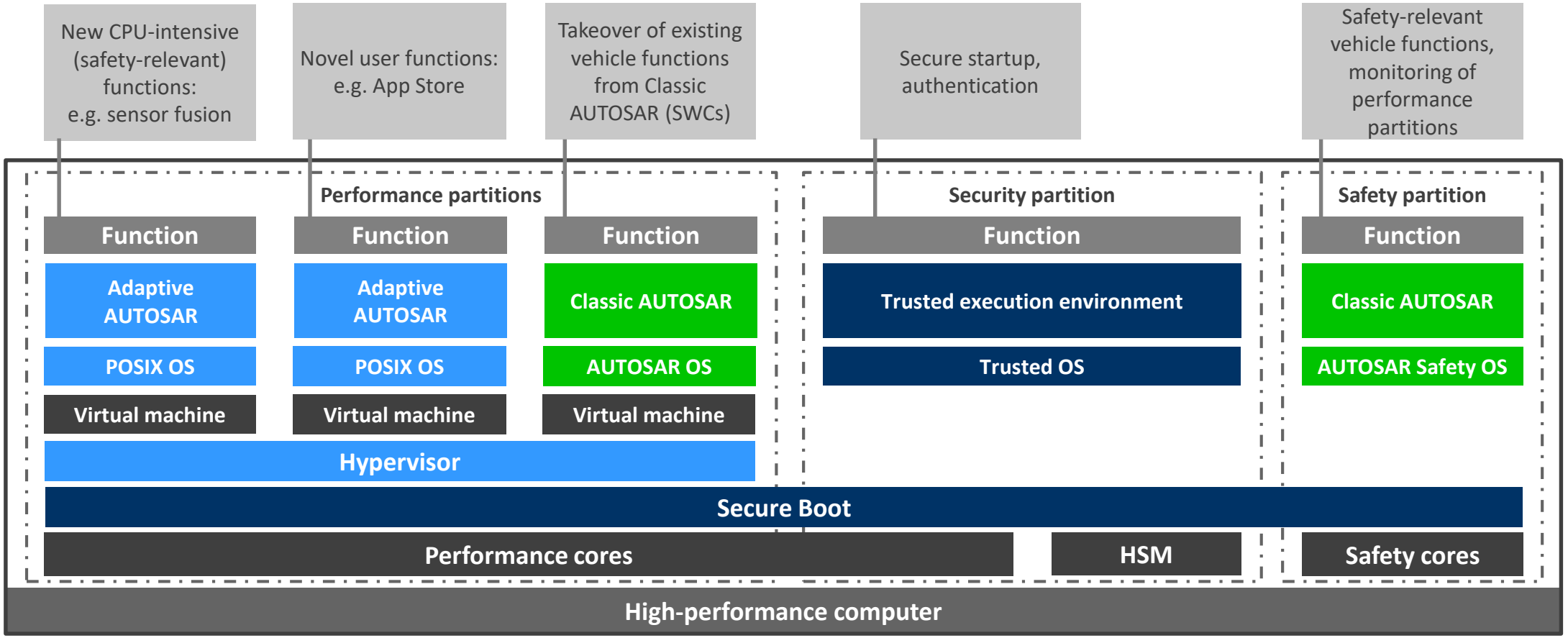
4 High-performance ECUs
60 Sensor/Actuator ECUs
1 Ethernet backbone
1 CAN per zone



Classic ECU | Performance/Safety ECU | Sensor/Actuator | High-performance controller

Possible HPC Architecture for SOP in 2019

Infrastructure software (Operating system and middleware)

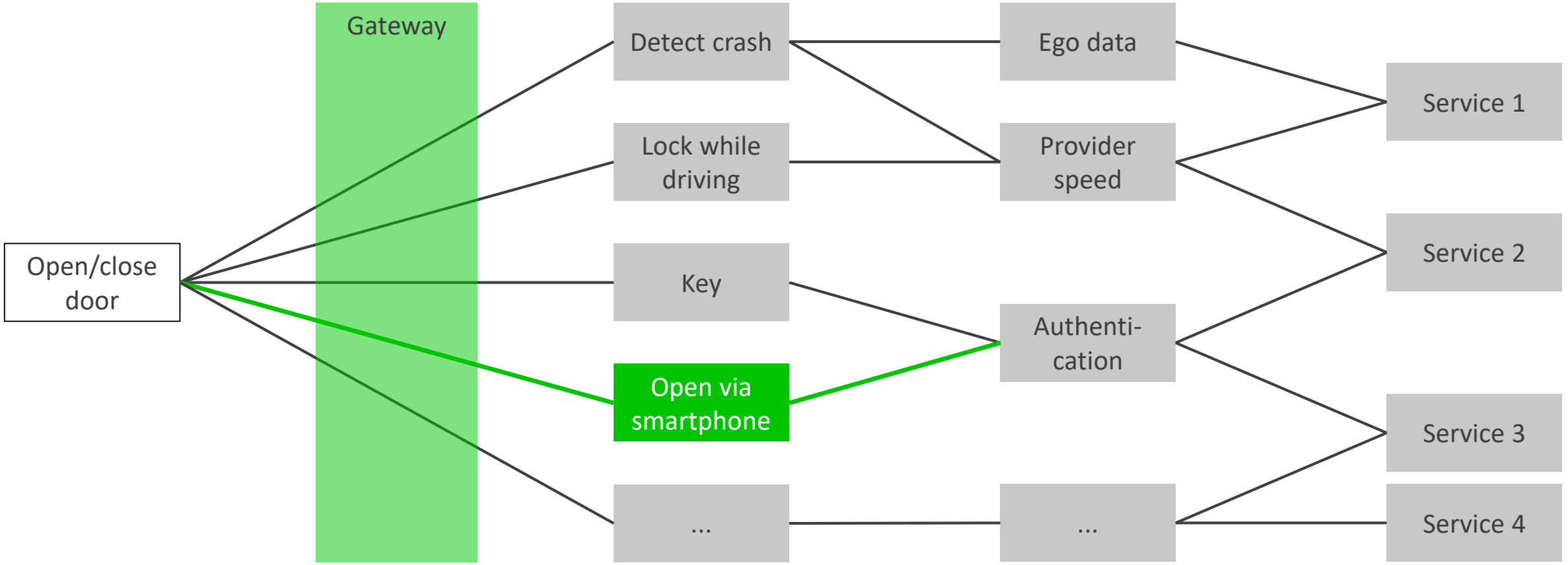


Communication in a Service-Oriented Architecture

Public speech

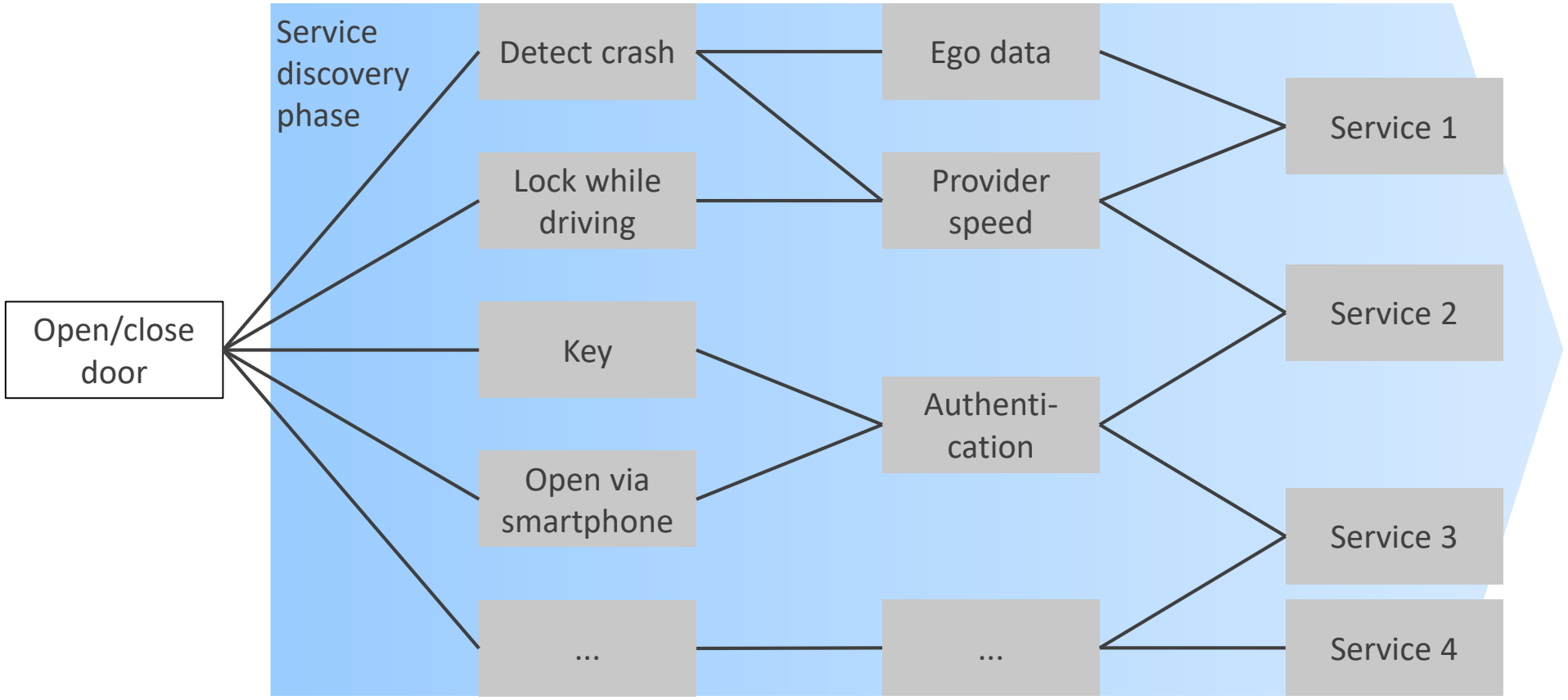
Bulletin board

New Services Require Changes to Gateway



Service and communication to be adapted

Service Discovery Phase to Find and Match Services



- Services can be distributed flexible on various ECUs
- No dependency or changes in Gateway necessary

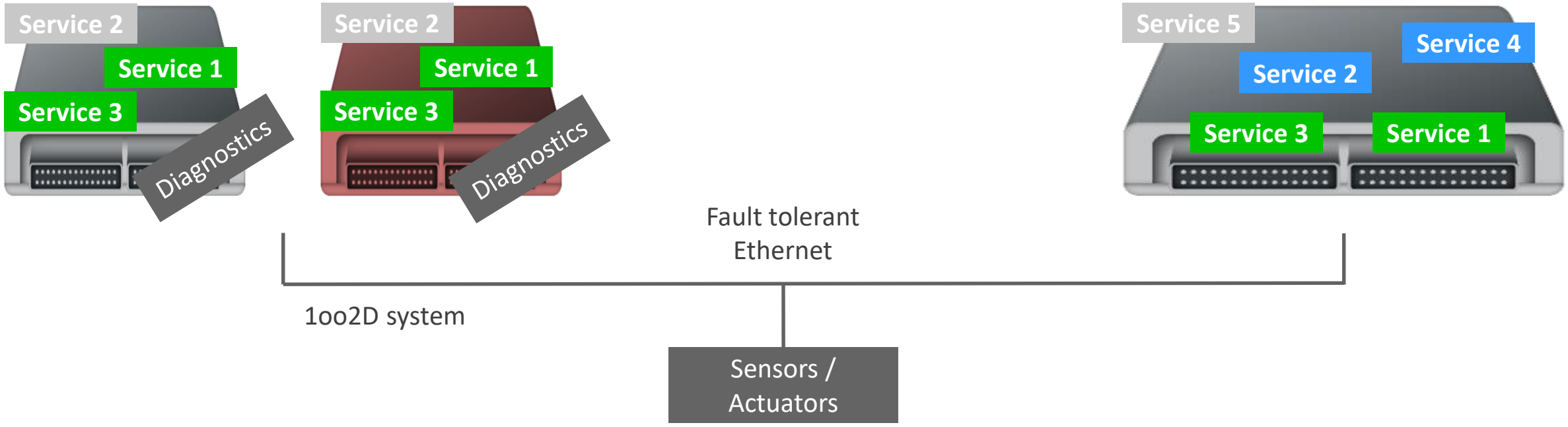
Additional Non-Functional Requirements Arise

Security

Cloud connectivity

Functional safety

Reconfiguration of Services



Requirements for reconfiguration

Req. 1: Services can be dynamically relocated

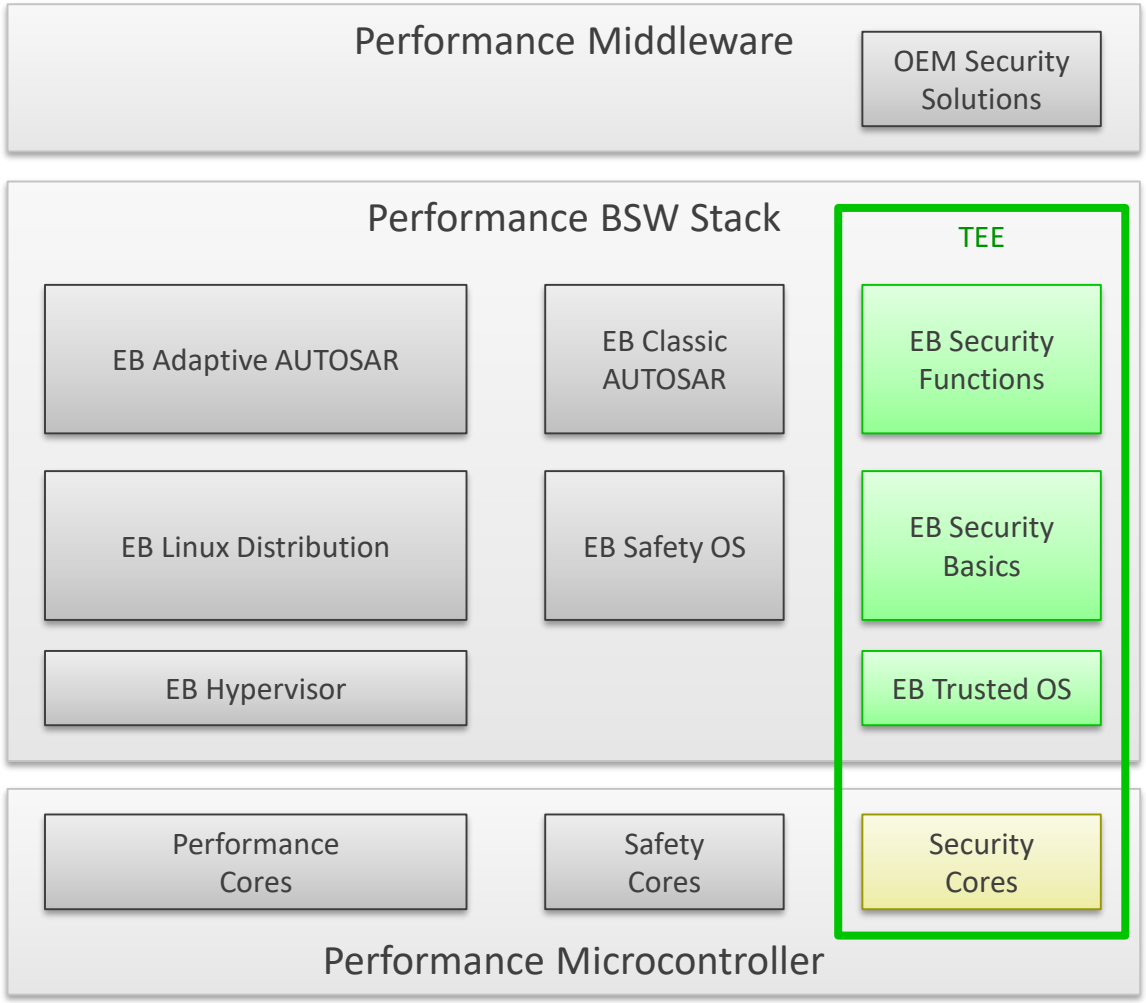
Req. 2: Sensor/actuators are redundant or accessible via network as a service

disabled | critical | non-critical

TEE (Trusted Execution Environment)

Security Stack for Performance Controllers

- Customizable implementations on security cores are the trust anchor in ECUs.
- Root of trust in hardware Trusted Platform Module
- Provides a generic security interface on top of security cores with API for Adaptive Applications
- Security basic software to enable security solutions
  - Enables secure boot, secure updates, secure debug, secure logging and secure storage.



Software Platforms for HPC: what lies ahead of us?

1 **Incremental Development**
- Feature-based approach
- Flexible handling of changes

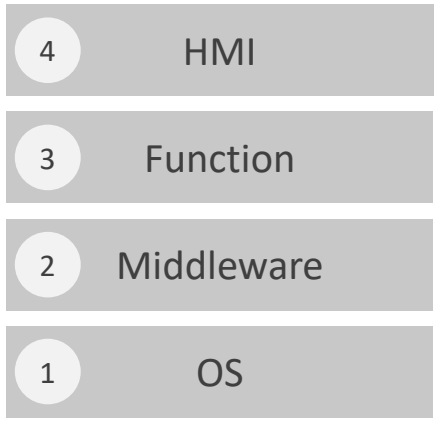
2 **Test and Validation**
- Analysis tools
- Validation processes

3 **Management of Software Variants**
- Reduction of software variants
- Total cost of ownership view

Agile and Lean Methods to Address Complexity and Change

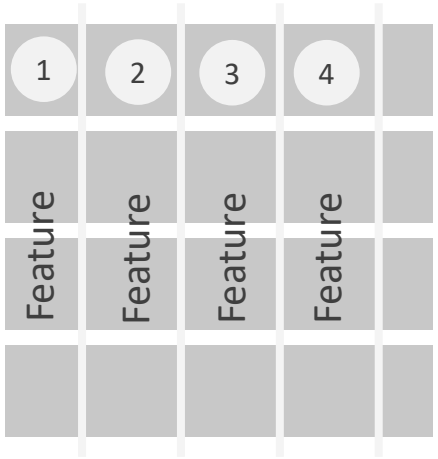
Sequential development

Software architecture often created in layers with long turnaround cycles



Incremental development

Focus on delivering features in short cycles



Agile and lean elements are already used today

- Continuous Integration, Continuous Delivery
- Test automation
- Daily (stand-up) meetings

Scaling agile methods for large projects

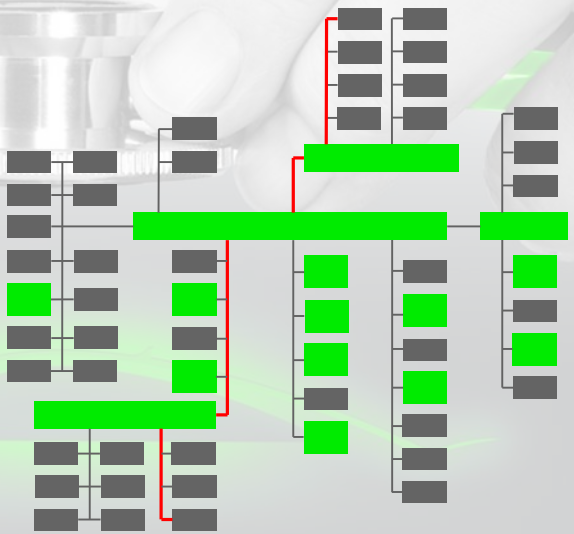
	Scrum-of-Scrum (SoS)	Scaled Agile Framework (SAFe)	Large Scale Scrum (LeSS)	Scaled Professional Scrum
Scale	Small	Med - Large	Enterprise	Small
Focal point	Team/structure Inter-team dependencies	Org. descaling, team/structure Agile thinking, PO scale via "areas"	Team/structure Customizable but prescriptive framework	Scrum concepts and mindset at scale

HMI: Human Machine Interface, OS: Operating System, PO: Product Owner

Right Tools to Analyze HPCs?

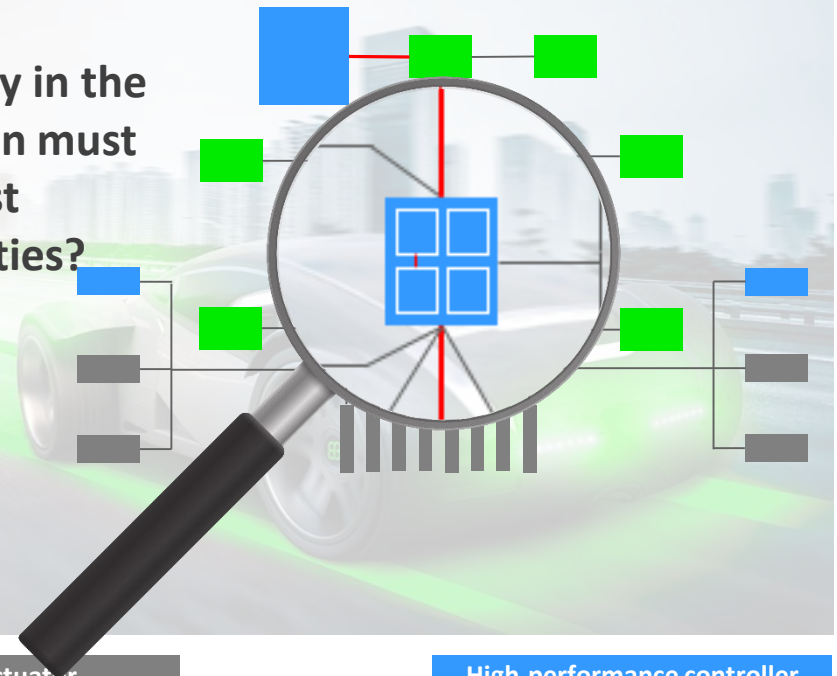
- Model-based testing
- Communication protocol tests
- Restbus simulation
- Hardware-in-the-loop tests

» **Wide range of established tools and processes**



Only few hardware-in-the-loop solutions in the market

» **Which party in the supply chain must and can test functionalities?**



Classic ECU

Performance/Safety ECU

Sensor/Actuator

High-performance controller

Amount of Hardware Variants Increases Software Costs

Variation of hardware requirements for HPC

Processor variants

- 2 Micro processors
- 1 Micro controller, 1 micro processor
- 1 Micro controller, 1 micro processor, 1 GPU
- 1 Micro controller, 2 GPUs

Performance

- 10k … >100k DMIPS

Network

- 1-16 CAN buses
- 8/24 LIN buses
- 0-8 FlexRay buses
- 1 … 7/11/20 Ethernet ports

Successful Introduction of Software Platforms for HPC Needs…

1. **New methods** e.g. incremental development to cope with complexity and changes
2. **Aligned tools to analyze and validate** software and behavior of HPC
3. **Active management** and reduction **of software variants and total cost of ownership view** on software

Thank you.

Questions?

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