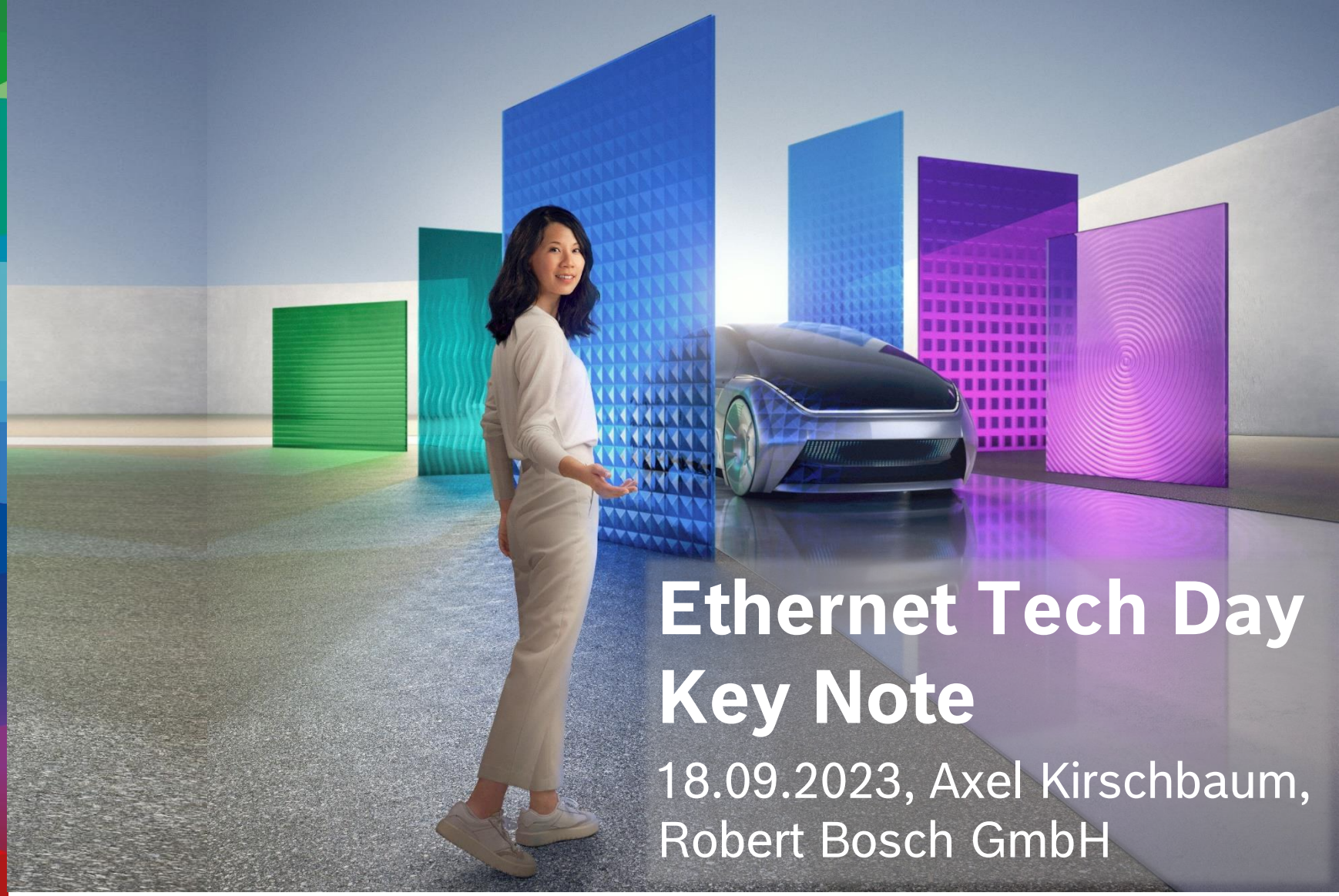

Ethernet Tech Day Key Note

18.09.2023, Axel Kirschbaum, Robert Bosch GmbH

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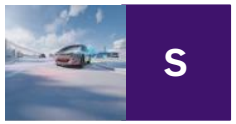
SW driven, Personalized, Automated, Connected and Electrified cars need new E/E-architectures to address important needs

SPACE changes… → **…customer and OEM needs; which needs to be addressed by…** → **…a new E/E-architecture**



Software & Services

Personalized

Automated

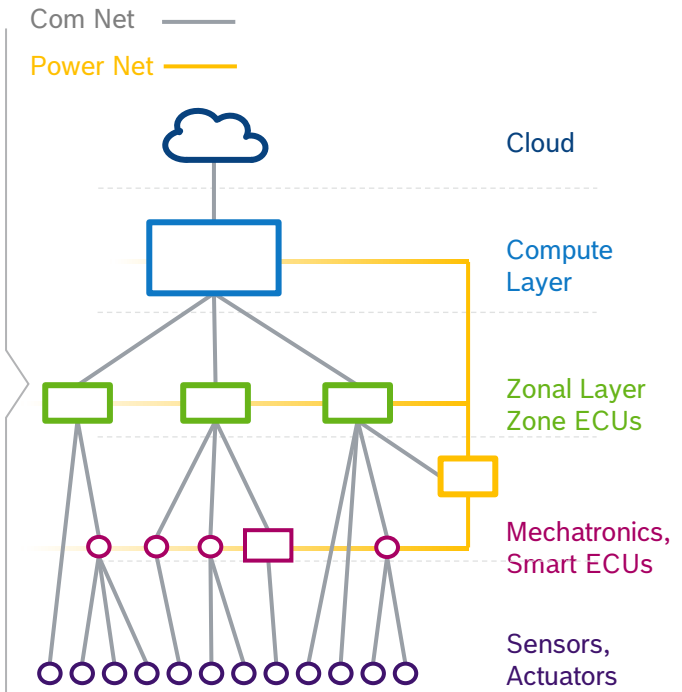
Connected

Electrified

- Fast and easy integration of updates, upgrades / new features
- Security & Safety (ensure freedom of interference, OBD, …)

- Manage EE architecture complexity
- **Get ready for the future!**
  Enable SdV!
- Enable UX features and smarter vehicles with deep in vehicle data access

- Improve multi-party collaboration for cross-domain features
- Resource efficiency (power consumption, weight, size, bus-load, memory, …)



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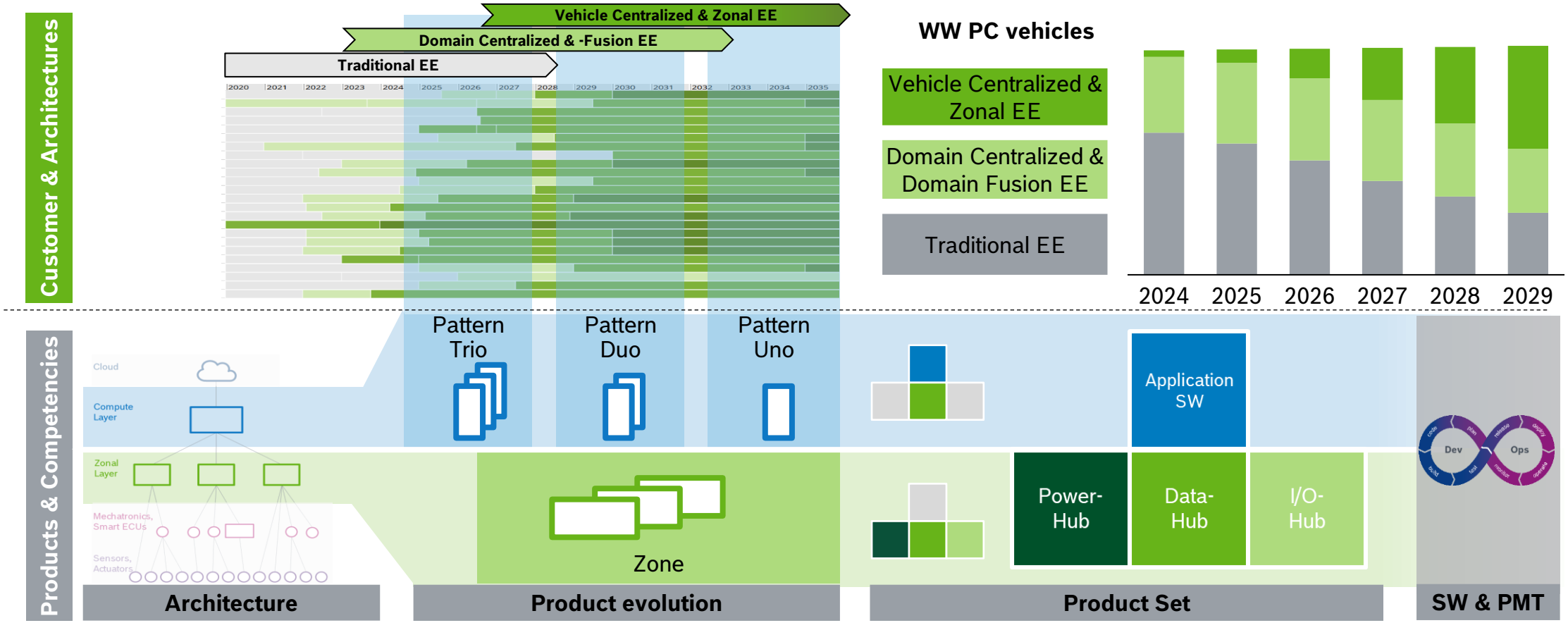
E/E-Architectures & product evolution towards “True North”
Vehicle Centralized & Zonal EE



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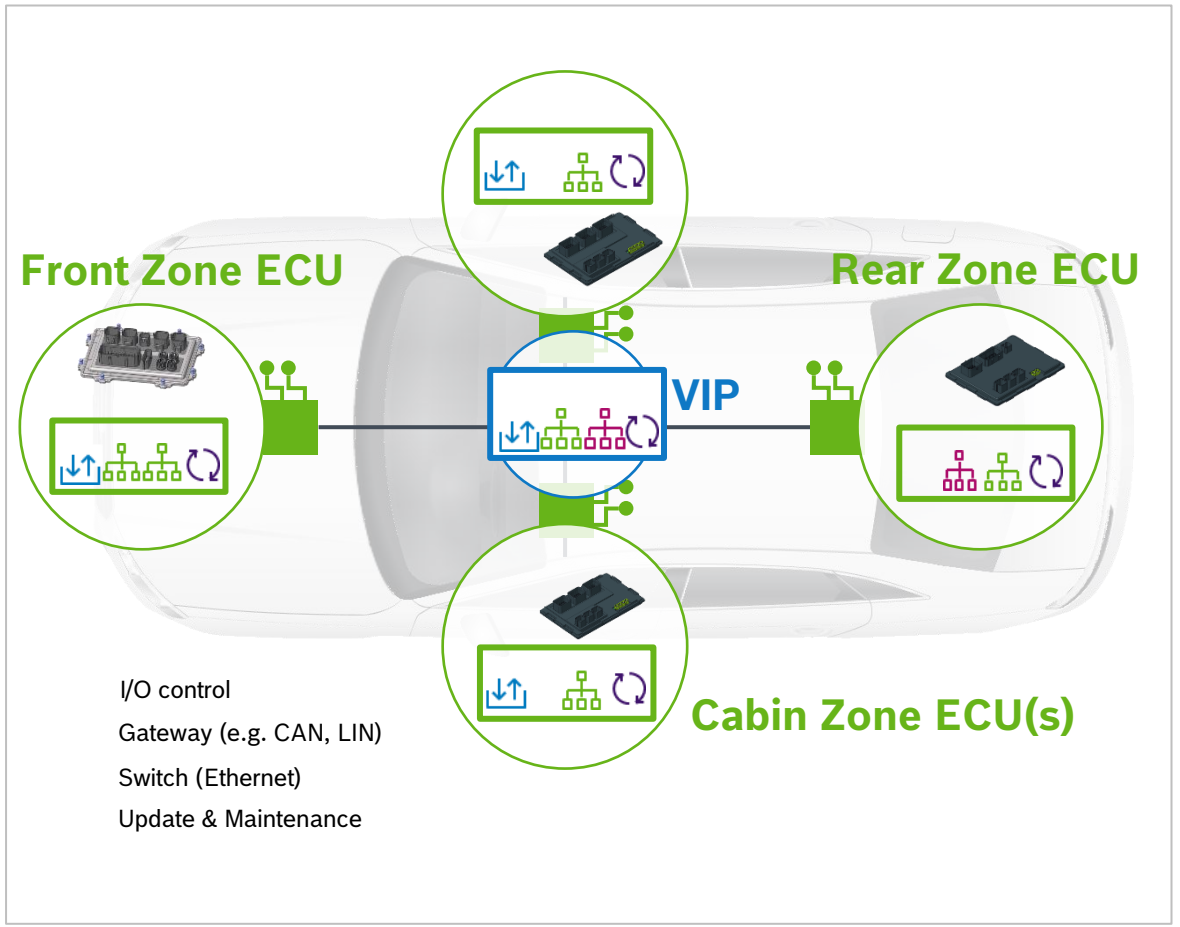
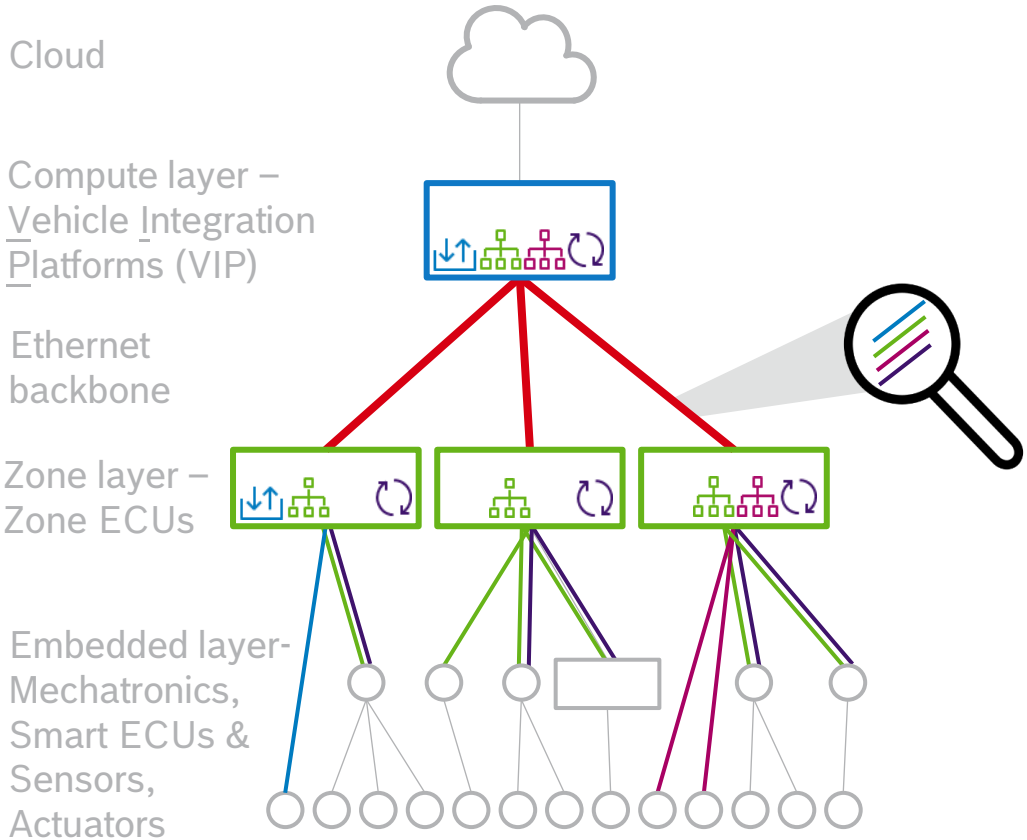
Prerequisite for performant, safe, secure OPs of Zone architecture is best ComNet performance between VIP & Zone ECU





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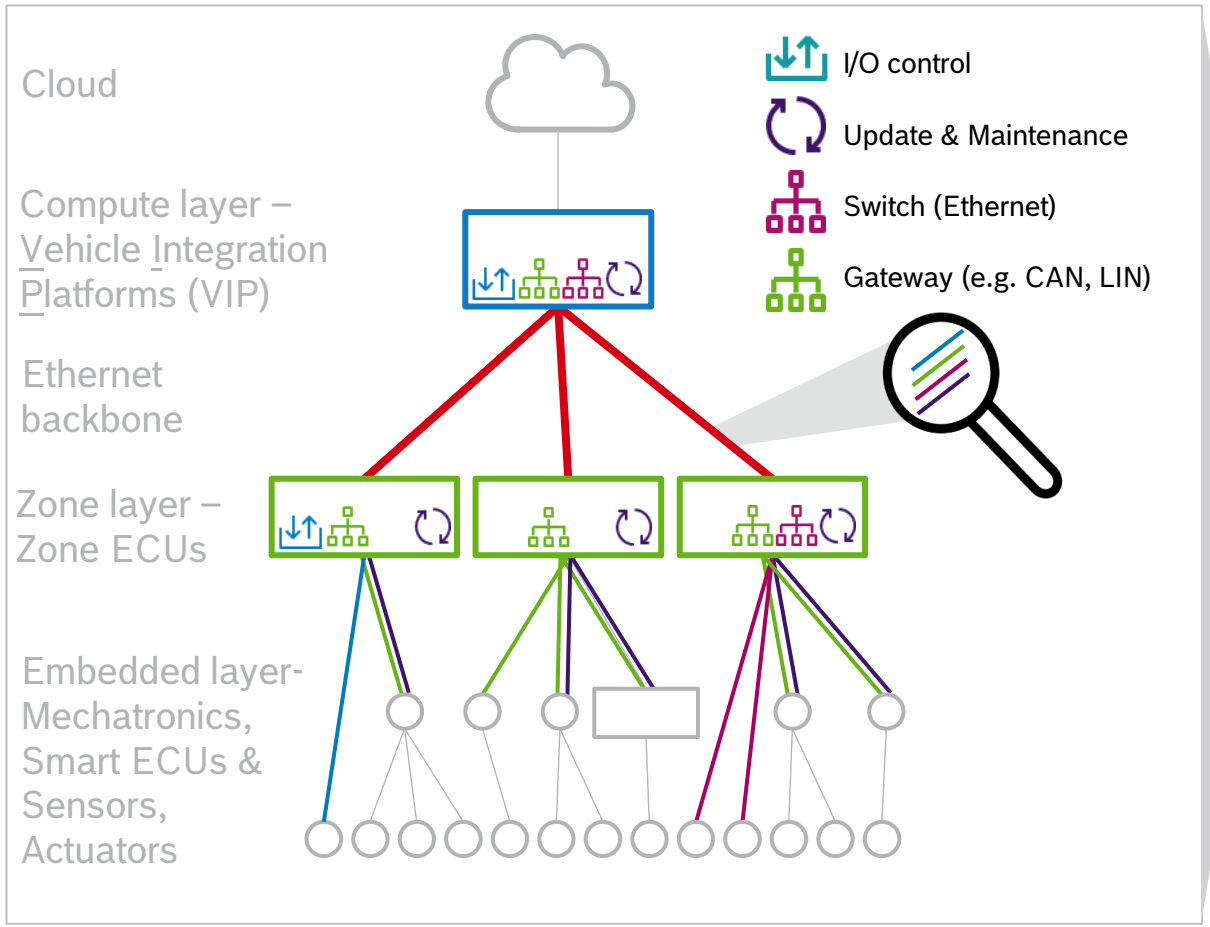
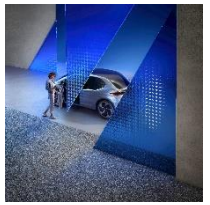
Single Ethernet backbone – different communication patterns



Data and Services

HW Acceleration / Routing



Configuration / Flexibility

Design and Simulation

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Data and Services

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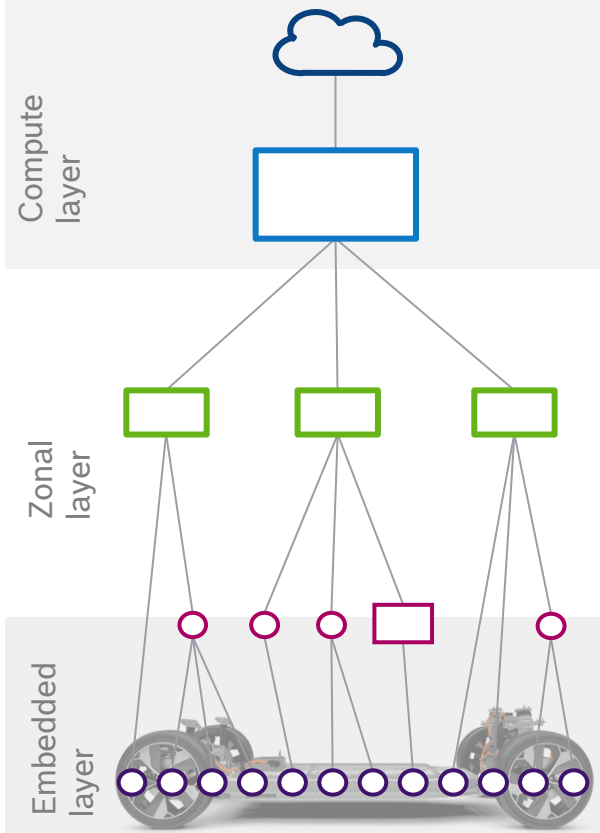
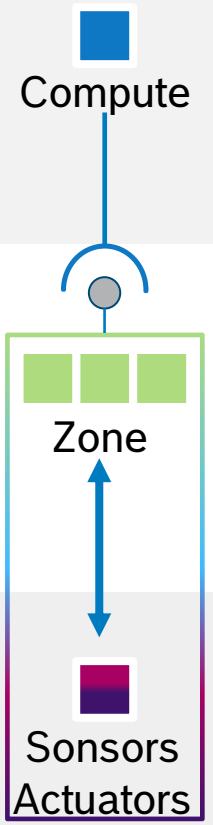
Data and Services

Architectural Layers



Data abstraction



Realize SDV
Centralize applications
Establish functional layer
Enable UX
Concentrate compute power

Function

Abstraction

Multiple data streams
with various protocols & physical layer
(CAN, LIN, Ethernet)

Vehicle

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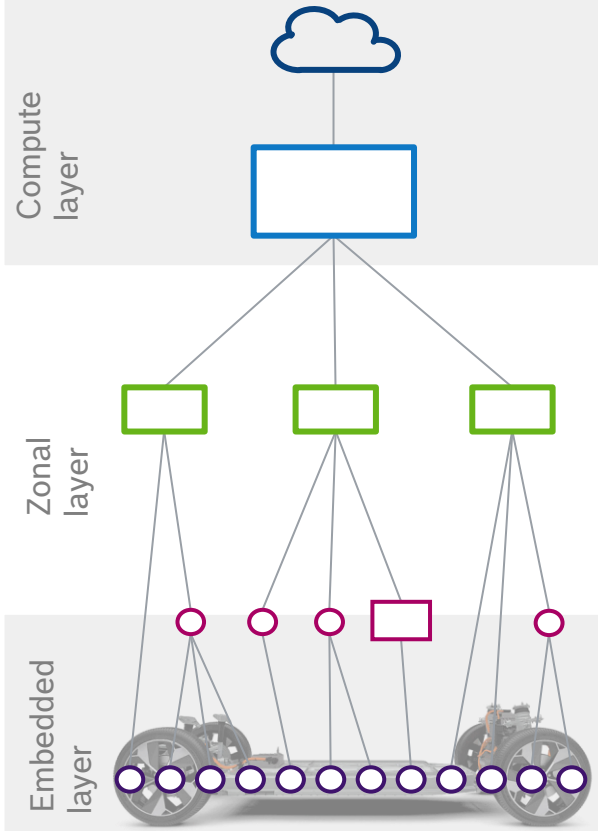
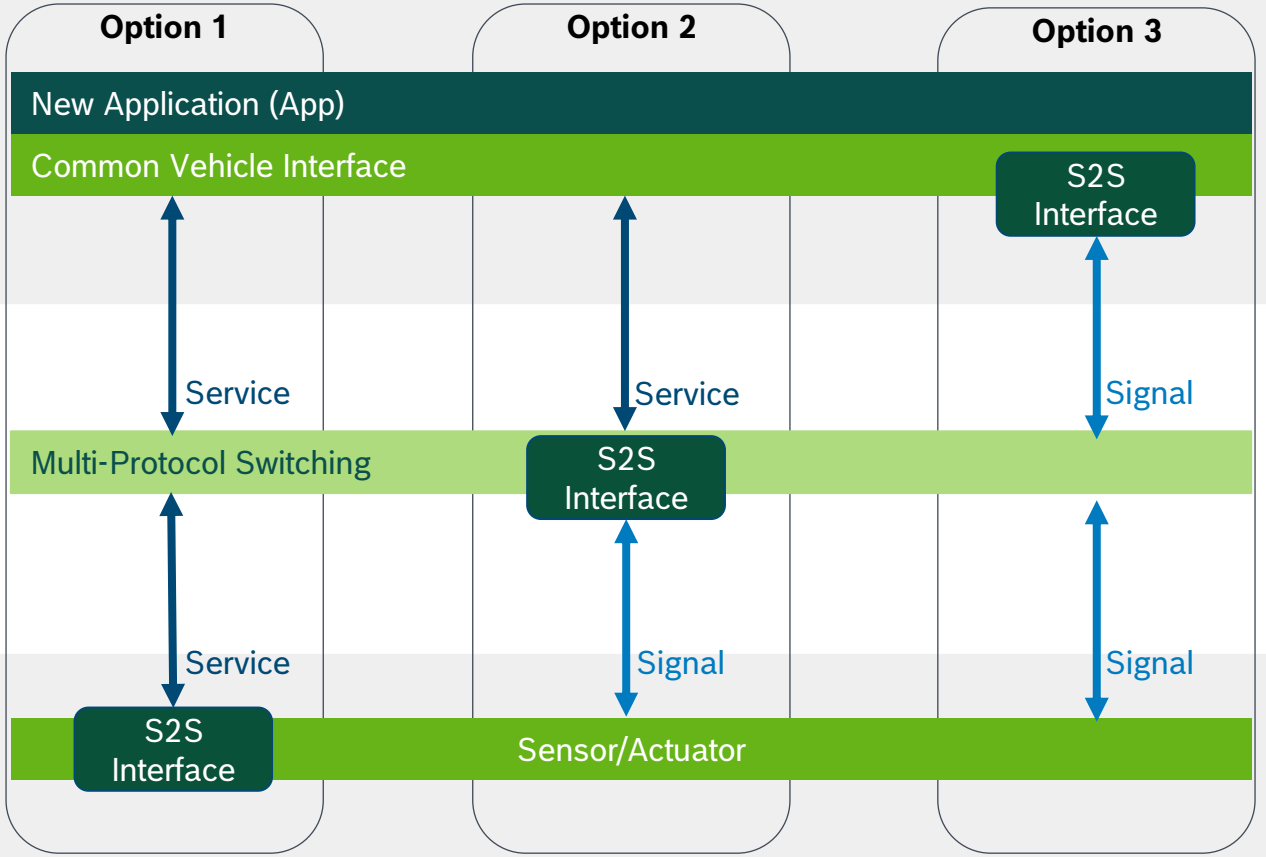
Options for S2S interface

Architectural Layers



Solution space for S2S interface



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HW Acceleration / Routing

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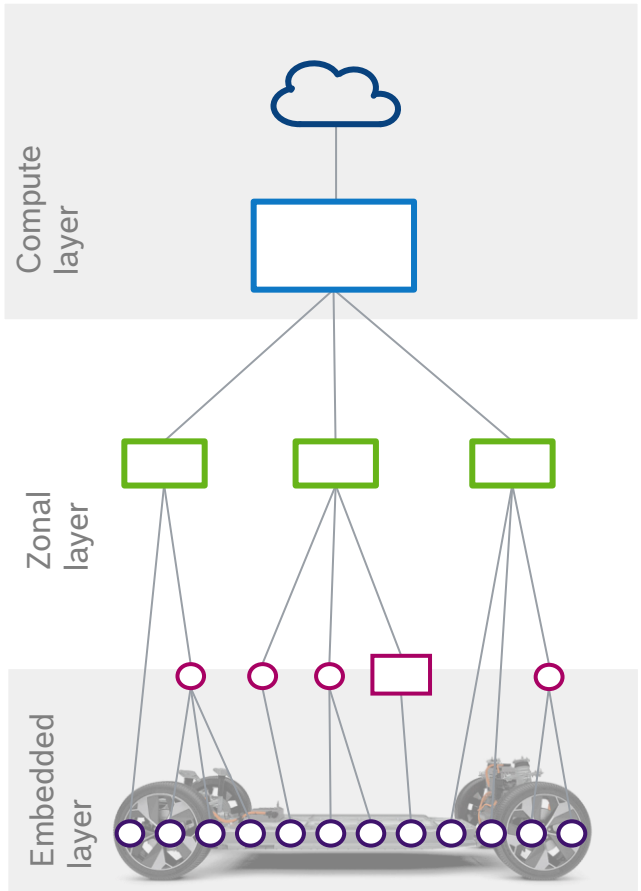
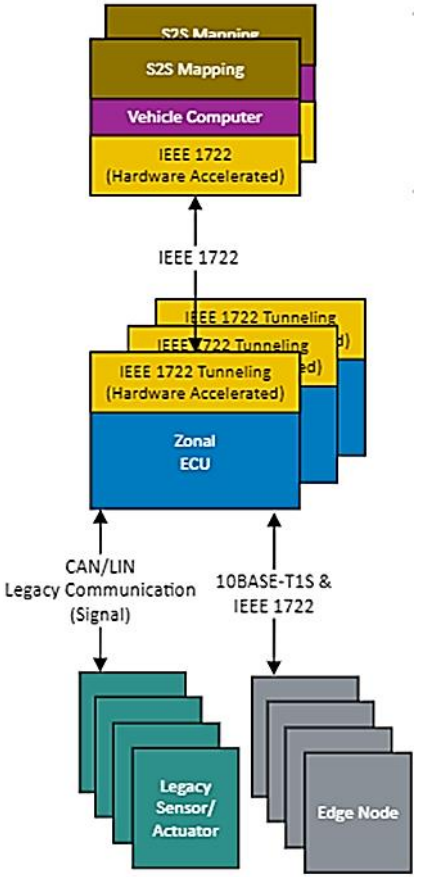
HW acceleration and 1722 enables QoS in communication

Architectural Layers



Signal Routing



- HW accelerator embedded in Switch or SoC
- DMA to De-capsulate 1722 streaming data

- Transparent connection of data rich sensors through ETH switch
- HW accelerated en-/de capsulation of various data/bus types
- Tunnelling of legacy communication (CAN/LIN) via IEEE1722-2016, released in R23-11 in Classic AUTOSAR

Samples for key components 2023

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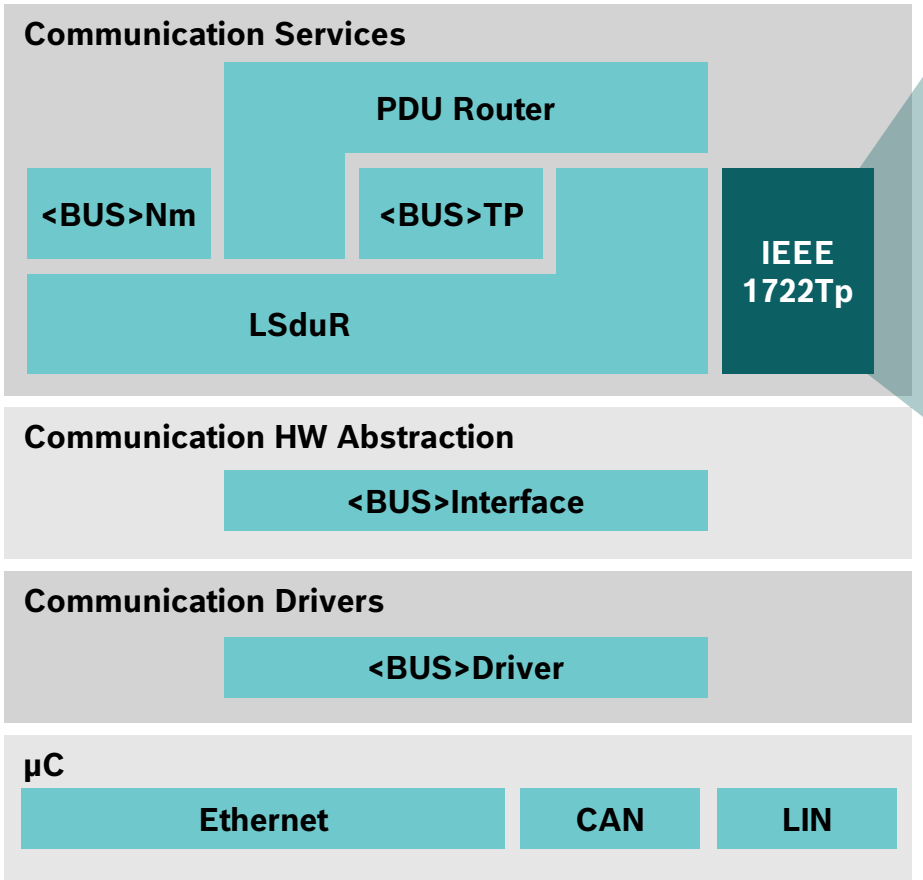
AUTOSAR and IEEE 1722 – Classic Autosar

AUTOSAR – New architecture w/integrated 1722 module



1722 software module (IEEE1722Tp) and model in supports

- Time Reference Plane (Presentation Time, including AVB/TSN mechanism)
- Audio/Video, e.g. IEC 61883/IIDC Format, AVTP Audio Format
- Tunnelling of control data (ACF)
- Clock Reference Format

In addition “Concept 710” introduces a new way of communication in Classic AUTOSAR

- Zero-copy Ethernet driver
- Streams and deterministic communication as a complete system solution

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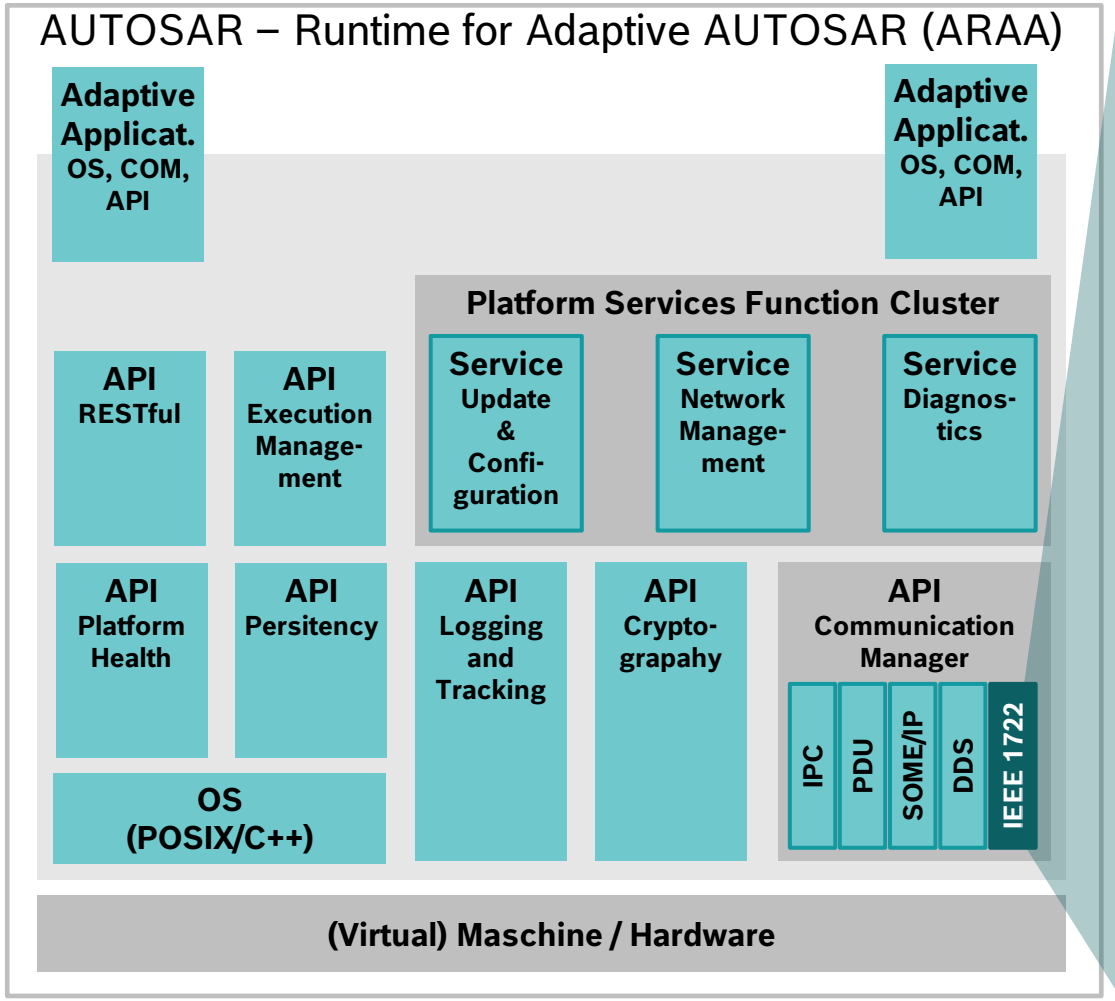
AUTOSAR and IEEE 1722 – Adaptiv Autosar (target)



Start a new project or initialize a new part(s) in Concept 710 to define

- IEEE 1722-2016 software module and interfaces to the communication manager for tunnelling of legacy communication
- Based on meta information (e.g. Tspec) a dynamic and static network management configuration for an Ethernet MAC (meta info shall be the same as in CP) in Adaptive AUTOSAR

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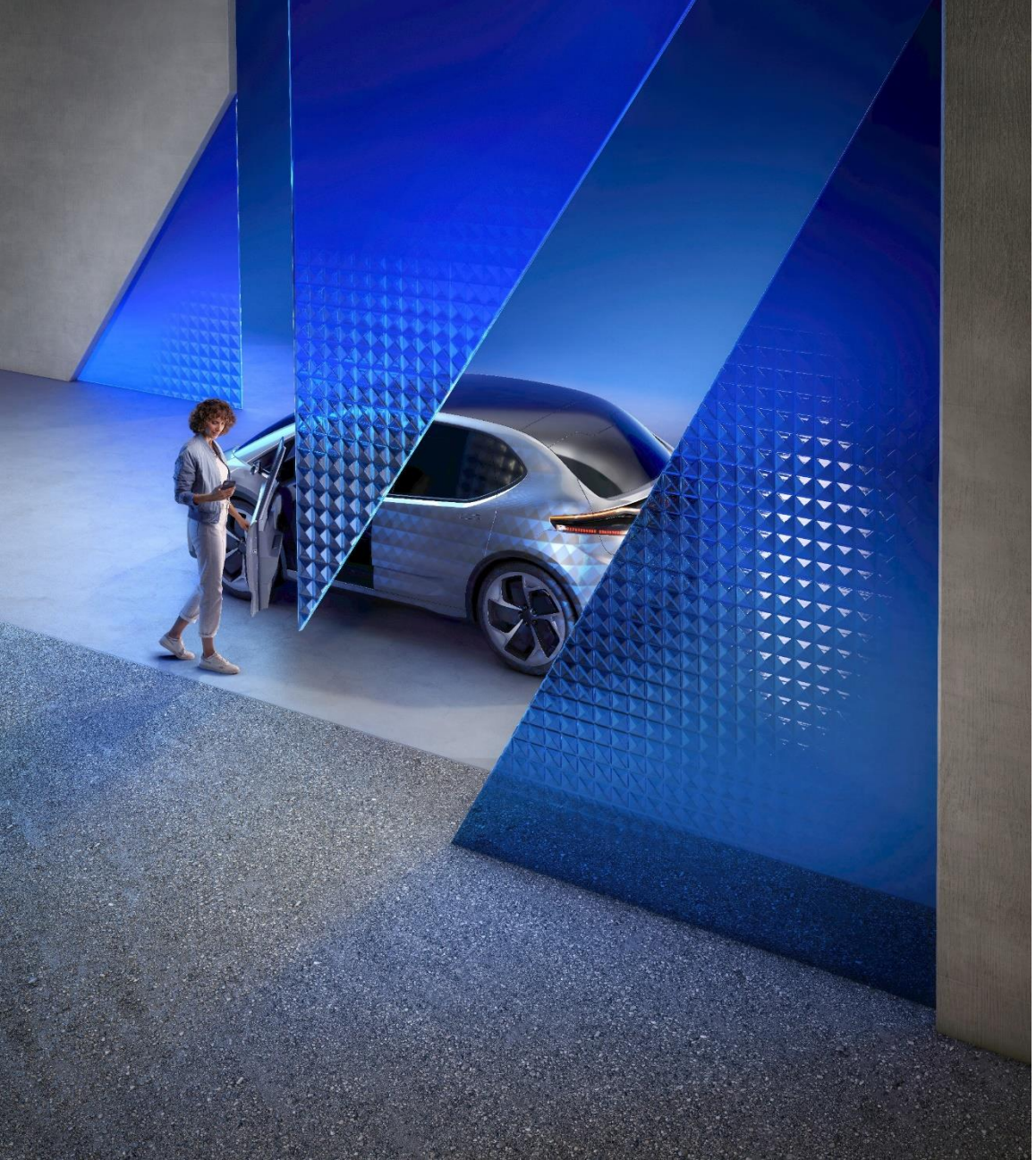
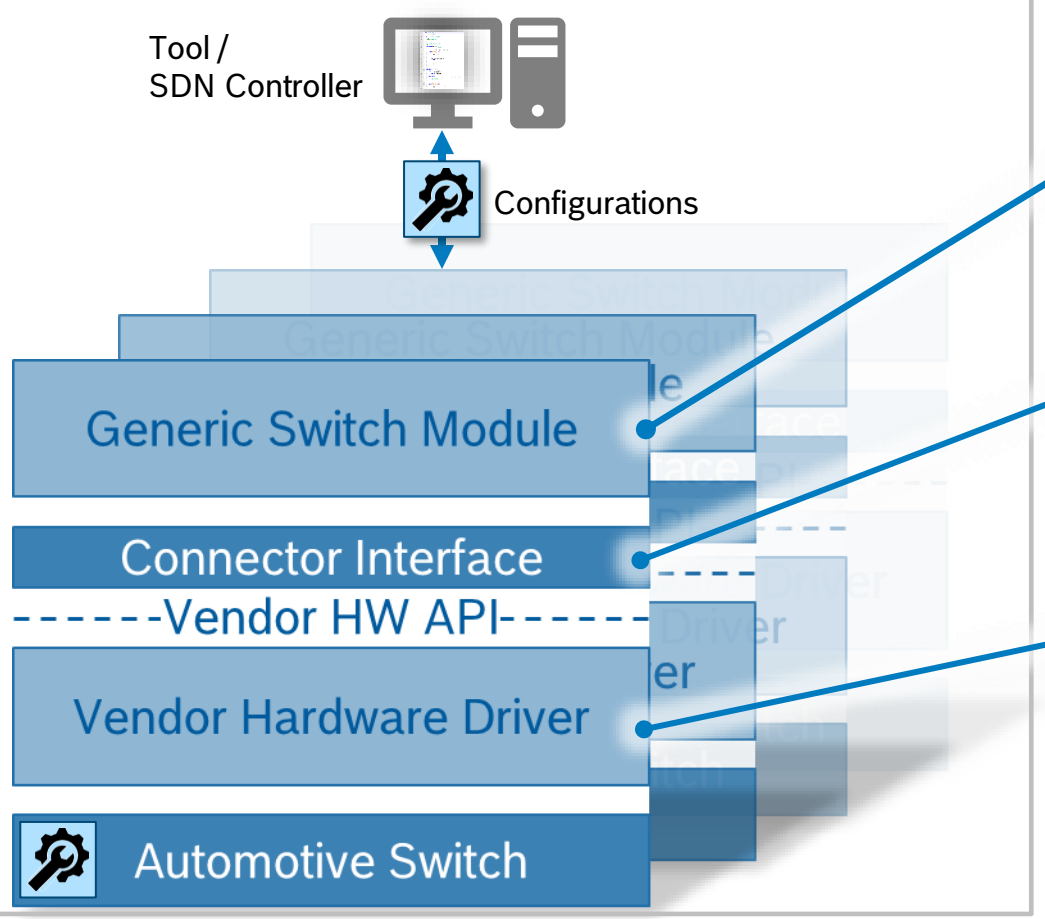


Configuration / Flexibility

BOSCH

Generic software on bridge devices

Concept overview - component Level



Embedded SW Layers on each component

Generic Switch Module

Protocol parsing, abstract switch model handling and read/write data

Connector Interface

Interface layer between generic layer and the physical hardware layer

Vendor Hardware Driver

Hardware driver to get an easy access to the whole register of the switch hardware in responsible of switch vendor

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Configuration & flexibility, SDN

System level overview

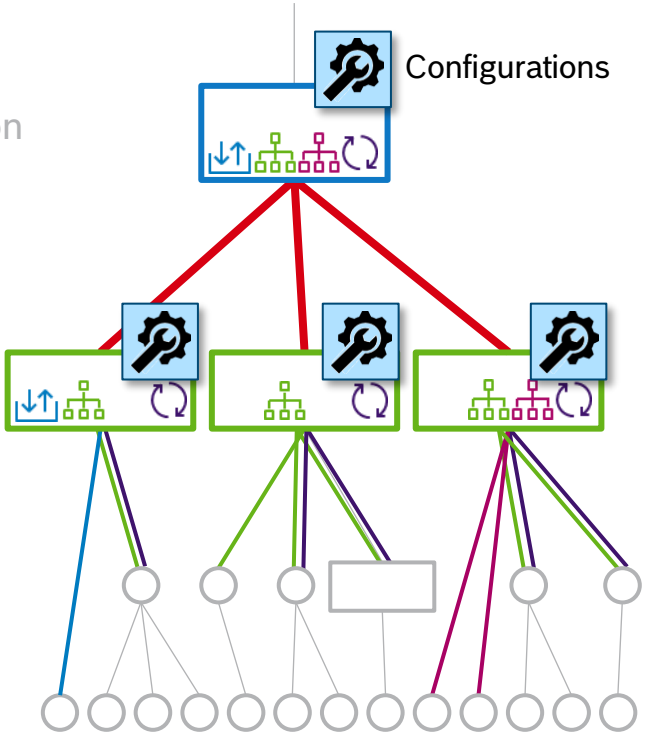
Cloud

Compute layer – Vehicle Integration Platforms (VIP)

Ethernet backbone

Zone layer – Zone ECUs

Embedded layer- Mechatronics, Smart ECUs & Sensors, Actuators



Components to enable automotive SdN

- SdN capable ETH HW
  - Dynamic reconfiguration of COM Net
- Configuration tooling
  - Ethernet bridges and End-stations (µC / µP)
- ASW with SdN support
  - Functions with active SdN config requests
- Com Net design and test concept
  - Support of dynamic configuration and test / analyze concept on system level wrt. SdN

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Design and Simulation

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Design / Simulation

System Design

Enterprise Architect, Preevision, PPT, XLS, Visio

Network Planning

Mapping communication demands to topology and comm. system wrt new technologies 1722, TSN. Generation of Network Configuration.

Network Simulation

Refinement of Network Configuration.

Network Configuration

Deployment of network configuration using standardized models w/o software dev.

Network Testing and Debugging

Test framework with mutligig TSN based networks for entire ComNet

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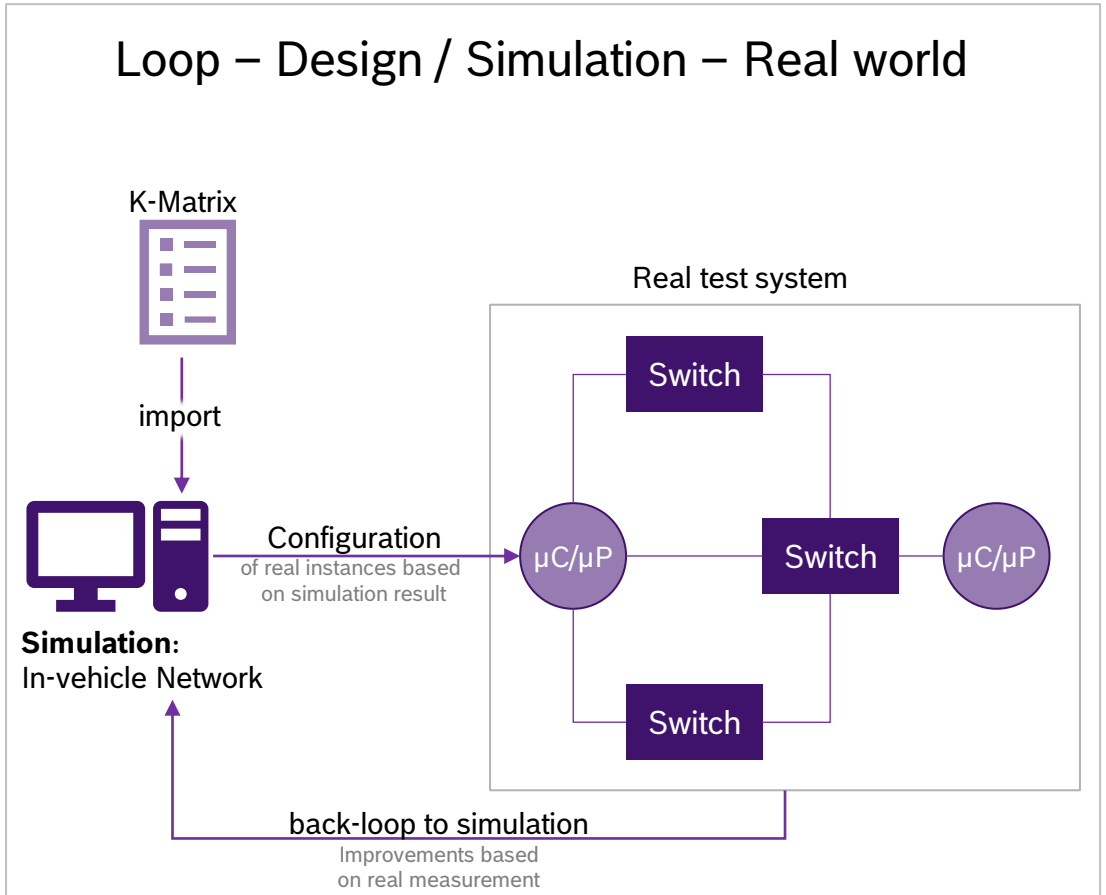
Hardware-in-the-loop: From simulation to real hardware



- Based on the concept of Software-defined networking (SDN), a generic configuration deployment of bridges and end stations is possible
- In combination of in-vehicle network simulation, deploying the results of the simulation (configuration of end-stations, bridges) via SDN mechanism and verifying the real behaviour, an automatic testing would be possible
- Finally, the results of the real hardware measurement can be used to improve the simulation tool

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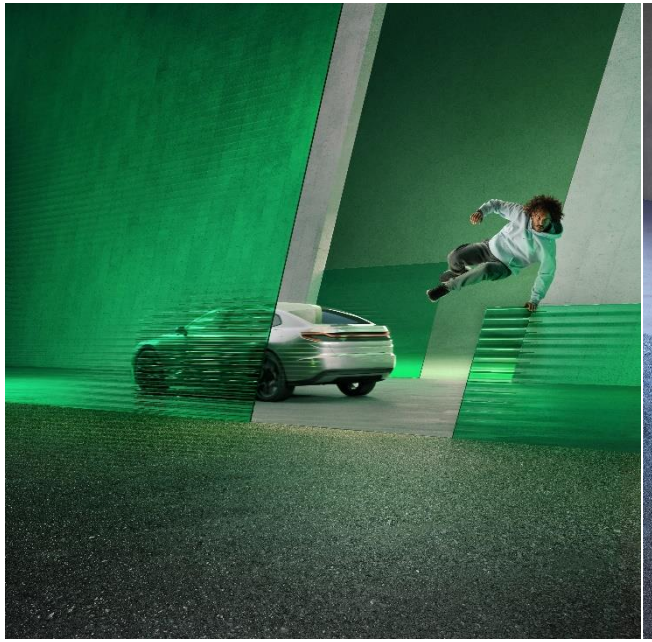

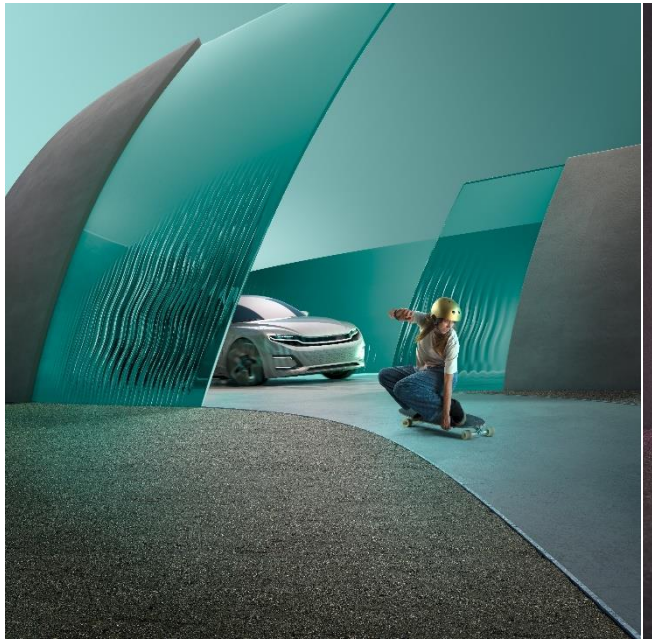
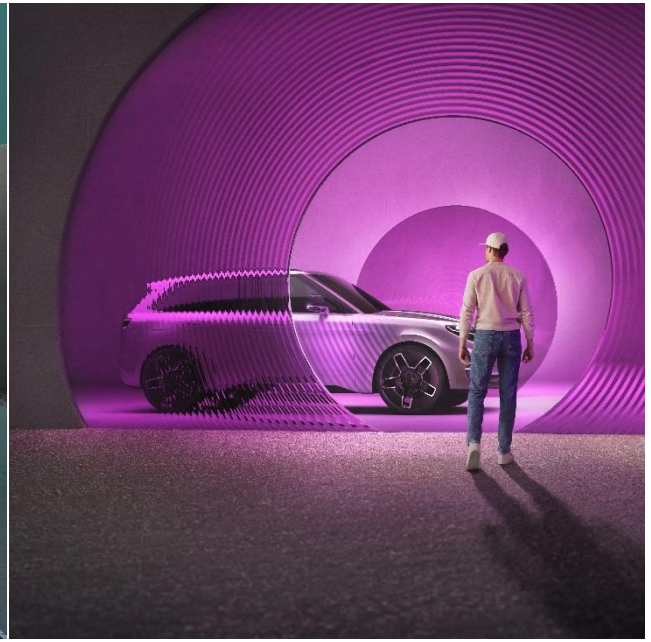

Wrap Up

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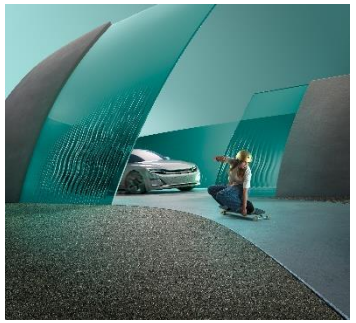
Data and Services

- SdV pushes introduction of centralized architectures
- Functional differentiation requires S2S mapping on “right” layer



HW Accelerating and Routing

- HW acceleration and 1722 enables QoS in communication
- AUTOSAR classic specifies 1722 with deterministic communication - first release Nov’23
- Target to introduce 1722 with deterministic communication in AUTOSAR adaptive (2025ff)

Configuration / Flexibility

- SW configuration for automotive Ethernet devices needs to be standardized
- Future COM networks has to be Software defined

Design and Simulation

- Network simulation required for realize stable and performant COM Net solution
- Closed loop approach between design – simulation and physical set up of COM Net

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ETHERNET & IP @ AUTOMOTIVE TECHNOLOGY DAY

19-20 September 2023 | São Paulo, Brazil