Automotive Ethernet Congress 2021

Keynote: Service-Oriented Architecture Chances and Challenges

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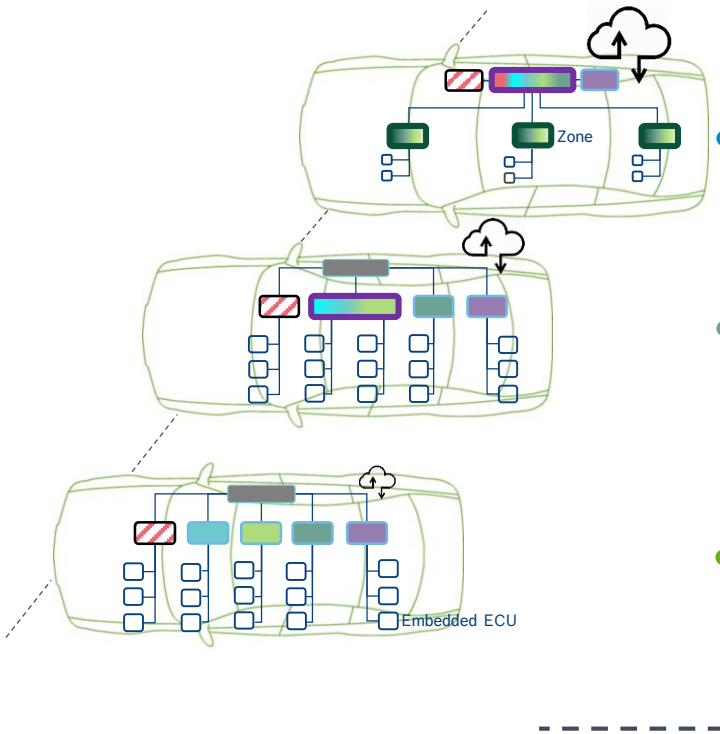
Agenda

- Introduction
  - Evolution of the Automotive E/E Architecture
  - Why do we need services?
  - What are the automotive companies thinking about SOA
- Chances and Challenges
  - Signal to Service conversion: On which level?
  - Migration of signal based effect chains
  - Syntax vs. semantics – or the towers of babel
  - How to approach and monetarize
- Summary

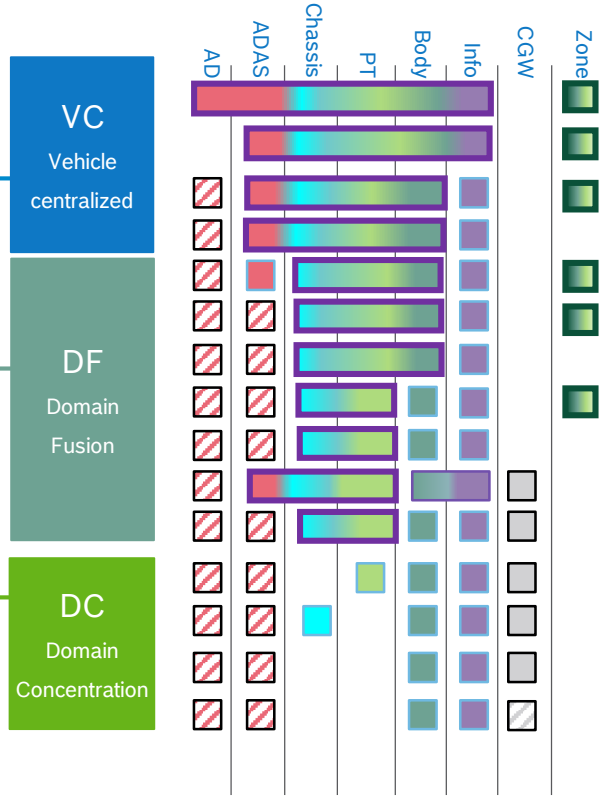
INTRODUCTION

Introduction
Evolution of the Automotive E/E Architecture

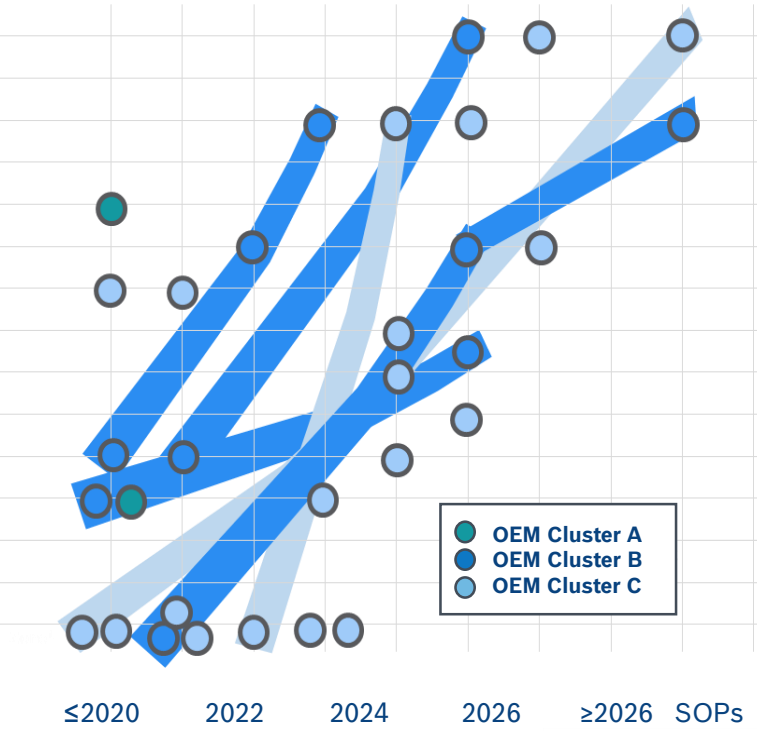
E/E Evolution



Funct. E/E Patterns*



OEM Evolution / Revolution hikes



*Shared housing concepts not shown

ECU: Electrical Control Unit; AD: Autonomous Driving; ADAS: Advanced Driving Assistance System; PT: Power Train; CGW: Central Gateway; OEM: Original Equipment Manufacturer; SOP: Start of Production;

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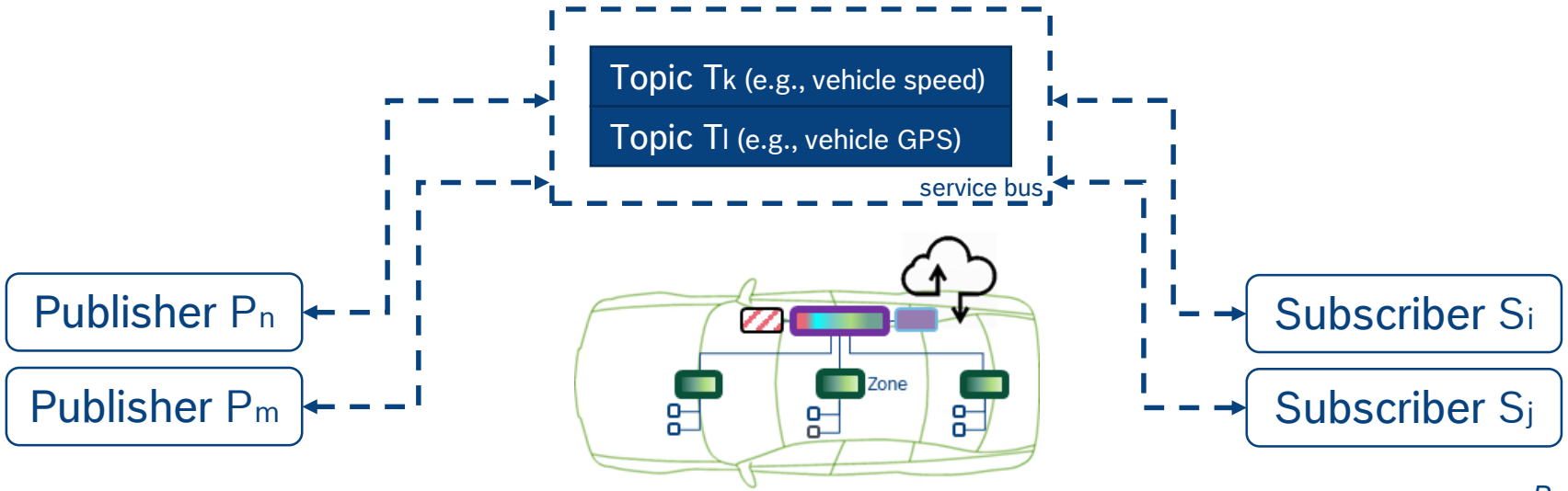
Introduction
Why do we need services?

Service Oriented Architecture (SOA) is a way to do the abstraction between hardware and software.

“Its principles are independent of vendors and other technologies, where services are provided by application components, through a communication protocol over a network.”*



Pub/Sub example

Services will complement the signal world and facilitate the introduction of cross-domain high level features

* https://medium.com/@SoftwareDevelopmentCommunity/what-is-service-oriented-architecture-fa894d11a7ec

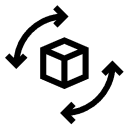
Introduction
Why do we need services?

Possible basic advantages for automotive Service Oriented Architecture (SOA):

Enables Abstraction
HW from SW and Signal from Service

Automated communication discovery
Generic determination of communication relations during assembly

Software update / upgrade
Service Discovery enables utilization of max. available features provided by embedded layer



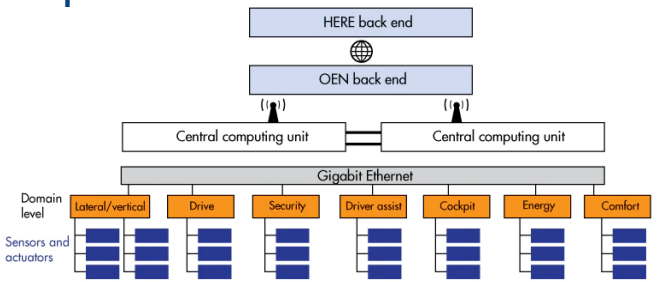
Update / Replacement of sensors / actuators / ECUs (e.g., extended functionality, enhanced quality)
Down-upwards compatibility by service negotiation

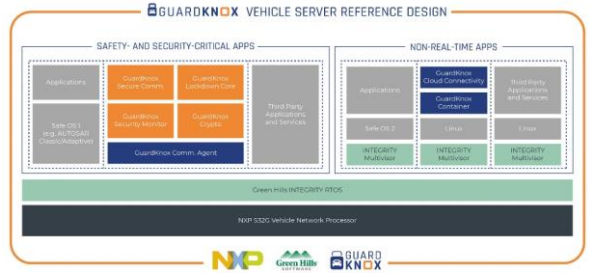
Backup/Redundancy (e.g., backup functionality provided by another network device)
Failure detection and disabling of service
Replacement of service (Backup)

Scaling
Reuse of sensors / actuators / ECUs within different platforms
Reuse of software implementation within different environments

Introduction
What is the automotive industry thinking about SOA?

Just a glimpse…

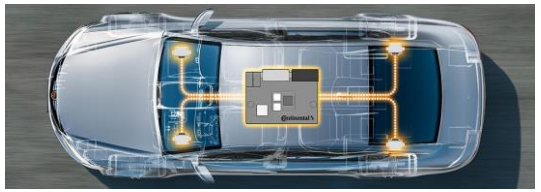




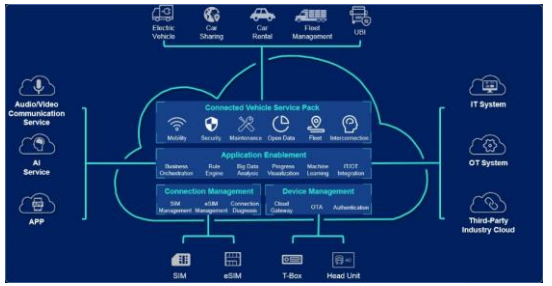
"BMW and Audi want to separate vehicle hardware from software. Two leading carmakers are leading the charge to develop new electronics architectures."*

"GuardKnox, NXP, and Green Hills Software partner to develop advanced, secure automotive platform … enabling commercial deployment for software-defined and service-oriented vehicles. "**

"Continental's new server concept is a central element for the conversion to a service-oriented electronics architecture in highly connected ID. electric cars."****



"Huawei considers that the achievement of SDV (software-defined vehicle) plays a key role in the revolution of automobile industry."***



* https://www.electronicdesign.com/markets/automotive/article/21804988/bmw-and-audi-want-to-separate-vehicle-hardware-from-software
** https://www.prnewswire.com/news-releases/guardknox-nxp-and-green-hills-software-partner-to-develop-advanced-secure-automotive-platform-for-the-next-generation-of-vehicle-architecture-301174541.html
*** https://www.huawei.com/minisite/iot/en/vehicle-networking.html http://autonews.gasgoo.com/china_news/70017444.html
**** https://www.continental.com/en/press/press-releases/2019-11-12-icas-vw-199636

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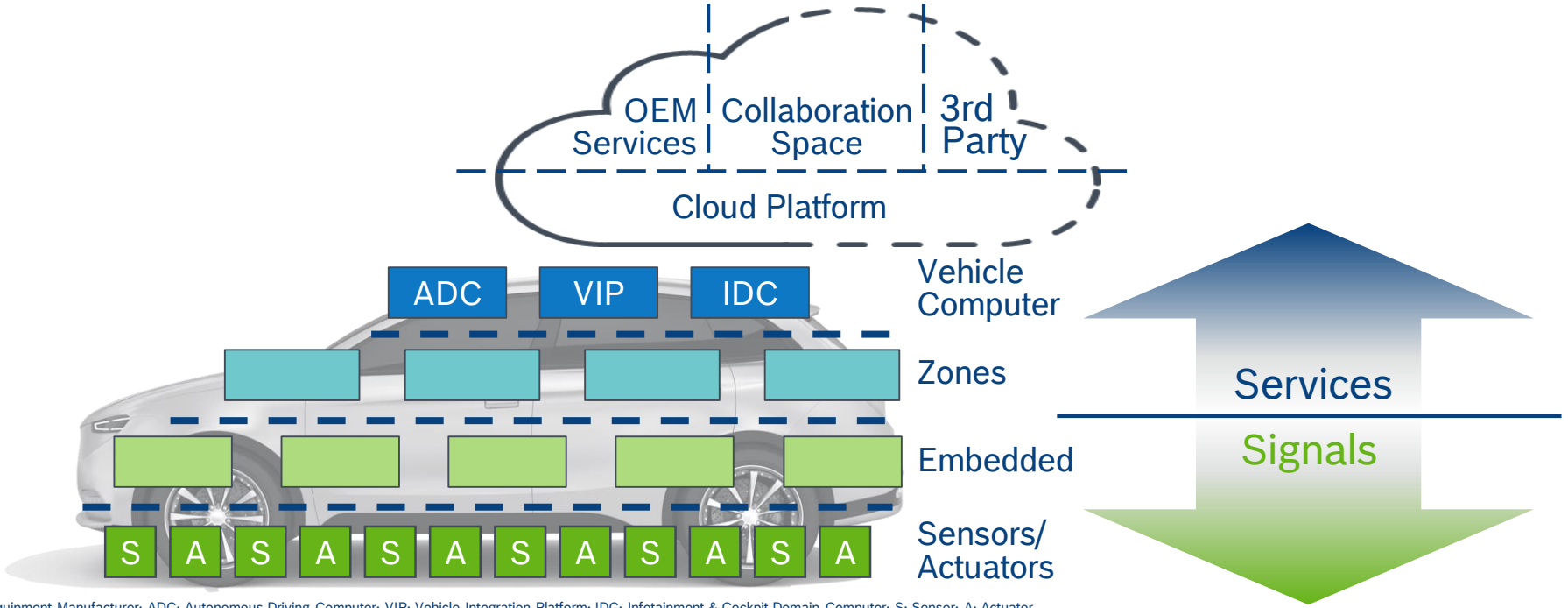
CHANCES AND CHALLENGES

Chances and Challenges
Signal to Service conversion: On which level?

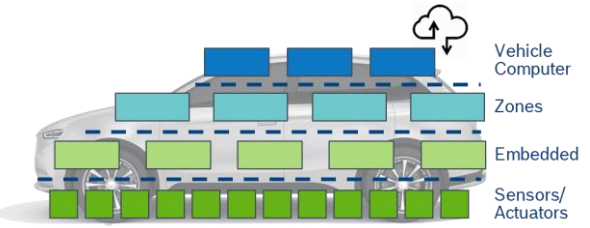
The point of translation could be located somewhere from the cloud to the Sensor/Actuators level.

Tradeoffs between the Signal to Service conversion level.



OEM: Original Equipment Manufacturer; ADC: Autonomous Driving Computer; VIP: Vehicle Integration Platform; IDC: Infotainment & Cockpit Domain Computer; S: Sensor; A: Actuator

Chances and Challenges
Signal2Service (S2S) conversion: On which level?



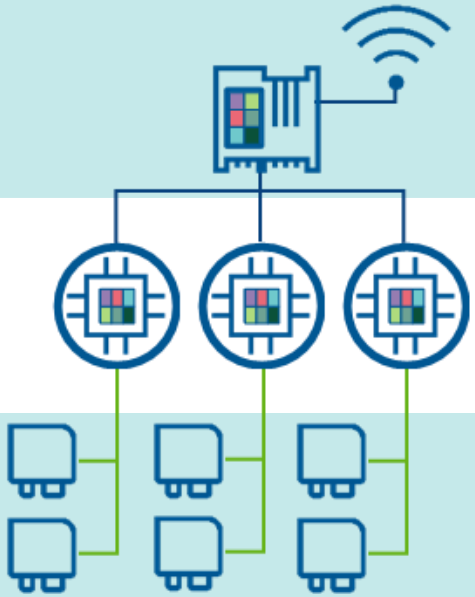
Technical Viewpoint

Logical Viewpoint

Integration Platform Layer

Vehicle/Zone Control Layer

Embedded Layer



Option 1	Option 2	Option 3	Option 4
New Application (App)			S2S Interface
Common Vehicle Interface (CVI)		S2S Interface	CVI
Service	Service	Signal	Signal
Multi-Protocol Switching	S2S Interface		
Service	Signal	Signal	Signal
S2S Interface	ECU		
Service Native in embedded ECU	Signal to Service interface in Zone	Signal to Service interface in CVI	Signal to Service interface in App

Eth Tech.
Bus Tech.

OEM: Original Equipment Manufacturer; HAD: High Autonomous Driving; VIP: Vehicle Integration Platform;
IDC: Infotainment & Cockpit Domain Computer; S2S: Signal to Service

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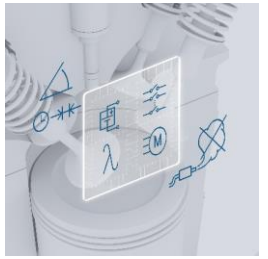
Chances and Challenges
Migration of signal based effect chains

Timing effects of the runtime environment influences the performance of signal based effect chains.

The migration of signals to services adds delay/jitter due to the SOA stack.

However, it is not necessary to migrate the whole signal effect chain. A separation of the functionality could be done having the best effort at the service level, and the hard controls loop at signal level.

Example: Powertrain driver characteristic



- Service: Driving mode (e.g., sport, comfort, and eco)
- Signal: Control loop of the Powertrain (low latency/jitter)

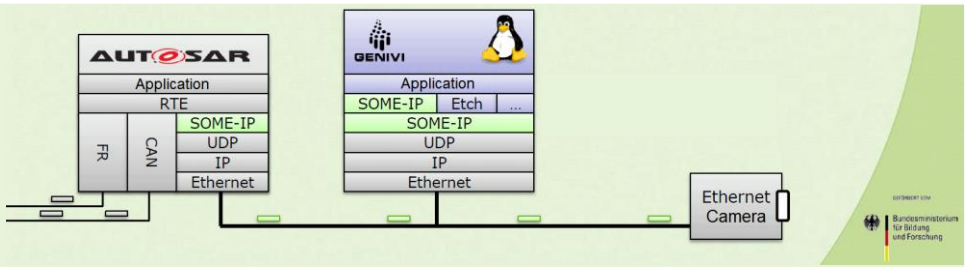
Chances and Challenges
Syntax vs. semantics – or the towers of babel

There is still no common definition for the services name and attributes.

Now is the time to discuss the interfaces definition, where there is already a synergy potential by the combination of todays open standards (e.g., AUTOSAR, GENIVI VSS VSC, SENSORIS, SOME/IP).

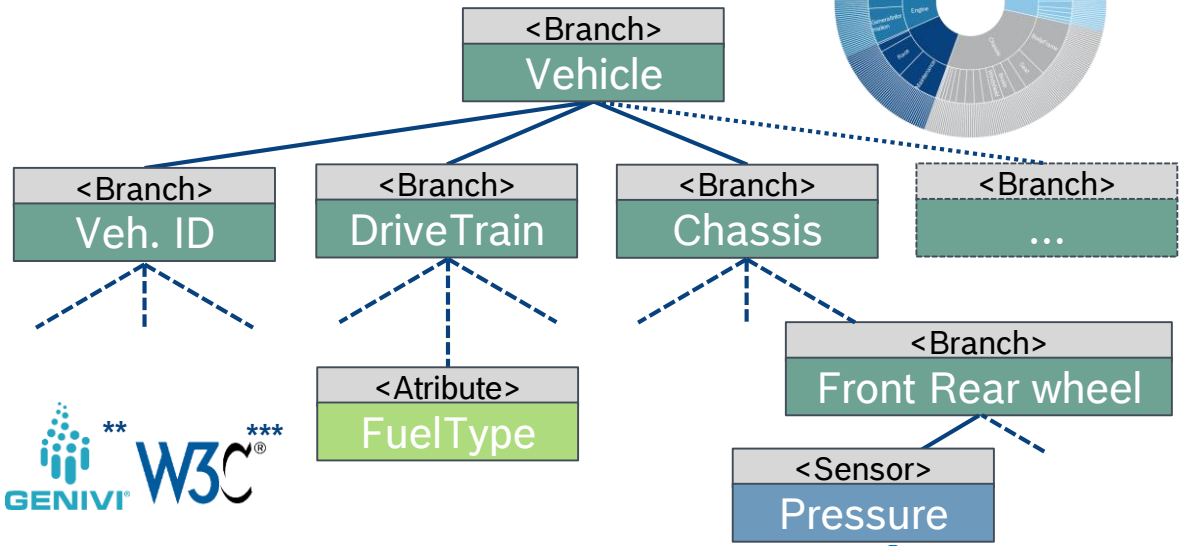
Possibility to have a standard for the harmonization of services in:

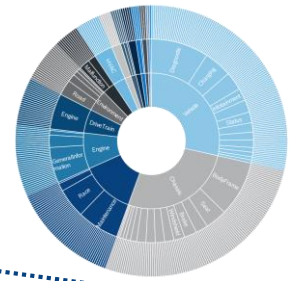
Syntax (e.g., SOME/IP*)



Event vehicleSpeed (UINT16 vehicleSpeed)
Method setVehicleSpeed(UINT16 vehicleSpeed) returns UINT16
Method getVehicleSpeed() returns UINT16

Semantics (e.g., VSS)





* http://some-ip.com/papers/2011-09-TP3_Ueberblicksvortrag.pdf
** https://at.projects.genivi.org/wiki
*** https://www.w3.org/;

VSS: Vehicle Service Specification;
VSC: Vehicle Service Catalog;
SOME/IP: Scalable service-Oriented Middleware over IP

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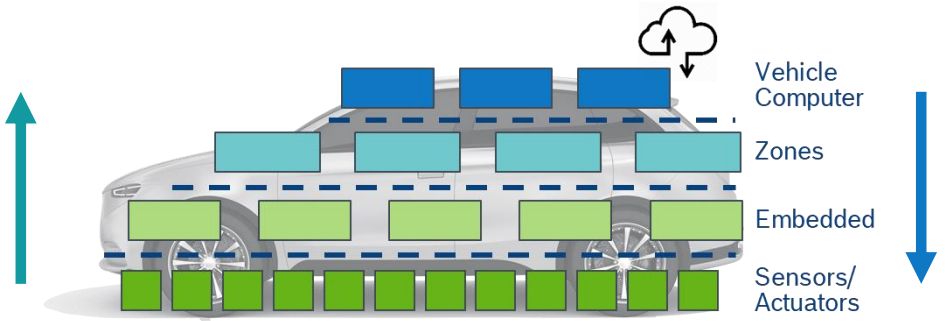
Chances and Challenges
How to approach and monetarize?

SOA should be gradually inserted.

Complexity to deal with legacy components for SOA implementation.

Two possible ways for integration:



Bottom Up: It is complex to adapt everything
Too many signals to evaluate
Probably not the best approach
Don't reinvent the wheel!

Top Down: Add things progressively, according the use case
On that way it is possible to gradually meet the current solutions
Probably a better approach

Chances and Challenges
How to approach and monetarize?

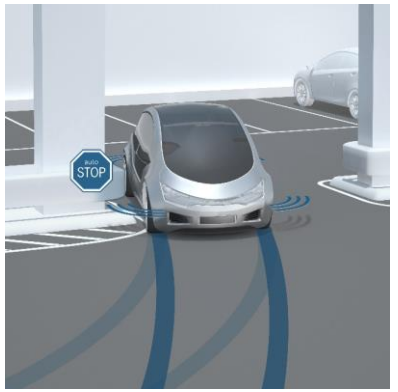
SOA enables new possibilities for automotive use cases and monetarization

However, which feature should be implemented first?

Cloud Services | Apps | Events → Coupling Intensity

New cloud based features
(e.g., fleet management, door control system*, and digital twin)

Apps enable flexible utilization of provided functionality



Events ensure appropriate reaction for each situation

* https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/eipatd-presentations/2020/D2-02-Sim-Service-Oriented-Gateway-Connecting-Automotive-Ethernet-and-Cloud-for-Eff.pdf

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SUMMARY

Summary

Service Oriented Architectures are neither new nor very complicated.

Automotive Ethernet enables Hardware Software abstraction via open standardize vehicle interface (e.g., GENIVI CVII).

The automotive industry is mobilizing to reach its full potential.
Most of the items and challenges to tackle the SOA dream were covered on the conference talks.

So far we had:

- Multi-gig Ethernet
- Common vehicle interfaces
- Quality of Service (TSN, Security, Safety)
- EMC design

Coming next:

- Switch/PHY design
- 10BASE-T1 Ethernet

CVII: Common Vehicle Interface Initiative; TSN: Time Sensitive Networks; EMC: Electromagnetic Compatibility; PHY: Physical Layer

Thank you for your attention.
Questions?

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