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標準化視点での車載組み込みソフトウェアの動向

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ISO TC22 SC32 Chair, AUTOSAR regional spokesperson Japan

Agenda

- 導入
 1. SDV(Software Defined Vehicle)のミニマム要件
 2. E/Eアーキテクチャの動向
 3. 必要な要素技術
 4. SDVに関する標準化活動
- 各標準化活動の動向
 1. AUTOSAR & COVESA
 2. SOAFEE
 3. Eclipse SDV
 4. ISO

Software Defined Vehicle (SDV) のミニマム要件

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簡単にいえば、

「主要な機能はソフトウェアで実現される」

であり

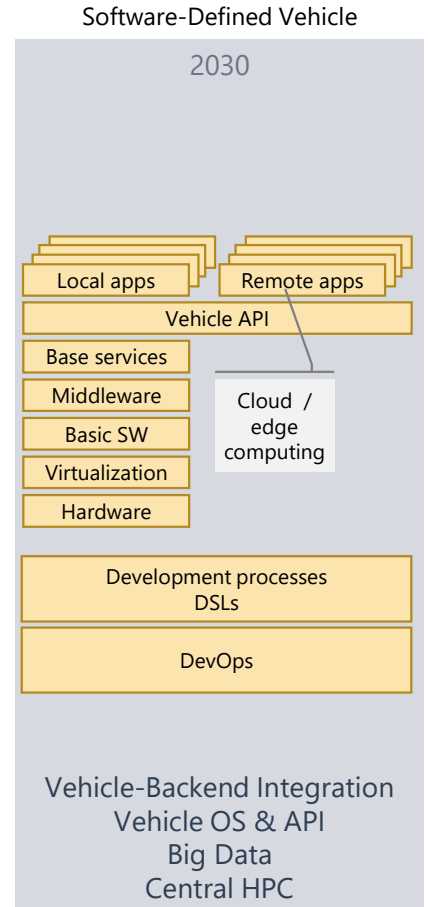
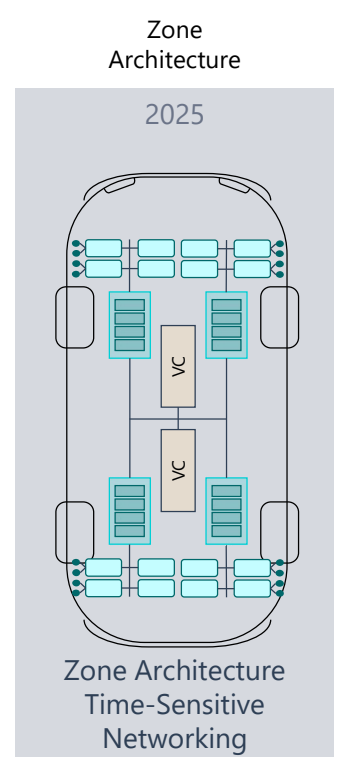
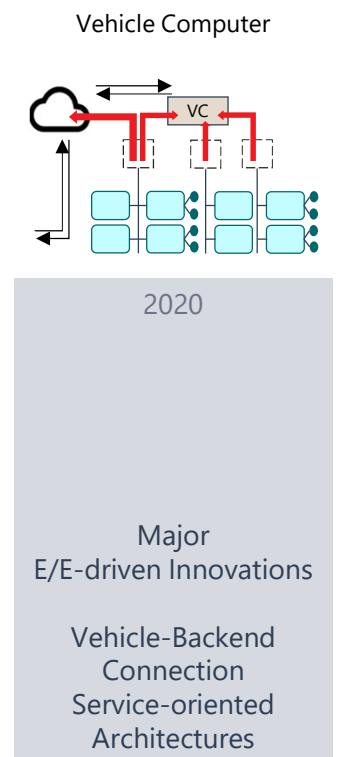
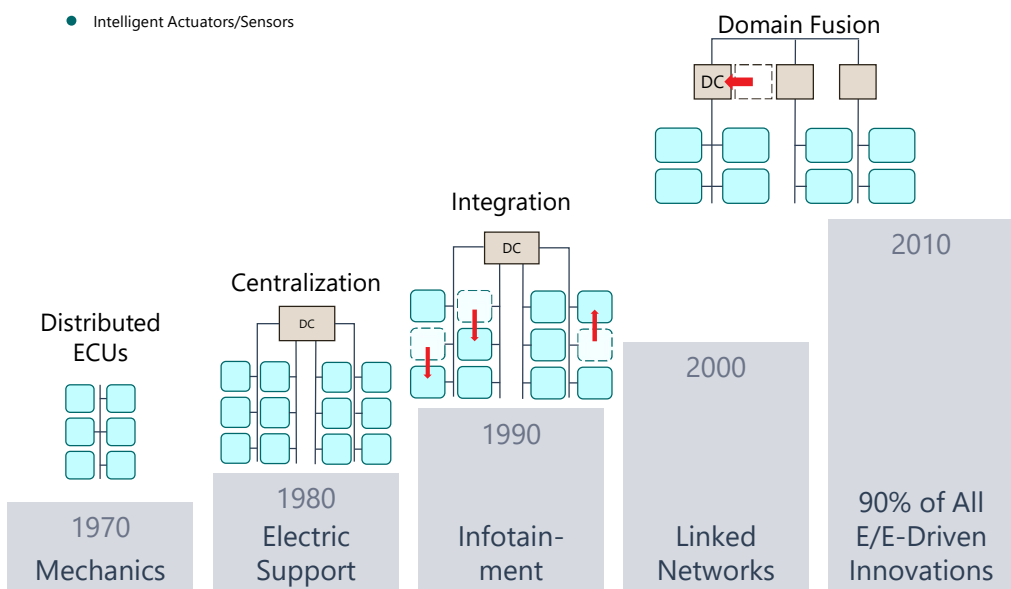
「ソフトウェアは更新可能であり、新しい機能もソフトウェアによって追加可能である」

ということ

車両E/E アーキテクチャの動向

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- Domain/Vehicle Controller
- Deeply Embedded ECUs
- Obsolete ECUs
- Part of Software Defined Vehicle eco-system
- Integration Process
- Intelligent Actuators/Sensors



要求される機能を実現するため、より高性能なプロセッサ、車両内のより高速な通信、車両とクラウドの接続、ソフトウェア技術の導入によってE/Eアーキテクチャは更新されより複雑になってきた

SDVのために必要な要素技術

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DevOps

- CI/CD
- Efficient use of cloud

Mixed criticality and Distributed real-time system

- Orchestration according to criticality
- Determinism in distributed environment

System modeling

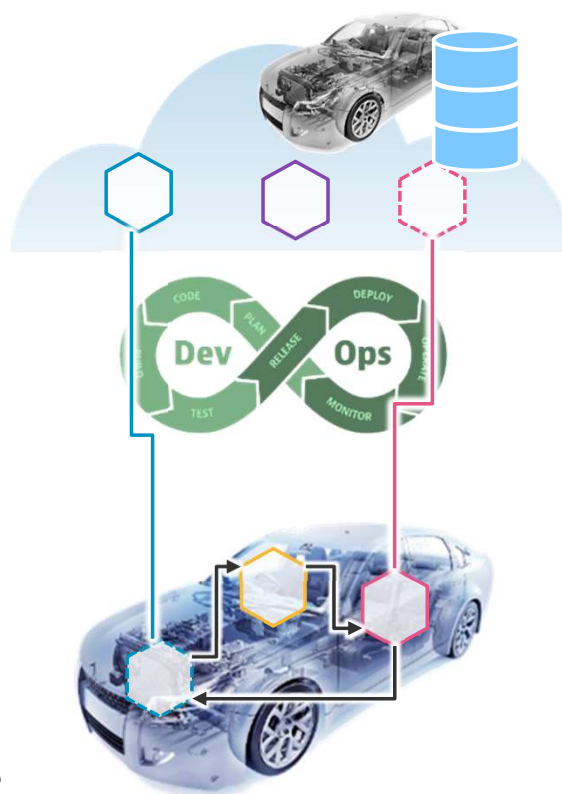
- Formalization of architecture and requirements of system

Digital twin

- Management of devices, OTA
- Data collection and QA, simulation by using data

Microservice

- Loose coupled system architecture
- Service discovery, dynamic orchestration



Standard I/F and API

- I/F and API independent of OEM, Vehicles

De-coupling SW and HW

- VM, Container, Middleware
- Software can work on any Hardware

Abstraction of communication protocols

- Aggregation or unification of protocol
- Framework, Middleware

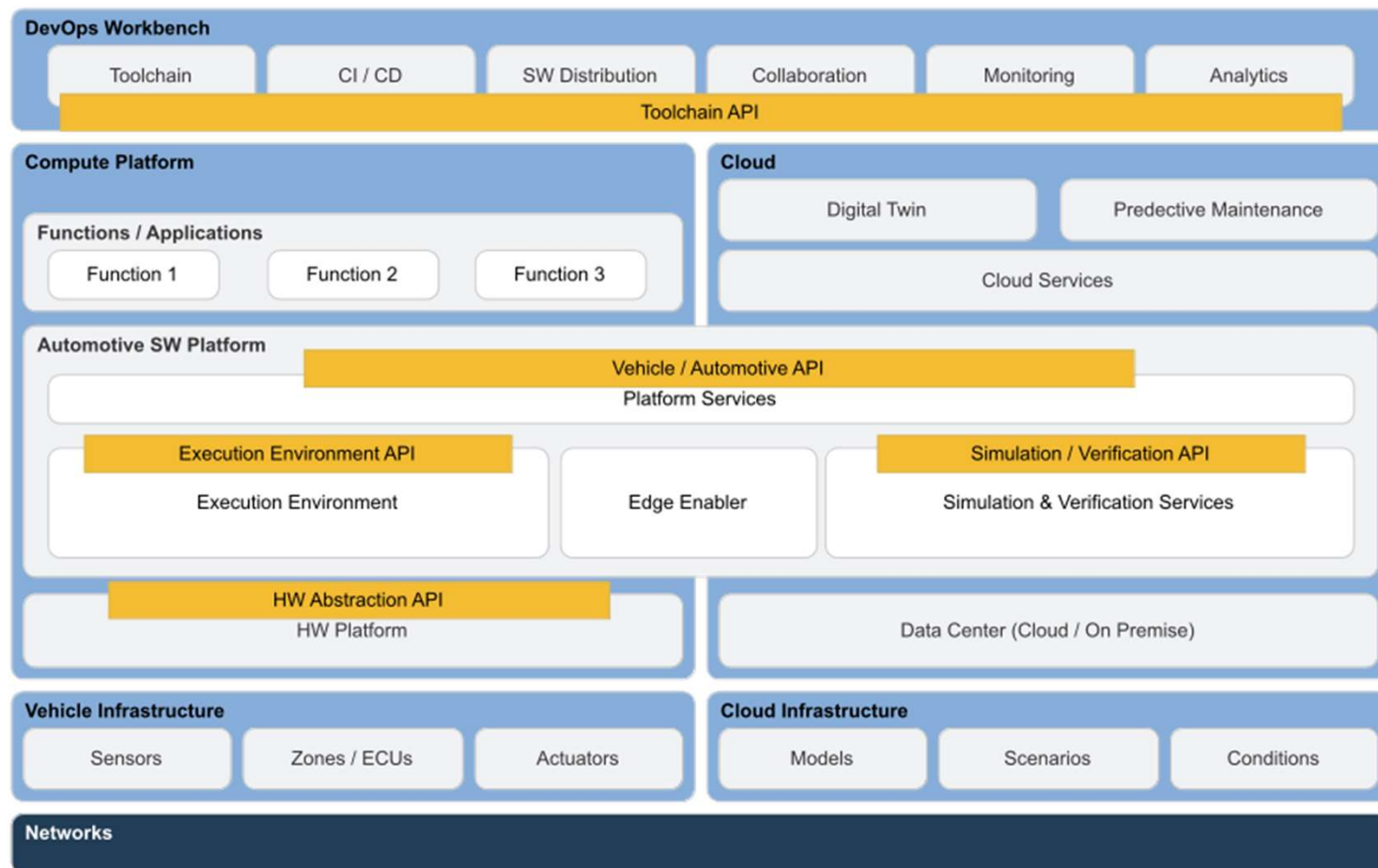
SDVに関する標準化活動-SDVのソフトウェアから見た論理構造-

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基本原理

SDVはそのインターフェースにより駆動される

システムが複雑になればなるほどインターフェースの標準化が必要になる



SDVに関する標準化活動-SDVのためのソフトウェアアーキテクチャの全体像とエコシステム(1)-

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AUTOSAR

Objective: Develop and establish standardized SW framework and open E/E system architecture for intelligent mobility

ASAM

Objective: Open Standards from Pegasus, Service Oriented Vehicle Diagnostics

Khronos

Objective: open standards for 3D graphics, Virtual and Augmented Reality, Parallel Computing, Machine Learning, and Vision Processing

SOAFEE

Objective: Cloud-native architecture enhanced for mixed-criticality automotive applications; building on technologies which define standard boot and security requirements for Arm architecture

Eclipse SDV

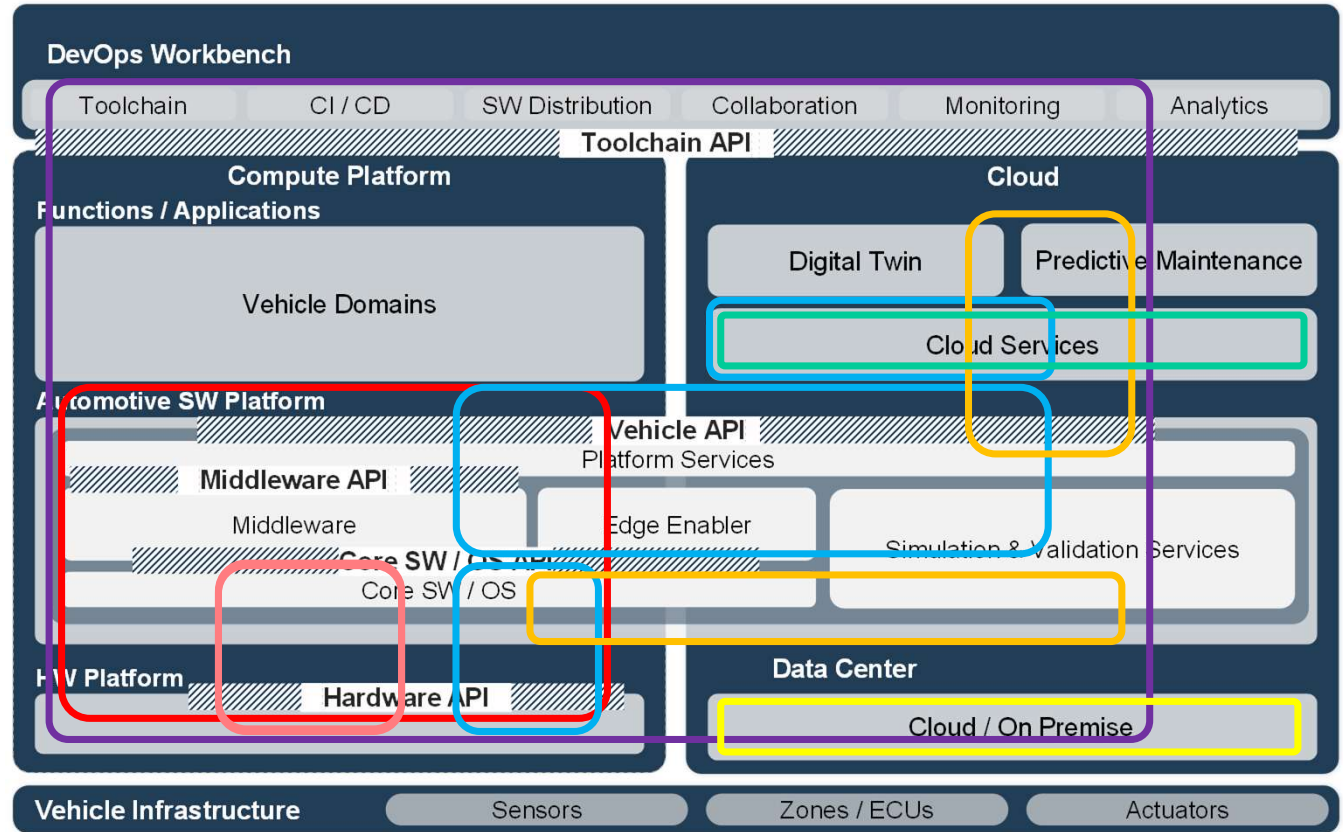
Objective: Open technology platform for the SW defined vehicle of the future; focused on accelerating innovation of automotive-grade in-car software stacks using open source and open specifications

Gaia-X, Catena-X

Goal: Gaia-X European data infrastructure for Hyperscaler
Catena-X tracability in supply chain

Cloud Native Computing Foundation (CNCF)

Objective: CNCF is the open source, vendor-neutral hub of cloud native computing, hosting projects like Kubernetes and Prometheus to make cloud native universal and sustainable.



*Example view without being complete

SDVに関する標準化活動-SDVのためのソフトウェアアーキテクチャの全体像とエコシステム(2)-

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COVESA (former GENIVI)

Objective: Connected vehicle systems including in-vehicle, at-edge and in-cloud services, interfaces and data exchange.

Extension of W3C Common Vehicle Interface Initiative (CVII)

AUTOSAR & COVESA Collaboration

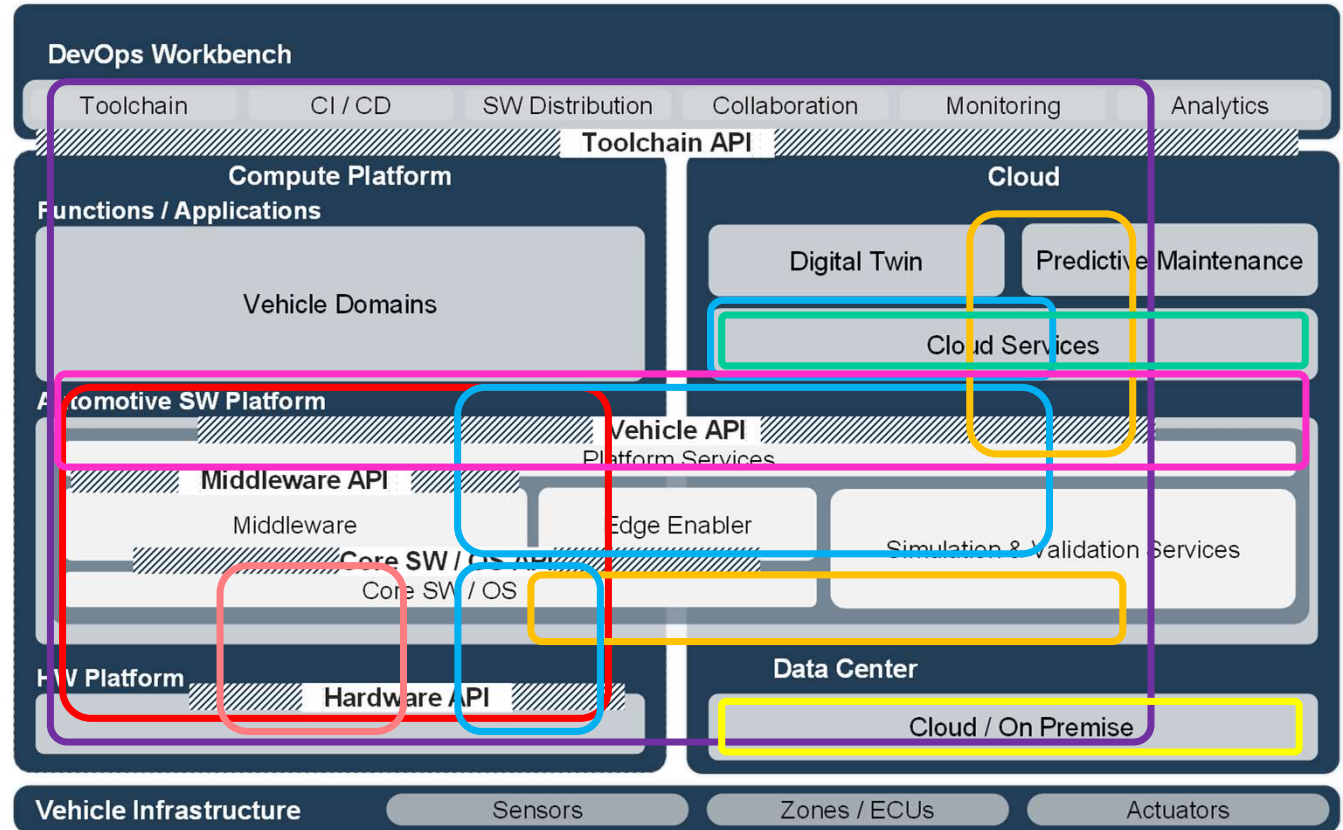
Objective:
Exchange of vehicle data, described by COVESA's Vehicle Signal Specification (VSS), between the cloud and AUTOSAR's platforms for in-vehicle communication.

- COVESA will focus on vehicle data and services as well as cloud interaction
- AUTOSAR will offer an open interface for the overall system architecture and the in-vehicle network

The collaboration will start with a **Vehicle API** concept being discussed by both organizations.

A joint proof of concept demonstration showing

- a seamless integration of communication
- exchange of data
- access of services between cloud and in-vehicle ECUs.



*Example view without being complete

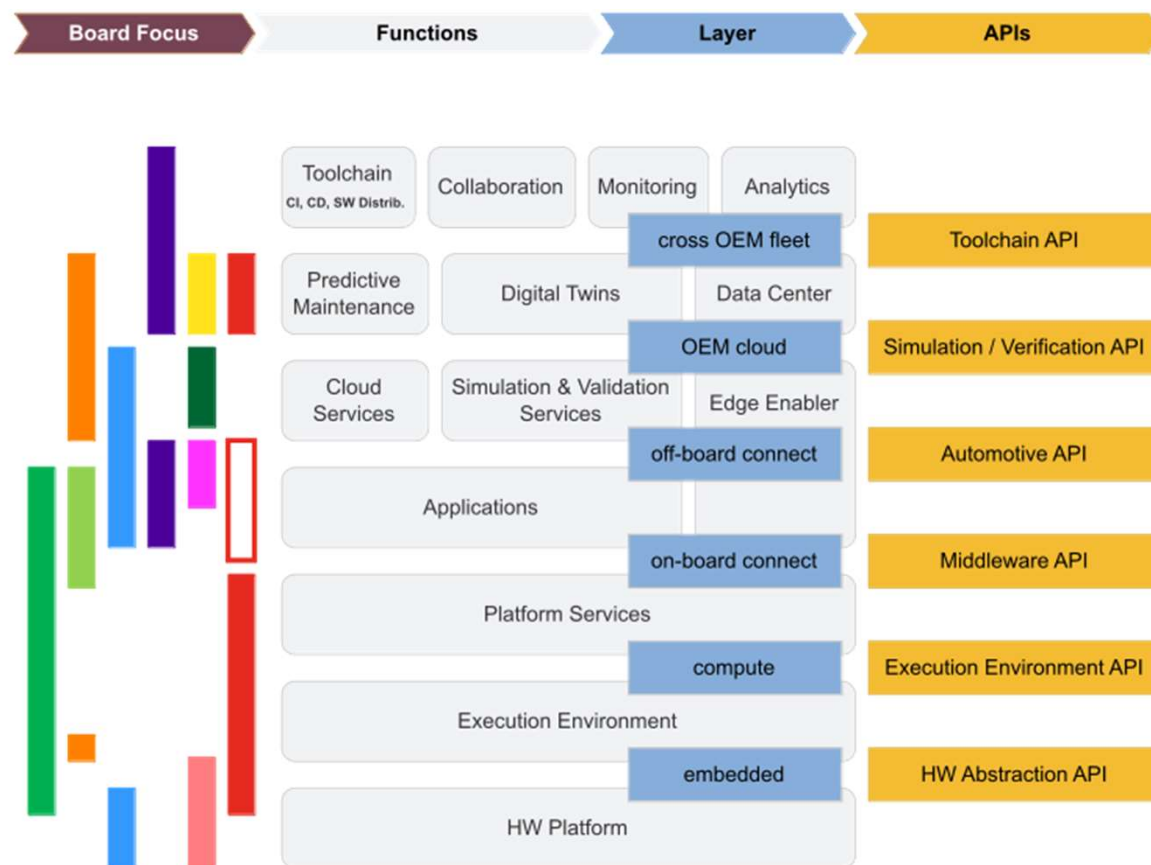
各標準化活動の動向-各活動のスコープ-

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自動車業界の状況

コンソーシアムとOSSコミュニティは

- 一貫した法的枠組み作りを行い
- 以下のために協調する
 - 相互補完
 - 重複作業の回避
 - 矛盾した結果の回避
 - 互換性の確保



the picture depicts just the principle. The representation has neither the claim to completeness nor to 100 percent precision.

各標準化活動の動向-SDV Alliance-

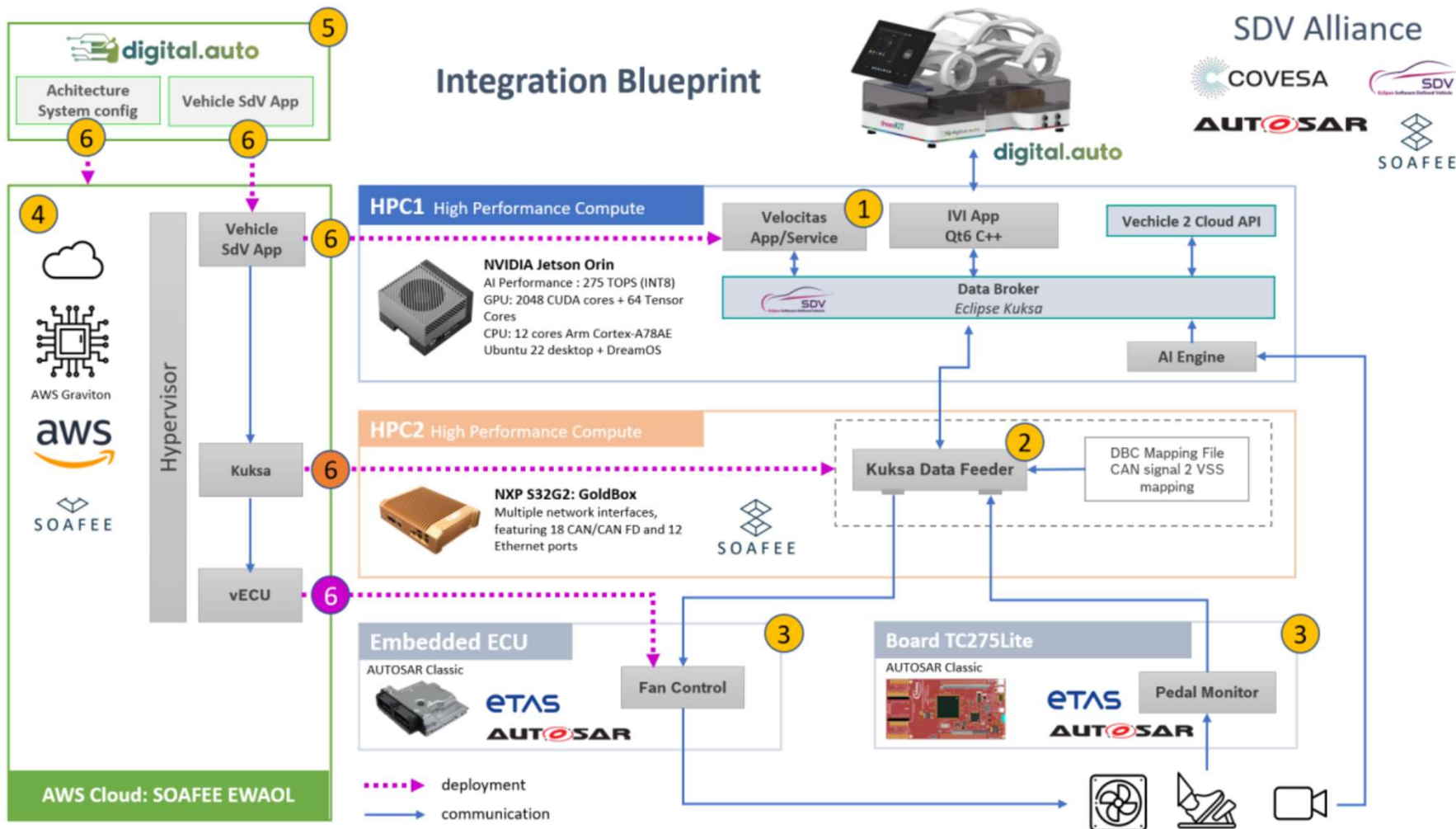
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Face2Face Workshop hosted @ Ford in Cologne on collaboration and solving the SDV together as a first result of continuous alignment

各標準化活動の動向-SDV Alliance : Blue print-

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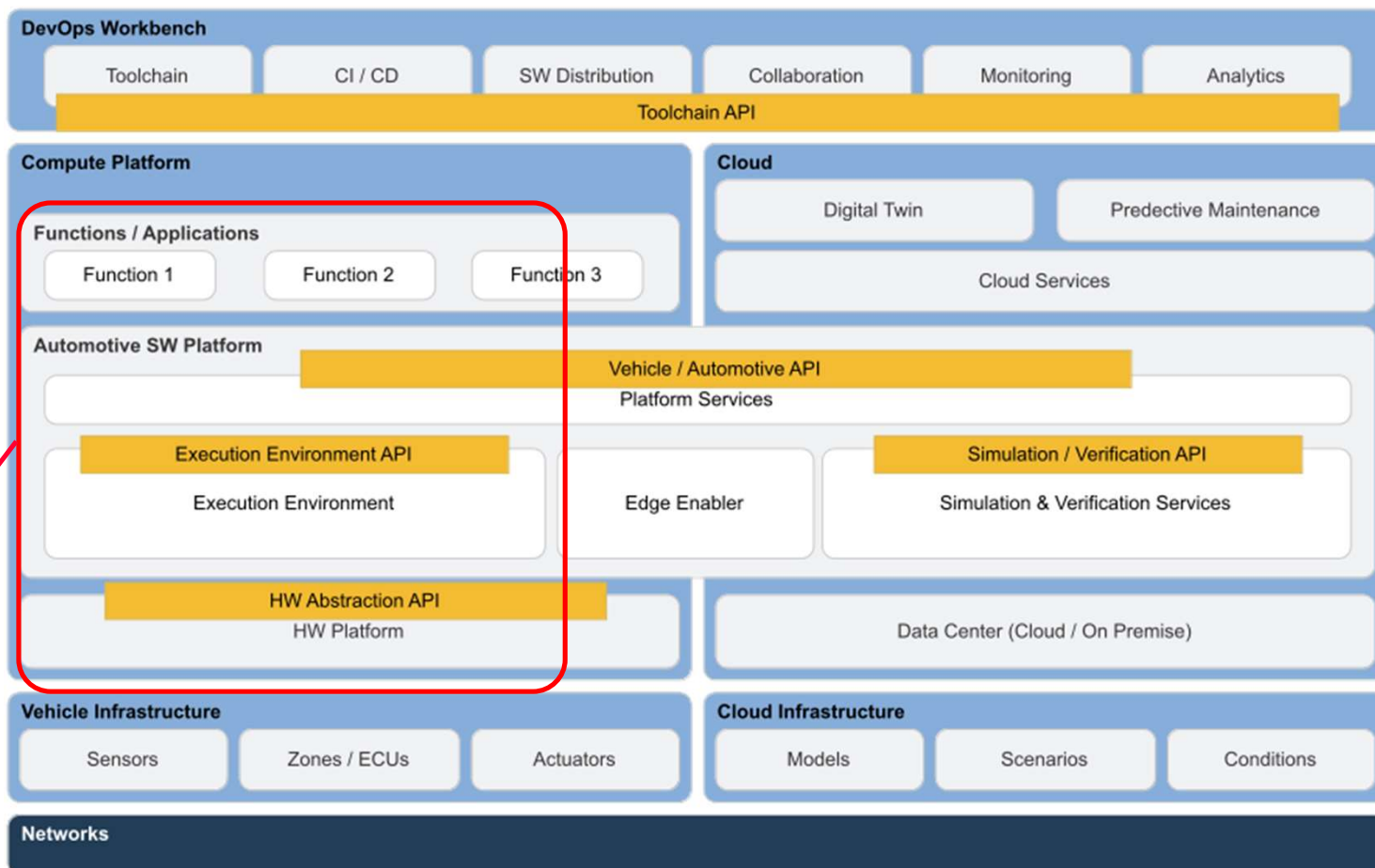
各標準化活動の動向-AUTOSAR & COVESA:AUTOSARのスコープ-

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SDVはそのインターフェースにより駆動される

システムが複雑になればなるほどインターフェースの標準化が必要になる

AUTOSARのスコープ



各標準化活動の動向-AUTOSAR : Automotive API-

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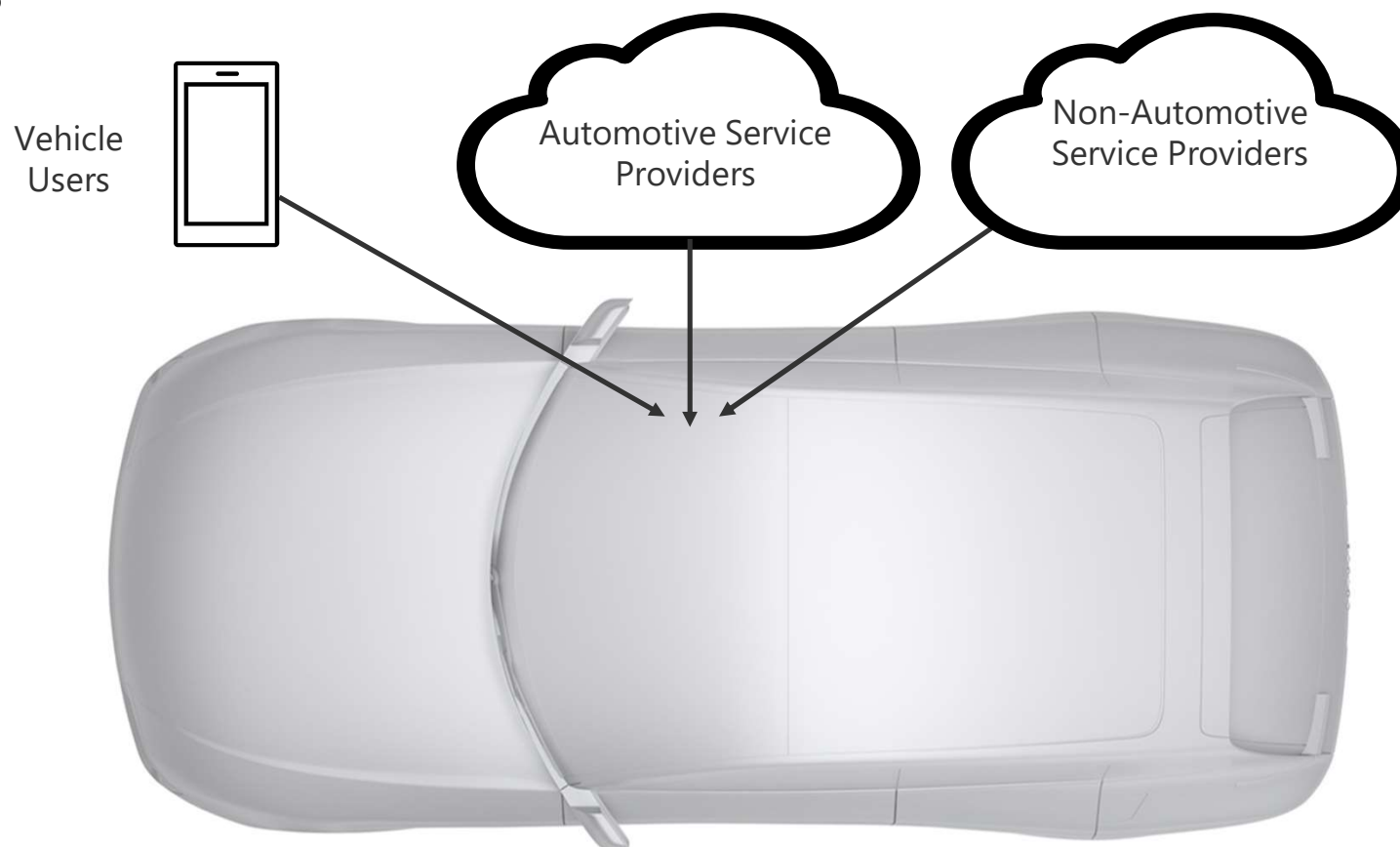
Goals

- **Open standard** to support **safe and secure** access to vehicle data and services
- For **on-board** applications and **off-board** applications
- For **Automotive and Non-Automotive** Service Providers

各標準化活動の動向-AUTOSAR : Automotive API-

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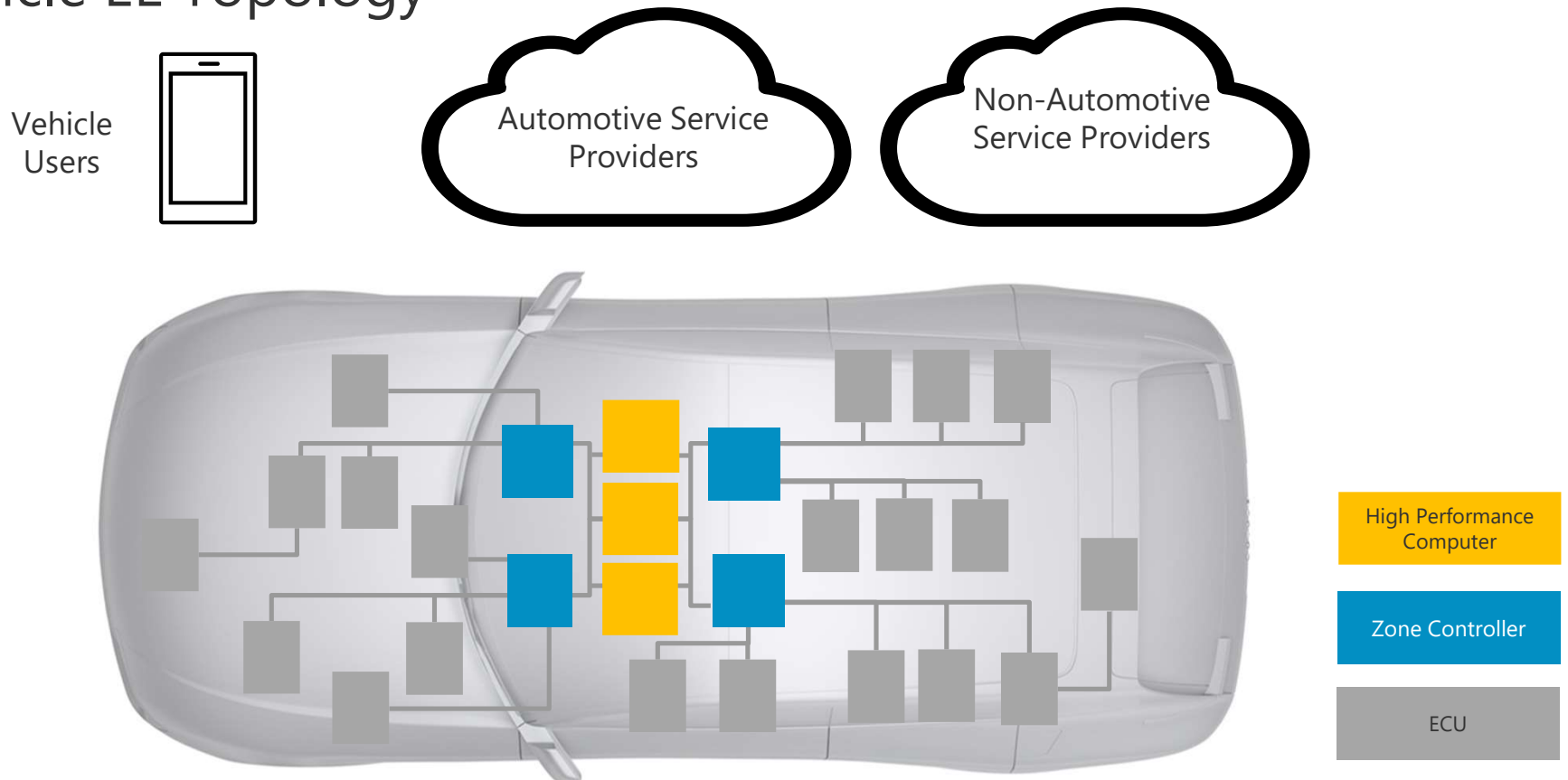
Stakeholders



各標準化活動の動向-AUTOSAR : Automotive API-

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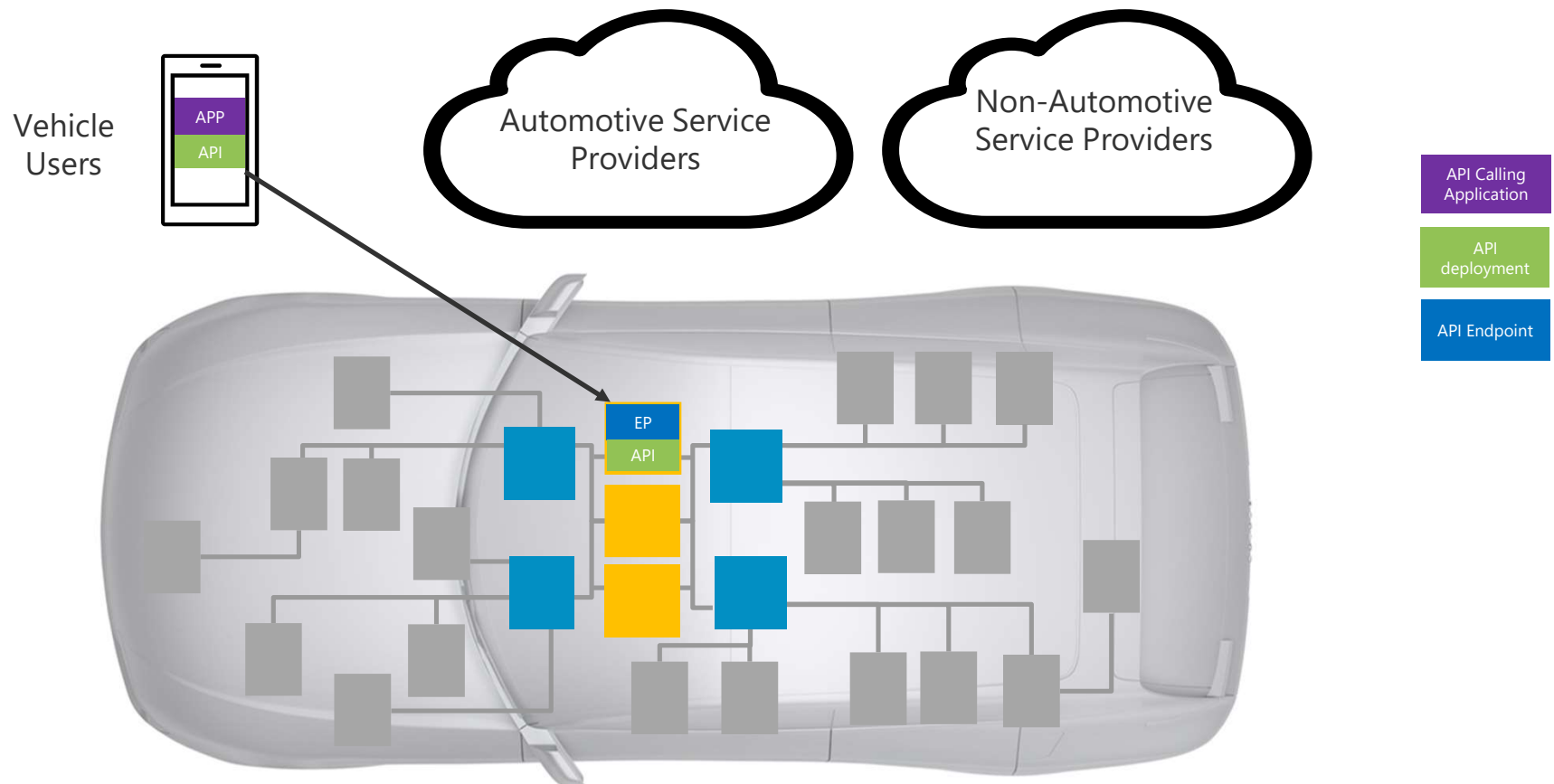
Example Vehicle EE Topology



各標準化活動の動向-AUTOSAR : Automotive API-

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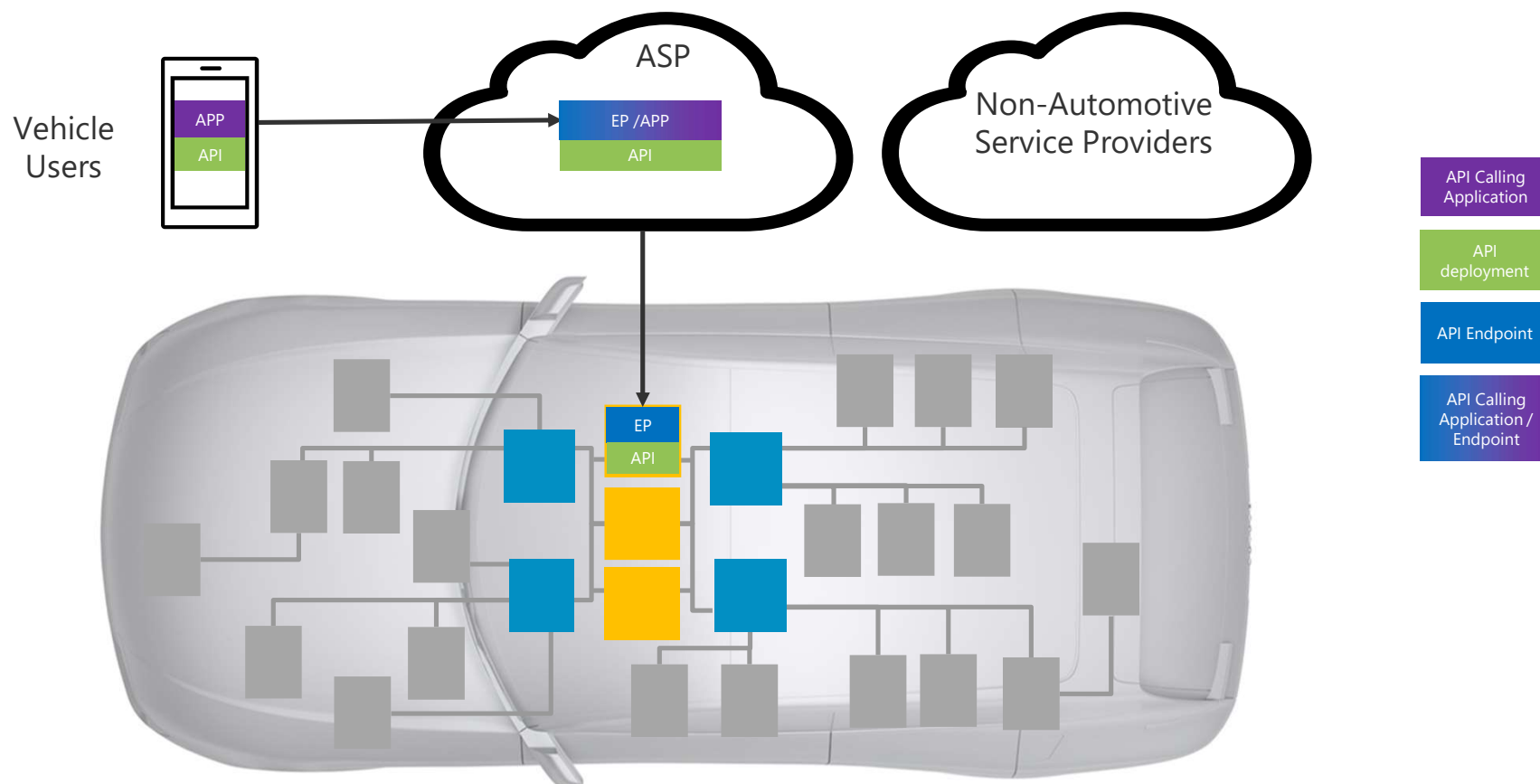
Scenarios



各標準化活動の動向-AUTOSAR : Automotive API-

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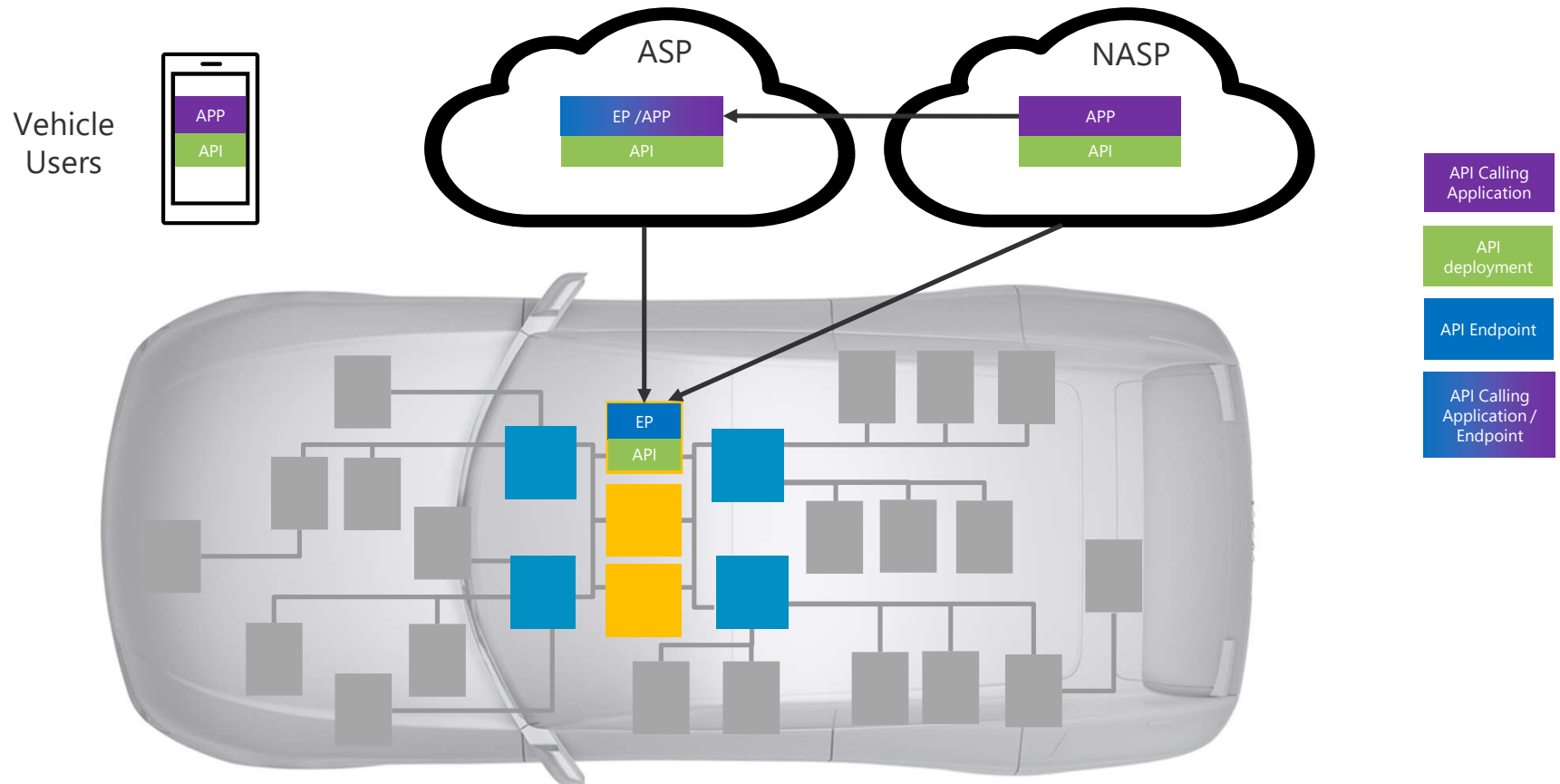
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各標準化活動の動向-AUTOSAR : Automotive API-

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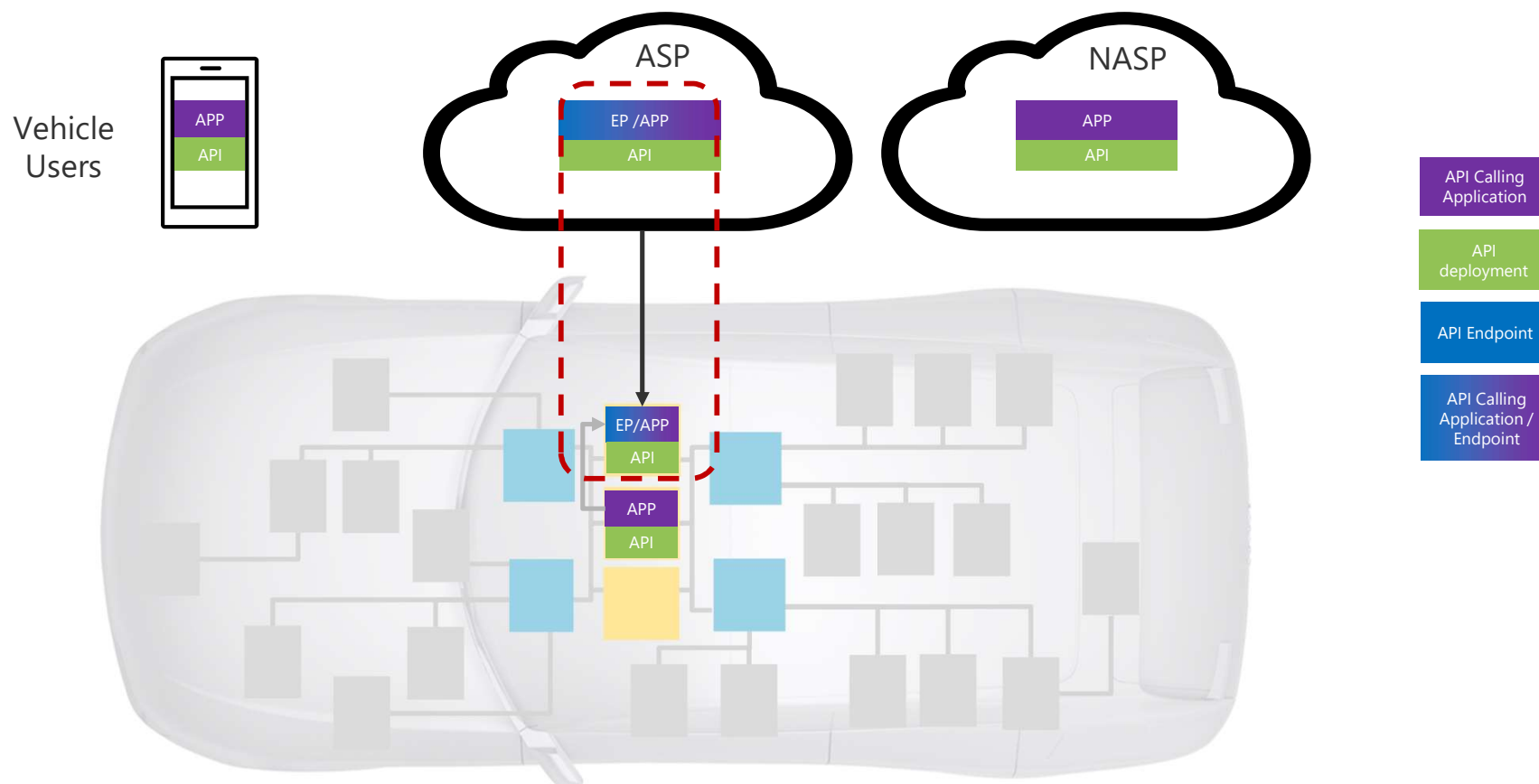
Scenarios



各標準化活動の動向-AUTOSAR : Automotive API-

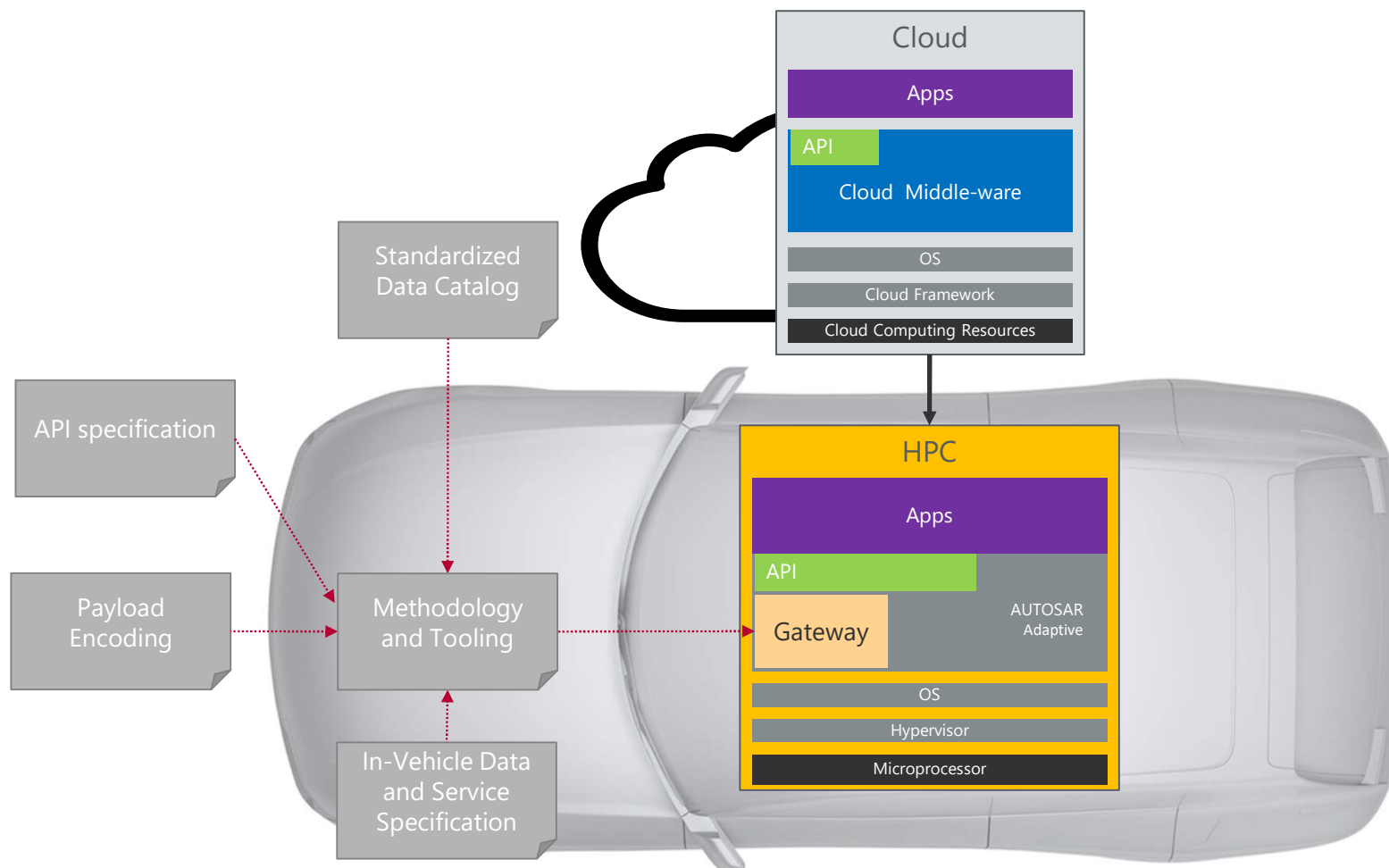
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Scenarios



各標準化活動の動向-AUTOSAR : Automotive API-

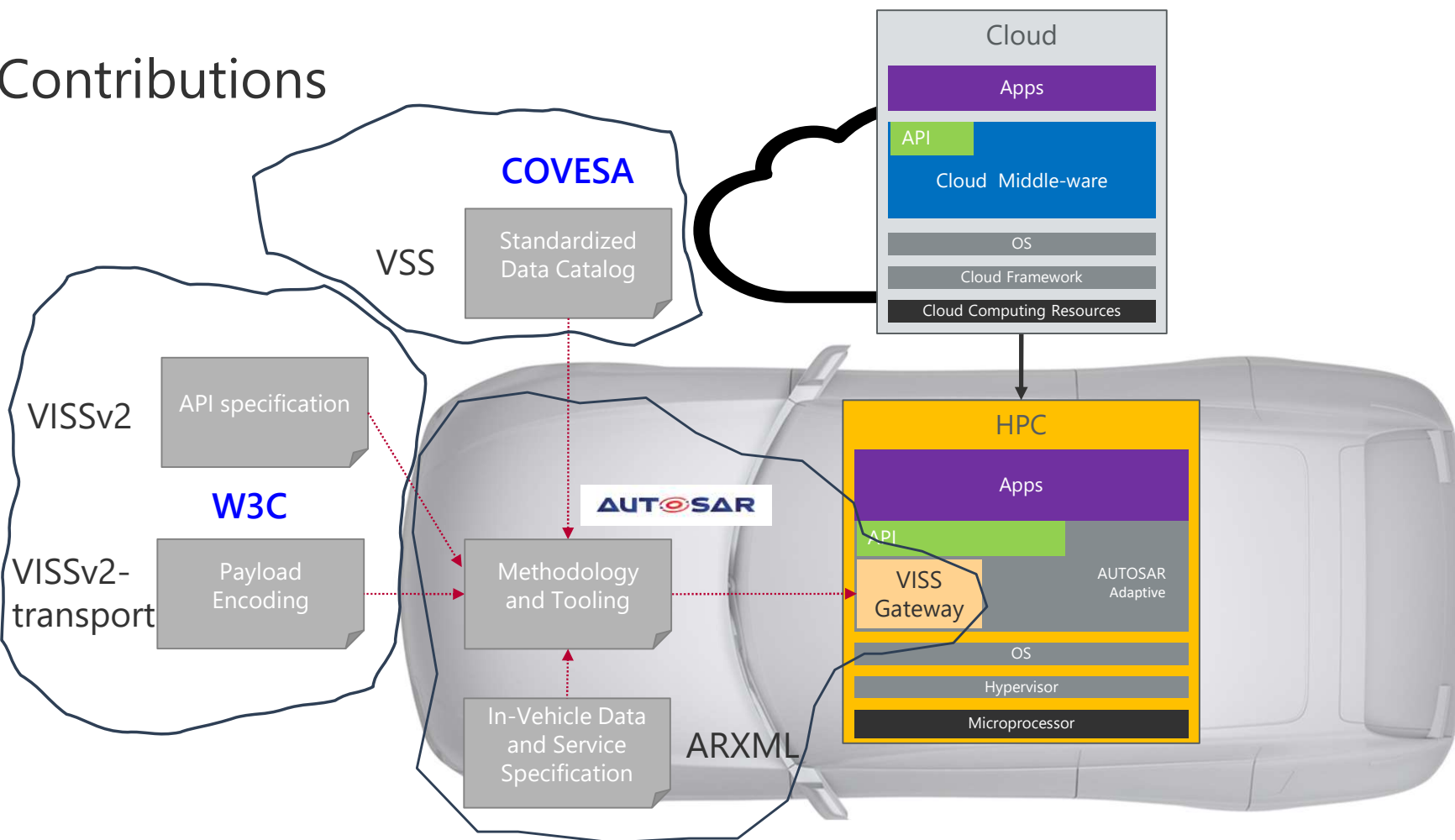
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各標準化活動の動向-AUTOSAR : Automotive API-

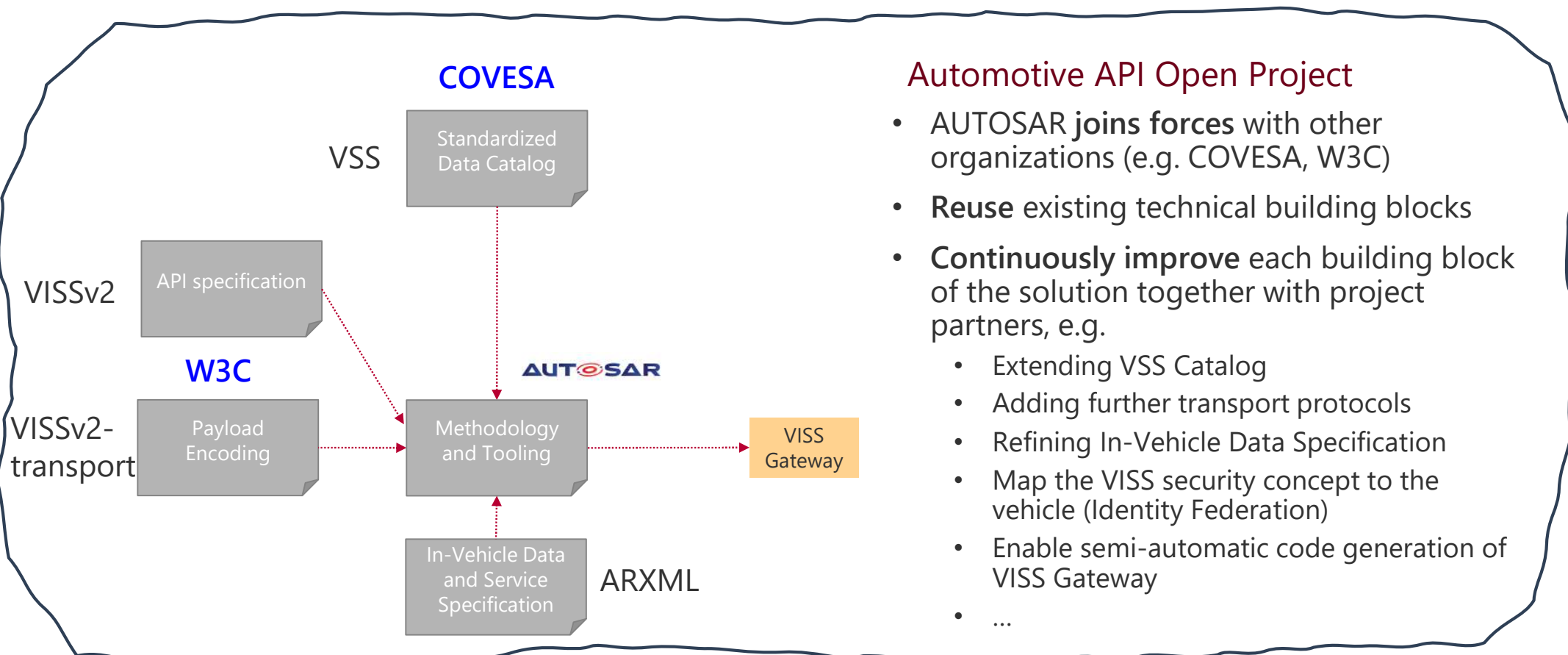
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Contributions



各標準化活動の動向-AUTOSAR : Automotive API-

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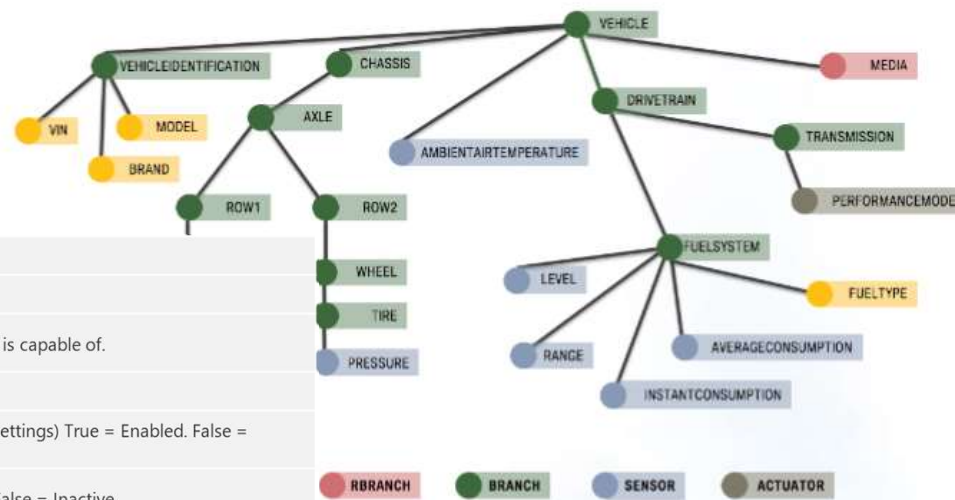
Automotive API Open Project

- AUTOSAR joins forces with other organizations (e.g. COVESA, W3C)
- Reuse existing technical building blocks
- Continuously improve each building block of the solution together with project partners, e.g.
 - Extending VSS Catalog
 - Adding further transport protocols
 - Refining In-Vehicle Data Specification
 - Map the VISS security concept to the vehicle (Identity Federation)
 - Enable semi-automatic code generation of VISS Gateway
 - ...

各標準化活動の動向-COVESA : VSS -

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COVESA Signal definition comply with VSS



VSS signal structure

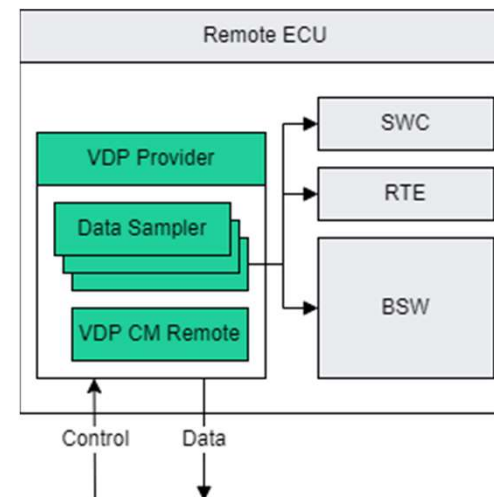
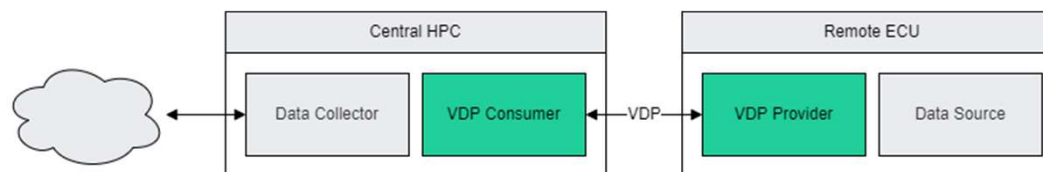
Vehicle.ADAS	branch			All Advanced Driver Assist Systems data.
Vehicle.ADAS.ActiveAutonomyLevel	sensor	string		Indicates the currently active level of autonomy according to SAE J3016 taxonomy.
Vehicle.ADAS.SupportedAutonomyLevel	attribute	string		Indicates the highest level of autonomy according to SAE J3016 taxonomy the vehicle is capable of.
Vehicle.ADAS.CruiseControl	branch			Signals from Cruise Control system.
Vehicle.ADAS.CruiseControl.IsEnabled	actuator	boolean		Indicates if cruise control system is enabled (e.g. ready to receive configurations and settings) True = Enabled. False = Disabled.
Vehicle.ADAS.CruiseControl.IsActive	actuator	boolean		Indicates if cruise control system is active (i.e. actively controls speed). True = Active. False = Inactive.
Vehicle.ADAS.CruiseControl.SpeedSet	actuator	float	km/h	Set cruise control speed in kilometers per hour.
Vehicle.ADAS.CruiseControl.IsError	sensor	boolean		Indicates if cruise control system incurred an error condition. True = Error. False = No Error.
Vehicle.ADAS.LaneDepartureDetection	branch			Signals from Lane Departure Detection System.
Vehicle.ADAS.LaneDepartureDetection.IsEnabled	actuator	boolean		Indicates if lane departure detection system is enabled. True = Enabled. False = Disabled.
Vehicle.ADAS.LaneDepartureDetection.IsWarning	sensor	boolean		Indicates if lane departure detection registered a lane departure.
Vehicle.ADAS.LaneDepartureDetection.IsError	sensor	boolean		Indicates if lane departure system incurred an error condition. True = Error. False = No Error.
Vehicle.ADAS.ObstacleDetection	branch			Signals from Obstacle Sensor System.
Vehicle.ADAS.ObstacleDetection.IsEnabled	actuator	boolean		Indicates if obstacle sensor system is enabled (i.e. monitoring for obstacles). True = Enabled. False = Disabled.
Vehicle.ADAS.ObstacleDetection.IsWarning	sensor	boolean		Indicates if obstacle sensor system registered an obstacle.

各標準化活動の動向-AUTOSAR : 新コンセプトVehicle Data Protocol-

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実際に製品として走行している車両から、多様なデータを集めるためのプロトコル

Criterion		Strategy	VDP	DLT	Diagnostics (UDS)	XCP	
Topic			Prod	Dev	Prod	Dev	
Dominant / target usage environment			Prod	Dev	Prod	Dev	
(Native) data access patterns		Pull (e.g. get-request, actively reading)	Y (pull can be realized by using an appropriate configuration request)	N	Y (e.g. service 0x22)	Y	
		Push (e.g. by notification)	Y	Y (by active code instrumentalization: calling DLT-APIs)	Y (Response on Event)	Y	
Direct data selection			Y	N (only via setting of log-/trace-levels per app id or ctx id)	Y (selection via e.g. DID; however, in practice are multiple data elements aggregated in one DID)	Y (address-based)	
Data transmission patterns		Coupled to retrieval/reception	On data retrieval/reception	Y	Y	Y	Y
			Periodically synchronously to data retrieval	Y	N	Y (not commonly used)	Y
		Decoupled from retrieval	Periodically	Y	N	N	N
			When other condition is fulfilled (e.g. buffer full, external trigger)	Y	N	N	N
Security features for control and data			Y (Relying on SecOC + Encryption)	N	Y	N	



各標準化活動の動向-AUTOSAR : 新コンセプトVehicle Data Protocol-

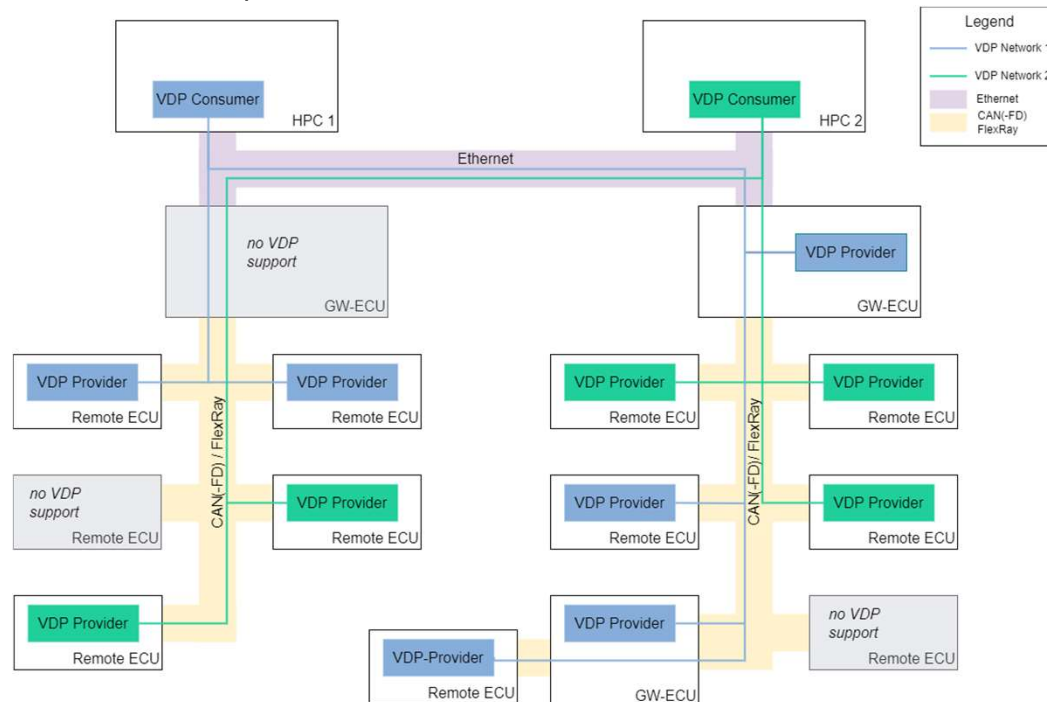
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Use cases of the protocol VDP and the CP component VDP CM Remote are:

1. The dynamic collection of data from ECUs in the vehicle. Therein it shall support both data following a push semantic (notifications, event-based) as well as data following a pull semantic (get-APIs); c.f. *Table 1*. The transmission may happen immediately after sampling, but it may also be delayed until a transmission trigger condition is fulfilled.
2. The dynamic collection of sensitive data analogously to the previous use case.
3. Collection of (sensitive) data according to (1.) and (2.) in ECUs which require different safety certification levels.
4. Multiple in-vehicle instances of VDP Consumers are possible which retrieve data from a specific set of VDP Providers. One VDP Provider responds/provides data to one VDP Consumer.
5. Average and high-throughput bus systems, such as CAN, FR, Eth.

No use cases of the protocol VDP and the CP component VDP CM Remote are:

1. The transmission of control messages and data messages between vehicle and cloud required for realizing data collection campaigns over vehicle fleets.
2. The retrieval/distribution of data for functional safety relevant use cases.
3. One VDP Provider responding/providing data to multiple VDP Consumers.
4. Data retrieval via extremely low-throughput bus systems, e.g. LIN.
5. Calibration in the sense of XCP of the VDP Provider ECU.



各標準化活動の動向-SOAFEE-

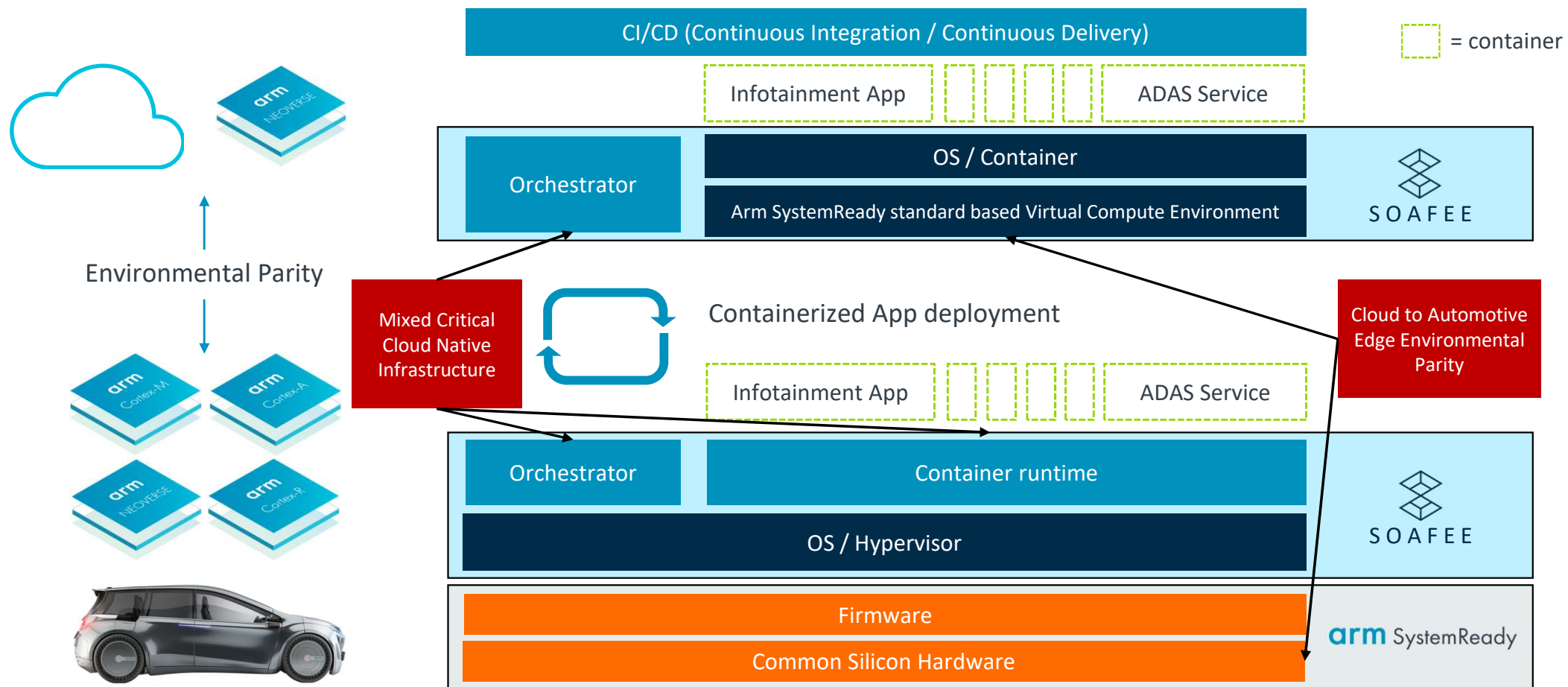
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Scalable Open Architecture For Embedded Edge project(SOAFEE)

- Armが主導して2021年9月に設立
 - Governing Body Members: 7社 ⇒ 9社 (Arm、AWS、Bosch、CARIAD、Continental、Red Hat、GM、Suse、LG electronics)
 - Voting Members: 108社 (2023年9月時点) (DENSO、ETAS、AMD、Green Hills、Qualcomm、Renesas 等)
- スコープ & 目的
 - オープンかつスタンダードなアーキテクチャとリファレンス実装
 - **Blueprint**によるPoC、**Codeベース**
 - 混在する安全性 (**Mixed Criticality**)を持った、クラウドからエッジまでのソフト開発を可能にする
 - Environmental Parity
 - クラウドからエッジまでのリソースの環境性能の最適化
 - 既存のコンソーシアム、OSSプロジェクト、標準化団体との連携と補完 (**置き換えることはしない**)
 - Eclipse SDV, COVESA, AUTOSAR他

各標準化活動の動向-SOAFEE：目さす方向-

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各標準化活動の動向-Eclipse SDV-

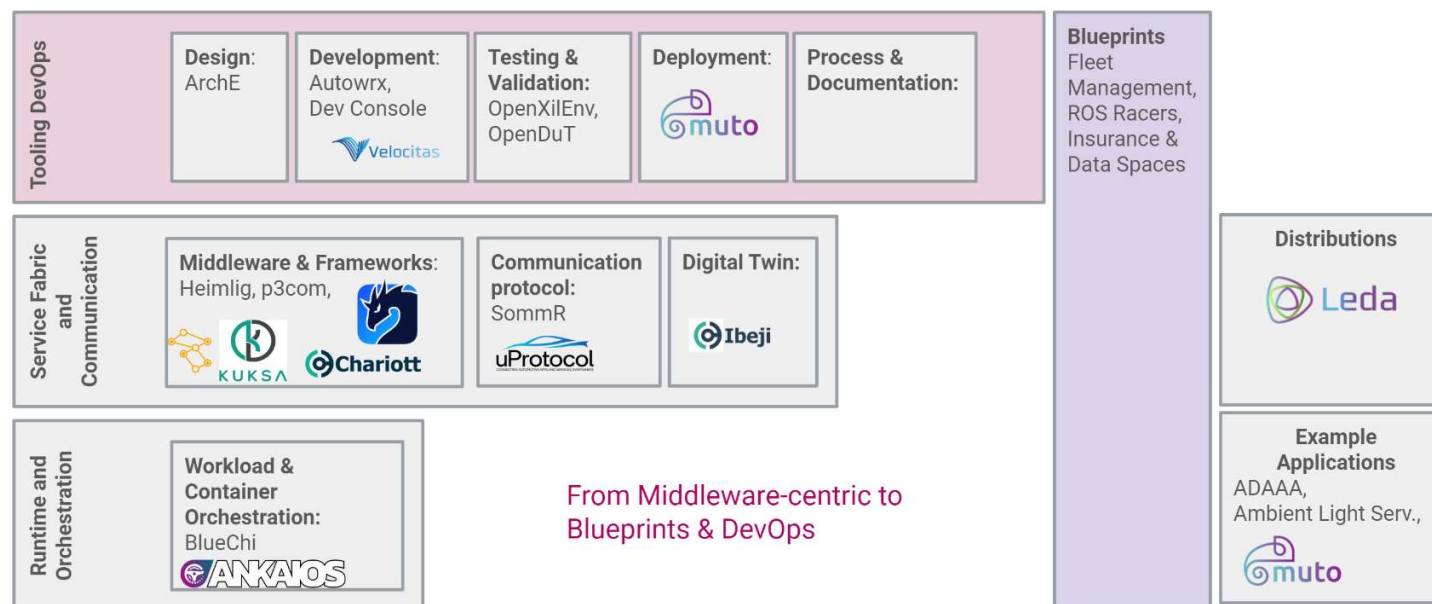
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- Eclipse Foundationが2022年3月にSDVに関連するEclipseプロジェクトの協調のためにWorking Group を設
- 将来のSDVのためのオープンテクノロジーラットフォームであり、オープンスタンダードを使用して自動車グレードの車載ソフトウェアスタックのイノベーションを加速することに重点を置く

Source: Eclipse

The SDV Landscape: how we are evolving

40 member
(2023/10時点)
Arm、ETAS、IBM、
GM、Qualcomm、
Bosch、Red Hat、
等
SOAFEEのメンバーと
重複しているメンバー
も多い



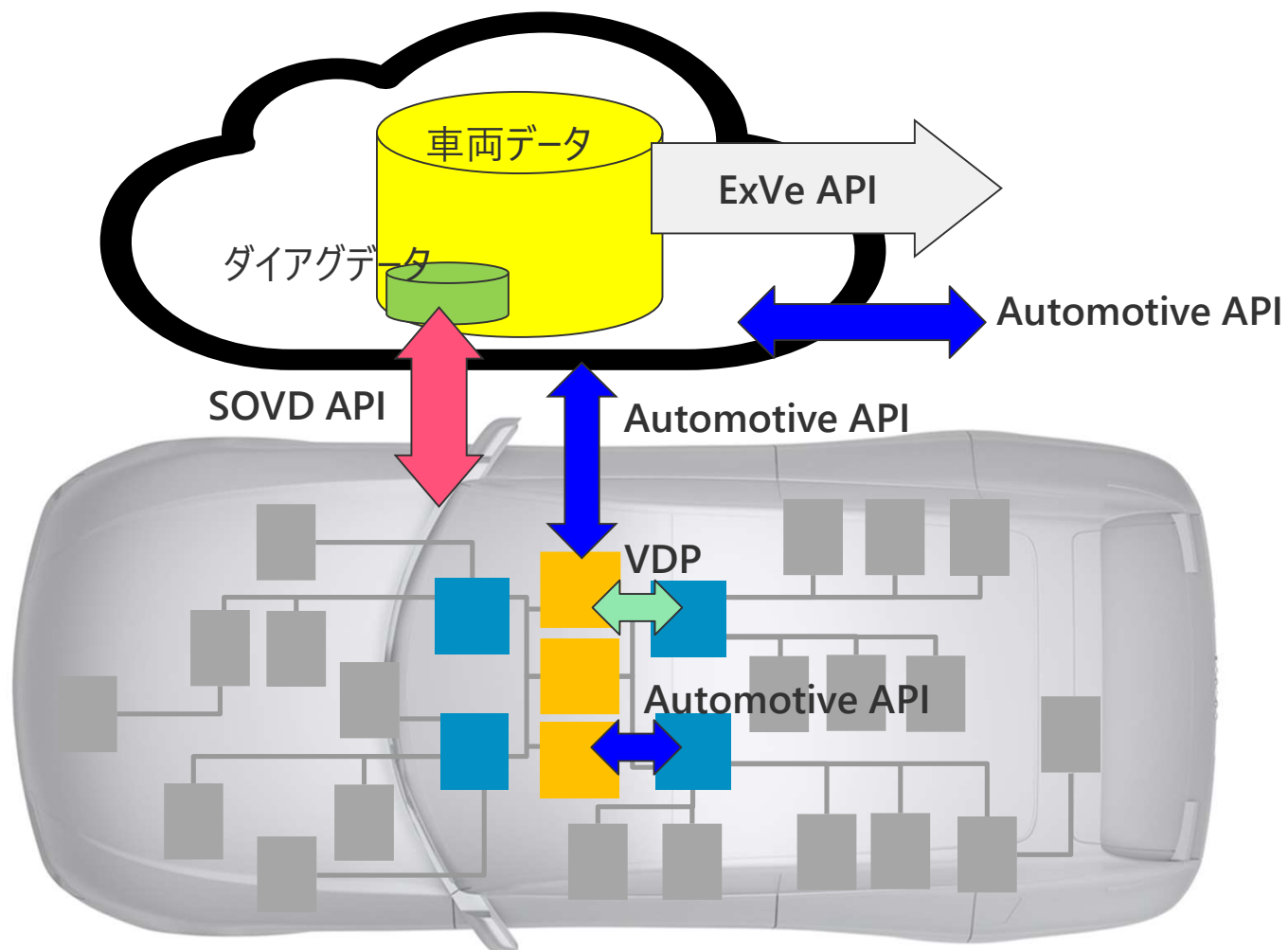
各標準化活動の動向-ISO(デジュール) でSDVに関連する標準-

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- ISO 20077-1,2:Extend vehicle(ExVe) methodology
- ISO 20078-1,2,3,4:Extend vehicle(ExVe) web service
- ASAM SOVD(Service Oriented Vehicle Diagnosis) is also started in ISO standardization, and AUTOSAR collaboration is ongoing
- ISO 23150 (Data communication between sensors and data fusion unit for automated driving functions) is developing
- China proposes "Vehicle-Info OS" as an ISO standard that will be decided if the project will be started
- Other general software related ISO standards are in ISO/IEC JTC1 Information Technology

ISO標準とAUTOSARのマッピング

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まとめ

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- 自動車業界では、オープンコミュニティ活動を通じてSDVの技術開発が加速している
- SDVの技術開発は多岐に渡るため、各標準化団体間でのコラボレーション（エコシステム構築）が必須
- AUTOSAR、COVESA、SOAFEE、Eclipse SDVがSDV Allianceを公表したが、具体的な活動は未だ議論中
- AUTOSARは車両に搭載されるEUCの基本ソフトウェアに注力する
- ISOの標準との関連が不明瞭部分があり、今後明確な定義が期待される

ご清聴ありがとうございました

DENSO
Crafting the Core