Impact of SDV Advancements on the Automotive Industry Ecosystem and Implications

Sept. 24, 2024.

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Kookmin University

Introduction

➢ Professional Positions

- 2005~present, Professor, School of EE, Kookmin University
- 2020~2022, Chair, School of EE, Kookmin University
- 2022~present, Non-Executive Director, Hyundai AutoEver
- 2019~present, Non-Executive Director, Humax
- 2023~present, Advisory Professor, Hyundai Kefico
- 2013~2021, Non-Executive Director, UbiVelox

- 2019~2020, Technical Advisor, CTO part, LG Electronics
- 2019~2020, Advisory Professor, Manufacturing Engineering R&D Center, Hyundai Motor Company

- 2019~present, Advisory Professor, AutonomousA2Z (Automated driving startup)
- 2019~present, Advisory Professor, Atech (Automotive AI startup)
- 2022~present, Advisory Professor, Kanavi Mobility (Automotive parts company)
- 2023~present, Technical Advisor, Pebble square (AI processor startup)

- 2020~present, Miilk shaker, The Miilk
- 2011~present, columnist, Inews24

- 2011~2013, Visiting Associate Professor, UC Irvine,
- 2015~2017, Advisory Professor, SW center, Samsung Electronics
- 2016~2016, Advisory Professor, Naver Labs, Naver

- 2004~2005, Manager, Terminal Development Team, SK Telecom
- 2001~2004, Senior Engineer/Co-founder, Research Center, NeoMtel, Korea

Introduction

➢ Professional Positions

- 2024~present, Principal PM, automotive committee, Super Gap Project, Ministry of Trade, Industry and Energy
- 2022~present, Member, automated driving committee, Mobility Innovation Forum, Ministry of Land, Infrastructure and Transport
- 2023~2023, Chair, SDV advisory group, IITP, Ministry of Science and ICT

- 2013~present, Chair, Infineon center, Kookmin university
- 2015~present, Chair, Hyundai AUTOSAR center, Kookmin university
- 2022~present, Chair, Garrett Motion Research center, Kookmin university
- 2007~present, Member, Infineon center, Kookmin university

- 2023~present, Senior Vice President, Korea Association of Mobility Studies
- 2020~present, Vice President, Korea Association of Mobility Studies
- 2013~present, Director, Information & Control Division, The Korean Institute of Electrical Engineering
- 2020~2022, Member, mechanical & material special committee, Presidential advisory council on science & technology

- 2015~2019, Chair, Automotive EE and Communication Committee, Korea Agency for Technology and Standards
- 2016~2018, Chair, IT-convergence committee, Korea Automobile Manufacturers Association

Introduction

➢ **SESL@Kookmin University, Korea**

HYUNDAI Target LAB

LG Electronics Target LAB

HYUNDAI KEFICO Target LAB

QNX QNX

LG Electronics LG Electronics

HYUNDAI AutoEver Hyundai AutoEver

QNX Center (TBD)

Self Driving | Infotainment Application | Control Application

Adaptive AUTOSAR (Adaptive AUTOSAR) | Infotainment Platform | Classic AUTOSAR (Classic AUTOSAR)

AP | AP | Micro Controller

Self Driving | **Infotainment** | **Control**

HYUNDAI AutoEver, HYUNDAI MOBIS, HYUNDAI KEFICO, HYUNDAI WIA, Mando, Hanwha Aerospace, SC Ps, INTREPID CONTROL SYSTEMS, GLIWA, dSPACE, TASKING, ETAS

Garrett Motion Center (Garrett ADVANCING MOTION)

Hyundai AUTOSAR Center (HYUNDAI MOTOR GROUP)

Infineon (infineon)

Infineon Center (infineon)

Contents

SDV Overview

➢ SDV(Software Defined Vehicle)

Source: Hyundai Motor Company

- **Software Defined Vehicle**
  - Vehicles where software defines not only driving performance, but also comfort features, safety features, and the emotional quality and brand identity of the vehicle

- **Features**
  - **OTA (Over-the-Air)**
    - ✓Updates the vehicle's software and firmware through wireless communication
    - ✓Allows the vehicle to receive new functions by updating like a smartphone
  - **Integrated ECU**
    - ✓Manages AI, autonomous driving, etc., with an integrated ECU through HPCs(High Performance Computers)
  - **E/E Architecture**
    - Convenience
    - Driving
    - Infotainment
    - ADAS (Advanced Driver Assistance Systems)
  - **Service Platform**
    - ✓Enables OEMs and third parties to provide services

SDV Overview

➢ Similar but different viewpoints on SDV

Company name	definition
Hyundai Motor Company	Vehicles where software defines not only driving performance, but also comfort features, safety features, and the emotional quality and brand identity of the vehicle
BMW	Vehicle that physical and digital components are decoupled, and features and functionality are defined through software
Samsung Electronics	Vehicles can be updated with the latest security features, other updates and new applications over the air, similar to a mobile phone
Bosch	Vehicles of software massively shaping the customer experience and in some cases even the specification of the hardware
BlackBerry	Vehicles where its core functions are managed by a software layer sitting between the driver's or fleet manager's interface and vehicular functions and sensors

SDV Overview

➢ Evolution toward SDV

Feature update

New functions

Infotainment applications

subscription services

Source: Hyundai Motor Company

Regulatory compliance

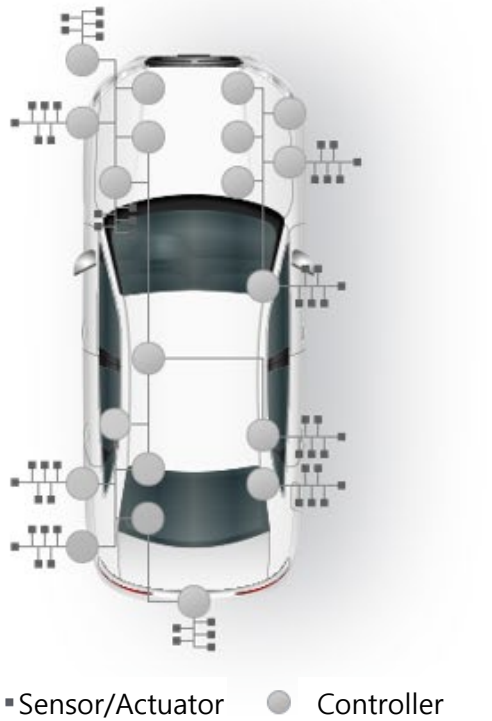
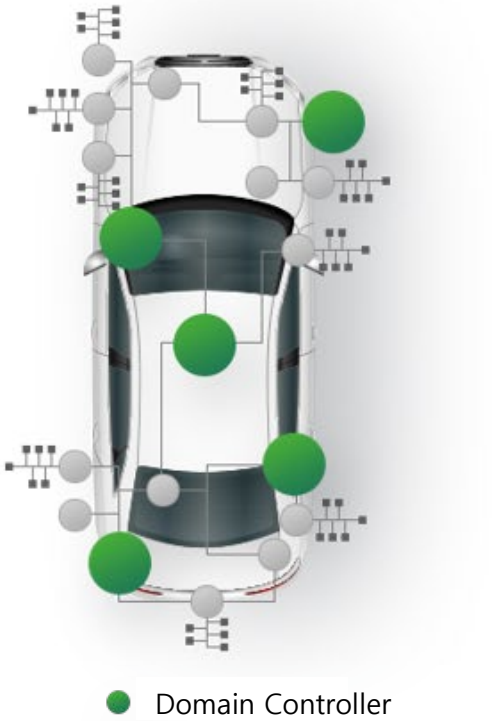
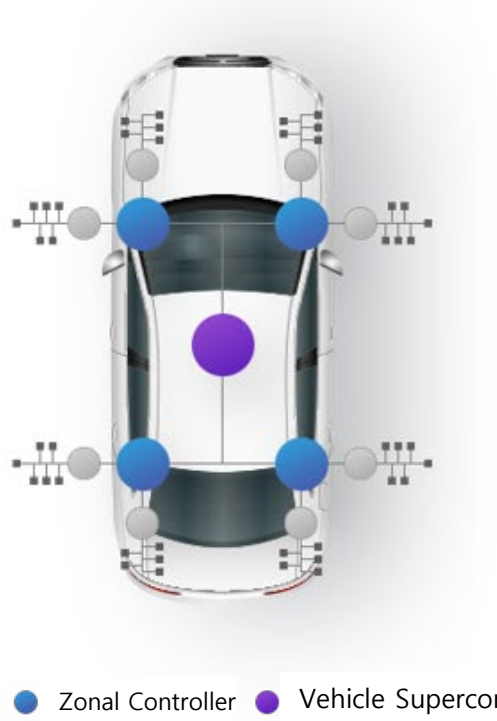
Bug fix

Recall Response

Parameter update

SDV Overview

➢ Evolution of vehicle E/E architecture

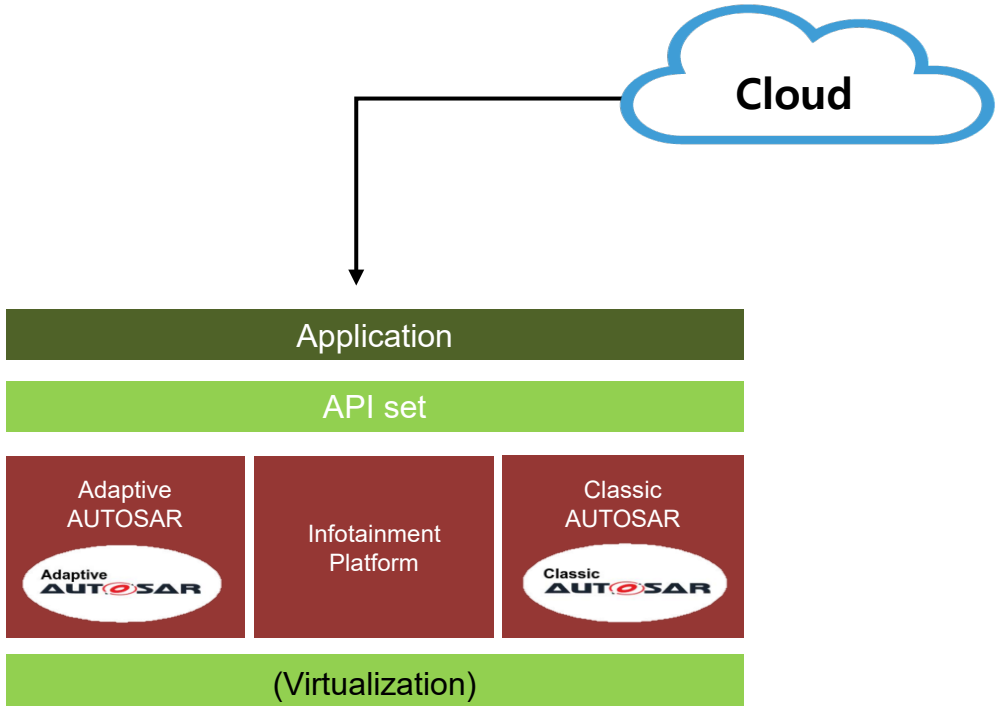
E/E Architecture	Distributed (Current)	Domain Centralization (Mid-term)	Centralized Architecture (Long-term)
High-performance Vehicle Control			

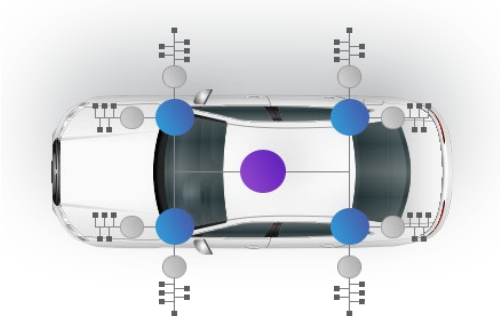
source: Hyundai Kefico

SDV Overview

➢ SDV main technical keywords

- **EE architecture**
  - Changes in electrical and electronic architecture
- **HW/SW decoupling**
  - Separation of hardware and software
- **API set**
  - App ecosystem through API's
- **SW platform**
  - OTA/autonomous driving-infotainment-vehicle control
- **Cloud**
  - Cloud becomes more important
  - Cloud native development & virtual simulation
  - App management
- **OTA**
  - Software update
  - Integrity verification and security
- **Application**
  - App store
  - Growth of app market
  - Subscription services





EE Architecture source : Hyundai Kefico

SDV Overview

➢ Evolution of Vehicle EE/SW Structure

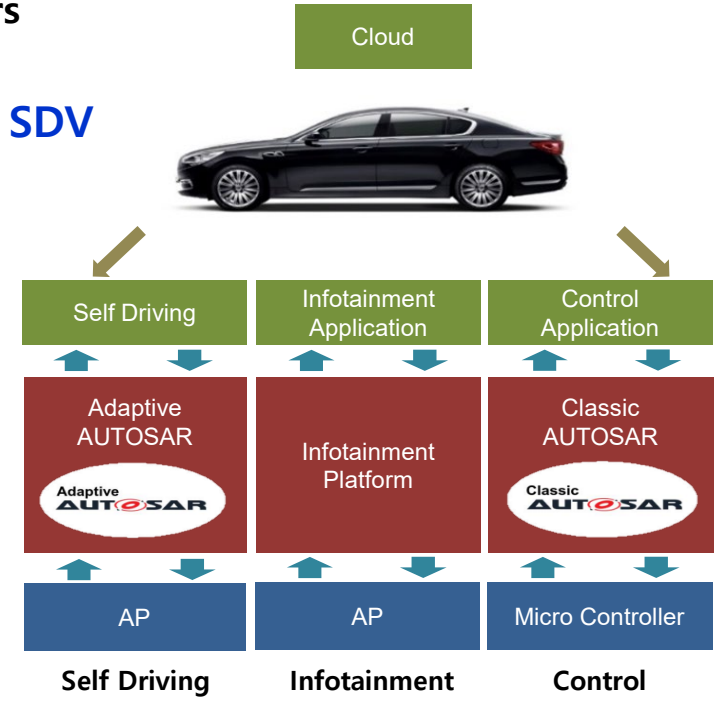
- Autonomous driving
- Infotainment
- Control
- Cloud

➢ Autonomous Driving Electric/Electronic SW Platform

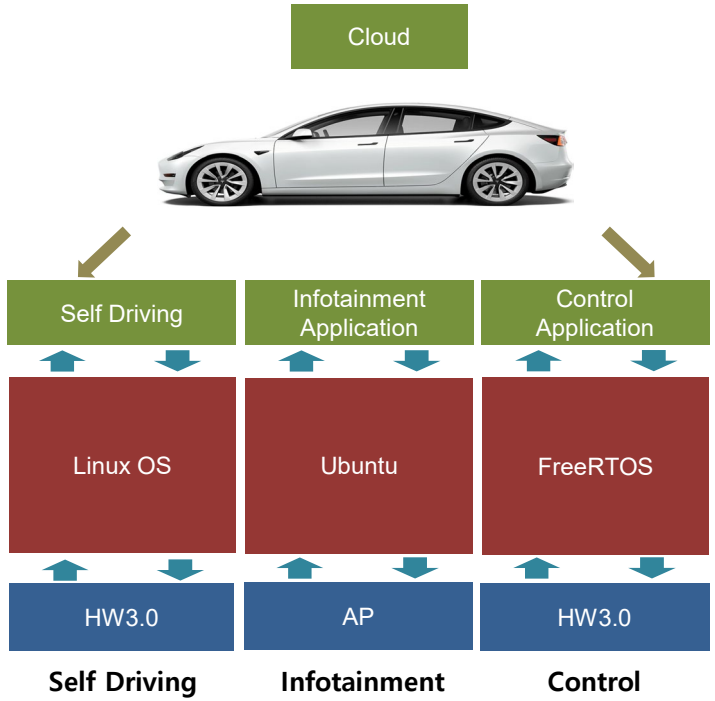
- High-performance autonomous driving processors
- High-performance autonomous driving sensors
- Software platform

➢ Stabilization of Automotive Platforms and SDV

- Expected between 2025 and 2027
- Similar to Tesla's structure
- ADV vehicle structure
- Advancement of SDV
- Advancement of autonomous driving



< Major OEMs' architecture>

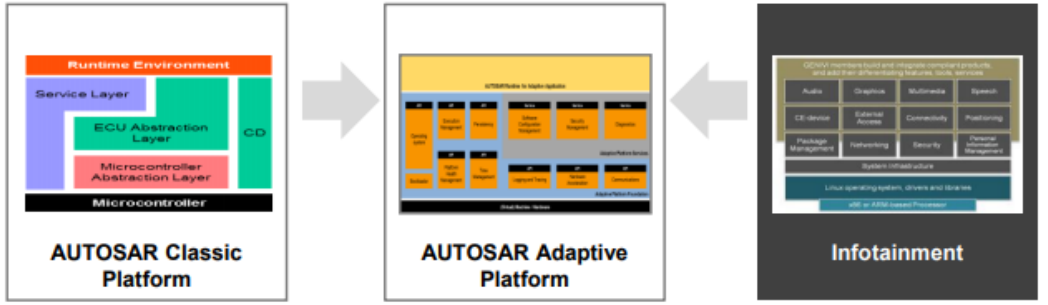


< Tesla's architecture >

SDV Overview

➢ Embedded System Structure of Major Automakers

- **Control**
  - AUTOSAR Classic Platform
- **OTA and Automated Driving**
  - AUTOSAR Adaptive Platform
- **Infotainment**
  - Infotainment Platform
- **Cloud**



Real time Requirements	High, in the range of micro-sec	Mid, in the range of milli-sec	Low, in the range of sec
Safety Criticality	High, up to ASIL-D	High, at least ASIL-B	Low, QM
Computing power	Low, ~ 1000 DMIPs	High, > 20.000 DMIPs	High, ~ 10.000 DMIPs

Comparison of Features by Platform

source : AUTOSAR 10th Open Conference, Welcome Note

SDV Overview

➢ Adaptive AUTOSAR Platform

- **For OTA/AD**
- **SOA & easy-to-update platform**
- **Based on R23-11**

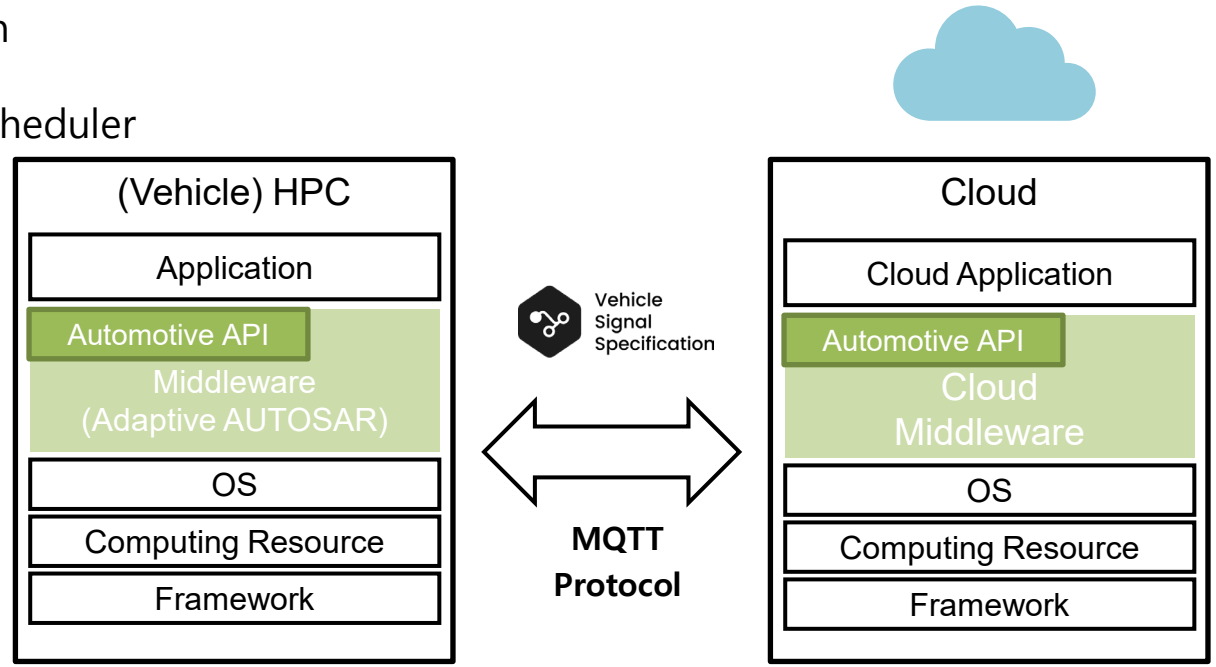
➢ Not supported by Adaptive AUTOSAR (R 23-11)

- **Protocol design for server-to-vehicle communication to receive software packages**
  - Designed by reflecting OEM-specific requirements
- **AI Platform**
  - Design of AI API for autonomous driving
- **Cloud API**
  - Requires individual protocol design for cloud utilization
- **Determinism**
  - The order of invocation is determined by the thread scheduler
  - Abnormal results may occur
- **OTA Process**
  - Considerations such as ISO 24089

➢ Future Evolution Directions

- **Platform integration for AI utilization**
- **Flexible environment through Cloud API definition**
  - Consideration of R24-11

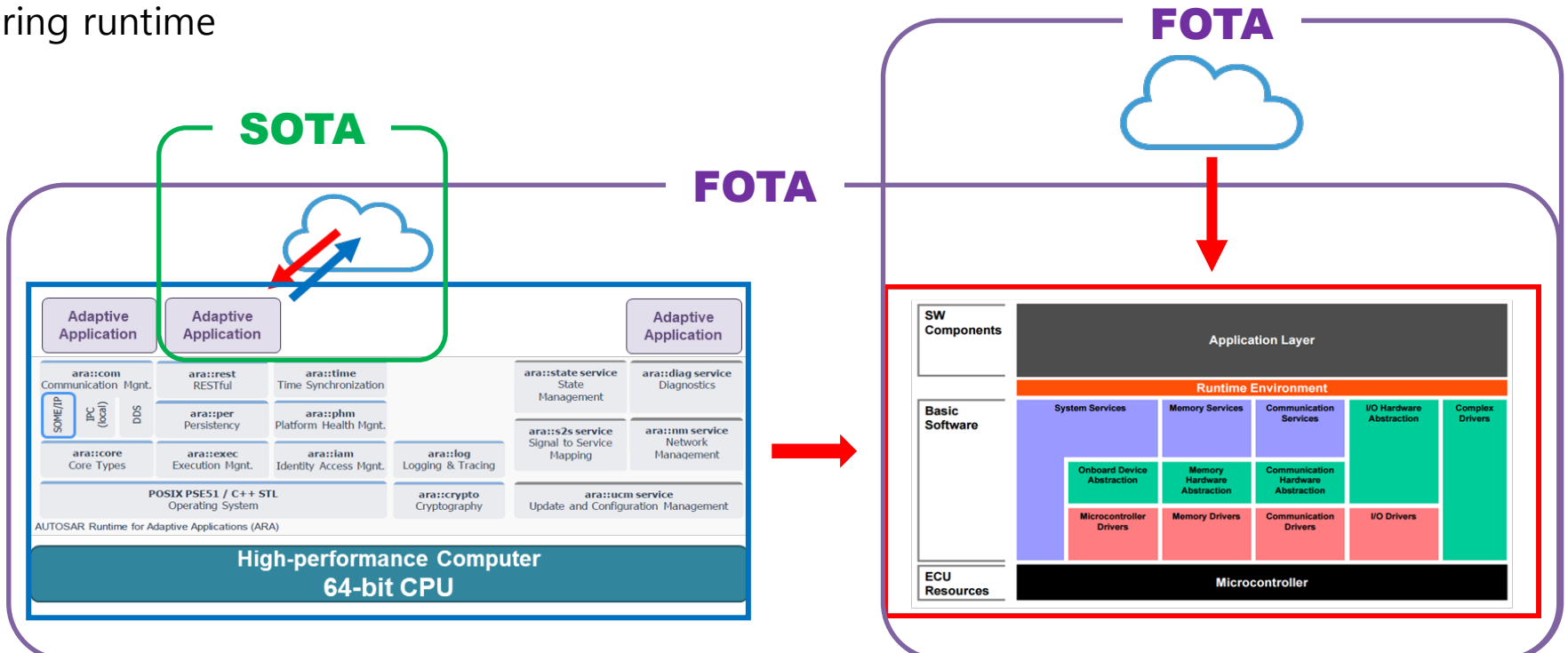
Source : Autosar.org



SDV Overview

➢ SW Updates via OTA

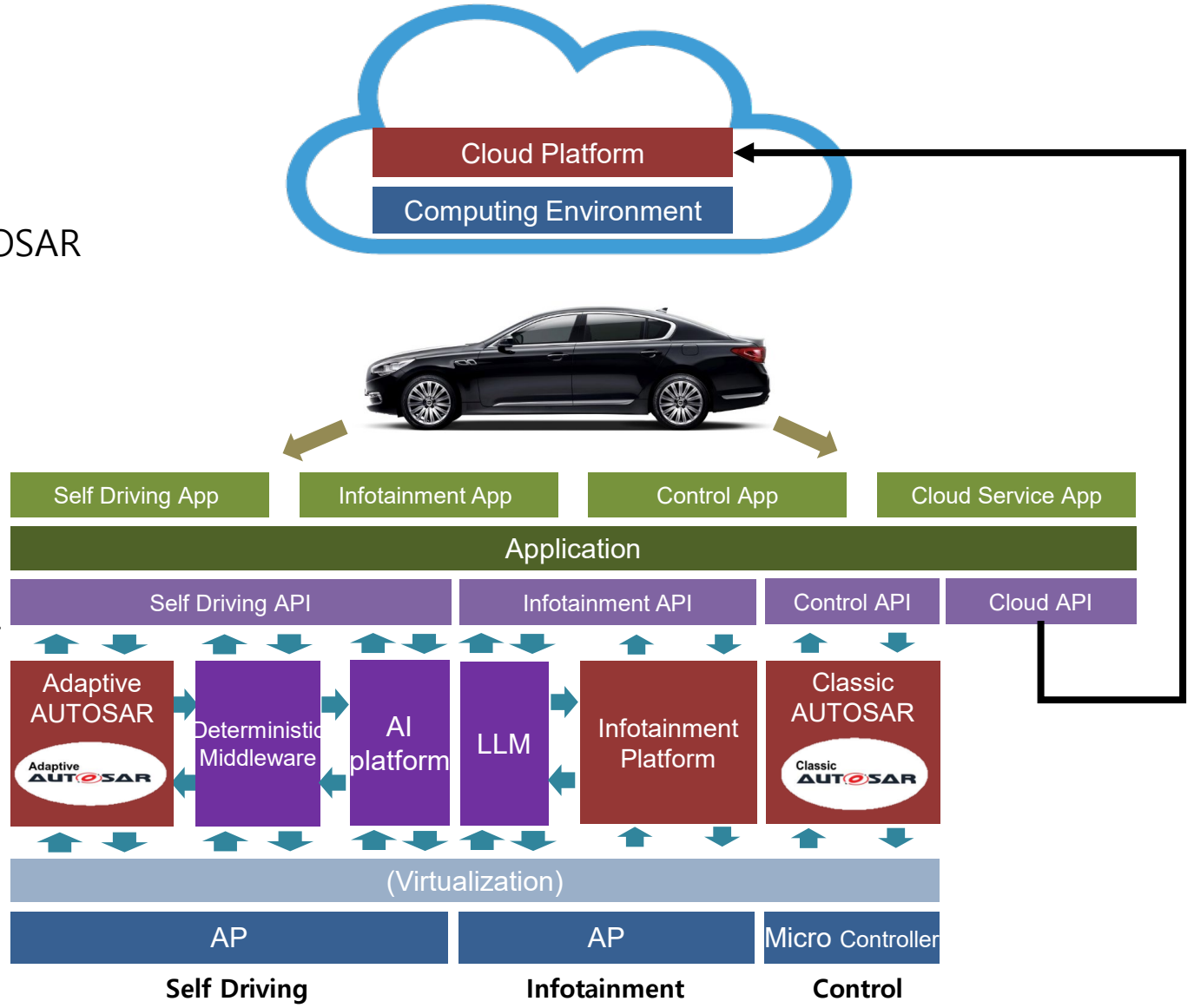
- **SOTA (Software Over-The-Air)**
  - Provided by Adaptive AUTOSAR
  - Can add/update applications individually
  - Can update during runtime
- **FOTA (Firmware Over-The-Air)**
  - Currently for Classic AUTOSAR
  - Requires the entire firmware to be updated even if only one application is updated
  - Cannot update during runtime



SDV Overview

➢ SW Platform Structure for SDV

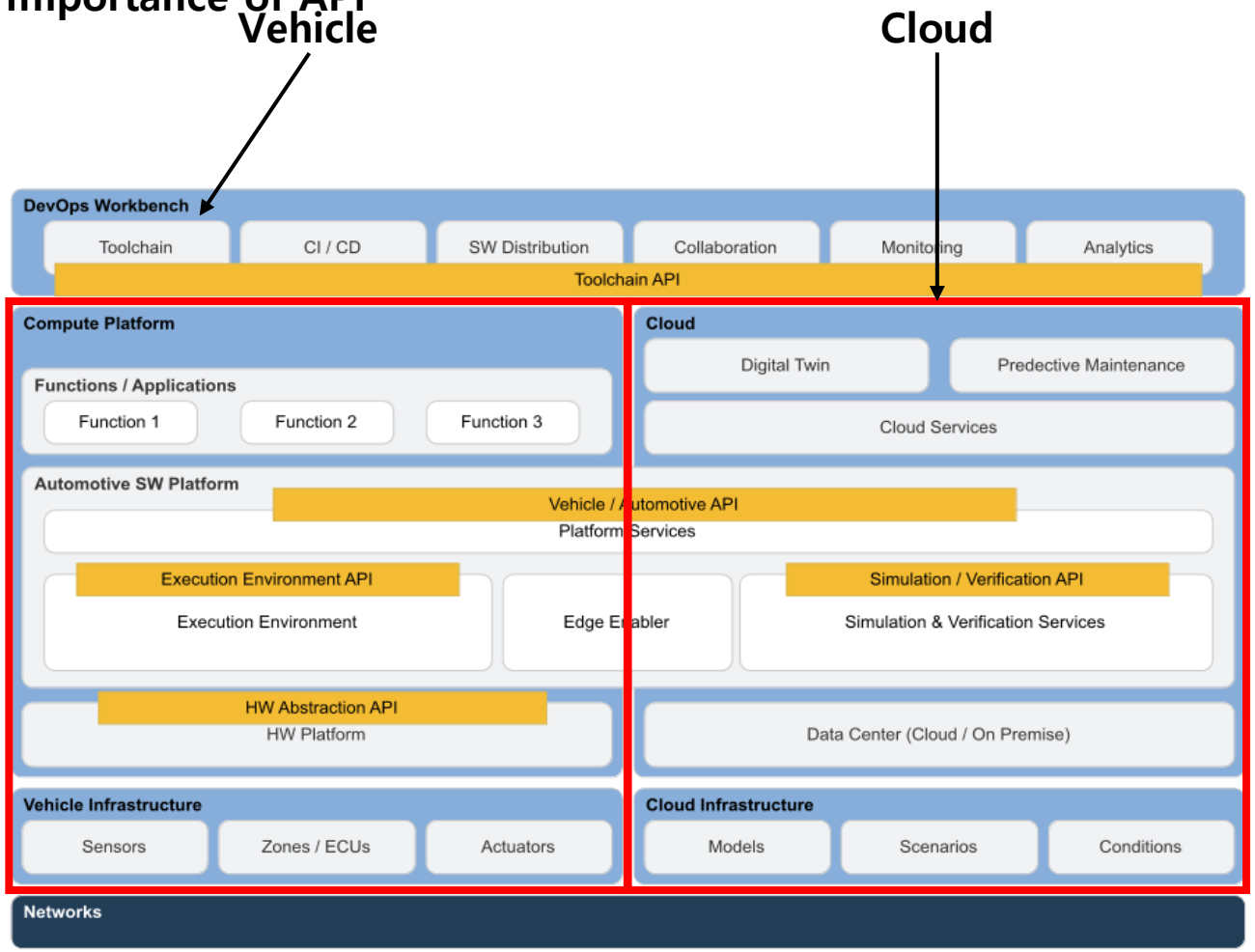
- **Automated Driving**
  - AI & Adaptive AUTOSAR
    - ✓Autonomous driving decisions using AI
    - ✓Processing AI results within Adaptive AUTOSAR
- **OTA**
  - Software updates
- **Infotainment**
  - Infotainment platform
- **Control Applications**
  - Classic AUTOSAR
  - Control of body, chassis and powertrain, etc.
- **Cloud**
  - Connection through Cloud API



SDV Overview

➢ AUTOSAR from the Perspective of SDV

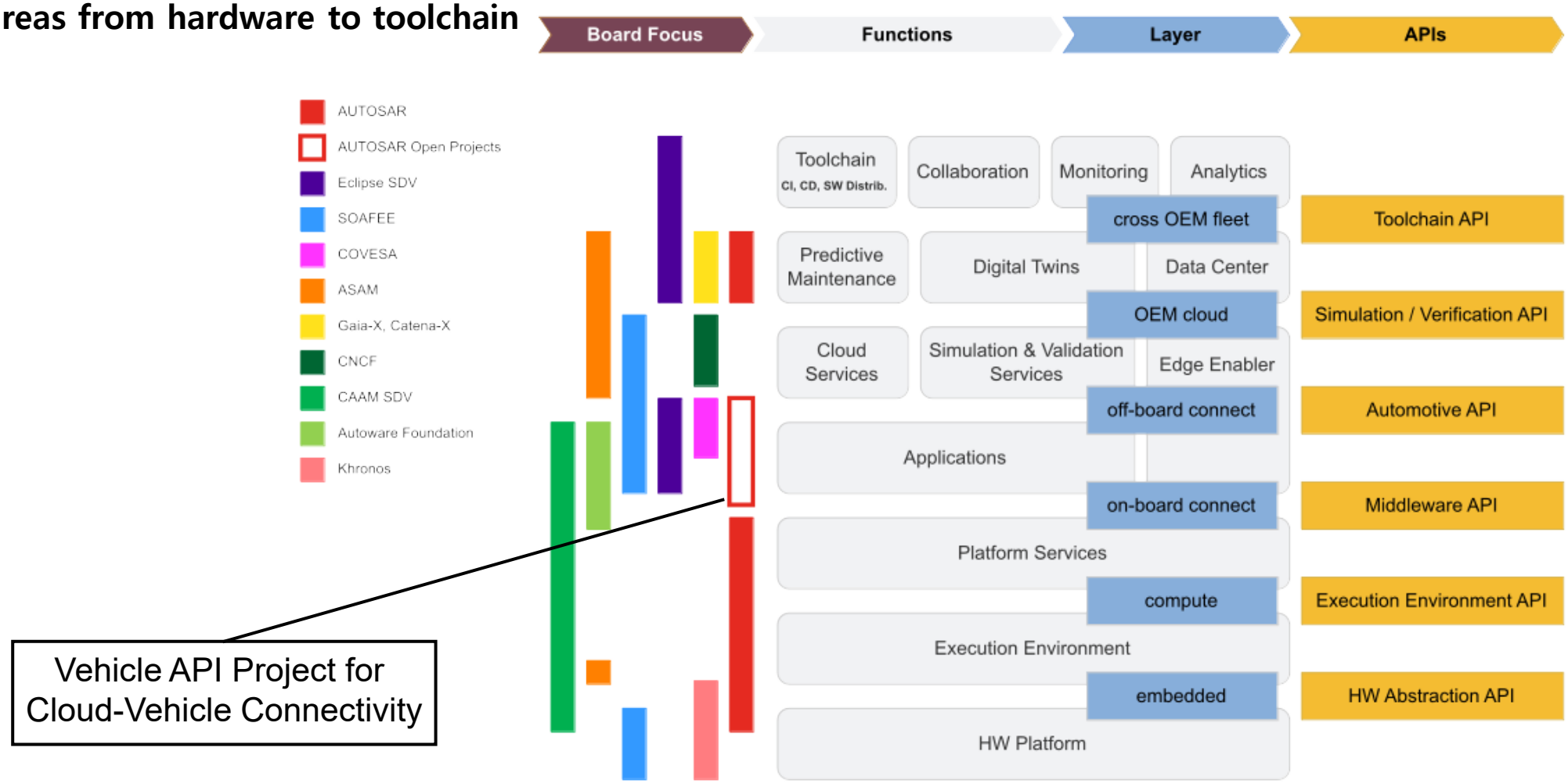
- **(Source: 15th AUTOSAR Open Conference, Jennifer Neumüller)**
- **Decoupling of HW and SW and emphasis on the Importance of API**
  - APIs exist in every abstraction layer.
  - Cloud-to-vehicle API.
  - Necessity of API standardization.
- **Cloud Mirroring**
  - Mirrors the physical layer on the left in the cloud on the right.
- **DevOps Workbench**
  - Toolchain APIs exist that manage both the physical layer and the cloud
  - Used for development, deployment, monitoring, etc.



SDV Overview

➢ AUTOSAR in the SDV(source: 15th AUTOSAR Open Conference, Jennifer Neumüller)

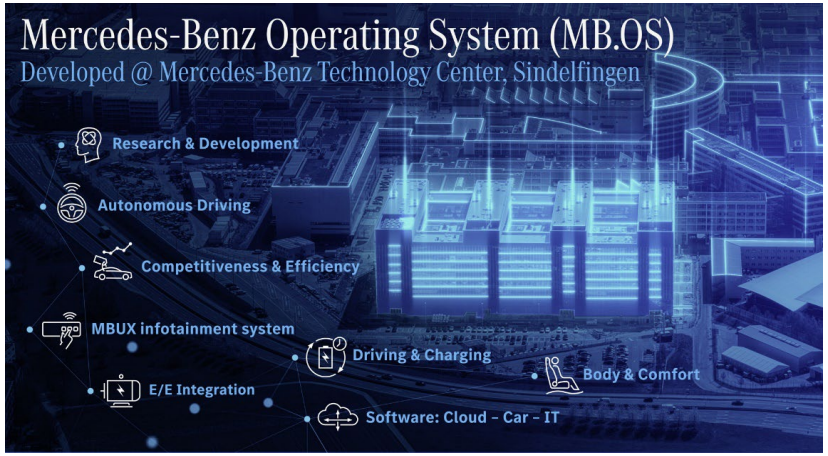
- Collaborative development between consortium
- Covers all areas from hardware to toolchain

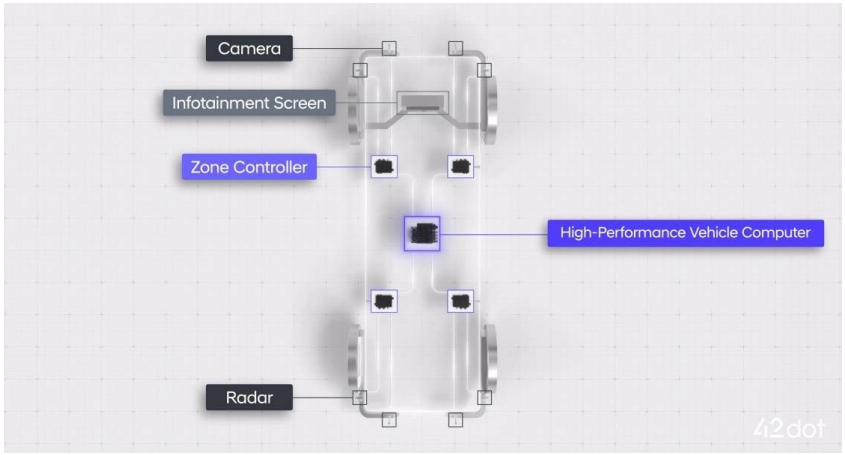


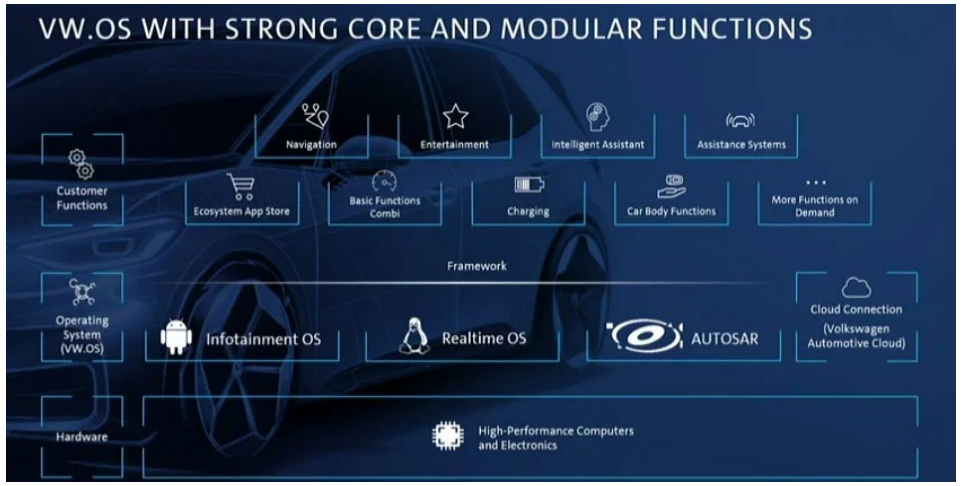
Evolution of HW/SW Platform

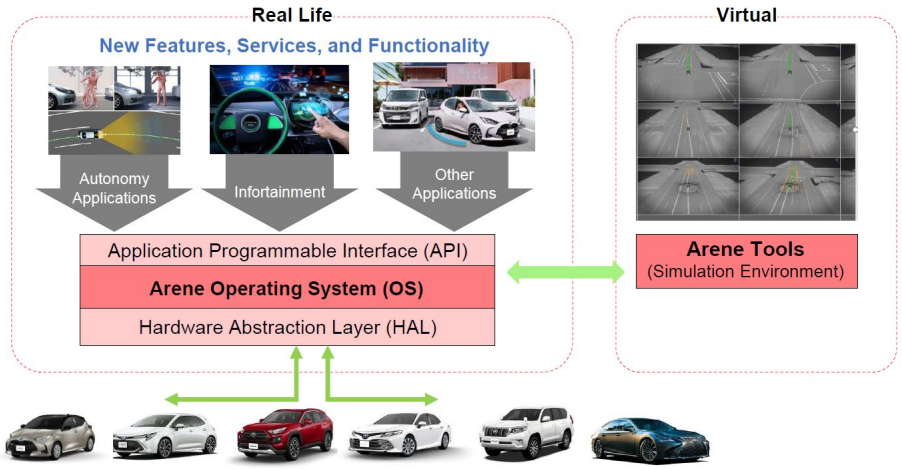
➢ Adaptive AUTOSAR-Infotainment-Classic AUTOSAR structure

- **Benz, Hyundai, Volvo, Volkswagen, Toyota cases**







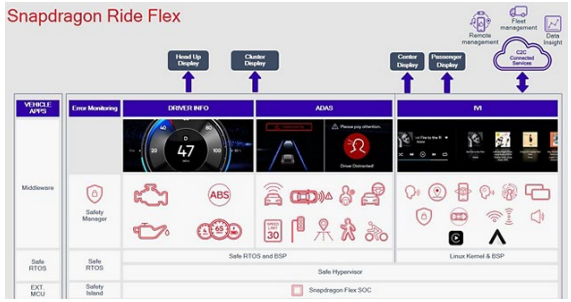


Evolution of HW/SW Platform

➢ HPCs for SDV

< Snapdragon Ride Flex, Qualcomm >

- Mass production contract with Volkswagen in 2022
- Showcased an integrated cockpit and ADAS platform with Bosch at CES 2024



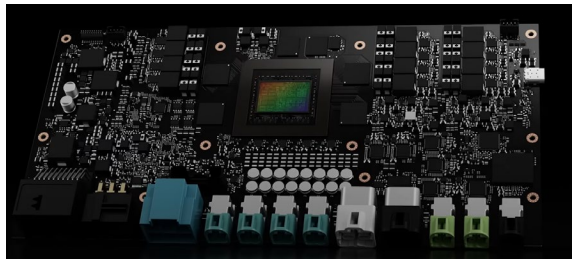
< EyeQ Ultra, Mobileye >

- Polestar 4 in 2024
- Bentley in 2025
- Collaboration with Porsche

EyeQ® Ultra

< Drive Orin, Nvidia >

- Mercedes-Benz in 2024
- Volvo EX90 in 2024
- 250 TOPS/80W performance



< Ambarella, N1 SoC >

- Contracts with Bosch and Continental

Source: Each Company

Evolution of HW/SW Platform

➢ HW platform evolution - Integration of main ECUs with HPCs

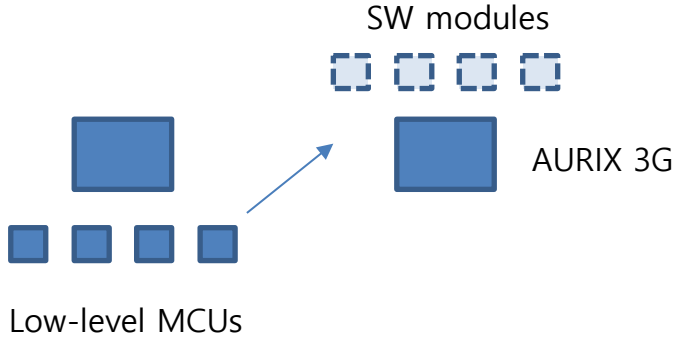
- **NVIDIA DRIVE Thor**
  - Scheduled for release in 2025
    - ✓2000 TOPS
  - Integration with HPC
    - ✓Digital Cluster
    - ✓Infotainment
    - ✓Parking
    - ✓ADAS and more
  - ASIL-D Level Achieved
    - ✓Utilization NVIDIA DriveOS SDK
  - Multi-domain Computing
    - ✓Can run Linux and Android simultaneously

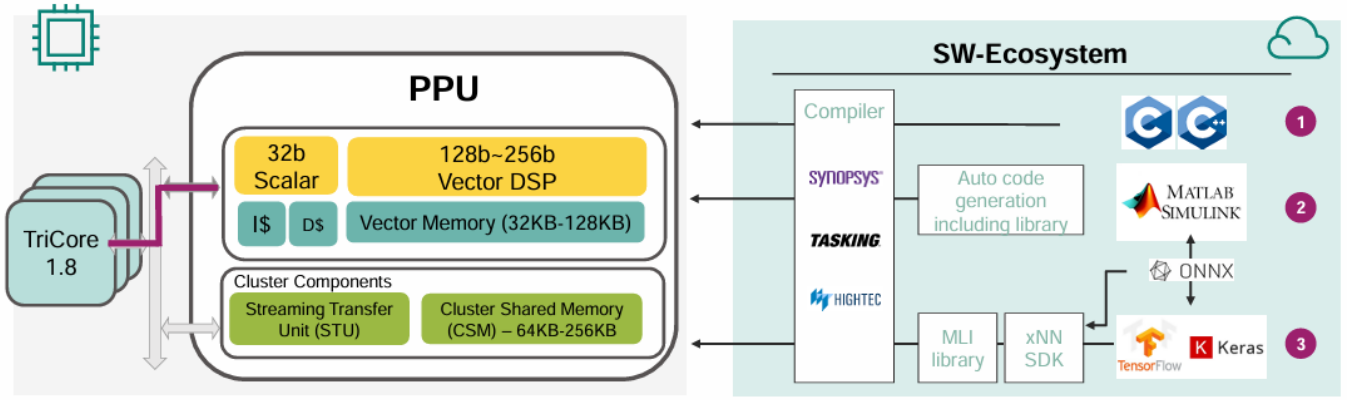
Source: NVIDIA

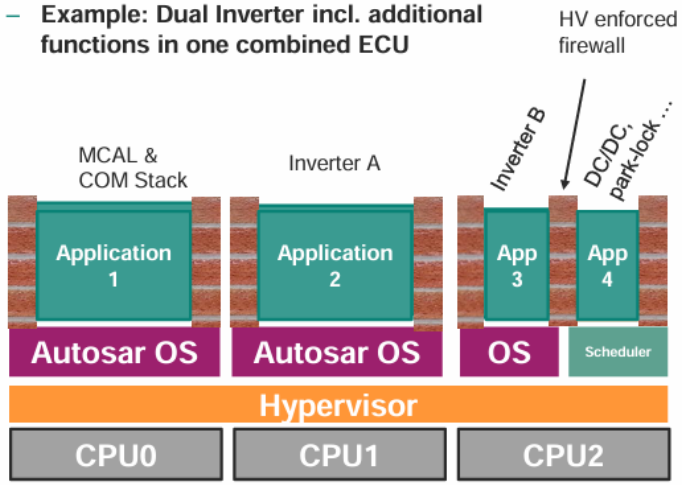
Evolution of HW/SW Platform

➢ HW platform evolution – Integration of low level MCUs with zonal processors

- **Infineon AURIX 3G**
  - Low-level zonal architecture implementation via hypervisor.
    - ✓Integration of sub-MCUs into a single MCU using Hypervisor
      - HW modules ↓ & SW modules ↑
    - ✓Minimize interference between applications through FFI Implementation
      - Freedom From Interference
  - Parallel Processing Unit (PPU)
    - ✓AI and Matrix Computation Accelerators
    - ✓Accelerate automotive AI algorithms, virtual sensors and MPC computation
  - RRAM (Resistive RAM)
    - ✓Ideal for updating applications via OTA
      - Fast data read and write speeds, Higher endurance



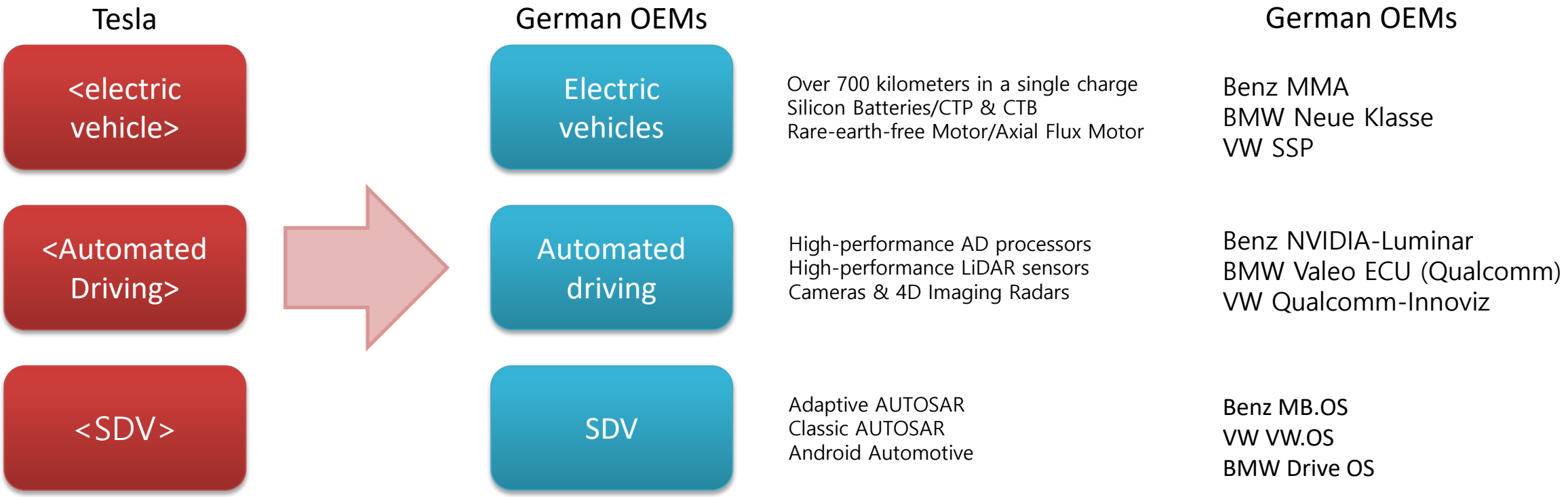




Evolution of HW/SW Platform

➢ Case study: IAA 2023

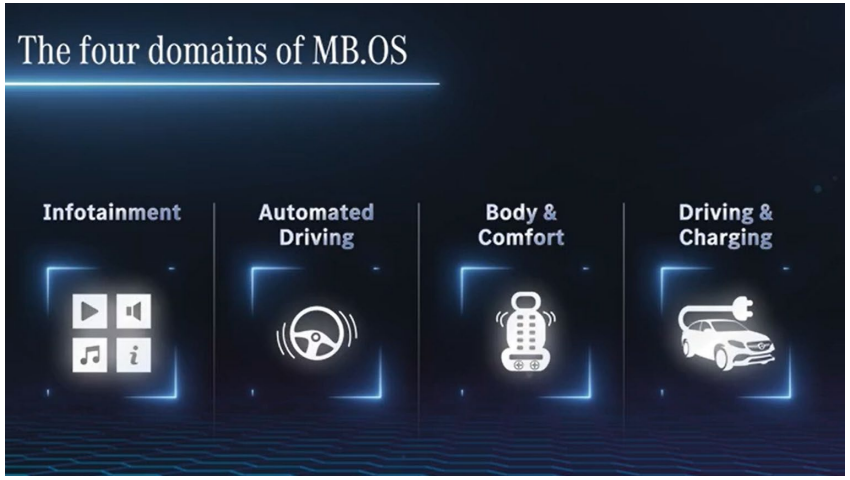
- **Stabilizing EV, autonomous, and SDV platforms**
  - Benchmarking Tesla's architecture
  - Targeting commercialization between 2024 and 2026.



Evolution of HW/SW Platform

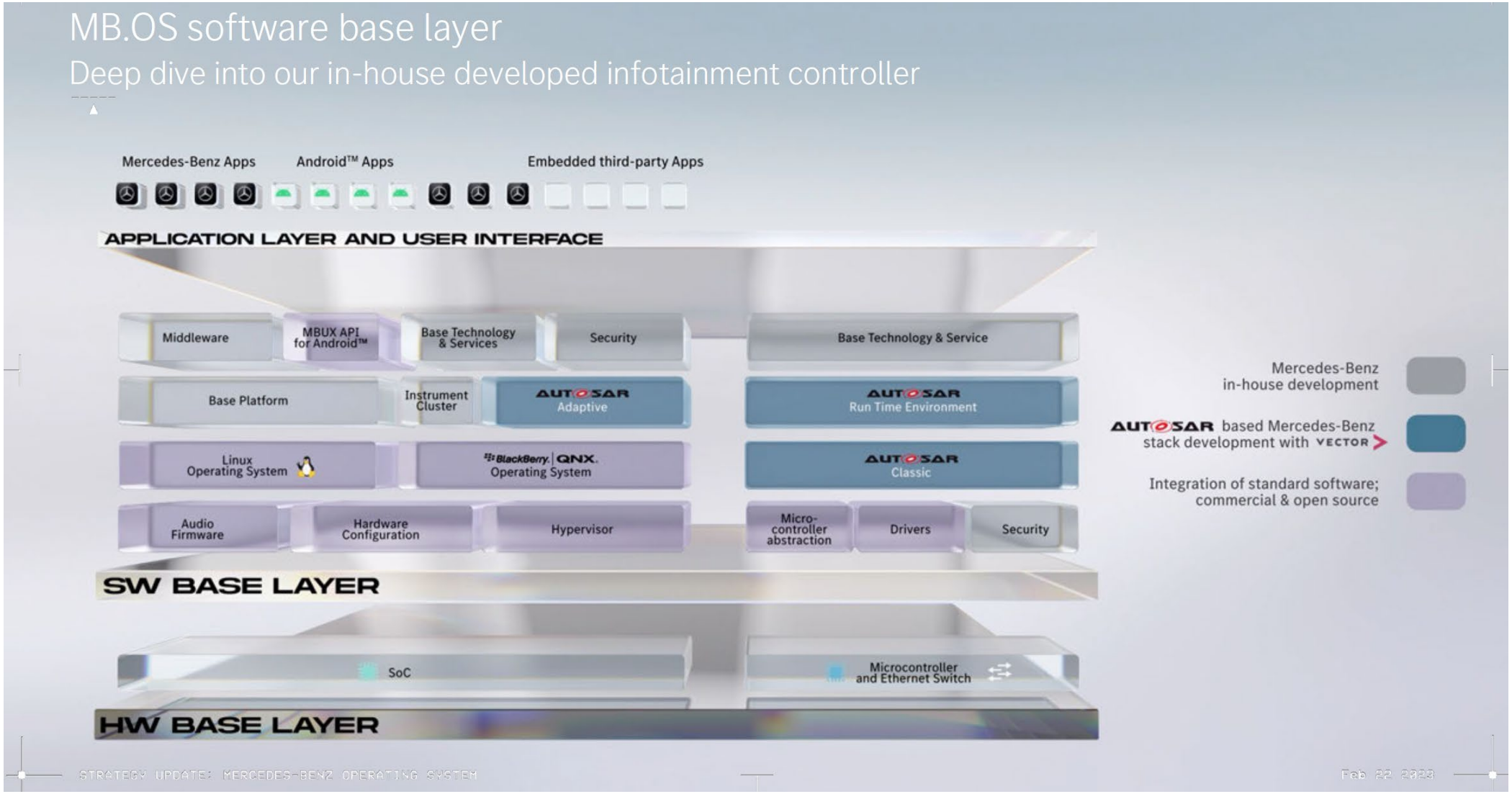
➢ Case study: IAA 2023, MB.OS

- **In-house developed OS for SDV**
  - Mercedes Benz Operating System
  - late 2024, starting with the concept CLA class
  - MB.OS-based infotainment system on The New E-Class 11th generation
- **Utilizing MMA as the HW platform, Planning to use MB.OS**
- **Related key vendors**
  - Nvidia Orin Processor & Luminar Iris Lidar
- **Chip-To-Cloud Architecture**
  - From Chip to Cloud in the Car
    - ✓Enable flexible capabilities for future SDV
- **Configured with four domains**
  - Infotainment, Automated Driving, Body&Comfort, Driving&Charging



Evolution of HW/SW Platform

➢ MB.OS Strategy Update: Mercedes Benz Operating System (2023.03.03)



Source: mbsu-os-2023-presentation-markus-schaefer-magnus-oestberg

Evolution of HW/SW Platform

➢ Connected cars with 5G

- **MWC23 & MWC24**
  - 5G Acceleration
  - Network API
- **Avanci Platform**
  - Patent platform - patents from Ericsson, Samsung, Nokia, Qualcomm, LG Electronics, Sony and more
    ✓Samsung Electronics (joined April 2023), LG Electronics (joined February 2022)
  - 5G Connected Vehicle License
    ✓License support for C-V2X, 5G, 4G, and more
    ✓$29 per vehicle on contracts prior to 2024.02
    ✓$32 per vehicle on subsequent contracts
    ✓Benz signs first 5G contract (2023.08.17)
    ✓Hyundai Motor Group signs deal in Nov. 2023

Licensees Participating in Avanci 5G Vehicle

Market-driven pricing

Avanci 5G license pricing *includes 4G, 3G, and 2G license*	**$32 / vehicle** base running royalty
Early licensee pricing *Avanci 5G license signed before the later of February 16, 2024 or first sale of 5G connected vehicle, other conditions apply*	**$29 / vehicle**

Evolution of HW/SW Platform

➢ China CAAM SDV API (AOC 24)

- **December 2022, AUTOSAR-based SDV API Standardization**
  - Mass production coverage of 20+ vehicles from 10 OEM groups

- **Developing APIs based on AUTOSAR Platform**
  - Classic AUTOSAR
    - ✓Body, powertrain, temperature management, chassis, ADAS, etc.
    - ✓345 total
  - Adaptive AUTOSAR
    - ✓Body, vehicle control, temperature management, energy management, ADAS, HMI, etc.
    - ✓504 total

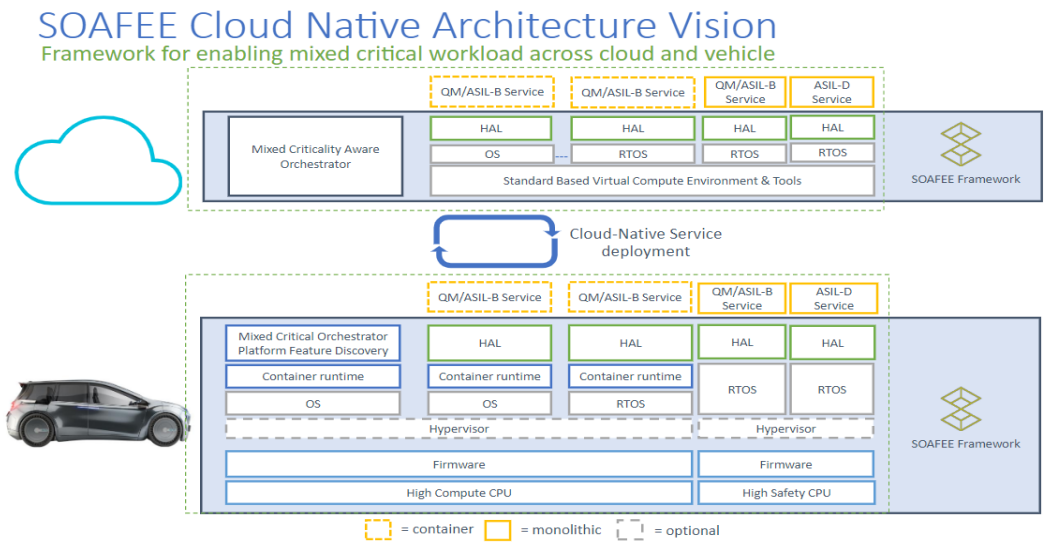
- **Mass production in 2023 (2 OEMs, 5 vehicles)**
  - BYD: Seal, Seal U, ATTO3
  - nio: et7, es7
- **Mass production in 2024 (4+ OEMs, 8+ vehicle types)**
  - Dongfeng, Changan, GAC, BAIC, Cyrus, Chery, Jianghuai, etc.

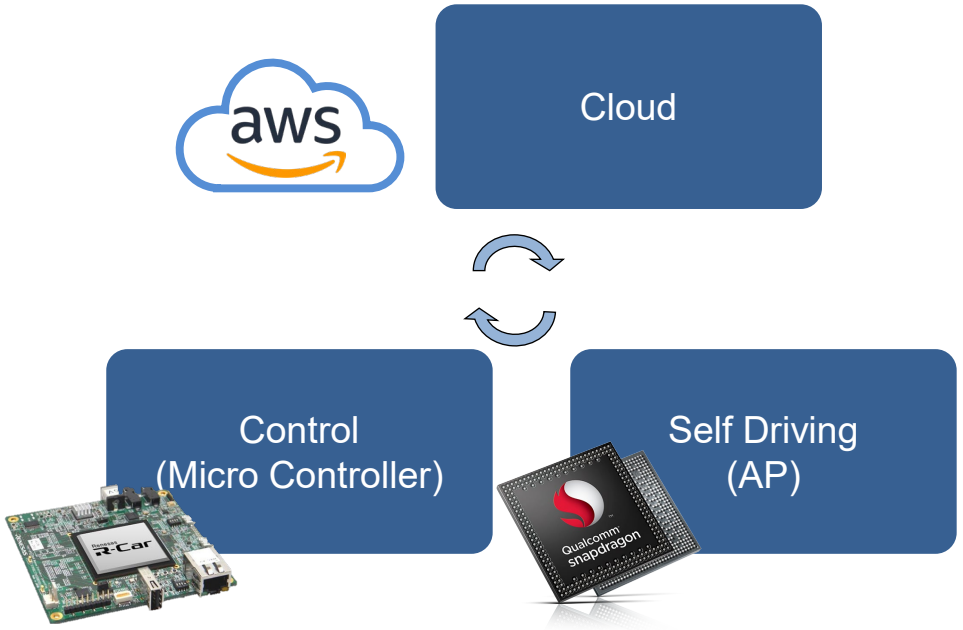
SDV API

Cloud Native Development

➢ Cloud Native Development

- **SOAFEE (Scalable Open Architecture For Embedded Edge)**
- **Collaborative organizations to build SDV open source architecture**
  - OEMs, system semiconductor, SW, cloud companies, and more
  - Governing Body Members - ARM, AWS, Bosch, Continental, LG Electronics, etc.
  - Voting Members - QNX, Elektrobit, ETAS, Mathworks, Renesas, etc.
- **Goals**
  - Goal of building a cloud-native architecture that accommodates diverse HW
    - ✓Reduce application development time
    - ✓Expansion of ARM ecosystem

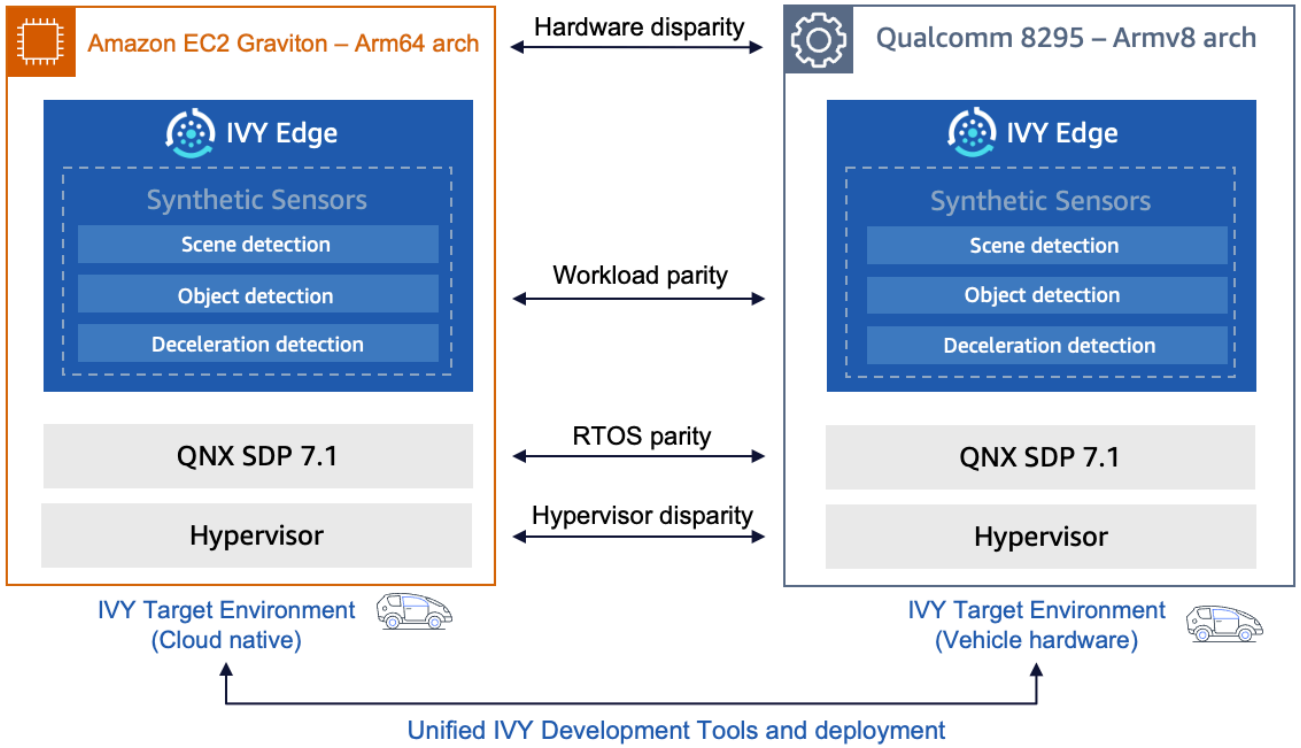




Cloud Native Development

➢ Cloud Platform for SDV

- **QNX's Cloud Native Architecture**
  - Cloud-Edge Virtualization on Hypervisor
  - Virtual Cockpit (2024.07.19)
    - ✓Develop 100x faster than before



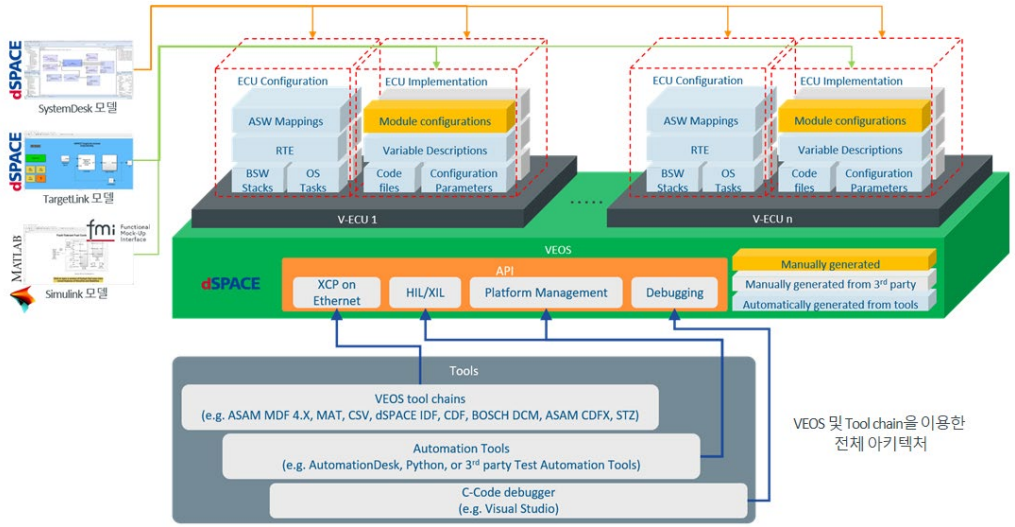
Source: BlackBerry

Cloud Native Development

➢ Case study: Virtual Simulation in the Cloud

- **dSPACE VEOS (Virtual ECU Offline Simulation)**
- **Automotive network and ECU simulation platform**
  - BMW, Jaguar-Land Rover, Volkswagen, Ford
  - Cloud-based testing of vehicle software
    - ✓Validation of AUTOSAR-based ASW and BSW code or legacy code
    - ✓Validation for several corner cases
  - Simulation of driving scenarios for autonomous vehicles
    - ✓Simulation of sensor data processing, path planning, vehicle control algorithms in the cloud

	Contains	Example Test Goals
Basic V-ECU (Level 1)	▪ Single application SWCs or complete application software	Functional tests of application software (SIL)
Advanced V-ECU (Level 2)	▪ Application software ▪ Non-production basic software, created just for the V-ECU	Diagnostic tests (SIL)
MCAL V-ECU (Level 3)	▪ Application software ▪ Production basic software	Complete ECU software tests (SIL)

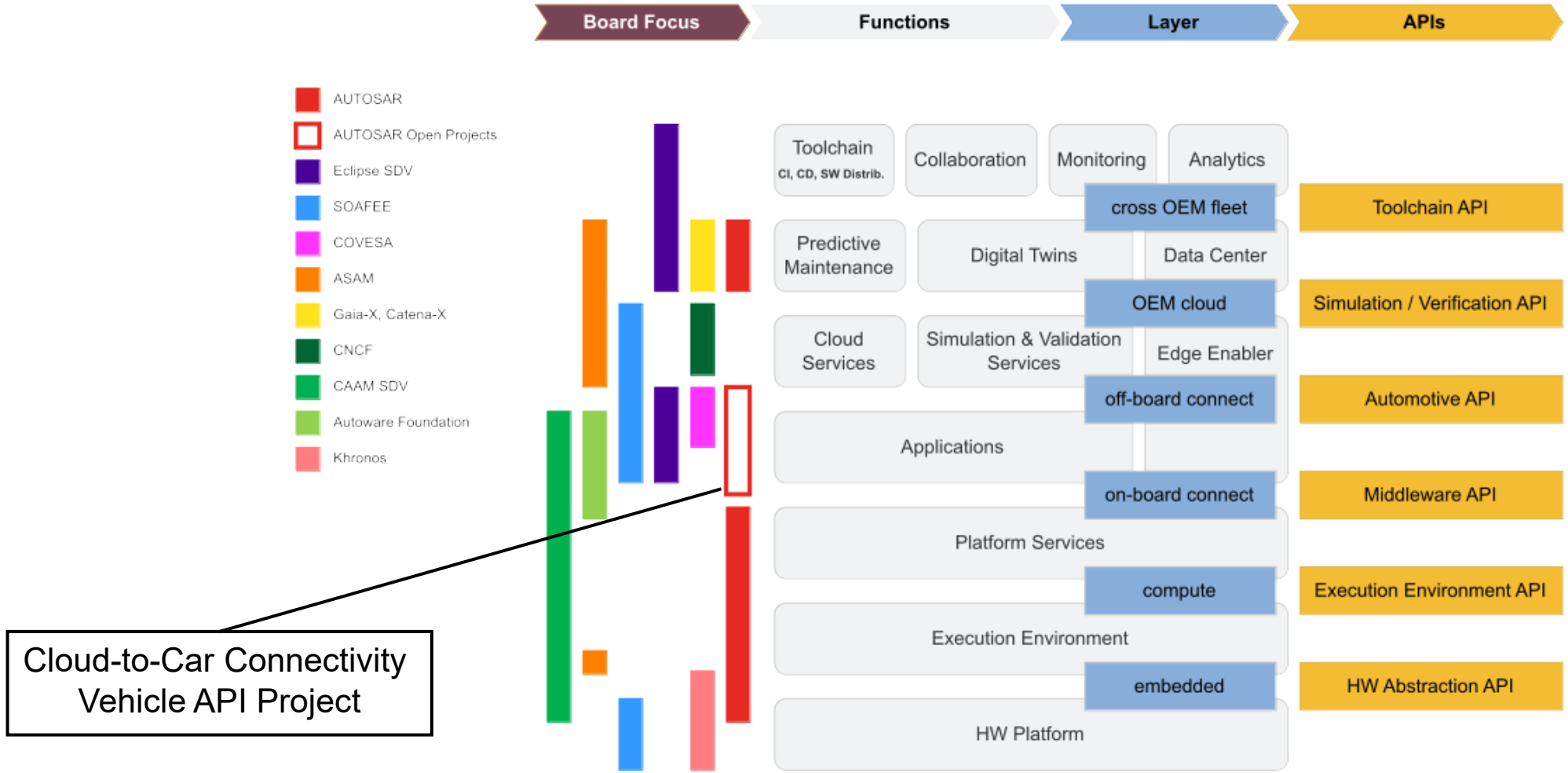


VEOS 및 Tool chain을 이용한 전체 아키텍처

Collaboration with Other Standards

➢ AUTOSAR from an SDV Perspective

- **Collaborative development among consortium members**
- **Covering the entire range from HW to toolchain**

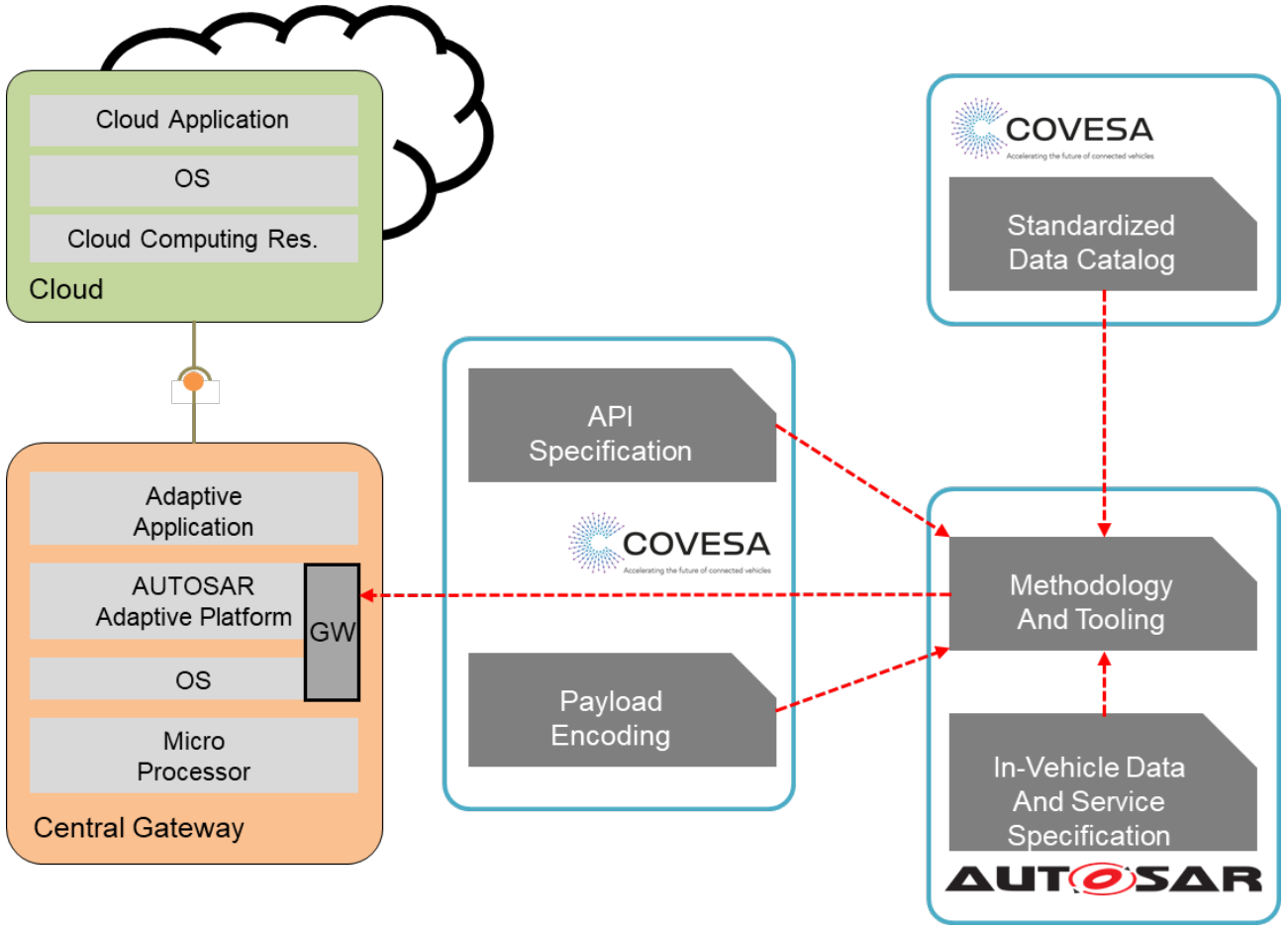


Source: 15th AUTOSAR Open Conference, Jennifer Neumüller

Collaboration with Other Standards

➢ AOC 2024, Various directions for the evolution of SDV

- **Adaptive AUTOSAR Commercialization**
  - Requires external platform support
    - ✓Cloud and cloud connectivity
    - ✓AI feature support
- **Integration with related standards**
  - Cloud and cloud connectivity
    - ✓VSS in COVESA
    - ✓SOVD in ASAM
    - ✓SOAFEE
  - AI feature support
    - ✓Embedded AI
    - ✓Cloud AI



Ecosystem Changes due to SDVs

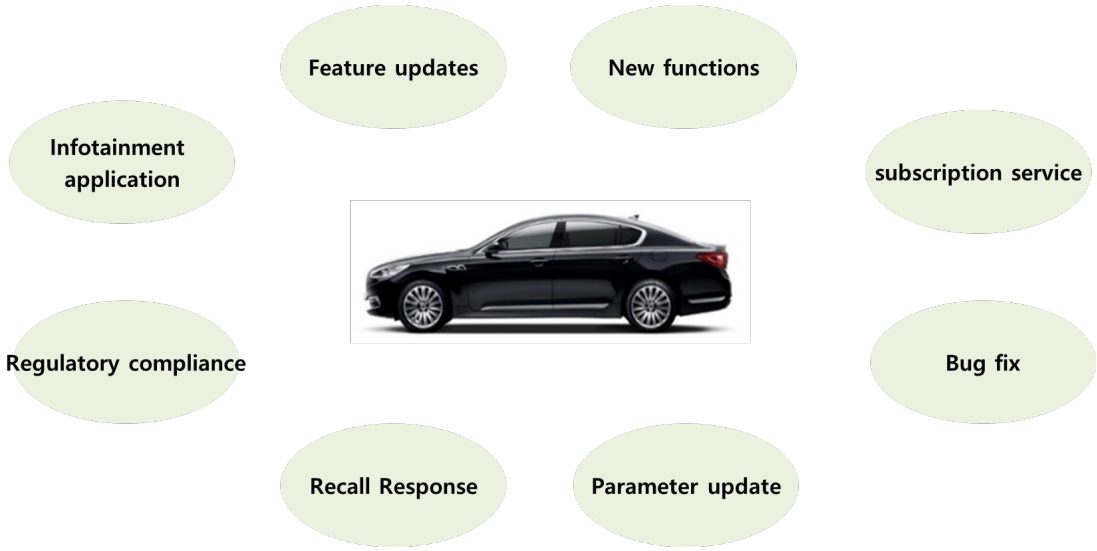
➢ Why SDV for OEM?

- **Competitiveness compared to other companies**
  - Maintaining ‘vehicle value’ through SDV

- **Software updates and recall response**
  - Error handling and recall response
  - Reduction of management costs

- **Consumer convenience features**
  - Infotainment, convenience, ADAS, and autonomous driving
  - Monetization

- **Subscription-based services**
  - Offer a variety of subscription services
  - Revenue and income for a new market

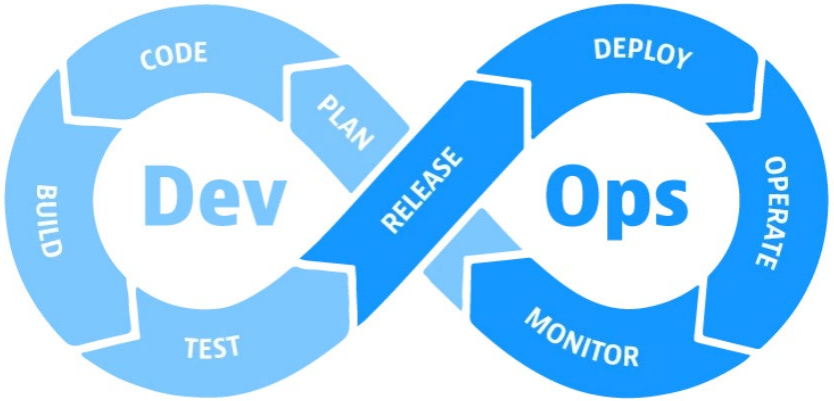


Gu-Min Jeong, Evolution of Software-Defined Vehicles and Their Implications for the Automotive Industry Ecosystem, The Korean Associations of Mobility Studies, 2024

Ecosystem Changes due to SDVs

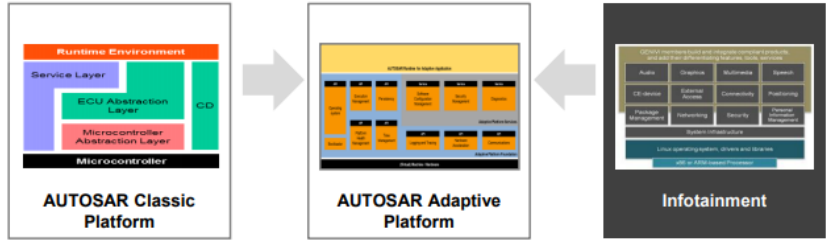
➢ Potential Changes with SDV - Evolution of Automotive Software Platforms

- **Increasing complexity of software development**
  - Integrated development of software with different development cycles
    ✓DevOps, CI/CD issues
  - Increase in development and management costs
  - The need for cloud development for OTAs



- **Development of in-house software platforms**
  - Development of an integrated platform for SDV
  - In-house software platform development by automotive companies
  - Adoption of Adaptive AUTOSAR-Infotainment-Classic AUTOSAR architecture
    ✓AA-AA-CA

- **Changes resulting from in-house platform development**
  - Transition from model-specific to in-house platform development
  - Challenges for companies not in the in-house ecosystem



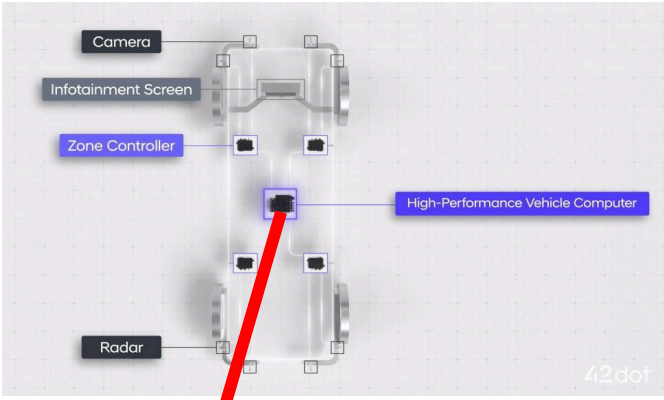
Ecosystem Changes due to SDVs

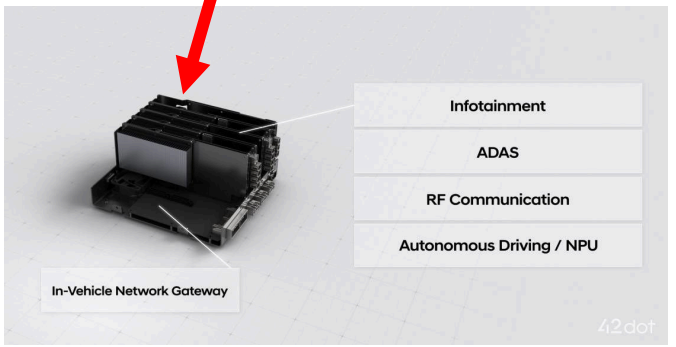
➢ Potential changes with SDV - impact to HW components

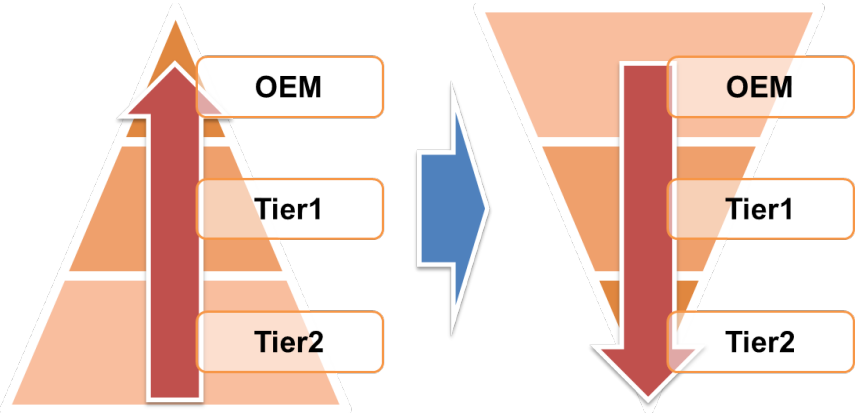
- **SDV platform for major OEMs**
  - Aligning with EV and ADV development
    - ✓Connecting with electric vehicle platforms
    - ✓Ex. Benz MMA Structure
  - Expanding to internal combustion engines

- **Possible changes in HW componetns**
  - Potential for hardware and component market impact from SDV platforms
  - Top-down software design impacts component markets

- **Classic AUTOSAR case study**
  - Similar architecture for AUTOSAR compliant MUCs
    - ✓GTM and more
  - Changes from top-down software design
    - ✓Increased similarity for HW components
    - ✓Increased influence of OEMs







Ecosystem Changes due to SDVs

➢ Potential changes with SDV – Connected car market

- **The evolution of a connected car market**
  - Avanci 5G Program
    ✓Hyundai, Benz, etc.
  - Standardization of network APIs by mobile service providers
    ✓Reduce service development difficulty
  - V2X Evolution
    ✓Services with V2X
  - Advancing connected car services
    ✓Advancing communications-based services

- **Infotainment services due to the evolution to living spaces**
  - Expanding Android automotive adoption be OEMs
  - Key revenue stream for OEMS
  - Vehicles that turn into living spaces

Ecosystem Changes due to SDVs

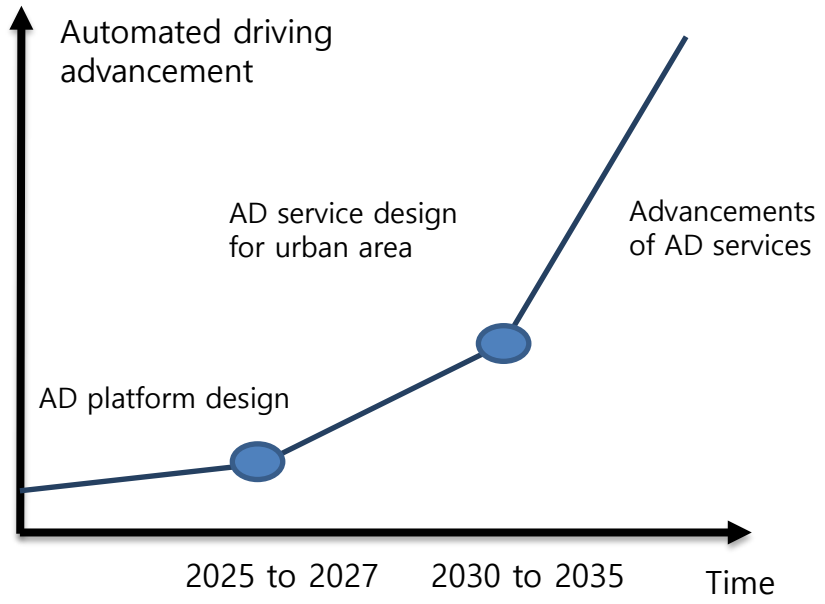
➢ Potential changes with SDV – Automated driving services

- **Collaborative development of AD-SDV-EV**
  - High-performance processors and high-performance LIDAR
    ✓Example) Benz, Volvo, BMW, VW, etc.

- **Updating AD capabilities with the SDV platform**
  - Enable advanced AD applications and services

- **Platform stabilization coming soon**
  - 2025-2027

- **Advances in AD services**
  - AD services with stabilized platforms



Gu-Min Jeong, Autonomous Driving 2035 (in Korean)

NIA Digital Transformation Strategy Report, 2022

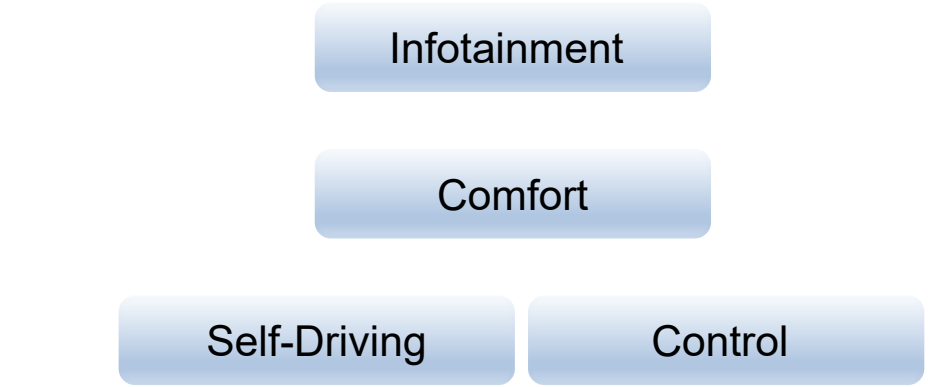
Ecosystem Changes due to SDVs

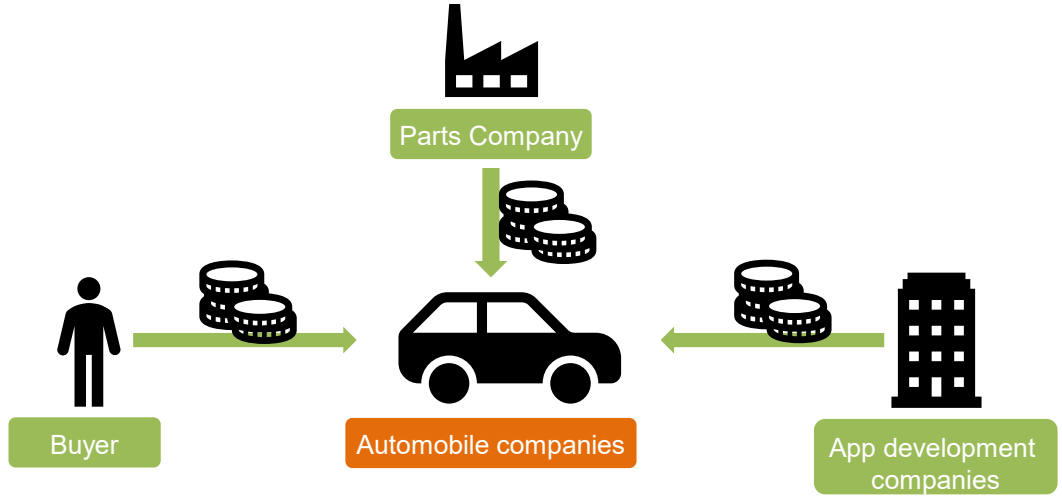
➢ Potential changes with SDV - Evolution of the subscription services market

- **Growth of subscription service market**
  - New sources of revenue
  - Download various apps and services
  - App recommendations with LLMs

- **Potential development of AD and infotainment market**
  - AD features
  - Infotainment apps

- **Potential changes in the vehicle sales model**
  - Subscription fee based model
    - ✓Ex) Initial sales price + monthly subscription fee
  - Two-sided or multi-sided market structure
    - ✓Ex) Profits from API usage fees and App store fees





Conclusion

➢ Ecosystem changes with SDV

- **In-house software platform development**
  - Possibility of an exclusive ecosystem
- **Potential changes in HW components market**
  - Aligning in-house software and hardware
- **The evolution of the connected car market**
  - New era of 'Communication in Car'
  - Developments in the infotainment market
- **Developments in the automated driving market**
  - Automated driving application download with SDVs
  - Platform stabilization and AD evolution
- **Evolution of subscription services**
  - Growth of subscription service market
  - AD and infotainment market development
  - Potential changes in the vehicle sales models

SDV development

Integrated collaboration

ICT-automotive technology convergence

Subscription service market

Automated driving market

Conclusion

➢ Key Considerations and Direction for SDVs (AOC 24)

- **Cross-consortium collaboration**
  - AUTOSAR-centric consortium collaboration
  - Cooperation with COVESA, ASAM, GAIA-X, Eclipse, SOAFEE, etc.
- **Open source leverage**
- **API set definition**

AUTOSAR Adaptive Platform

COVESA
Accelerating the future of connected vehicles

SOAFEE

eclipse

ASAM

GAIA-X
data-infrastructure.eu

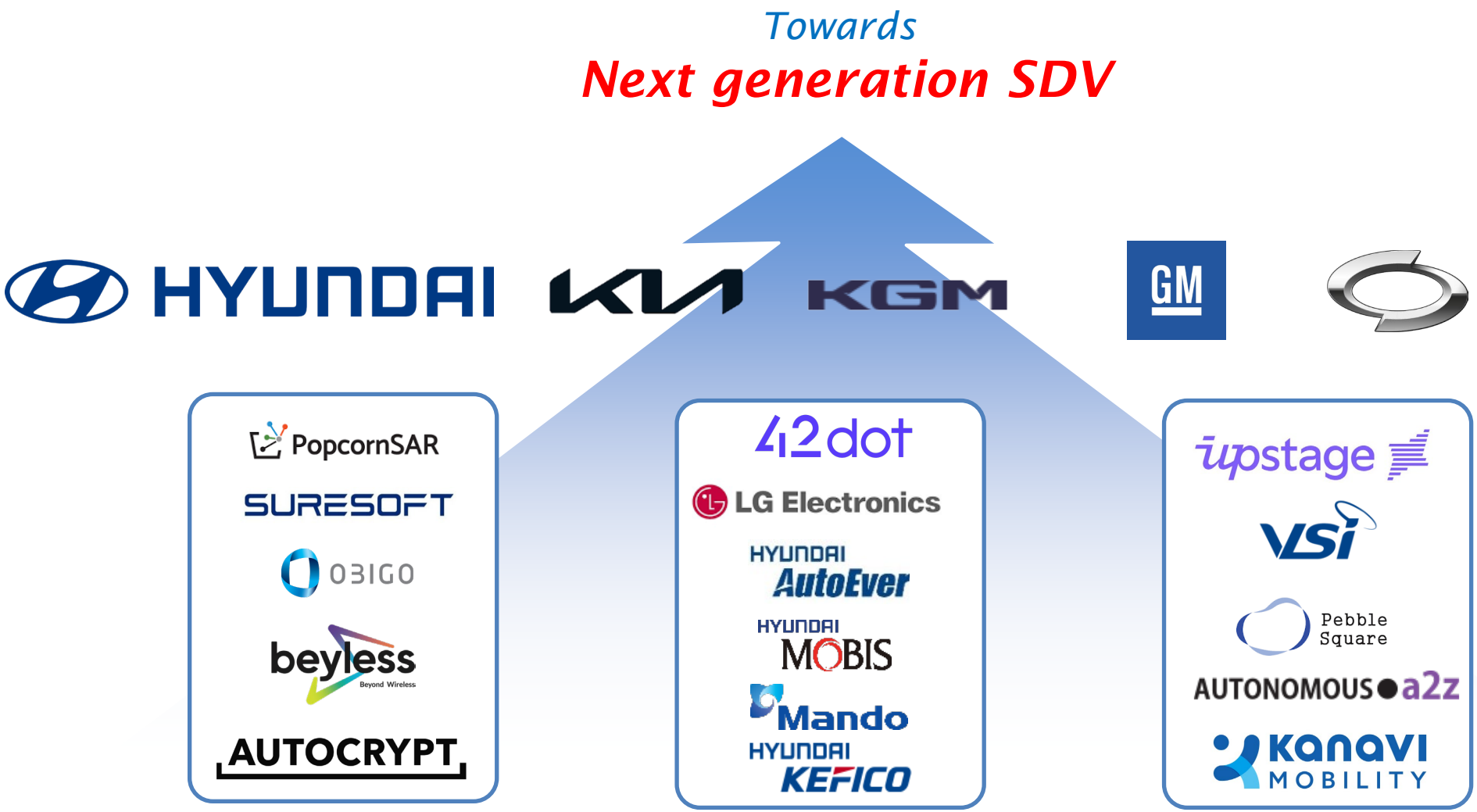
FEDERATE

CLOUD NATIVE COMPUTING FOUNDATION

THE AUTOWARE FOUNDATION

Conclusion

➢ **Integrated collaboration for next-generation SDV in Korea**



Conclusion

➢ **Representative SDV and automotive SW startups in Korea**

Infotainment

kanavi MOBILITY

MOTREX

DRIMAES

OBIGO

AUTOSAR

PopcornSAR

beyless

SURESOFT

RTst Reliable & Trustworthy

Automotive SW and App Platform

OBIGO

PERSEUS

yellowknife

SURESOFT

AUTOCRYPT

wondermove

Automotive Apps

TUNEIT

WAYS1

wondermove

yellowknife

Conclusion

➢ Automated driving startups in Korea

Automated Driving

a2z AUTONOMOUS
THORDRIVE
RideFlux

Lidar

SOS LAB
kanavi MOBILITY
AutoL

Recognition SW

STRADVISION
SEOUL ROBOTICS

Data Processing

AIMMO
INFINIQ

Automated Driving

MARS
sonnet.ai 주식회사 소네트
Unmanned Solution

Radar

SMART RADAR SYSTEM
bitsensing

HD Map/Simulator

MOBILTECH
Stryx MORAI

OS/SW/Platform

PopcornSAR
OBIGO
PERCEUS

Camera

OptoLiv
MCNEX
partron

V2X

ettifos Connected-in-Motion
RAMIX

Sharing & service

tune!t

Thank you!

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Linkedin:Gu-Min Jeong
Youtube: 9민선생