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Reengineering Automotive Development: Organizational and Technical Challenges in the SDV Era

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  - ✓OSPO Operations
- Keywords
  - ✓Operating System, Cloud Infrastructure, etc.
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Agenda

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- Why Software-Defined Vehicles Matter Now
- Beyond Technology—What's Really Required
- Technically Addressable Challenges (Overview)
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- Synthesis
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Introduction

- Software is no longer a component—it's a core competency.
  - ✓The automotive industry is undergoing a fundamental shift from hardware-centric to software-driven development.
  - ✓Software-defined vehicles (SDVs) require not only new technologies, but also new ways of working.
  - ✓Traditional development models are struggling to keep pace with the need for continuous feature delivery.
  - ✓Organizational and business transformation is now as critical as technical innovation.

Why Software-Defined Vehicles Matter Now

- E/E Architecture Change
- Development Workflow Change
- Continuous and Rapid Delivery of new features to Customers

Beyond Technology—What's Really Required

- SDV transformation is not just technical—it's organizational and strategic
  - ✓Software-defined vehicles (SDVs) demand not only new technologies, but also new ways of working.
  - ✓Organizational structures built around hardware components are no longer sufficient.
  - ✓Cost management models must evolve to reflect software-centric development.
  - ✓Legacy product portfolios make transformation especially difficult for established OEMs.

Technically Addressable Challenges (Overview)

🧠 Virtual ECUs

✓Enable early integration and testing, but virtualization cannot fully replace physical validation.

🔁 CI/CD at scale

✓Enable early integration and testing, but virtualization cannot fully replace physical validation.

🔗 Software supply chain

✓Managing dependencies and security is critical; industry-wide standards are still emerging.

🛠Diagnostics

✓Traditional hardware-focused diagnostics fall short as functionality shifts to software.

⚖️ Compliance & Functional Safety

✓Dynamic software updates challenge existing certification and functional safety processes.

🧩 Architectural governance

✓Maintaining consistency across evolving platforms demands robust governance frameworks.

Deep Dive – Technical Challenges

Enabling Early Integration and Testing

- Problem
  - ✓Need to start development ahead of Physical SOC Delivery
- Current approaches
  - ✓vECU Solution utilizing various Virtualization Technologies
- Limitations
  - ✓We often see troubles because of compatibility of various technical layers
    1. ISA/Instruction Set
    2. Device I/O
    3. Speed, Timing
    4. Software Component Dependencies (e.g., BSP affects everything, but cannot be finalized until SOC delivery)
- Implications for SDV development
  - ✓Virtualization Technology is not the perfect silver bullet (yet)
  - ✓Even if we got a perfect solution, still need configuration management for multiple product lines

Deep Dive – Technical Challenges

CI/CD at Scale

- Problem
  - ✓‘Scale’ does not only mean test coverage of a single complex product, but also multiple product lines
- Current approaches
  - ✓Per-product CI/CD pipeline practice
- Limitations
  - ✓Difficult to reduce cost because of duplication across multiple product lines
- Implications for SDV development
  - ✓CI/CD pipeline must be integrated with configuration management of multiple product lines and needs for overall cost optimization

Deep Dive – Technical Challenges

Supply Chain Management

- Problem
  - ✓In the SDV Era, features are provided by software and software exists across multiple components. This is difficult to track in a uniform way to optimize multiple products stand point.
  - ✓FYI: Toyota Talk at the SOAFEE APAC Seminar Tokyo 2025
- Current approaches
  - ✓Per-project based resolution using SCM products/services
- Limitations
  - ✓SCM products/services incompatibility
  - ✓Needs for integration with other systems, e.g. configuration management, cost management, etc.
- Implications for SDV development
  - ✓Needs for efforts refining and automating the SBOM based E2E process covering multiple product lines
    - ✓AGL Assessment Automation Project
    - ✓Automotive SBOM (Talk by Endo, Takase, Watanabe at OSSEU 2025)
  - ✓Need for consideration on multiple product lines overall management

Deep Dive – Technical Challenges

Diagnostics

- Problem
  - ✓In SDV Era, Need to diagnose software implemented features. Current UDS based mechanism does not fit.
- Current approaches
  - ✓OEM specific/proprietary solutions to get diagnostics information of software (not firmware), even if exist.
- Limitations
  - ✓UDS does not have enough flexibility for software implemented features
  - ✓Difficult to comply with emerging regulations such as ePTI
- Implications for SDV development
  - ✓Adopt the emerging next generation diagnostics mechanism, SOVD (Service Oriented Vehicle Diagnostics)

Deep Dive – Technical Challenges

Diagnostics – SOVD POC at AECC –

- A new protocol (REST API) for vehicle diagnostics defined by ASAM
  - ✓https://www.asam.net/standards/detail/sovd/
  - ✓Now under standardization process at ISO. (ISO 17978)

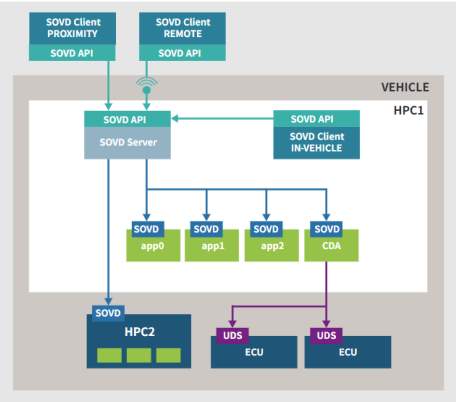


Diagram excerpted from the above ASAM SOVD page.

- Use Cases of SOVD

Dynamic discovery including Software

OTA : Over-The-Air (software update)

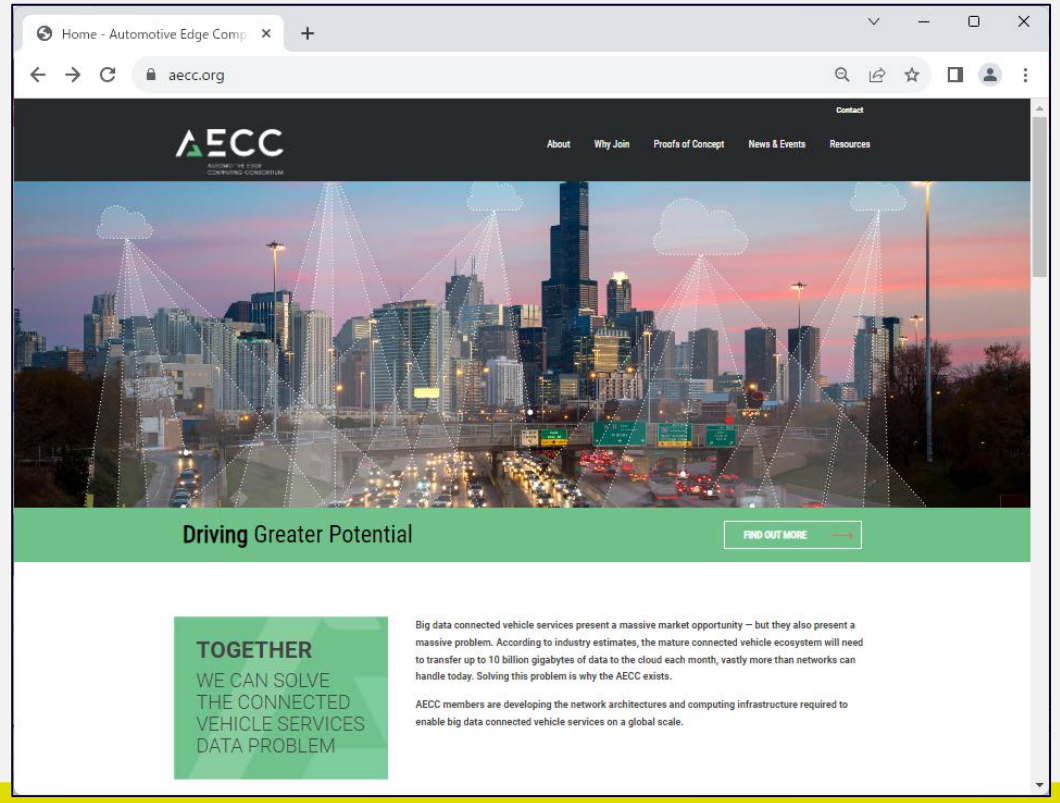
Runtime is OEM specific, but SOVD can use script based in-vehicle generic processing

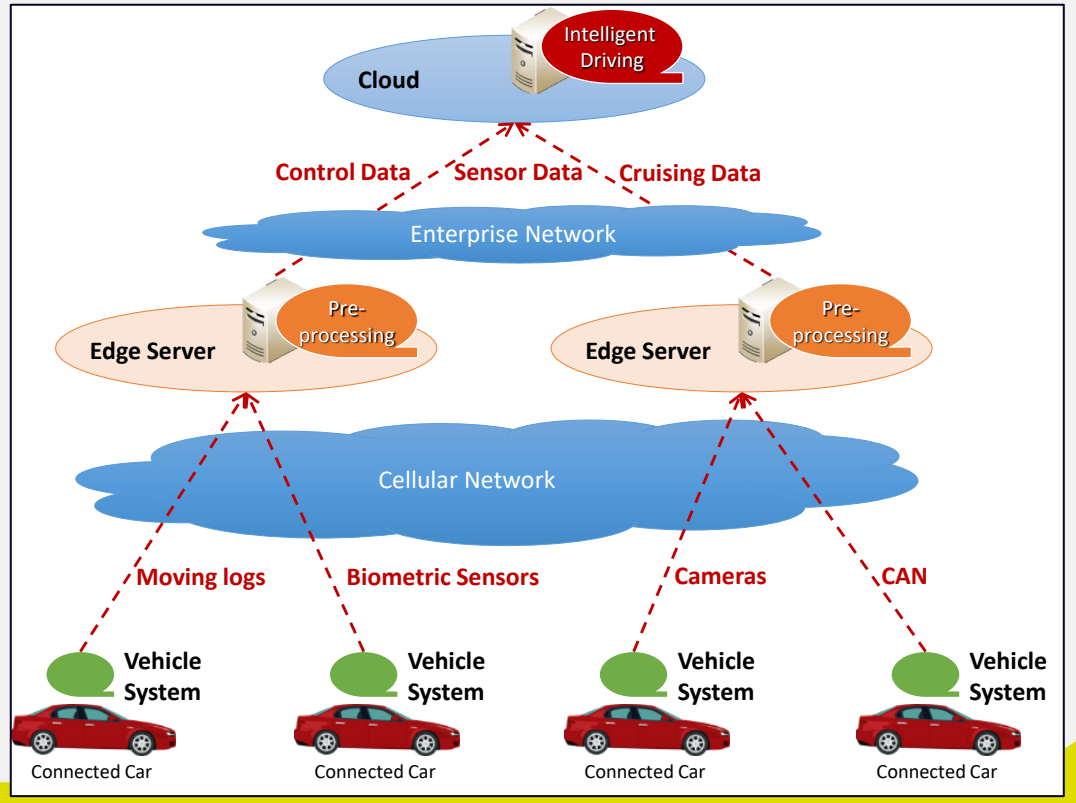
1. Discover SOVD Server(s)
2. Discover Entities
3. Authenticate and Authorise SOVD Clients
4. Read Fault(s) and/or its Details from an Entity
5. Delete Fault(s) of an Entity
6. Read Data Resources
7. Write Data Items
8. Control Operations
9. Read and Write Configurations
10. Control Software Updates
11. Handle Bulk Data
12. Control Logging and Retrieve Logs
13. Control Communication Logging
14. Manage and Execute Scripts
15. Manage Triggers and subscriptions
16. Query an Online Capability Description
17. Provide an Offline Capability Description

Deep Dive – Technical Challenges

Diagnostics – SOVD POC at AECC –

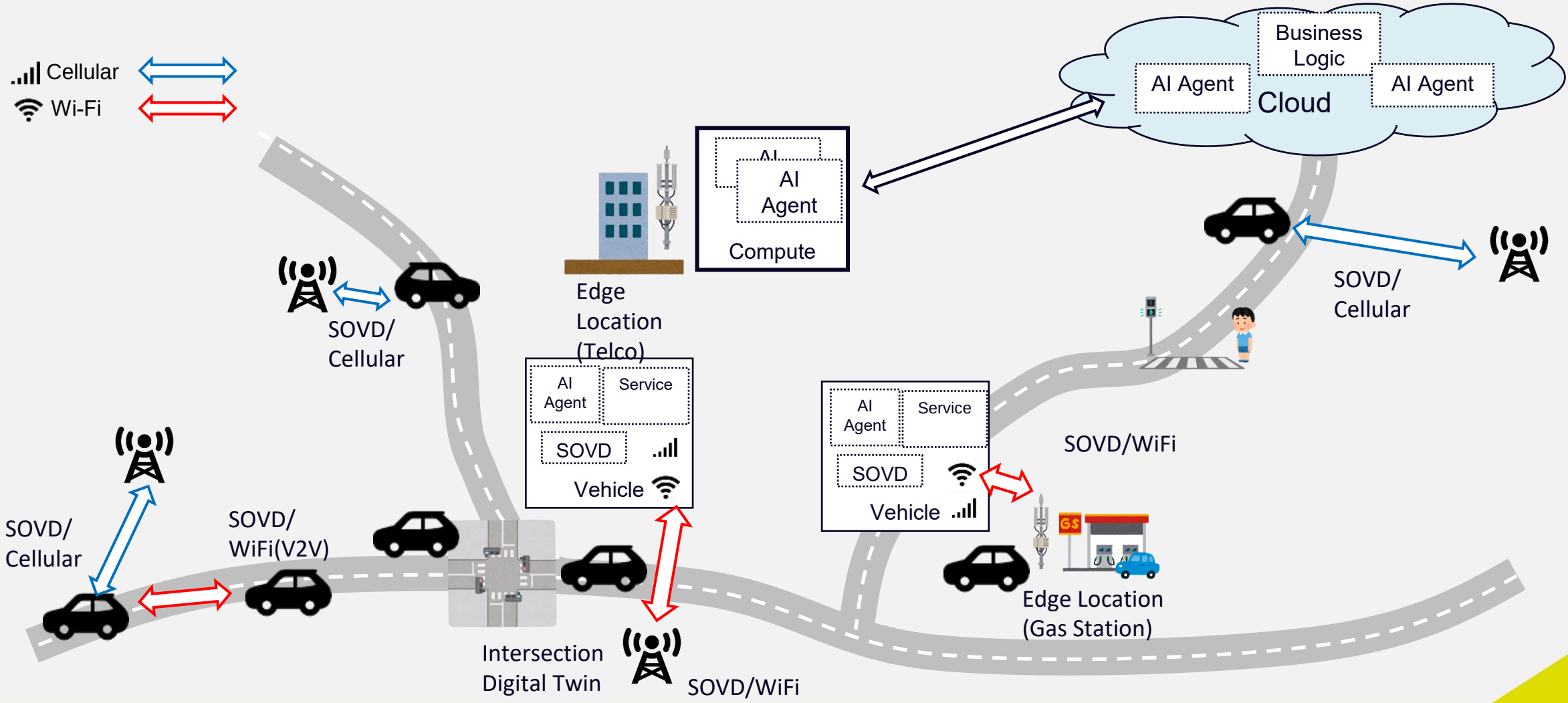
- AECC : Automotive Edge Computing Consortium (https://aecc.org)
  - An Open Collaborative Activity for promoting Edge Computing focusing on Automotive Use Cases, with POCs





Deep Dive – Technical Challenges

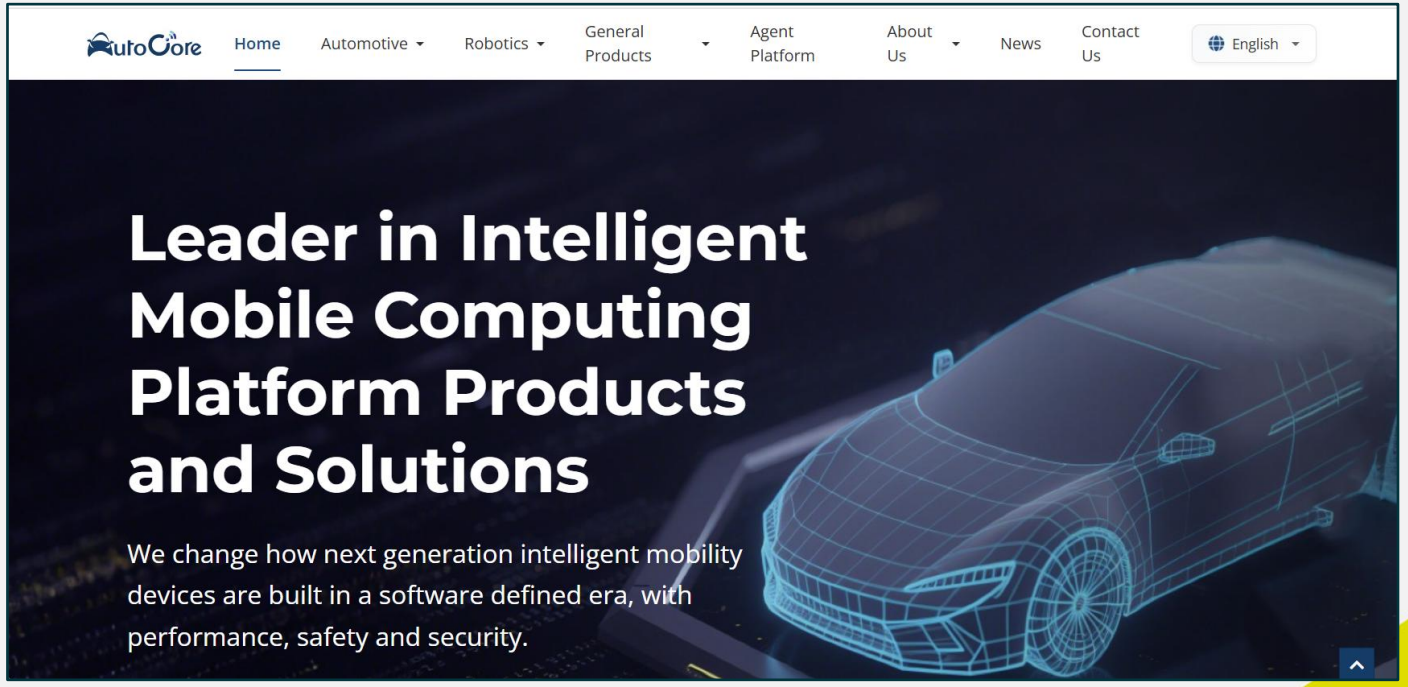
Diagnostics – SOVD POC at AECC – A Big Picture



Deep Dive – Technical Challenges

Diagnostics – SOVD POC at AECC –

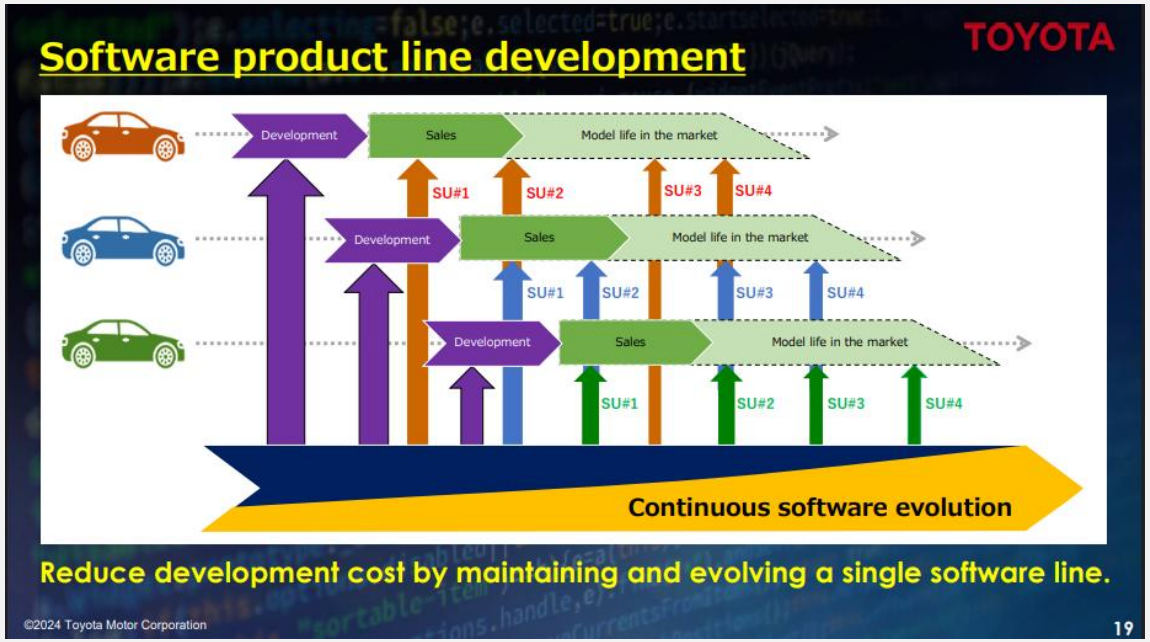
- Collaboration with AutoCore (https://autocore.ai/en/)
- Planning to introduce preliminary results at:
  - ✓Automotive Linux Summit Japan 2025
    - ✓https://events.linuxfoundation.org/open-source-summit-japan/



Deep Dive – Technical Challenges

Architectural Governance across Multiple Product Lines

- Problem
  - ✓Need to control hardware/software component specification/design and also cost
- Current approaches
  - ✓None ?
- Implications for SDV development
  - ✓Cost control often has close relationship with organizational structure
  - ✓ Product structure too (Conway's Law)
  - → Needs for integrated solutions and organizational optimization
- Reference
  - ✓"Keynote: How to Design SDV" Kenichi Murata, Toyota at the AGL AMM Summer 2025
  - ✓"Conway's Law " Wikipedia



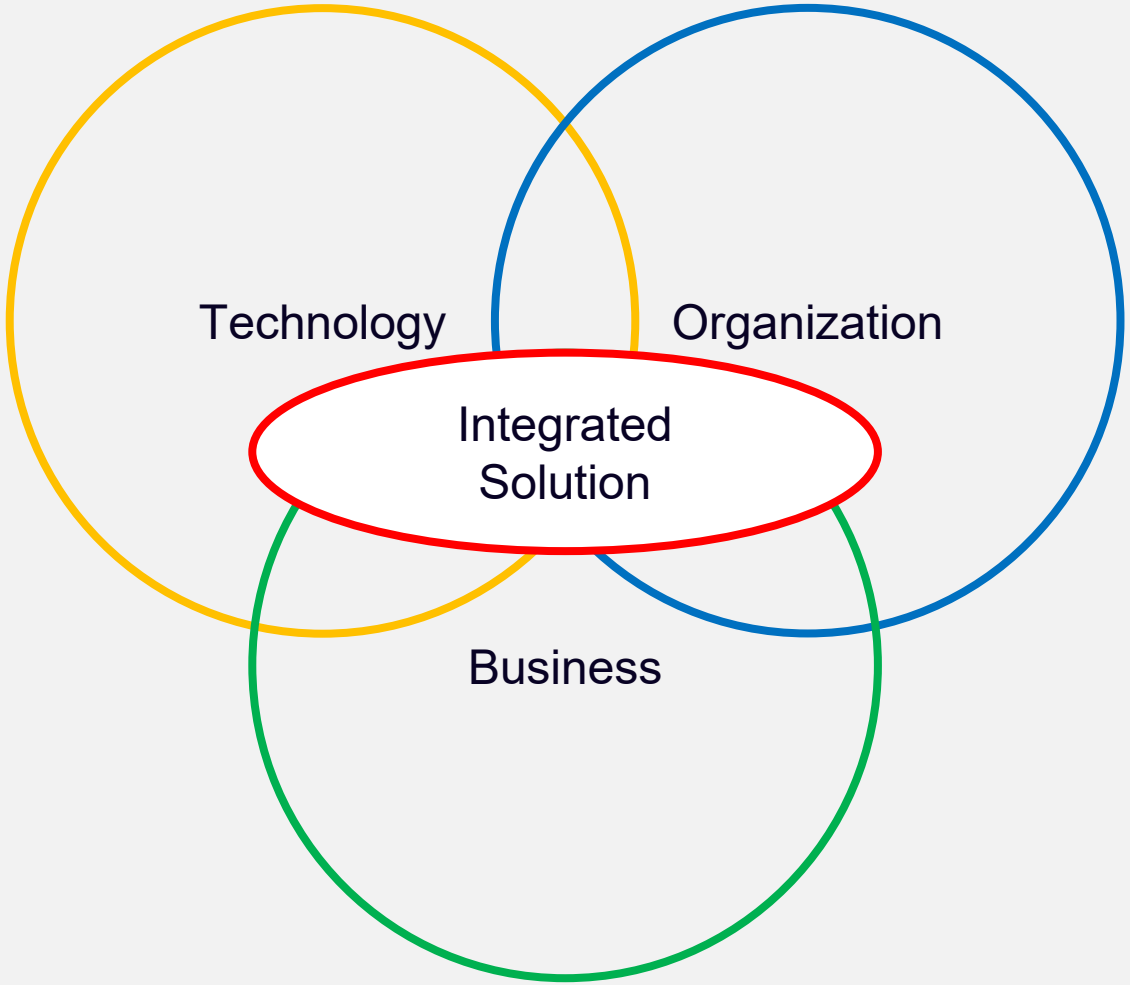
Challenges Beyond Technology

- ✓ Cost management models remain hardware-centric, misaligned with software-driven development.
- ✓ Organizational silos around hardware components hinder cross-functional collaboration.
- ✓ Legacy product portfolios make transformation especially difficult for established OEMs.

- ✓ Skill-up/Education of employees

- ✓ Cultural shift: moving from “hardware-first” to “software-first” mindset.

Synthesis



Solving SDV challenges requires more than technical innovation.
It demands organizational transformation and business alignment—**integrated solutions** across all domains.”

Expectations for Ecosystem

- ✓ Tools that scale across multiple product lines
- ✓ Support for organizational transformation
- ✓ Integration of business and technical perspectives
- ✓ Long-term partnerships, not just point solutions

Summary

- Software as a core competency requires reengineering not just systems, but organizations.
- Cross domain collaboration across the Ecosystem is necessary

FYI: AGL OSPO-EG Survey on the Barriers to OSS Contributions

汽车行业中阻碍开源软件贡献的因素调查
https://shanghaiopen.feishu.cn/share/base/form/shrcnMVgP53Cyk7JA2oTnqPLwNc
(Simplified Chinese (Feishu for the Mainland China))

A Survey on the Barriers to OSS Contributions in the Automotive Industry
https://docs.google.com/forms/d/e/1FAIpQLSdZ1VInvBj72zV6CCTSSU0misi4Az2T9j2ggtawutMLX3b_YA/viewform
(English (Google Forms))

汽車產業中阻礙開源軟體貢獻的因素調查
https://docs.google.com/forms/d/e/1FAIpQLSdPboiNYj9KbzKY_s8UsqC_pxrz2uZUL4BYbNfjqTs0KfJLBQ/viewform
(Traditional Chinese (Google Forms))

自動車業界におけるOSSコントリビューションの阻害要因に関する調査
https://docs.google.com/forms/d/e/1FAIpQLSeYM4q8DUy0S0D2aV6f5QEittTIZ0b5bekGT_-BNhcPIBmDPA/viewform
(Japanese (Google Forms))

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Thank You