

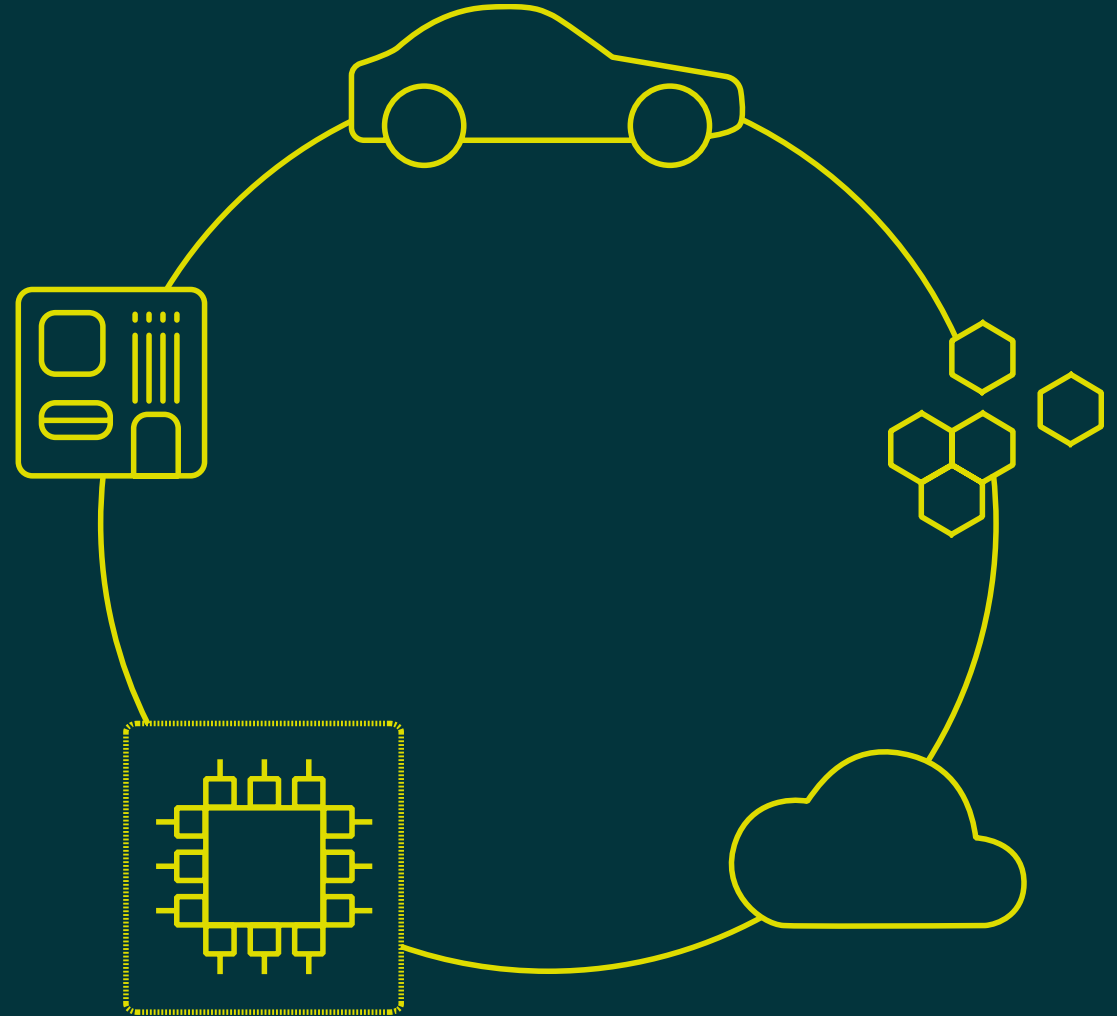


# Internet of Vehicles Platform : Towards Value-First Development

**Astemo**

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Hitachi Astemo, Ltd.

May 9, 2024



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1. Company Introduction
2. Hitachi Astemo's Vision for Software-Defined Vehicle
3. Approach: Internet of Vehicles Platform
4. Value-First Development
5. Conclusion

Hitachi Astemo was born in January 2021 from the merger of

Hitachi Automotive Systems, Keihin, Showa and Nissin Kogyo with the strengths and abilities to make significant contributions to safety, comfort, and environmentally sustainable technologies for mobility.

Hitachi Automotive Systems

**KEIHIN**

**SHOWA**

**NISSIN**

are integrated to be

# Hitachi Astemo

We will realize safe and comfortable mobility through technological innovation in CASE area



AD/ADAS



Powertrain Systems  
(Electric / Engine)



Chassis Systems



Motorcycle Systems



Connected



Software



Aftermarket



Power Products  
Industrial Equipment

## Advanced driver assistance ECU and high-definition map position unit adopted in Nissan's new model "SKYLINE"

**Tokyo, September 8, 2020** --- Hitachi Automotive Systems, Ltd. today announced that their advanced driver assistance ECU (Electronic Control Unit) and high-definition map position unit capable of automatic map updates via OTA (Over The Air)\*1 has been adopted in Nissan Motor Corporation's (hereinafter "Nissan") new model "SKYLINE", which went on sale in September 2019, for the first time.



Advanced driver assistance



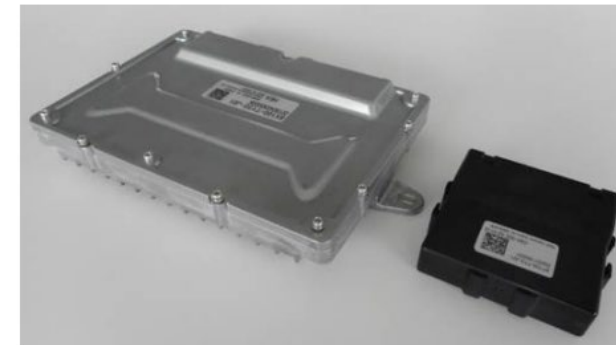
High-definition map position unit

<https://www.hitachi.com/New/cnews/month/2020/09/200908.html>

## AD ECU and OTA Unit Adopted in New Model Legend -Capable of Over-the-Air (OTA) Vehicle Control Software Updating-

**Tokyo, April 26, 2021** --- An AD ECU\* capable of updating vehicle control software and an OTA Unit that receives and manages update data, both developed by Hitachi Astemo, Ltd. as "over-the-air (OTA) software update solutions", have been adopted by the new model Honda Legend, which is equipped with a traffic jam pilot function that achieves Automated Driving Level 3 and was released in March by Honda Motor Co., Ltd. (President and Representative Director: Toshihiro Mibe) The solutions have been realized with the technologies of the Hitachi Group as one-stop solutions that establish a platform from a data center (OTA Center) that sends software updates to the in-vehicle device system.

\* AD ECU: Autonomous Driving Electronic Control Unit



AD ECU and OTA Unit Adopted by New Model Legend

<https://www.hitachi.com/New/cnews/month/2021/04/210426.html>

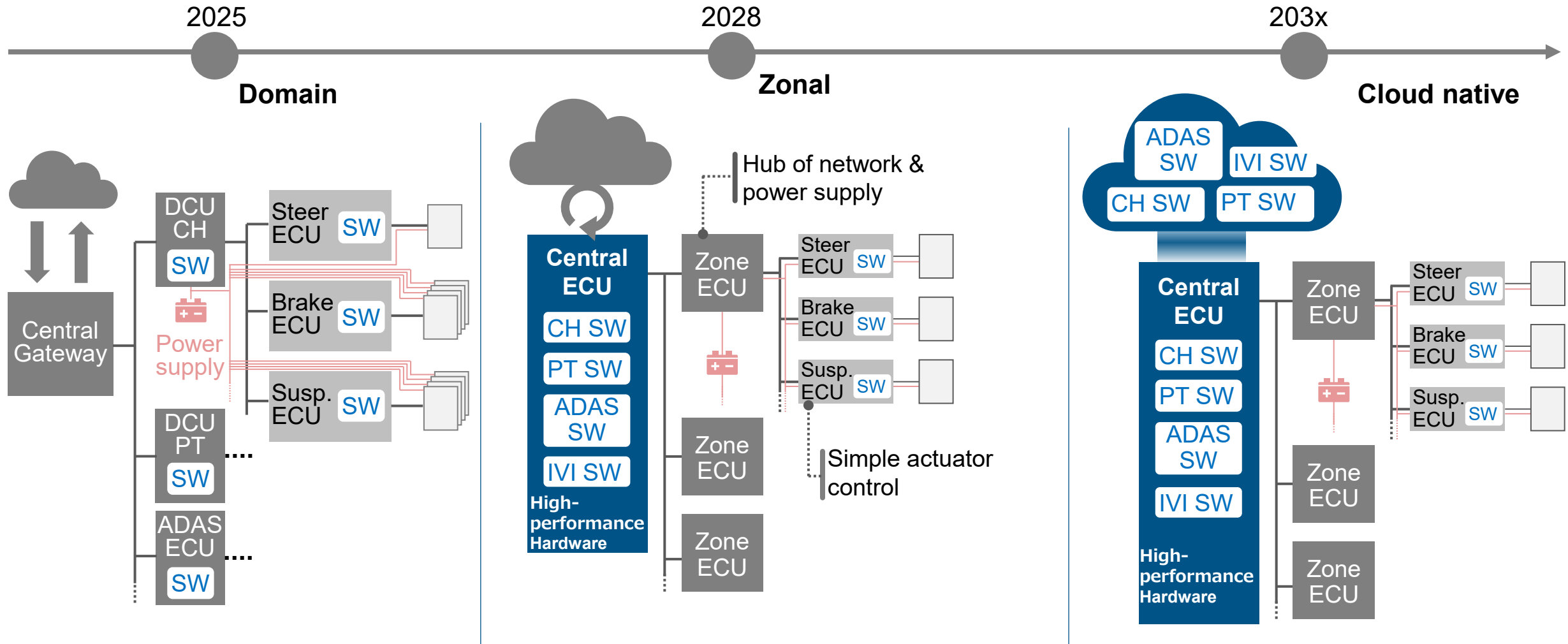
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# 2-1. Market Trend [Architecture]

- E/E Architecture is evolving from distributed to **centralized, accelerating HW/SW decoupling.**
- **Evolving performance & functionality by software,** achieving above on **high-performance HW**

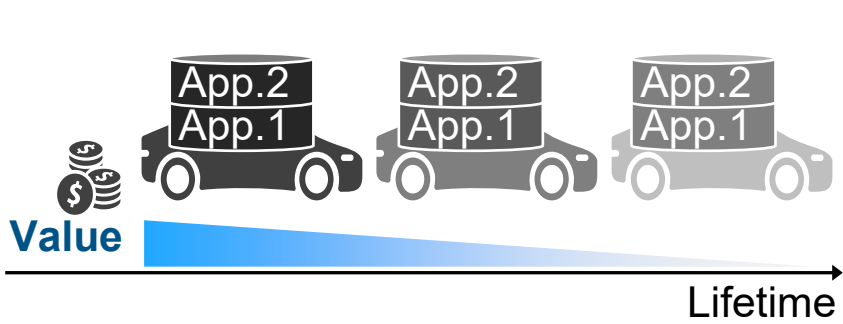


# 2-2. Market Trend [Software-Defined Vehicle]

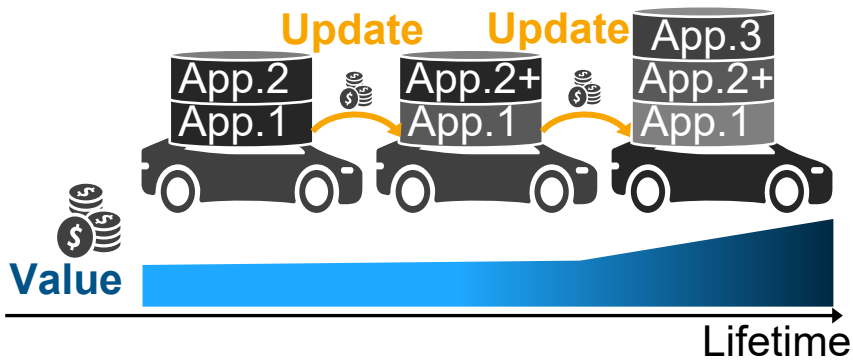
- As user needs diversify, the business model is **shifting to continuous improvement model**.
- Monozukuri transforms to DevOps. **Software-Defined Vehicle** is better approach for vehicle evolution.

## Change of automotive business

### One-time Sales Business

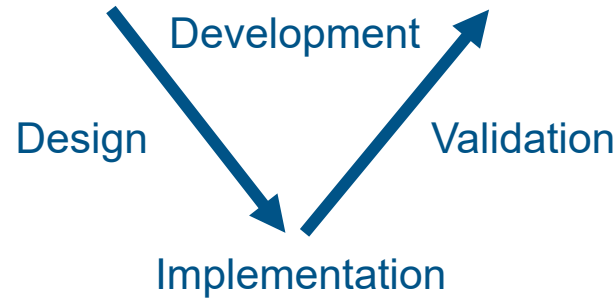


### Vehicle Evolution Business

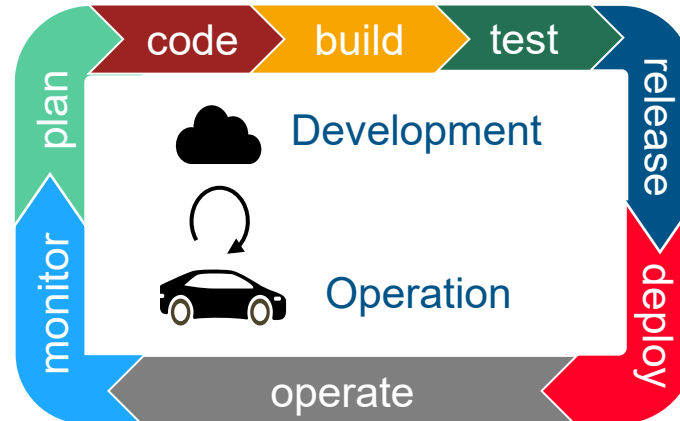


## Transformation of Monozukuri (Development Process)

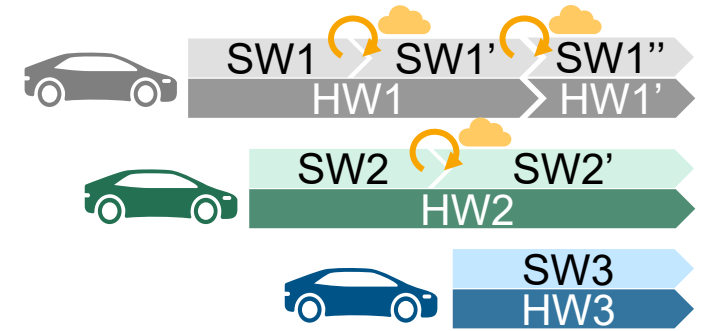
### V-process



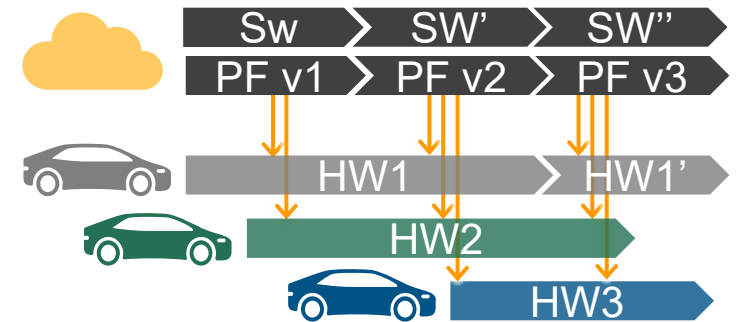
### DevOps



### Hardware-Defined Vehicle



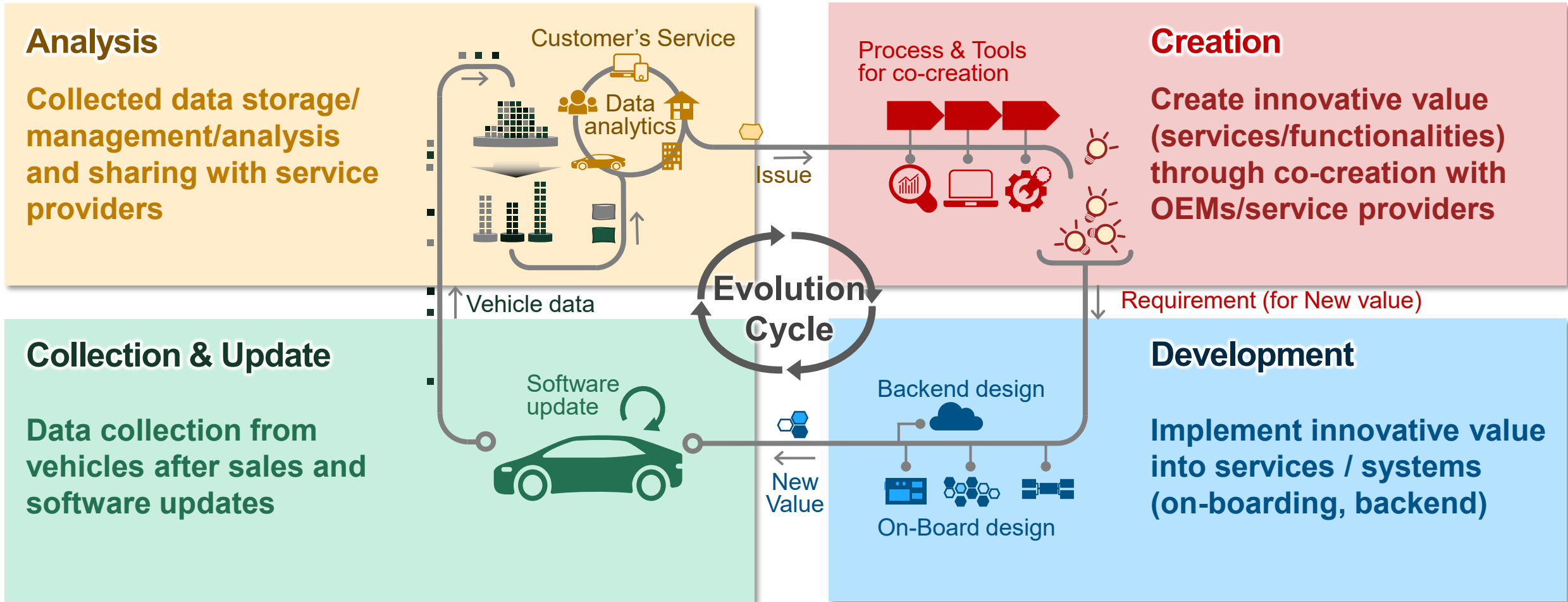
### Software-Defined Vehicle





# 2-3. Vision: Vehicle Evolution

- Defined the **essential functions as: Collection→Analysis→Creation→Development→Update.**
- For following the change of user needs, **a platform that can accelerate this cycle is necessary.**



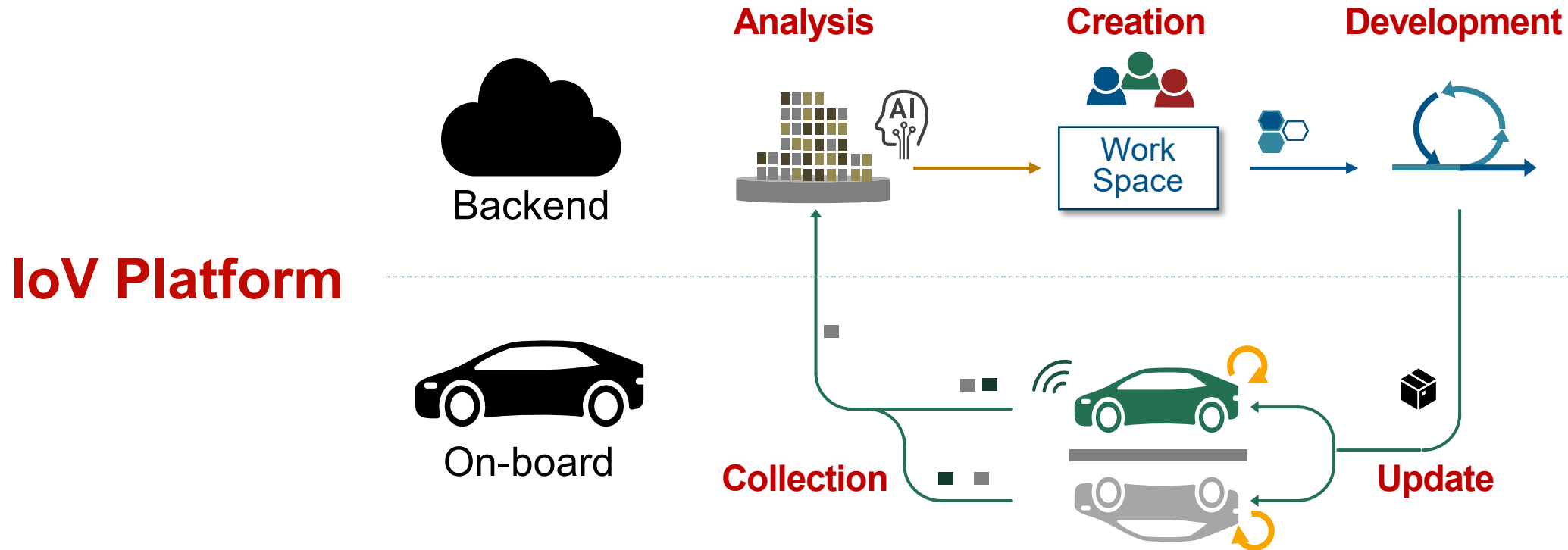
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# 3-1. Approach: IoV (Internet of Vehicles) Platform

- Platform to realize the cycles (collection, analysis, creation, development, update) for vehicle evolution through on-board and backend collaboration
- IoV platform will enable the continuous evolution of vehicles and a growing cycle to drive higher profits for OEMs, Astemo, and partners.



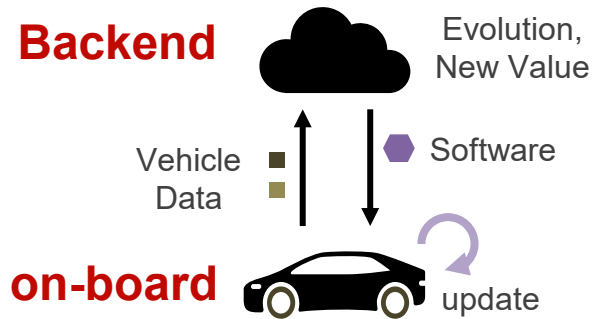
# 3-2. IoV Platform Concept

- IoV Platform: **reference platform and customizable** by OEM & service provider demand.
- Enable co-creation of new product & service and **acceleration from PoV & PoC to mass production.**

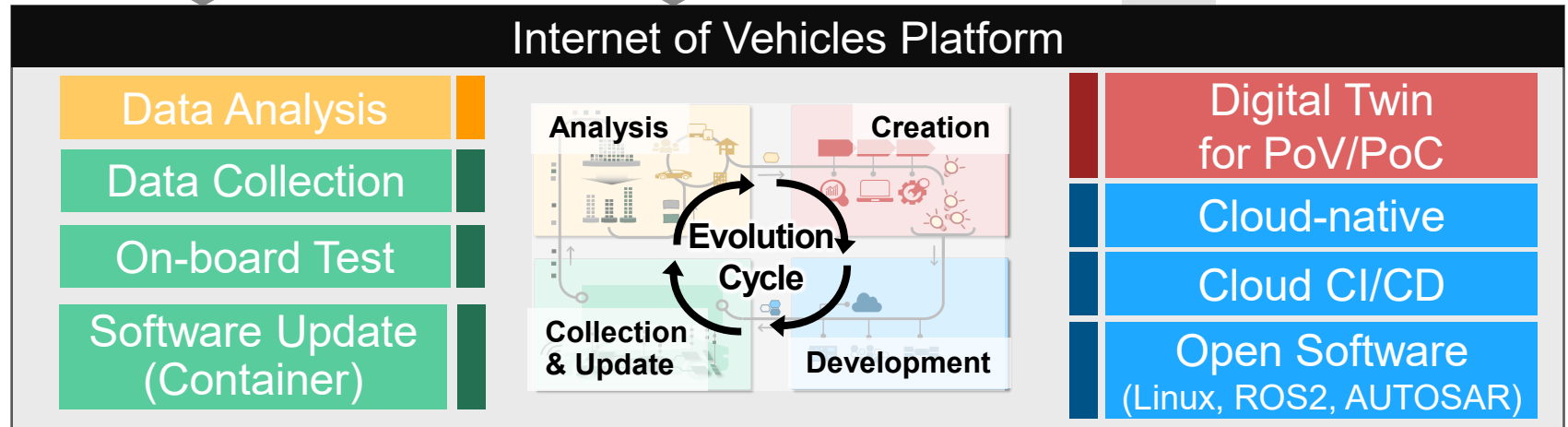
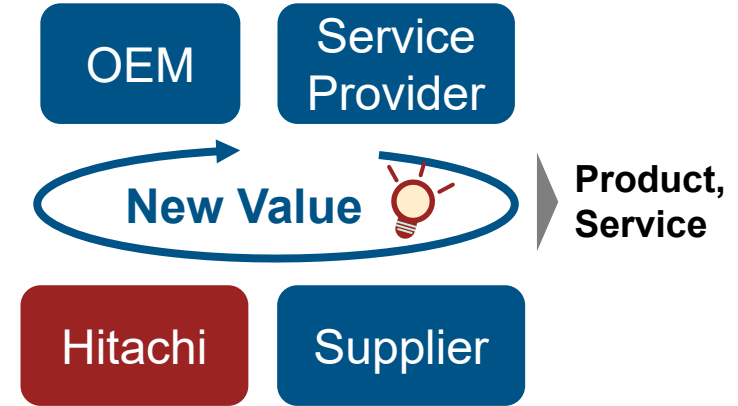
## Features

- 1 On-board x Backend**  
Astemo OT x Hitachi IT
- 2 Zero-Day Start**  
Reference Platform & Customization
- 3 Value-First Dev.**  
Digital Engineering
- 4 Life Cycle Support**  
PoV/PoC – Mass Production – Next
- 5 Open Platform**  
Community, Data Business Support

## Vision: Updatable Vehicle

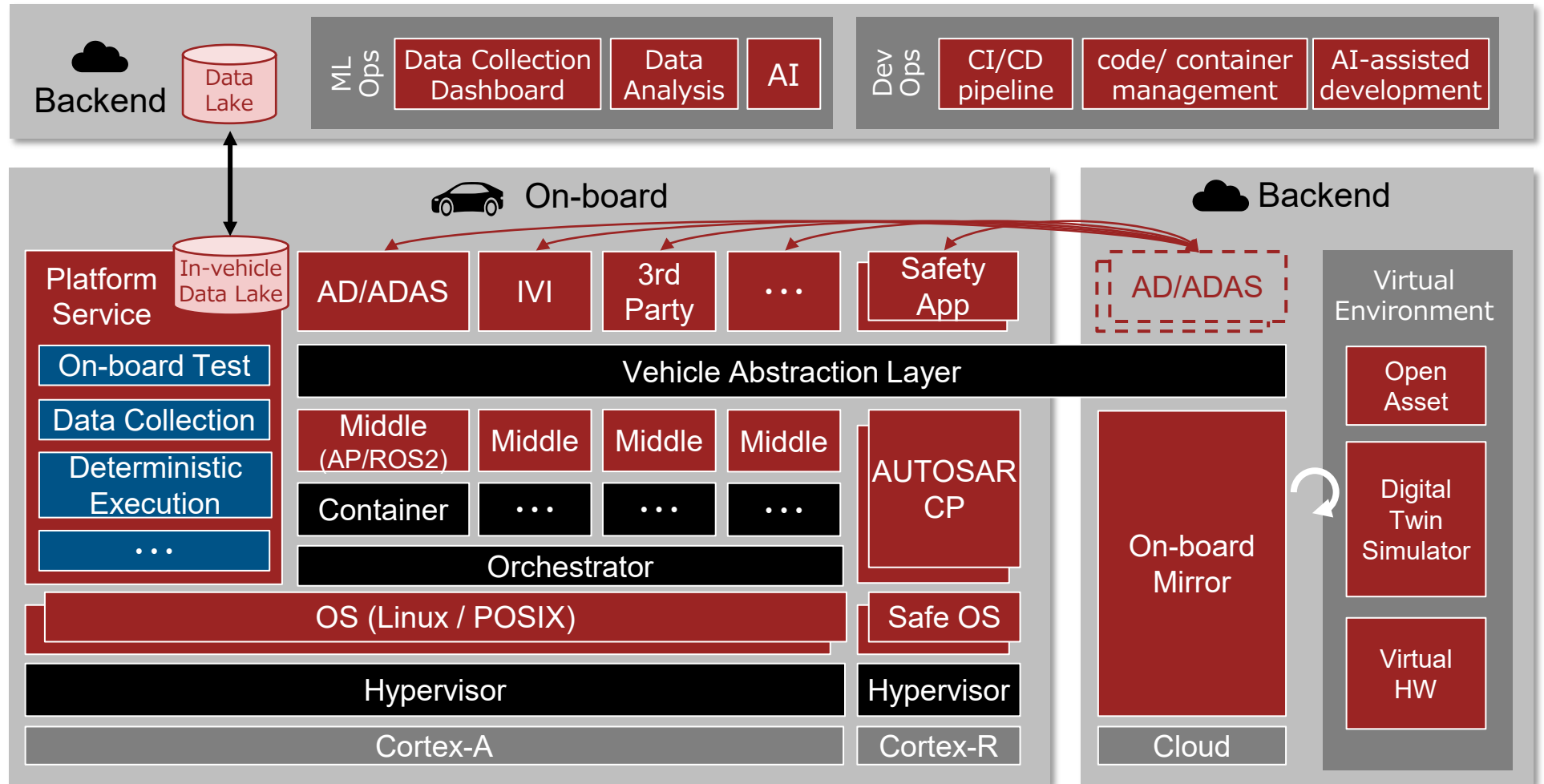
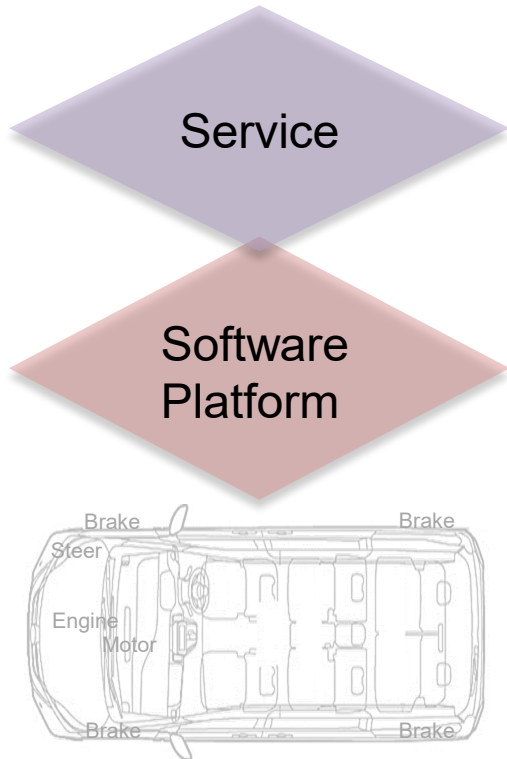


## Co-creation



# 3-3. IoV Platform: Software Architecture

- **Cloud-native** Software Architecture for SDV to realize Updatable Vehicle
- IoV PF is referring to **SOAFEE / Eclipse SDV** and provides **platform services as extension**.



SOAFEE, Eclipse SDV

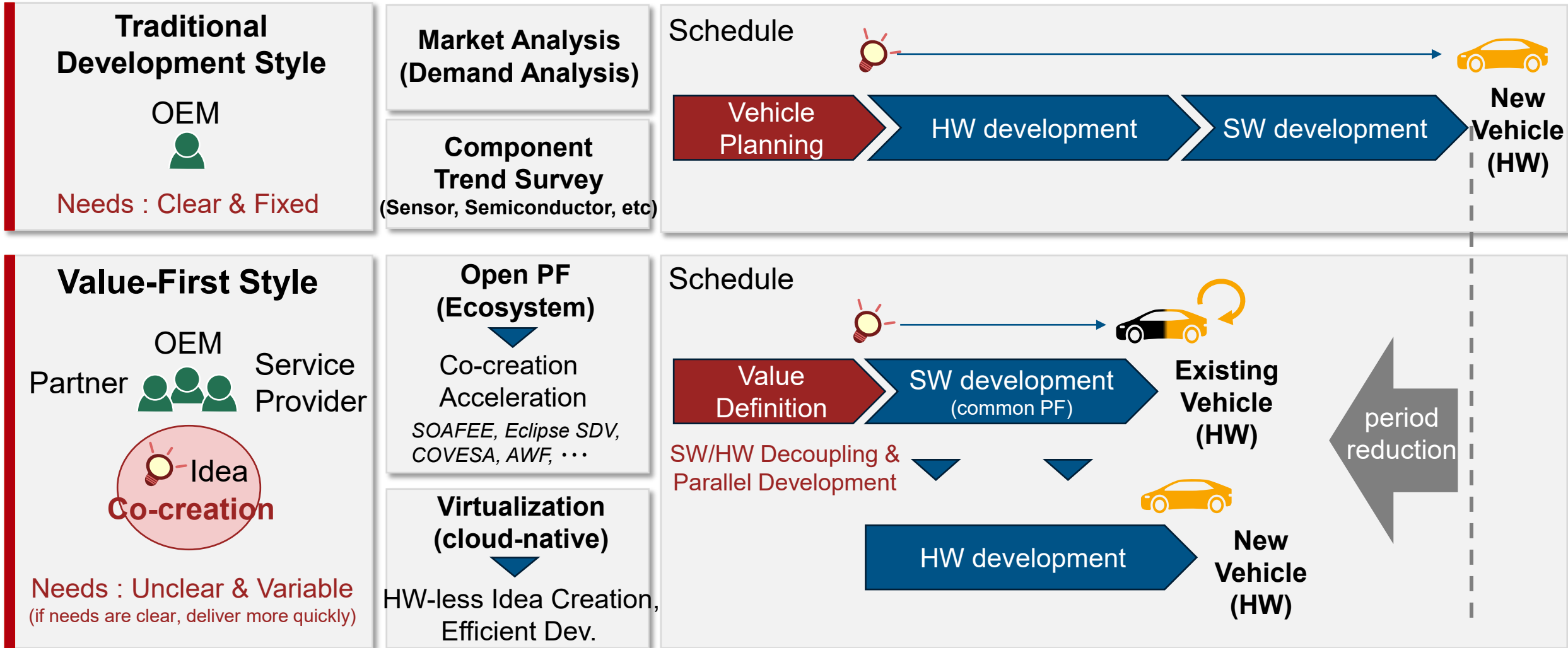
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# 4-1. Value-First Development Style

- **Value-First Development Style** is a key to realize high-speed evolution cycle.
- Need “**Open**” & “**Virtualization**” to create development process based on Value-First.



# 4-2. Use-case of Virtual Environment

- **Traditional use-case** of virtual environment contributes **efficient software development**.
- **In value-first development**, virtual environments are also used for **efficient PoV/PoC**.

## Hardware-Defined Vehicle (trad.)

dev sequence: HW ⇒ SW

Target: specific vehicle and service

 HW/SW integration

System Development (SD)

control dev

SW dev

Shift left  
by HW  
virtualization

## Software-Defined Vehicle (Value-First dev.)

dev sequence: Value ⇒ SW ⇒ HW

Target: all vehicles and various service

 ↔  HW/SW de-coupling

Digital Engineering

PoV

PoC

PF update

SD  
SD  
SD

Idea Creation → Value Validation  
PoV

Feasibility study  
by virtual vehicles

Implementation  
on common PF

Integration  
into specific  
HW/SW

Various Simulator

**Early extraction  
of development  
issue for product**

**Early value validation**

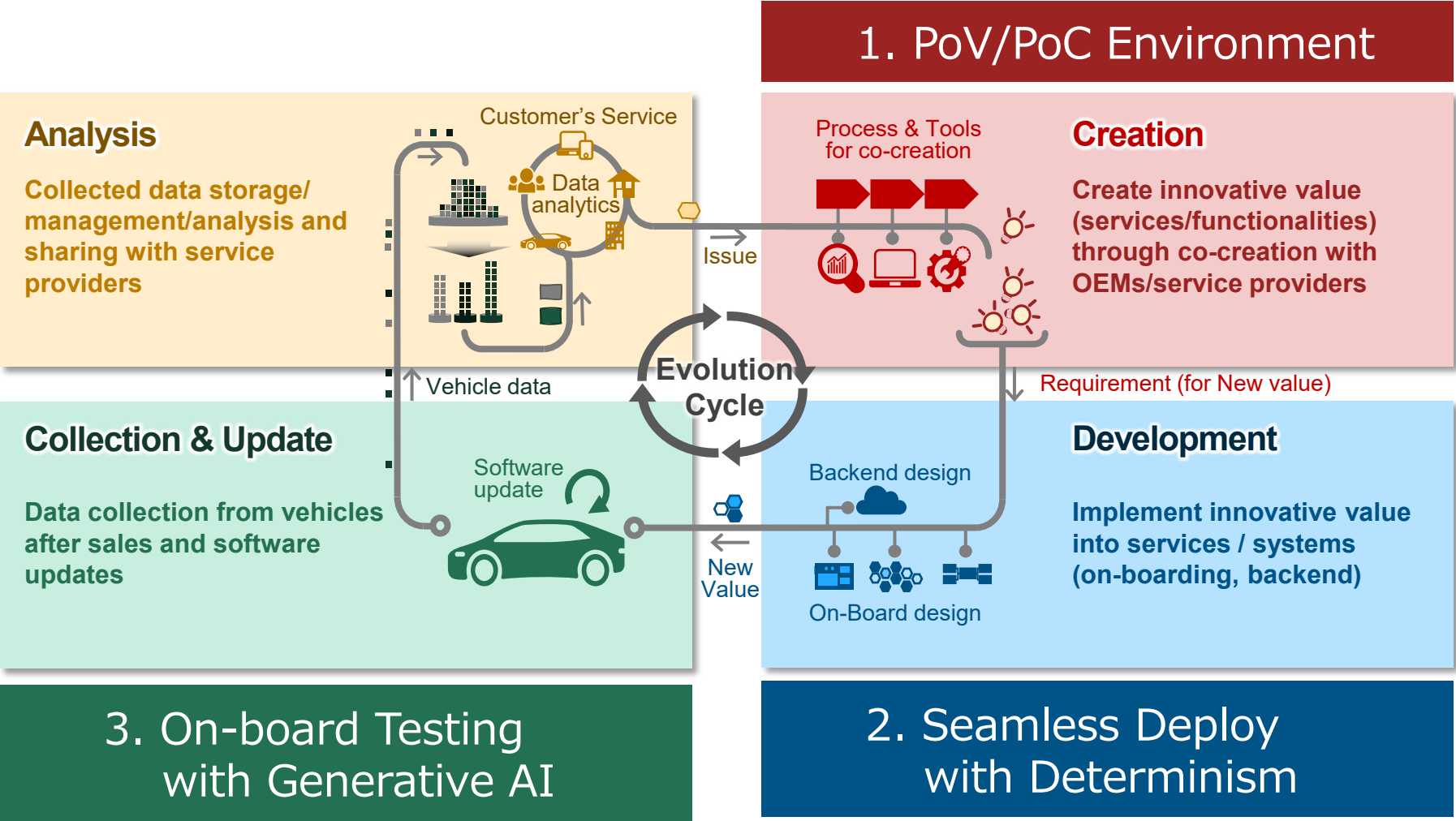


PoV: Proof of Value, PoC: Proof of Concept



# 4-3. IoV Platform Service for Value-First Development

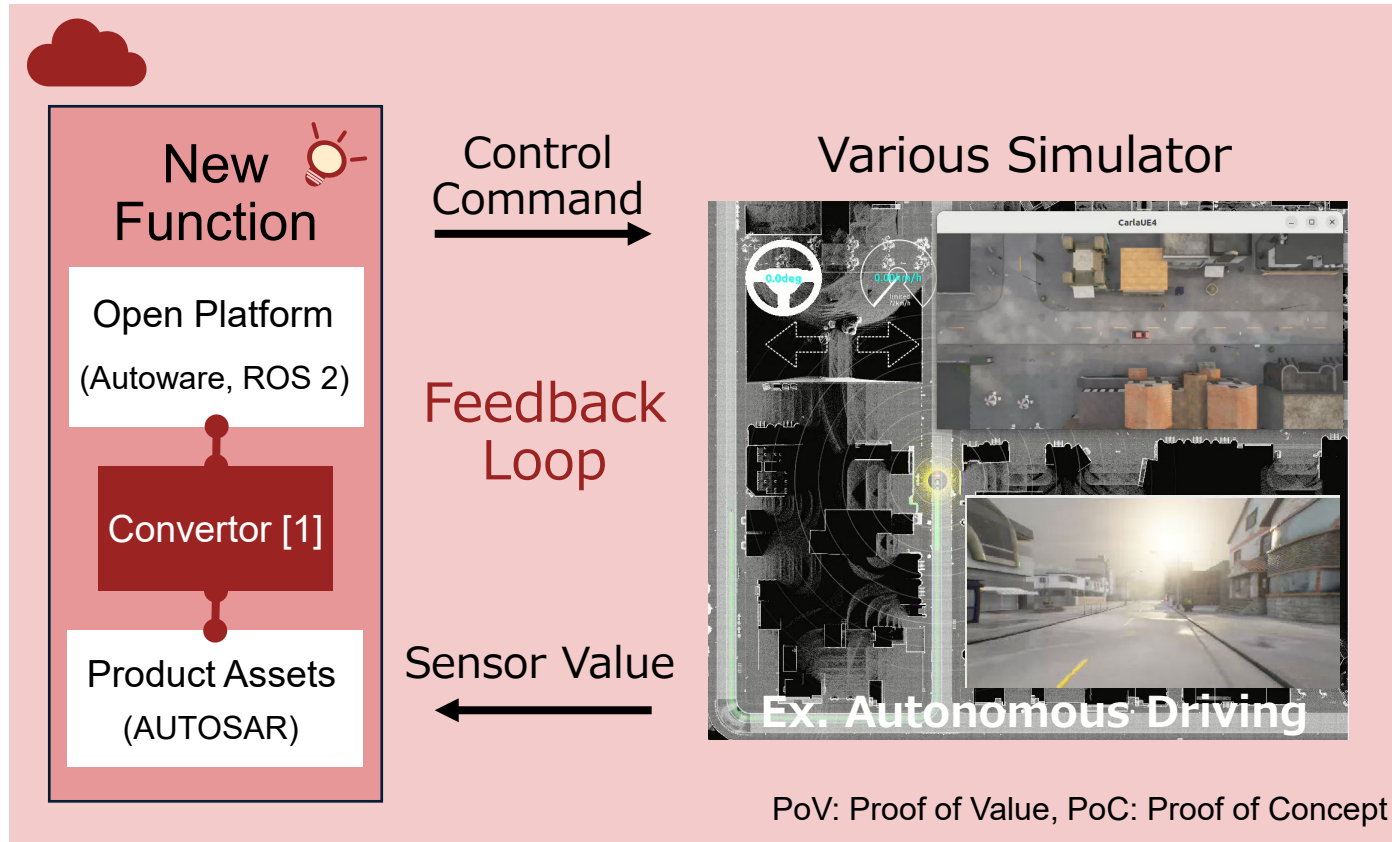
■ IoV Platform accelerates the evolution cycle based on value-first development



# 4-4. Virtual Prototyping Environment for PoV/PoC : Overview

- Enable new idea prototyping by utilizing both **open platform** and **product assets**.
- Enable **performance estimation in SoC** from execution logs in cloud without SoC migration.

## ■ Virtual Prototyping Environment for PoV/PoC



[1] DDS and SOME/IP Collaboration Framework (Japanese), ETENT2024

## ■ bottleneck analysis towards production



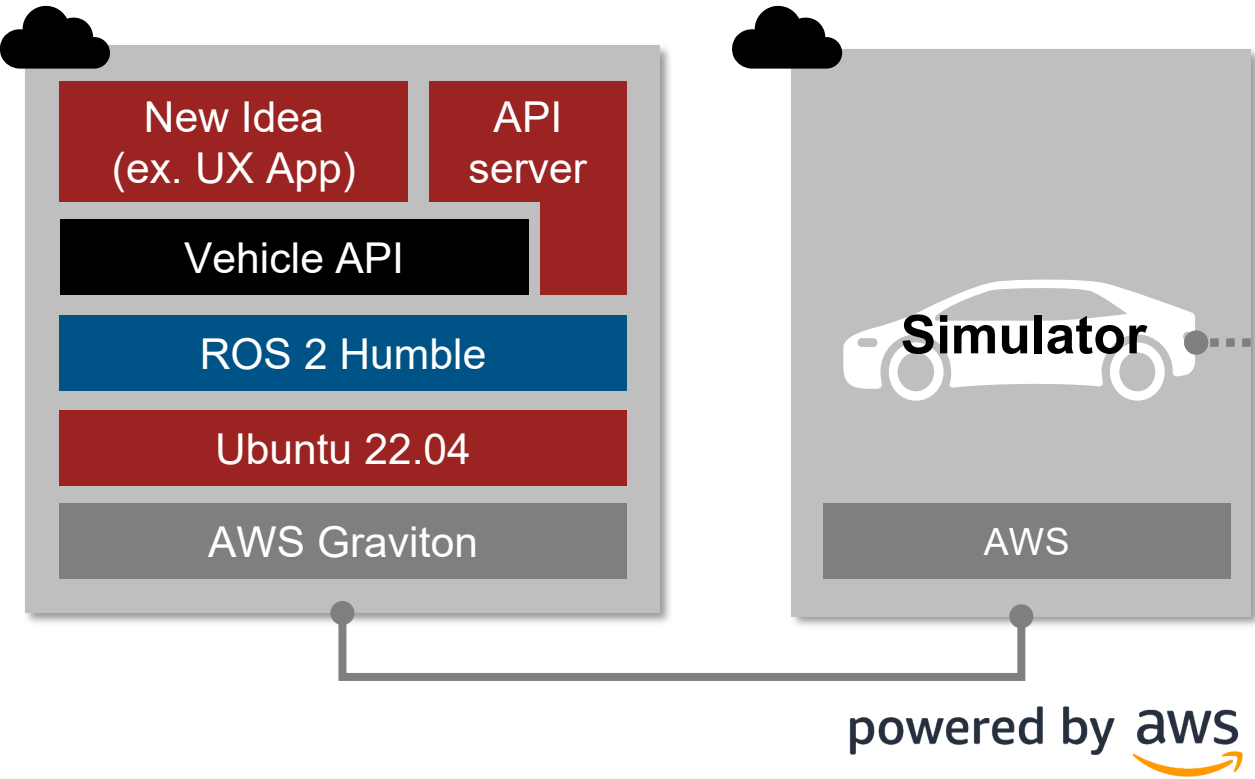
**Check feasibility at early phase**

Execution logs Analysis

# 4-5. Virtual Prototyping Environment for PoV/PoC : Example

- As an example, we developed **an application idea utilizing vehicle API** and check it in the simulator.
- Utilization of simulators enables interactive idea concretization and rapid value validation.

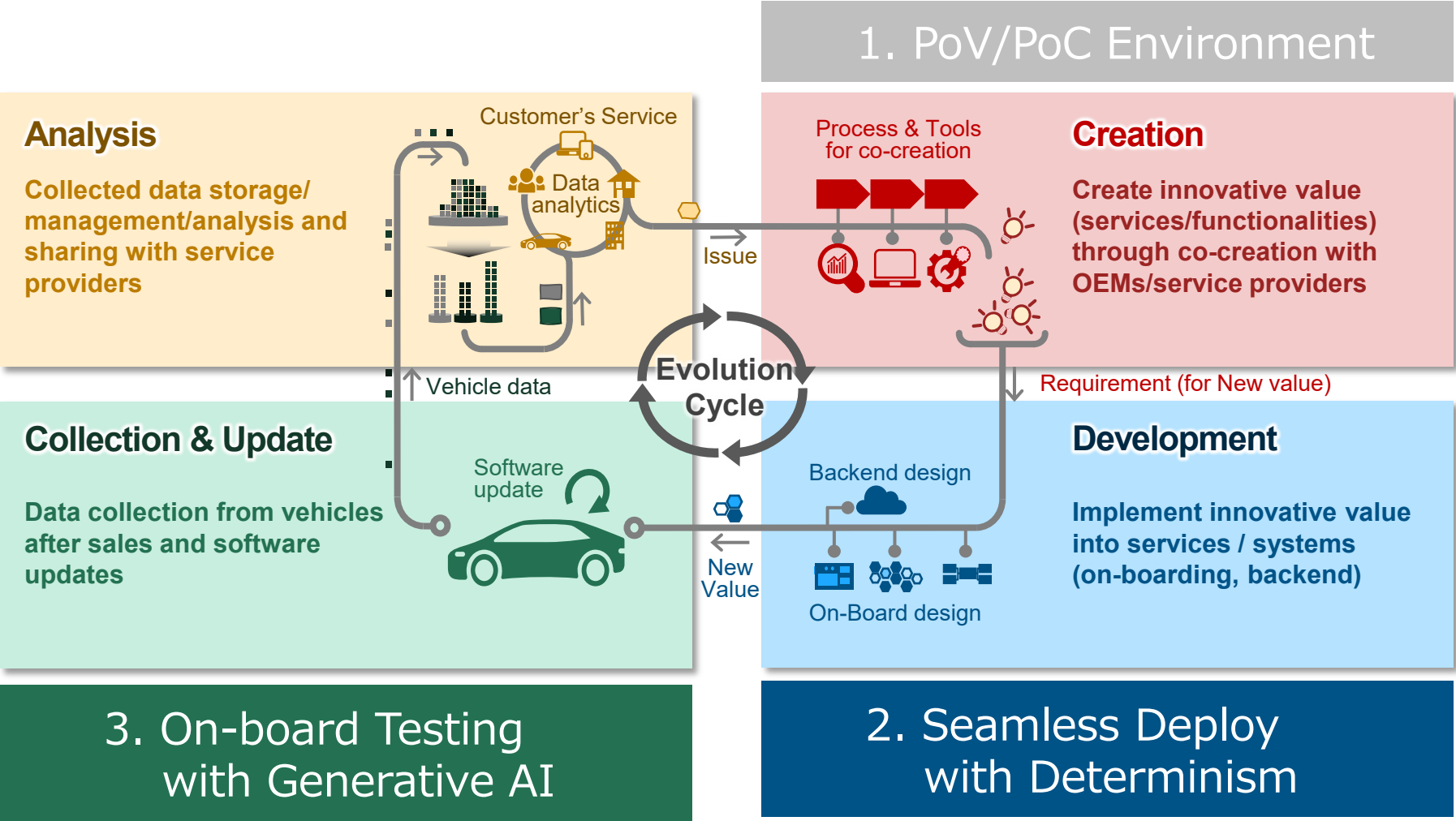
## ■ Example: application idea utilizing Vehicle API (VSS)



VSS: Vehicle Signal Specification

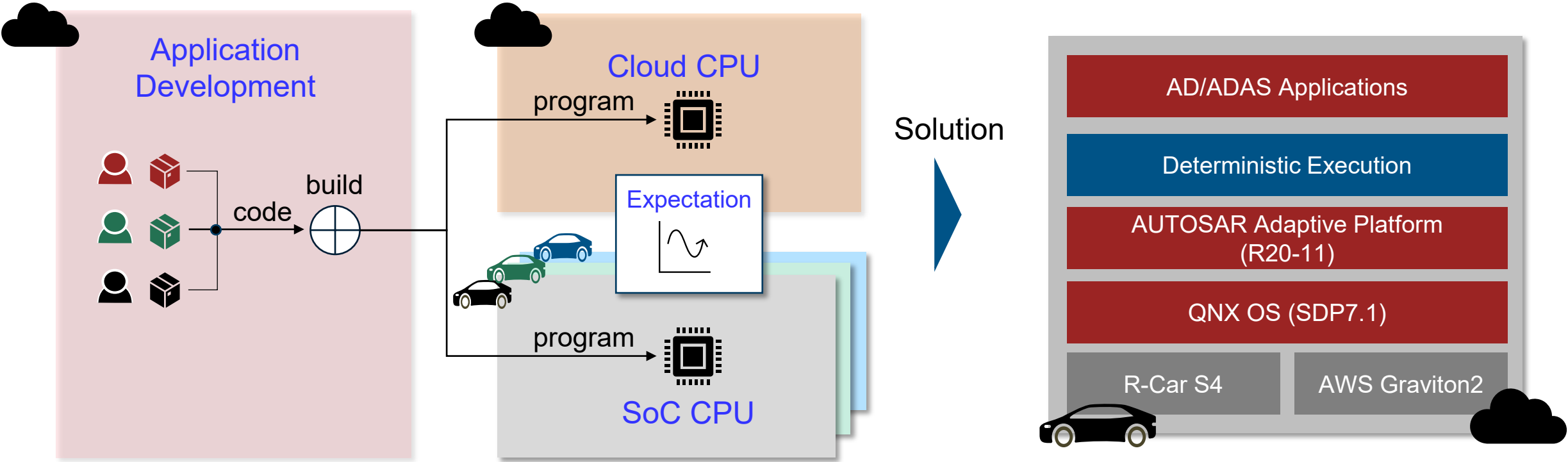
# 4-6. IoV Platform Service for Value-First Development

■ IoV Platform accelerates the evolution cycle based on value-first development



# 4-7. Seamless Deploy with Determinism: Overview

- **Engineers develop software and test in cloud.** Expectation: software can run on-board like in cloud.
- There is **timing issue between on-board and backend.** Solution: **Deterministic Execution.**



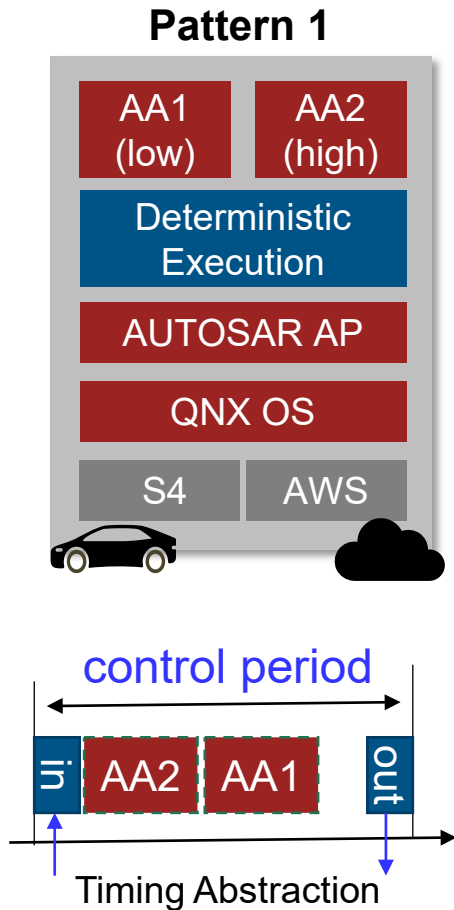
CPU performance  $\neq$  Timing Issue

powered by

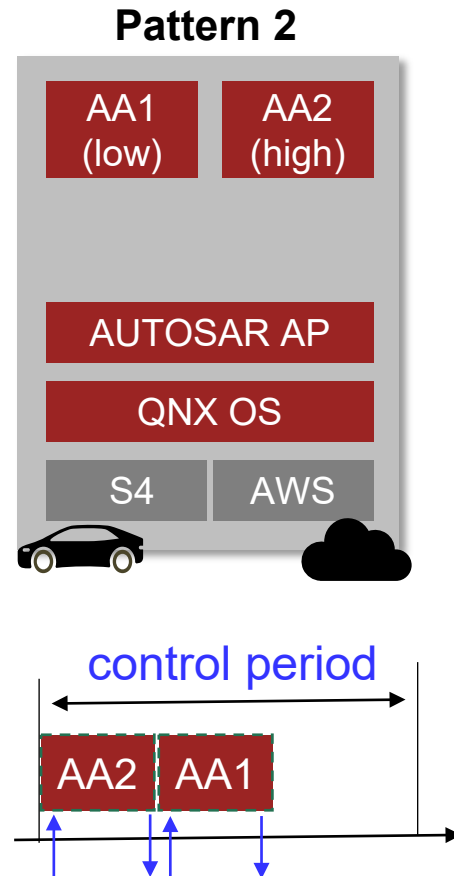
# 4-8. Seamless Deploy with Determinism: Prototype

- Developed and Evaluated a prototype. **Confirmed deterministic exec realize timing gap reduction.**
- Expect the technology contributes to **efficient software development** with seamless deploy.

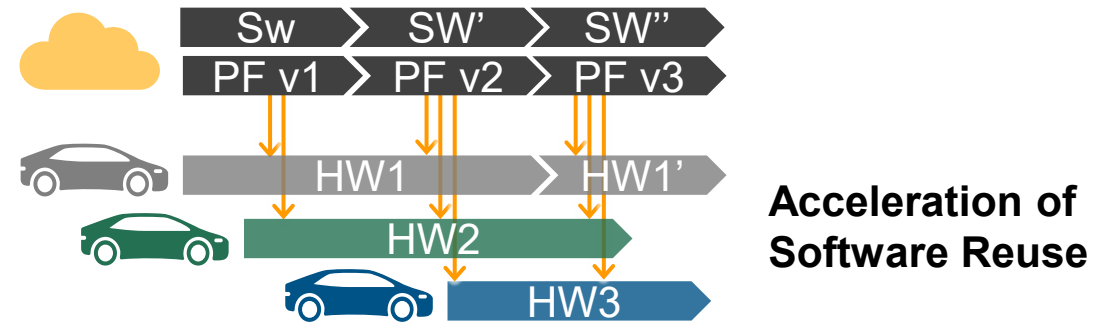
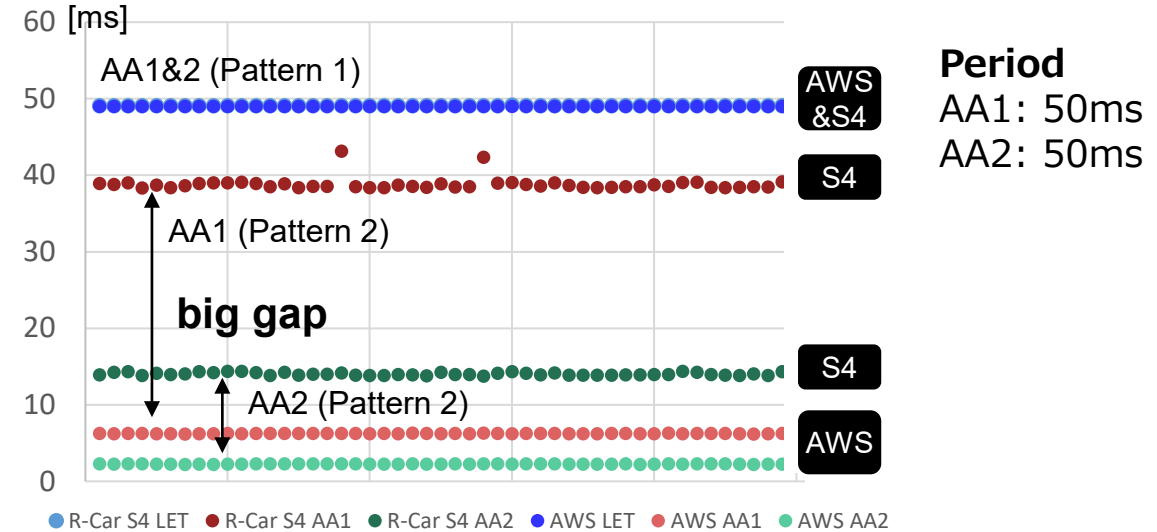
## Evaluation Setup



AA: Adaptive Application



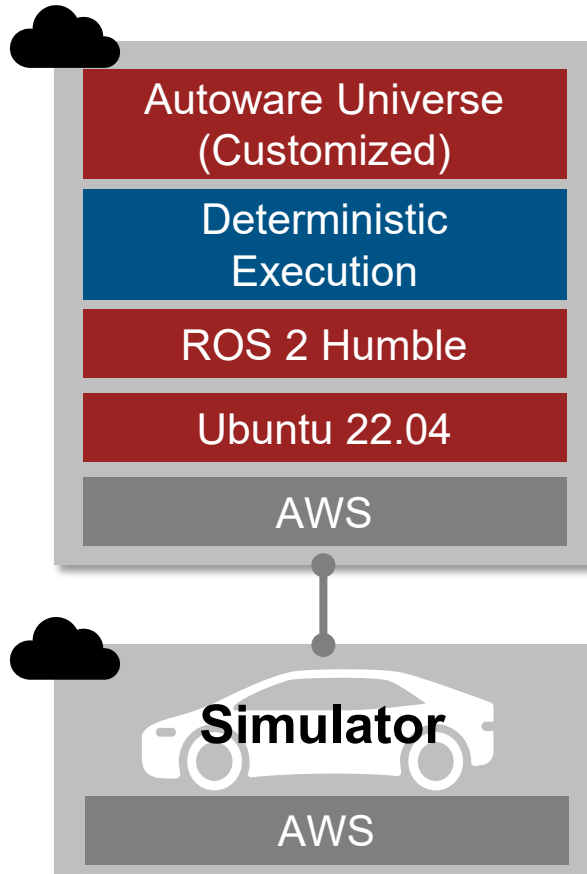
## Results (output timing)



# 4-9. Seamless Deploy with Determinism: Example

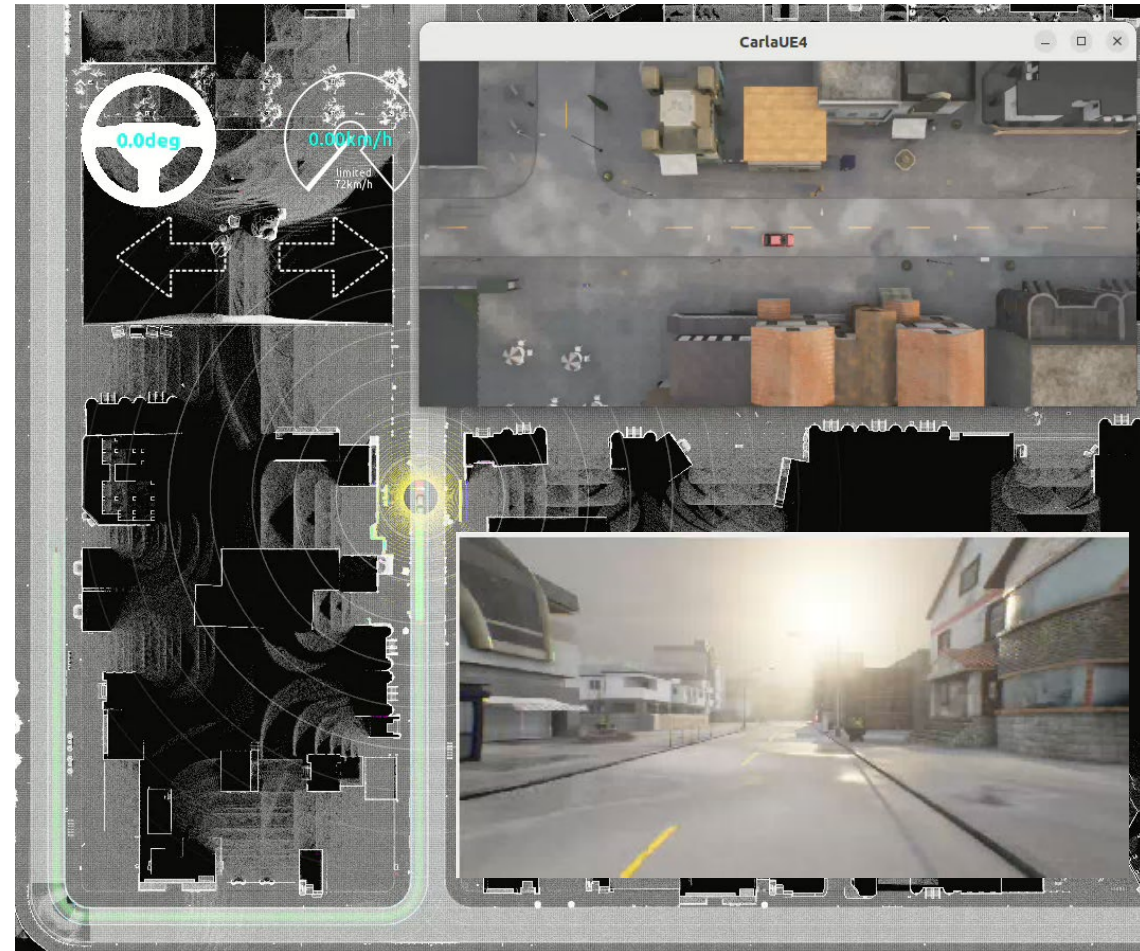
- Trial: applying **deterministic exec to Autoware** as an example to evaluate real-scale systems.
- Progress: **completed partially** and investigating whether **real-time performance is maintained**.

## ■ Example Setup



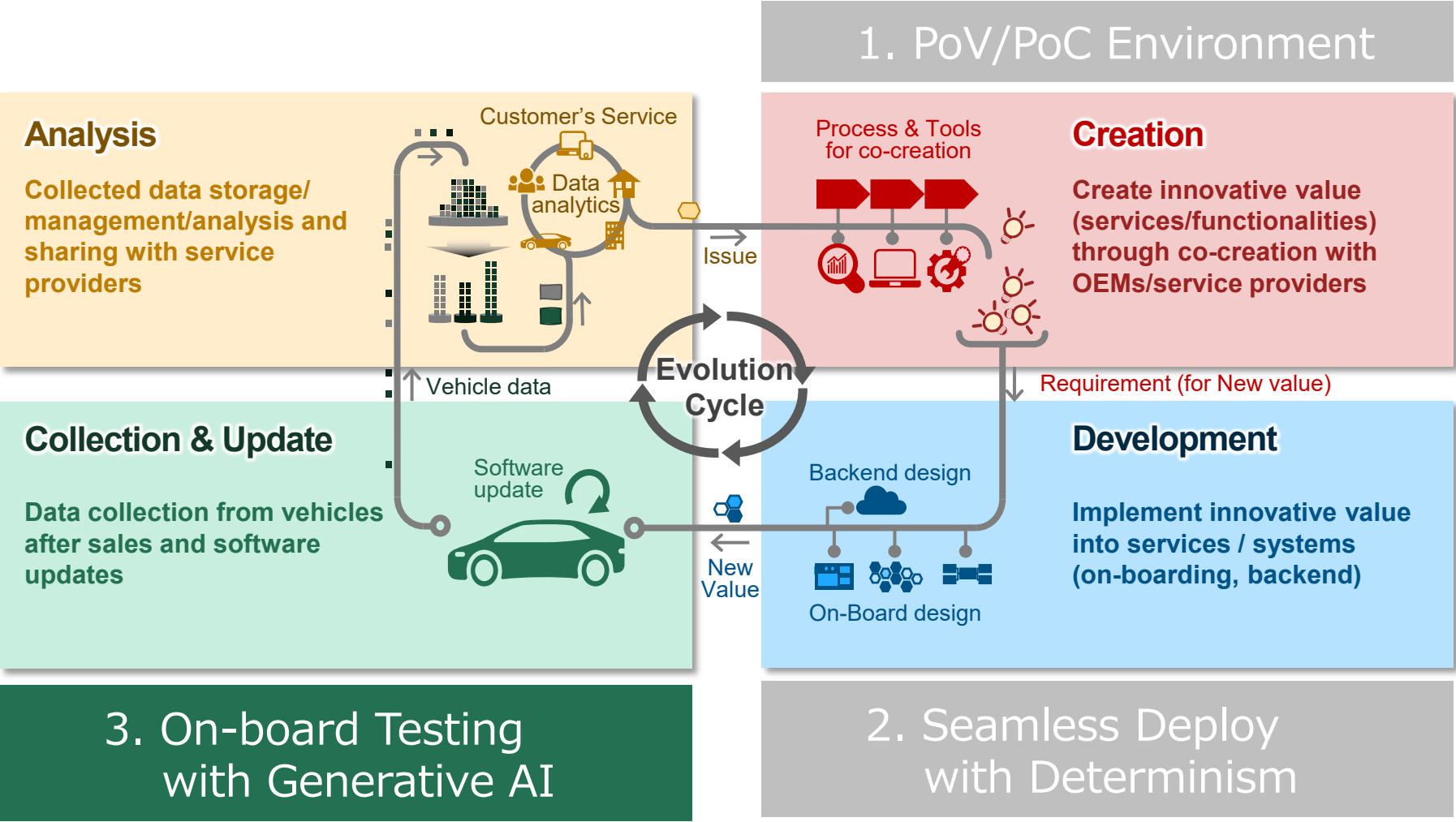
powered by  aws

## ■ Evaluation by Simulator



# 4-10. IoV Platform Service for Value-First Development

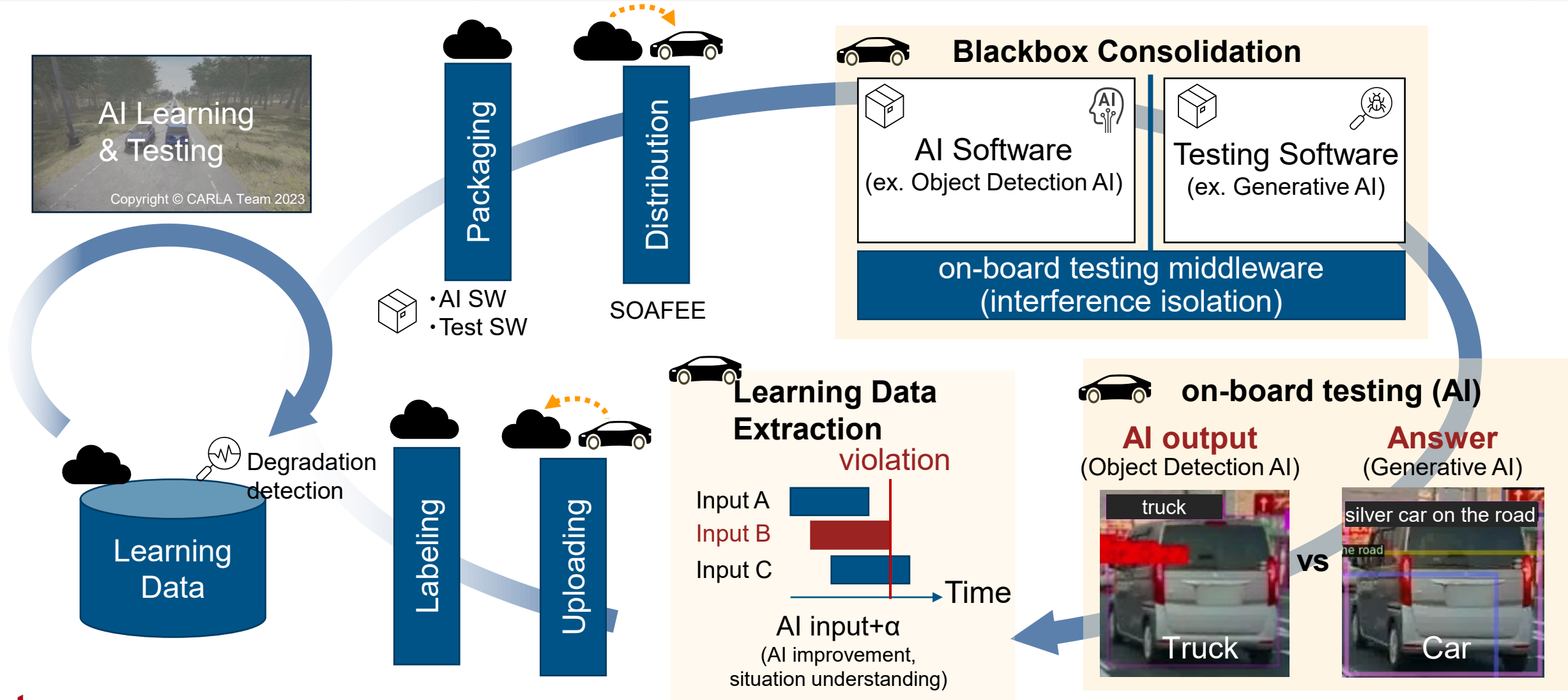
■ IoV Platform accelerates the evolution cycle based on value-first development





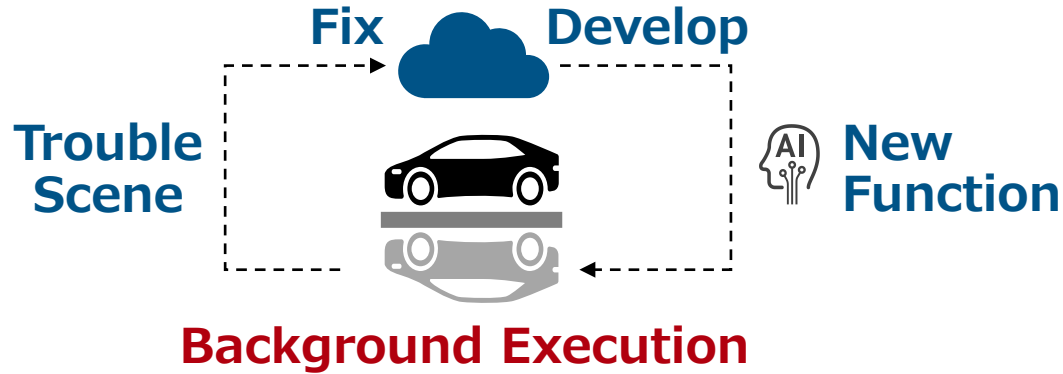
# 4-11. IoV Platform: Example of Vehicle Evolution (AI)

- After AI is well tested in backend, it's distributed by container. On-board testing MW enables that testing software can test AI by utilizing sensor value. If AI error happen, input data is uploaded for re-learning.

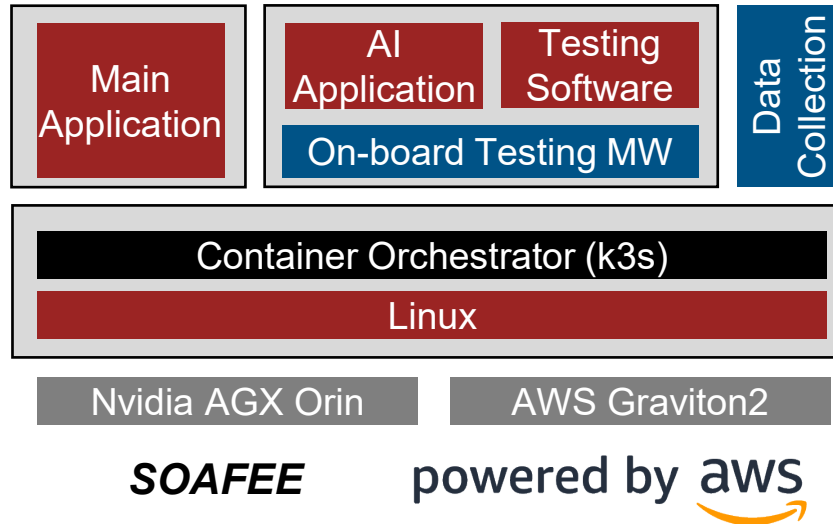
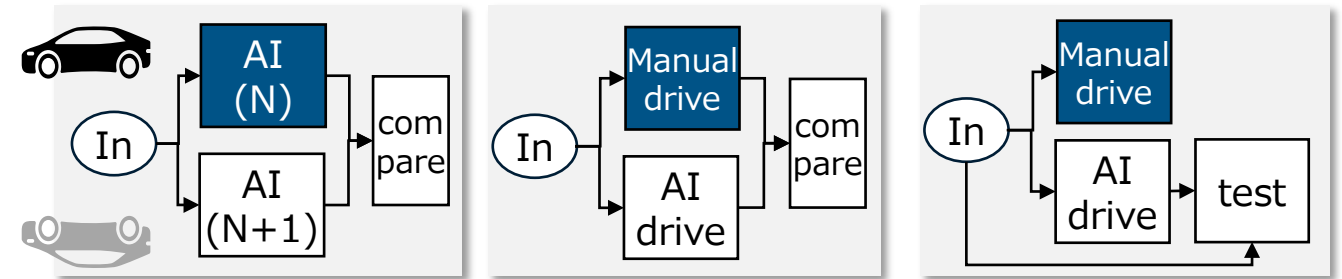


# 4-12. On-board Testing: Overview

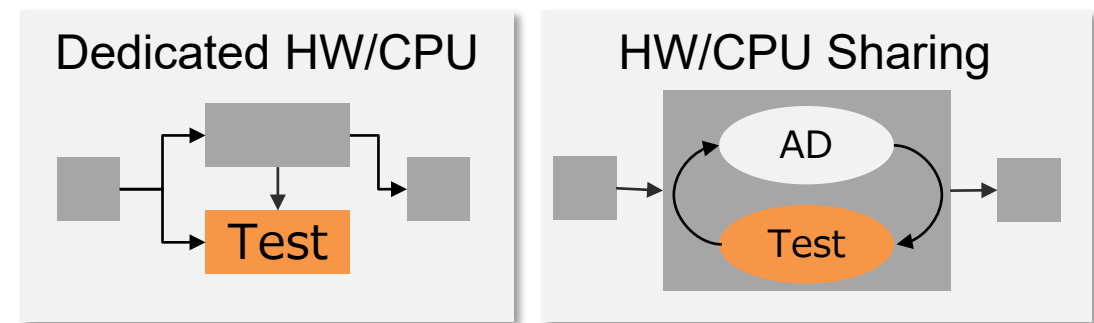
- On-board testing middleware enables to **test new functions in user's vehicle**.
- On-board testing technologies can accelerate software development.



## Use case (Example: AI)

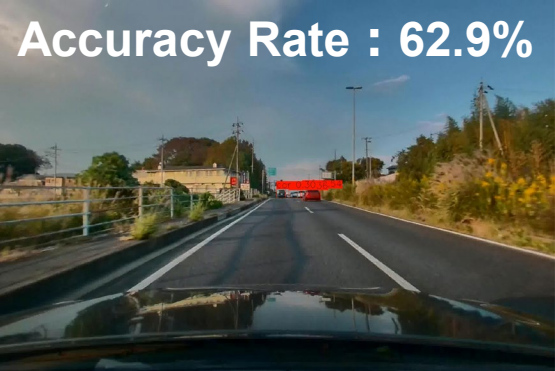


## Architecture



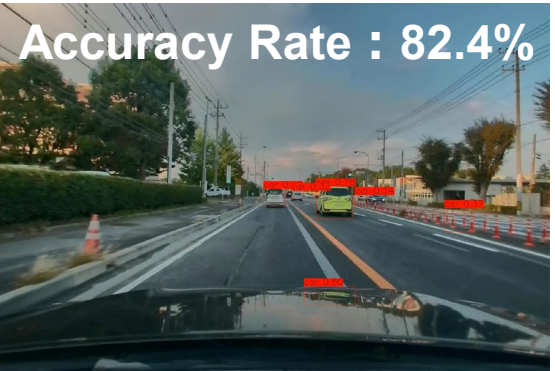
# 4-13. On-board Testing: Example (Object Detection AI)

## Before Update (old)



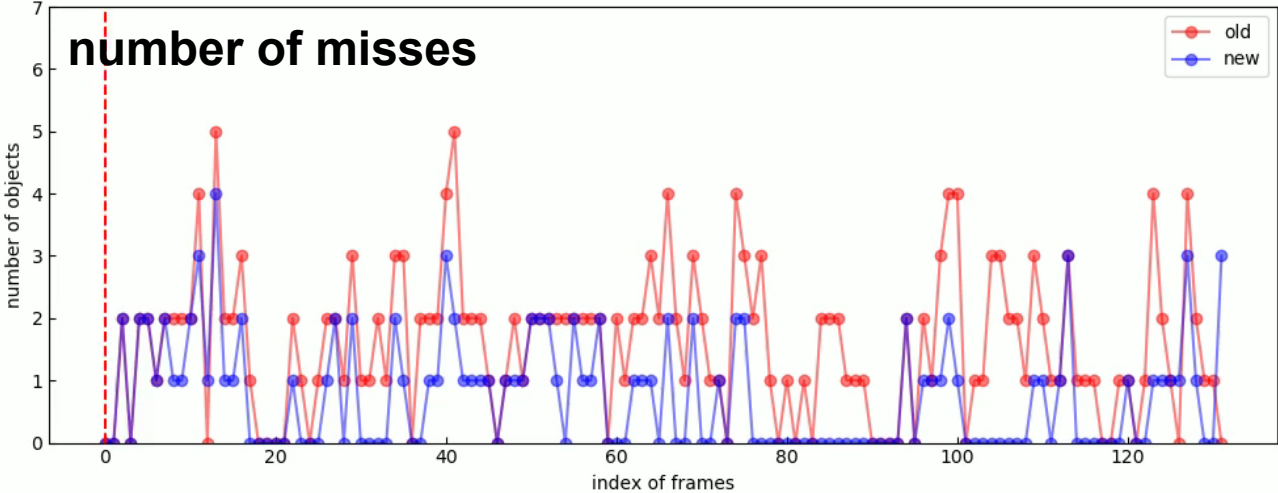
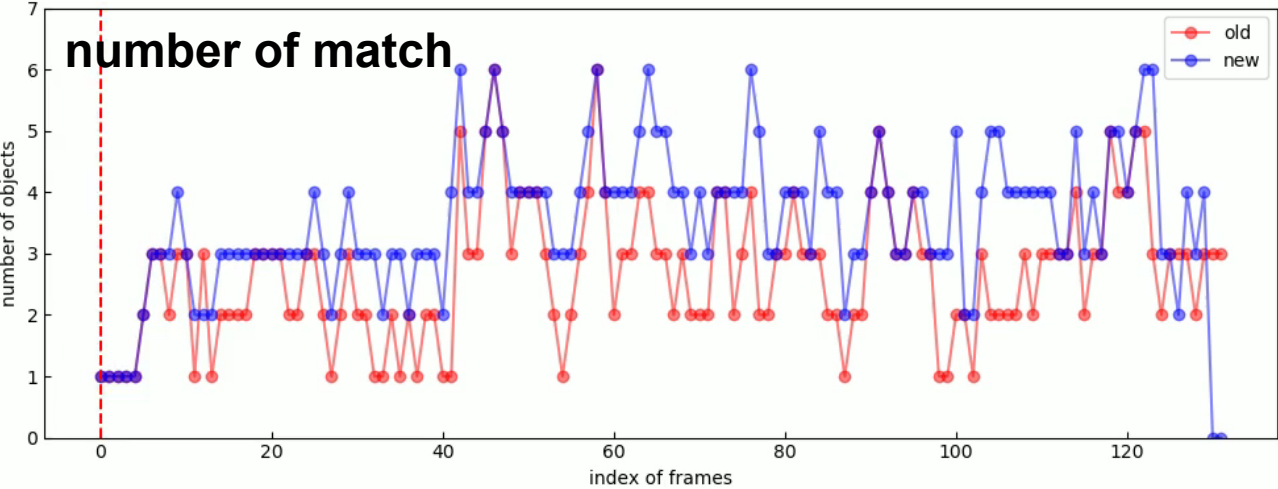
Training

## After Update (new)



car: red  
truck: purple

## Test Result (comparison with Gen-AI)



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We introduced “Hitachi Astemo’s Vision for Software-Defined Vehicle” and “Internet of Vehicles(IoV) Platform”.

- ❑ Value-First Development
- ❑ Use-case
  - ✓ PoV / PoC Environment
  - ✓ Seamless Deploy with Determinism
  - ✓ On-board testing with Generative AI

We welcome further SOAFEE collaboration partner.

**HITACHI**  
Inspire the Next 