



PopcornSAR

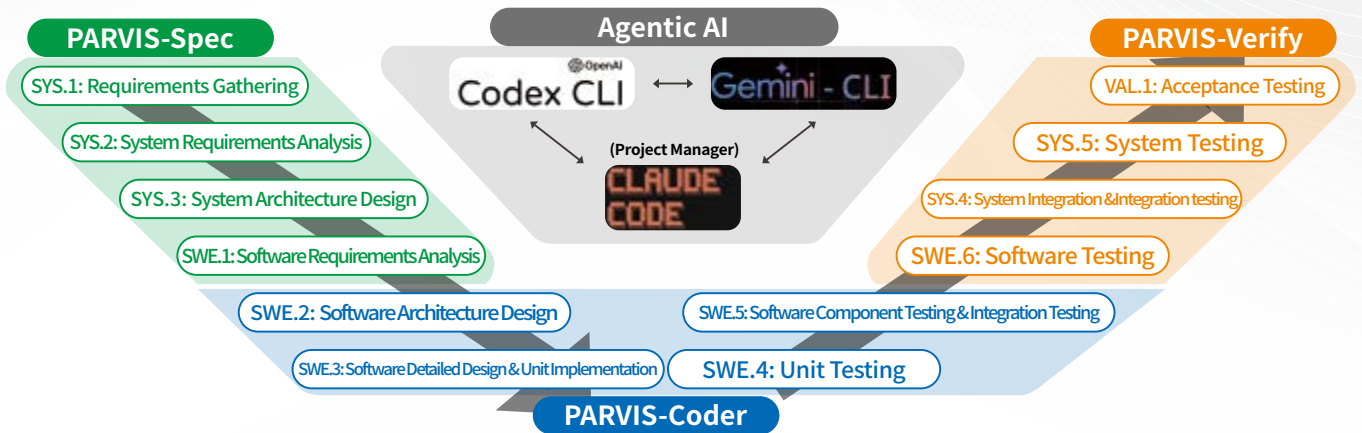
Driving Mobility Innovation with SDV & AI

*AI-Driven SDV Development Innovation:
Opening a New Era for Vehicle Software*

PopcornSAR Co., Ltd.

Automatic Generation of ASPICE Work Products Through Agentic AI: Covering the Entire Vehicle SW Development Process from Design, Development, to Verification

© PARVIS (PopcornSAR Adaptive & Classic Runtime Vehicle Intelligence System)



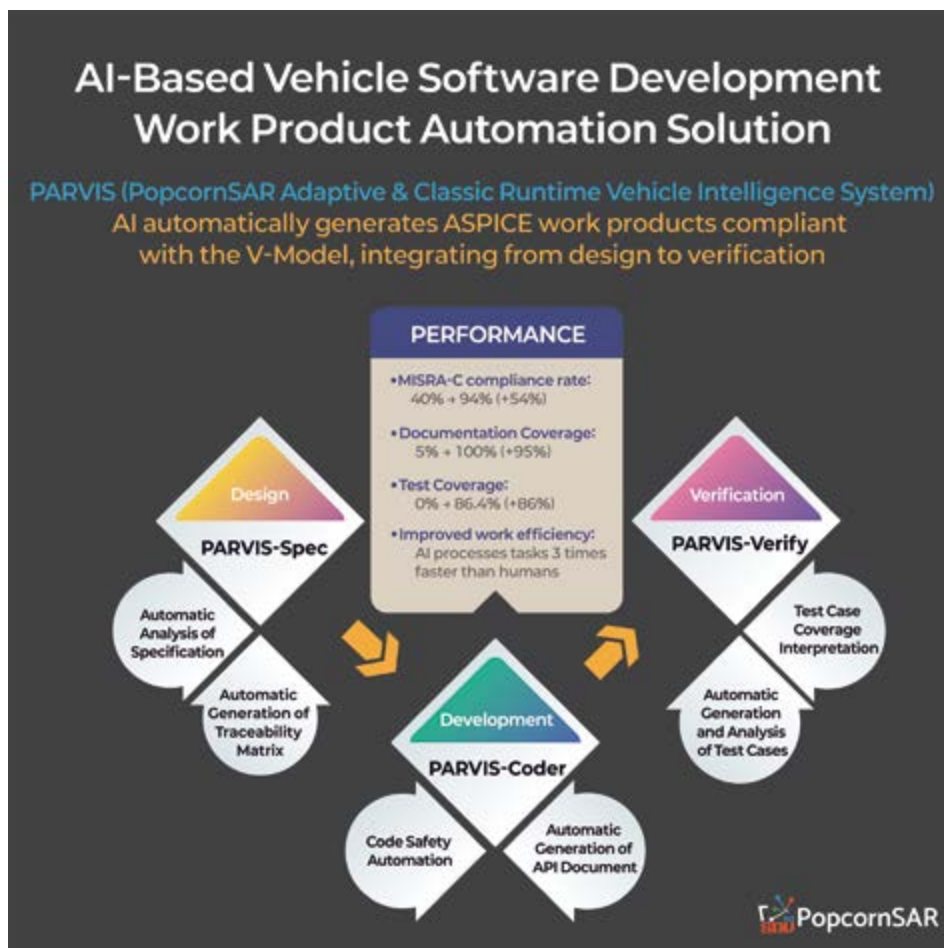
Source : Automotive SPICE

ASPICE is an assessment model for systematically managing the quality and safety of the automotive software development process. Nowadays, it is widely used by OEMs and major Tier1s as a key standard for ensuring project quality.

However, it has significant limitations such as lengthy development hours and high dependency on manual labor, due to the massive documentation and verification steps.

To address these inefficiencies, PopcornSAR has developed an AI-based solution for automating vehicle software development work products.

It minimizes repetitive work by connecting the design, development, and verification process into a single data flow, and improves both quality and productivity by automatically generating documents, code, and test work products that complies with ASPICE



◎ PARVIS-Spec

PARVIS-Spec automatically analyzes specifications to structure requirements and generates a traceability matrix between requirements, code, and tests. The AI-based natural language interpretation engine analyzes the meaning of documents to automatically extract technical requirements, minimizing repetitive document analysis tasks. This ensures that even when requirements change, the code and test items are immediately synchronized, maintaining consistency across the entire project.

◎ PARVIS-Coder

PARVIS-Coder ensures the quality and consistency of development work products through Code Safety automation and automatic API documentation generation. The AI refactoring algorithm automatically applies MISRA-C and internal coding rules, simultaneously generating comment-based API documentation. Developers can focus on securing code quality, free from repetitive, formal tasks.

◎ PARVIS-Verify

PARVIS-Verify systematically accelerates the verification phase by performing test coverage analysis and automatic test code generation. It automatically generates test cases based on test requirements and continuously updates coverage by reflecting code change history. This enhances verification quality and significantly reduces testing time.

PARVIS provides design-code-verification automation optimized for the Adaptive AUTOSAR environment through linkage with our design tool, AutoSAR.io, and our AUTOSAR stack, PARA. The automatic generation function for each specific module can be executed via the PARVIS command-line tool, which also integrates easily with existing DevOps and CI/CD environments. This enables a complete transition from traditional manual-centric development methods to an AI-Driven development pipeline.

AI Usage Scenarios that Address Blind Spots in SDV Development

◎ HITL(Human In The Loop) in Generative AI and AI Agent

◆ Definition of HITL(Human In The Loop)

1. HITL (Human In The Loop) refers to a "control loop" where humans intervene to verify, approve, or correct when an AI automatically makes decisions and generates results.
2. A key principle that combines the "Autonomy" of AI with the "Accountability" of humans.

◆ The Need for HITL(Human In The Loop)

1. AI models are based on probabilistic inference → cannot be fully trusted
2. Human verification is essential in areas requiring safety, legal responsibility, and ethical judgment
3. Mitigates risks from incorrect AI judgments and ensures quality assurance.

Steps	AI Action	HITL Intervention
① Draft Generation	Automatic generation of documents, code, plans, etc.	Review for quality and accuracy
② Result Interpretation	Decision making based on Data	Contextual judgement, correction
③ Execution Approval	Pre-execution step	Execute after human approval

◎ HITL Application Cases in Automotive V-Model & ASPICE

◆ Application Background

1. Compliance with functional safety (ISO 26262) and quality processes (ASPICE) is mandatory in automotive SW development
2. When automating with generative AI/agents, certification is not possible without a human verification process (HITL)

◆ HITL Intervention in V-Model: HITL is performed by an expert with prior development experience on the specific ECU before the AI is introduced

V-Model Steps	AI Action Example	HITL Role
Requirement Analysis (SWE.1–SWE.2)	Natural language requirements → Automatic extraction of functional requirements	Review for omission of functional and safety requirements
System Design (SWE.3)	Automatic drafting of ARXML and Interface design	Architecture verification, performance constraint confirmation
Implementation & Unit Testing (SWE.4–SWE.5)	Automatic test code generation	Check boundary conditions, MISRA rules
Verification & Approval (SUP.4–SUP.8)	Automatic change history summary	QA manager approval record

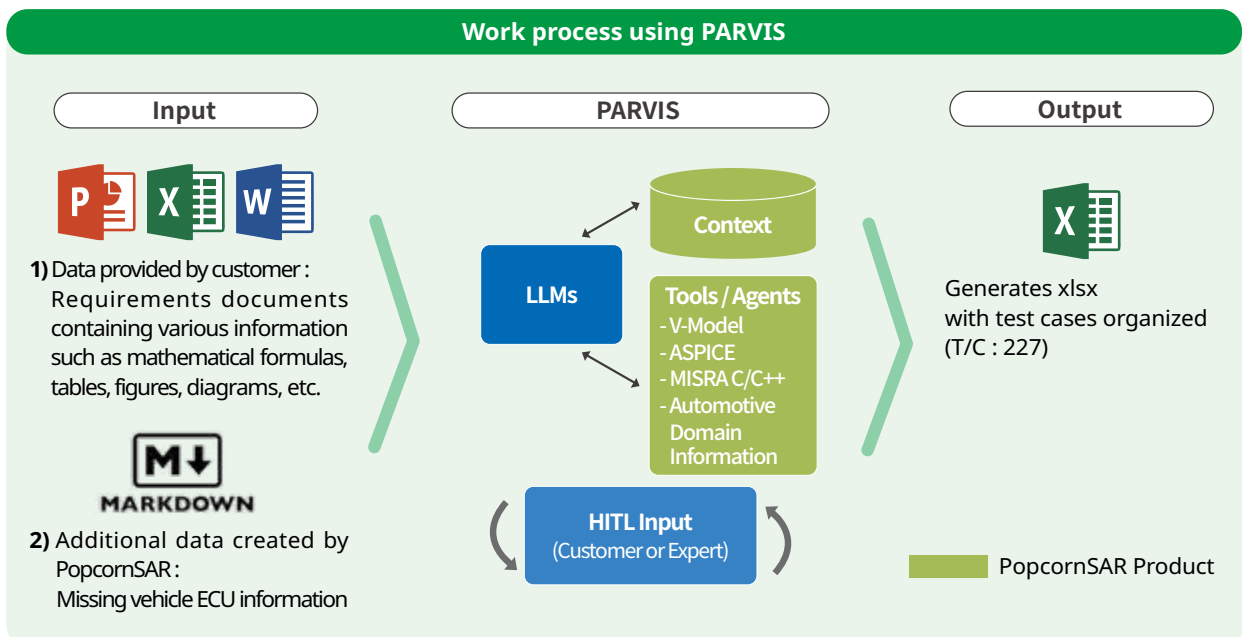
◆ Expected Effects

1. Increased speed with AI automation, ensured quality with HITL.
2. Capable of meeting ASPICE Level 2 or higher assessments through an "AI assistance + human approval" system.

In automotive SW development, HITL is not just a review, but a core process that determines the possibility of certification.

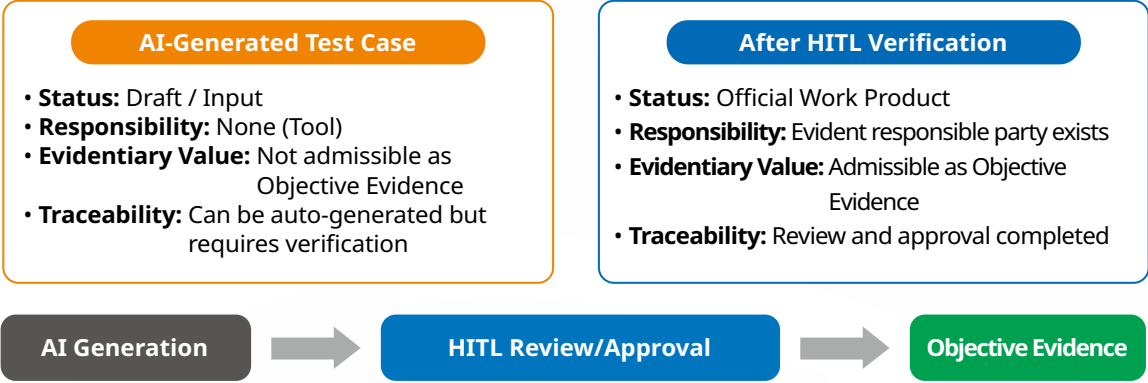
AI Agent Adoption Cases in SDV Development

◎ Automatic Test Case Generation for Tier1



PARVIS not only automatically generates test cases from requirement specification, but also integrates HITL (Human In The Loop) based on V-Model and ASPICE processes, supplementing the validity of AI output with human expertise to achieve high-precision verification automation

Limitations of AI Work Products and the Role of HITL



Key Point: In all verification processes, test case generation occurs at BP1, and HITL review and approval are essential.

BP1 (Base Practice 1): Specify Verification Measures – Test Case, Coverage Criteria, Pass/Fail Criteria

Process	Parts related to test case generation
SWE.4 Software Unit Verification-BP1	Define unit test cases and verification conditions (boundary, branch, statement coverage, etc.)
SWE.5 Software Integration and Testing-BP1	Define interface test cases between SW components
SYS.4 System Integration and Testing-BP1	Define test cases for system requirements verification
SYS.5 System Qualification Testing-BP1	Final test cases for verifying fulfillment of customer/regulatory requirements

HITL Verification Process and Securing Objective Evidence

Essential HITL Verification Steps

- 1. Review**
 - Check if coverage is met
 - Verify requirements consistency
 - Assess technical validity
- 2. Approval**
 - Final approval of the official approver
 - Review record creation is mandatory
- 3. Documentation**
 - Record Who, When, What, Result

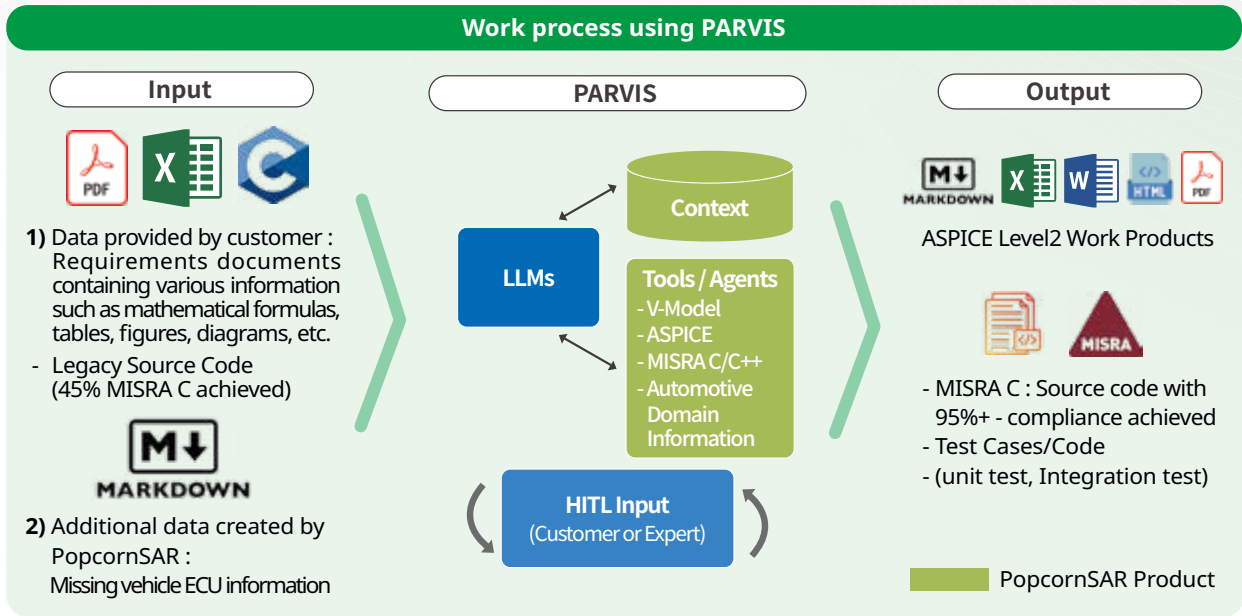
Objective Evidence Composition

- ✓ **Review Record**
 - Reviewer, review date, review scope
 - Findings and results
- ✓ **Approval Record**
 - Approver, approval date, approval comments
 - Work product version information
- ✓ **Traceability Matrix**
 - Establish bidirectional traceability

• **HITL verification transforms AI work product into “Objective Evidence”**

AI Agent Adoption Cases in SDV Development

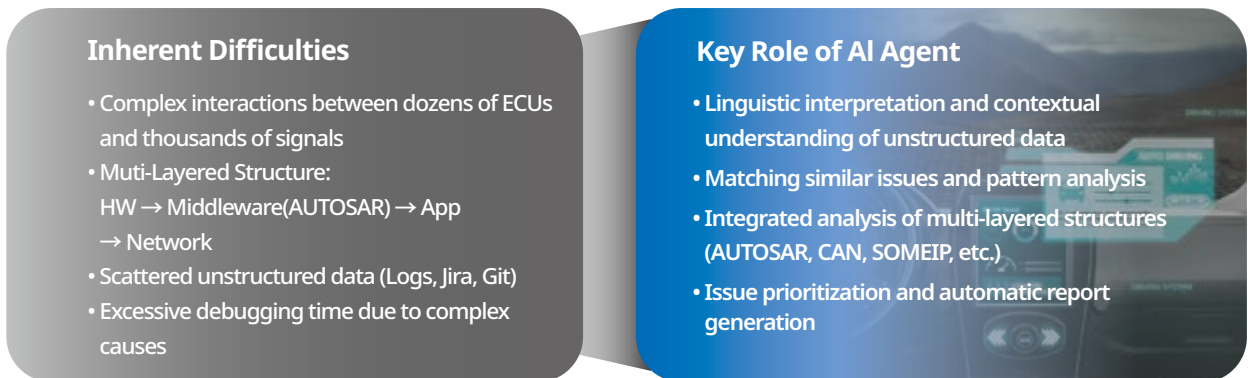
⦿ Achieving ASPICE Level 2 Compliance for Tier1's Legacy SW



Why AI Agents are Needed from the Perspective of Complex Vehicle SW Development

⦿ Complexity of Vehicle SW Development and LLM Solutions

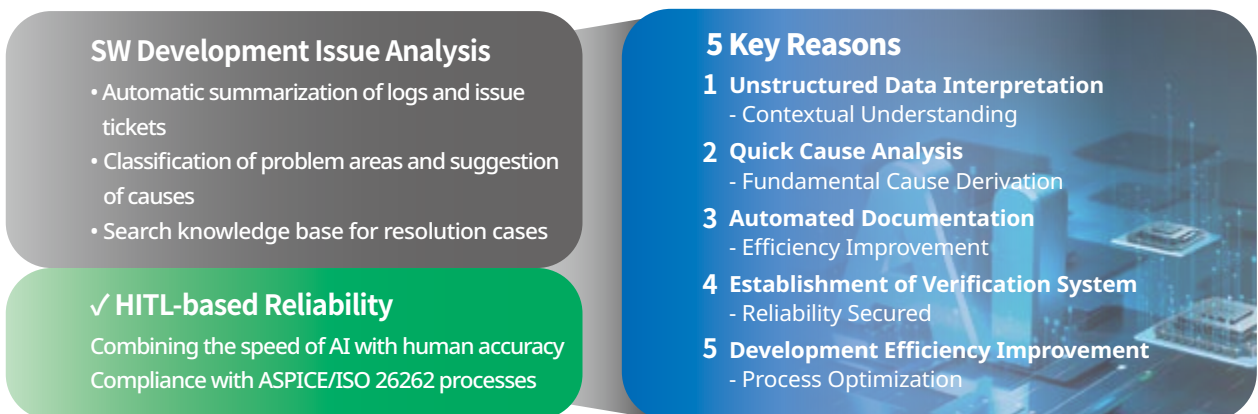
- AI "visualizes" complex vehicle software development by understanding vast amounts of data



Why AI Agents are Needed from the Perspective of Complex Vehicle SW Development

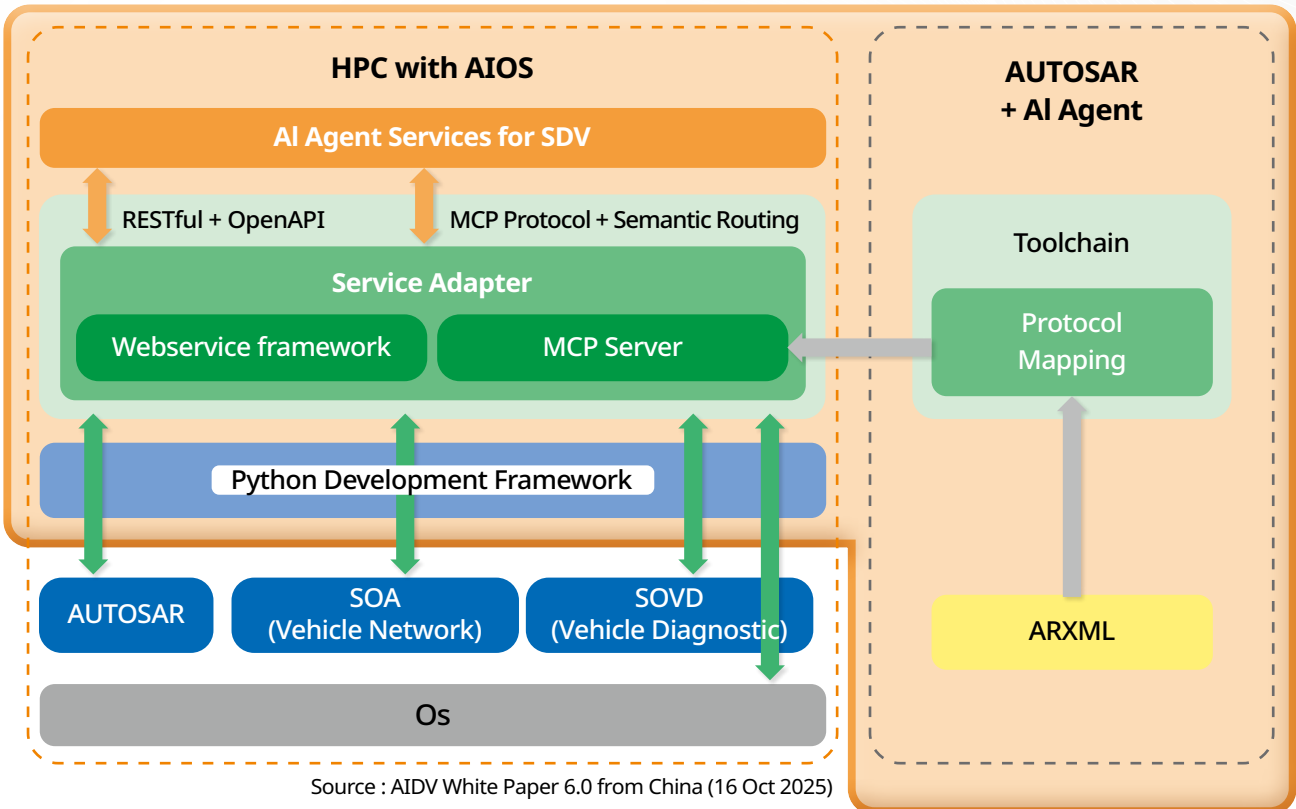
⦿ Application in Vehicle SW R&D and Core Value

- Next-generation vehicle SW development: AI thinks, humans assure, and HITL accelerates



ARXML-Connected AI Agent: PopcornSAR's Fully Integrated SDV Architecture

China is already standardizing the AI integration of vehicle SW under the AIDV(AI-Defined Vehicle) concept. This structure is evolving into a form that integrally manages design, verification, network, diagnostics, and application development based on ARXML. Open-source software (OSS) alone cannot replace these standardization and certification processes (A-SPICE/ISO26262). Our company possesses the full range of corresponding AUTOSAR, AI Agent, MCP, Webservice, and Toolchain domains in-house.



PopcornSAR Product

© Application Stages of AI Test Cases in SDV Development

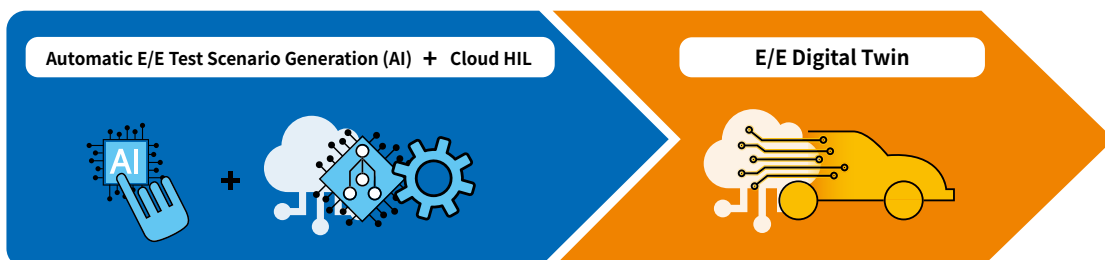
AI is utilized to automatically generate test cases based on the vehicle E/E architecture.

Quality verification and maintenance can be performed in a cloud environment based on those results

This allows the simultaneous improvement of development speed and quality.

In the upcoming era of AI and SDV convergence, a development environment where AI and ECUs are integrated is essential.

In other words, a development environment capable of simulating the entire vehicle development process will become the key.

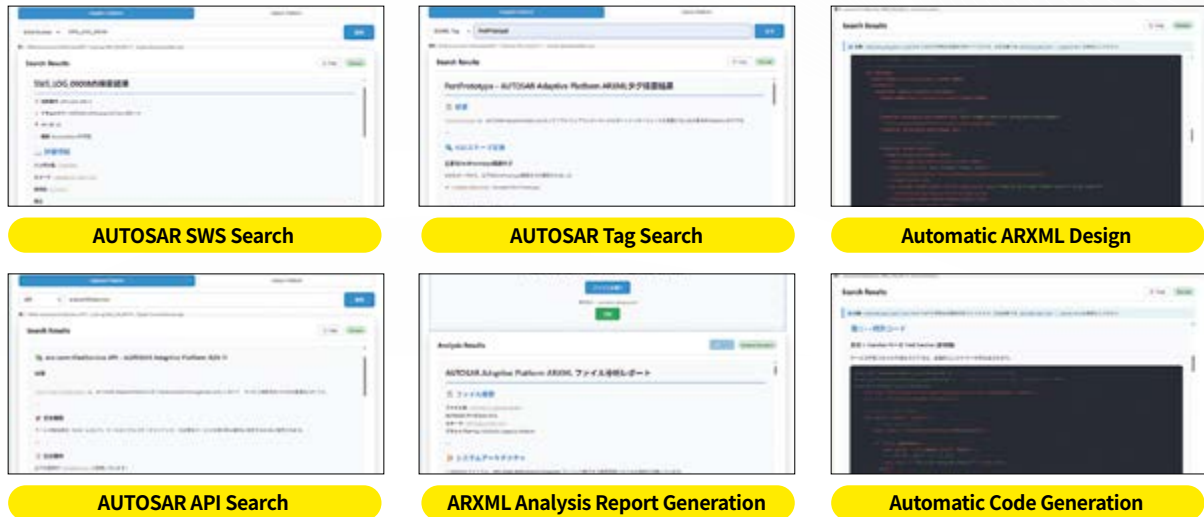


AUTOSAR Development: Faster and Smarter with AI Agent

The AUTOSAR AI Agent is a documentation platform that fully integrates ARXML structure analysis, SWS number-based document search, and AUTOSAR tag and API search functions. It is also capable of source code analysis, and by simply reading an ARXML, the AI Agent automatically suggest and generate the optimal SWC User code.

It is designed to quickly and accurately search complex AUTOSAR documents and code structures, supporting both Classic AUTOSAR and Adaptive AUTOSAR specifications to easily find desired information.

◎ Key Features of AUTOSAR AI Agent



AI Agent Practical Training for Next-Generation SDV Developers

This is a practical, hands-on training program based on PopcornSAR's proprietary AI technology, where participants can systematically learn the intelligent **AI Agent design and implementation skills** required in the Software Defined Vehicle (SDV) era.

This course reflects the actual vehicle software development environment, providing experience in understanding AUTOSAR and MISRA-based standard architectures and in personally designing, developing, and applying **SDV-customized Agents** using AI Agents.

Through this, participants can internalize the **next-generation development paradigm** that converges AI and SDV, and strengthen their capabilities for **efficient development, verification, and automation** of vehicle software.

◎ Training Scope

- Design and development practice of AI Agents optimized for the vehicle software development lifecycle
- Application and practice of AI Agents based on automotive standards such as AUTOSAR and MISRA
- Automation of V-Model-based requirements analysis, code generation, and verification processes

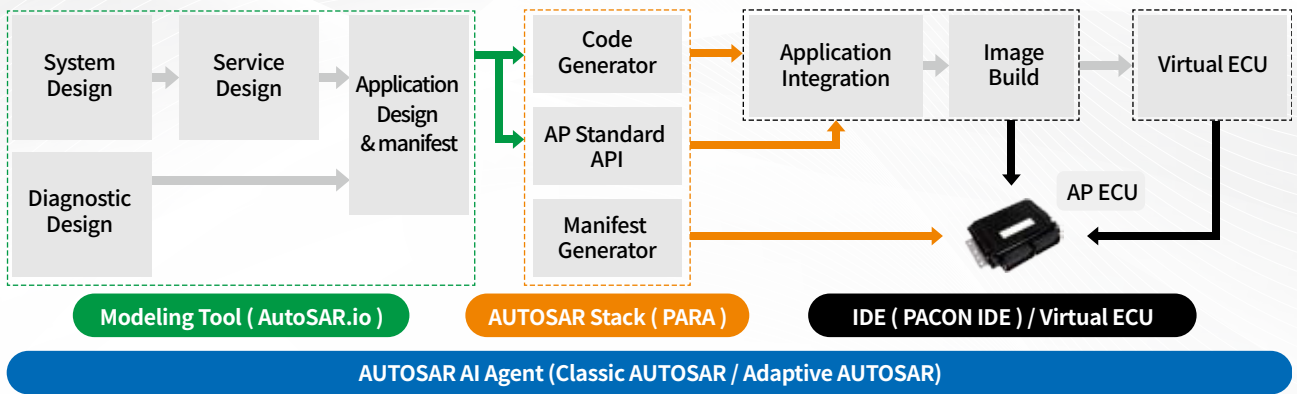
Next-Generation AUTOSAR Leader Evolving with AI

24-11 First Release



The key point of the SDV (Software Defined Vehicle) era is a sustainable software architecture and a secure update system. PopcornSAR is leading the innovation of Adaptive AUTOSAR-based SDV structure to meet these demands. Our company has built a full lineup of AUTOSAR development tools (AutoSAR.io, PARA, PACON IDE) solely with our own technology, enabling us to promptly reflect customer requirements and provide optimal engineering solutions.

Particularly, we are evolving into a SaaS-type AUTOSAR platform that ensures integration and security between HW, SW, and cloud services in the SDV environment where vehicle software is becoming increasingly complex. Through this, we are realizing a complete SDV development ecosystem that encompasses the design, development, and integration of the next-generation vehicle platform components



© Key Features (On-premise & Cloud-based Solution)

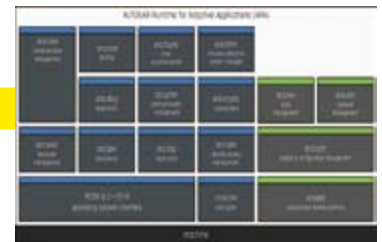


Supports all Classic · Adaptive Platform Design

Integrally supports the system design of AUTOSAR Classic and Adaptive Platforms, enabling the visualization and efficient construction of complex E/E architectures.

Stack corresponding to the Adaptive Platform

Fully supports the AUTOSAR Adaptive Applications (ARA) runtime structure, allowing for integrated management of various services such as communication, diagnostics, security, cryptography, and log management.



Built-in Code Generation function for development efficiency

Automatically generates C/C++ code based on requirements and design information, shortening the development cycle and ensuring uniform software quality.

Container-based integrated development environment

Provides an integrated development environment built on Docker containers, enabling consistent development and testing regardless of cloud or local setup.



Member Login Page

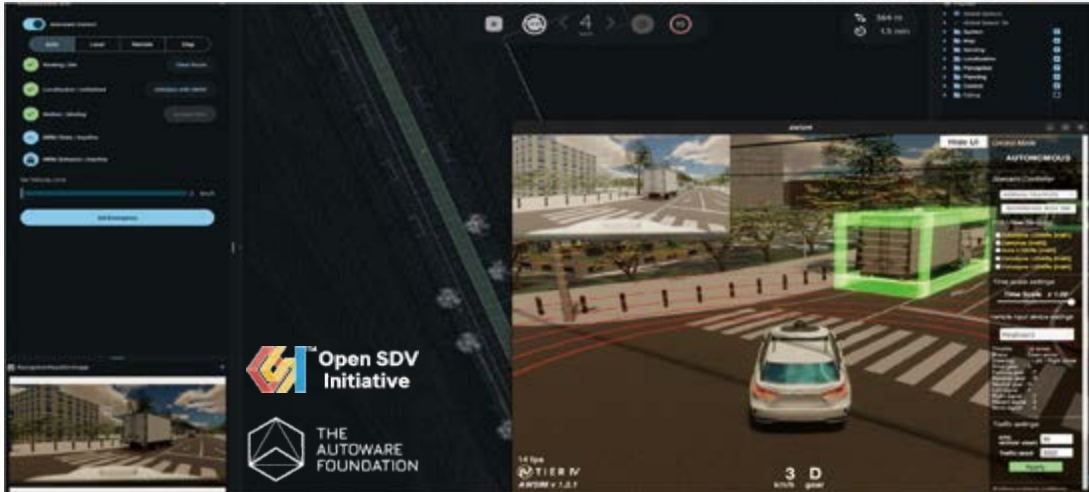
Users can log in to the PopcornSAR cloud platform to securely access the AUTOSAR development environment via a browser. Project management, tool usage, and development history checks are available as a one-stop service.

Admin Screen: Member Management

Administrators can centrally manage user accounts, development environment (instance) status monitoring, permission settings, and resource allocation on the cloud.



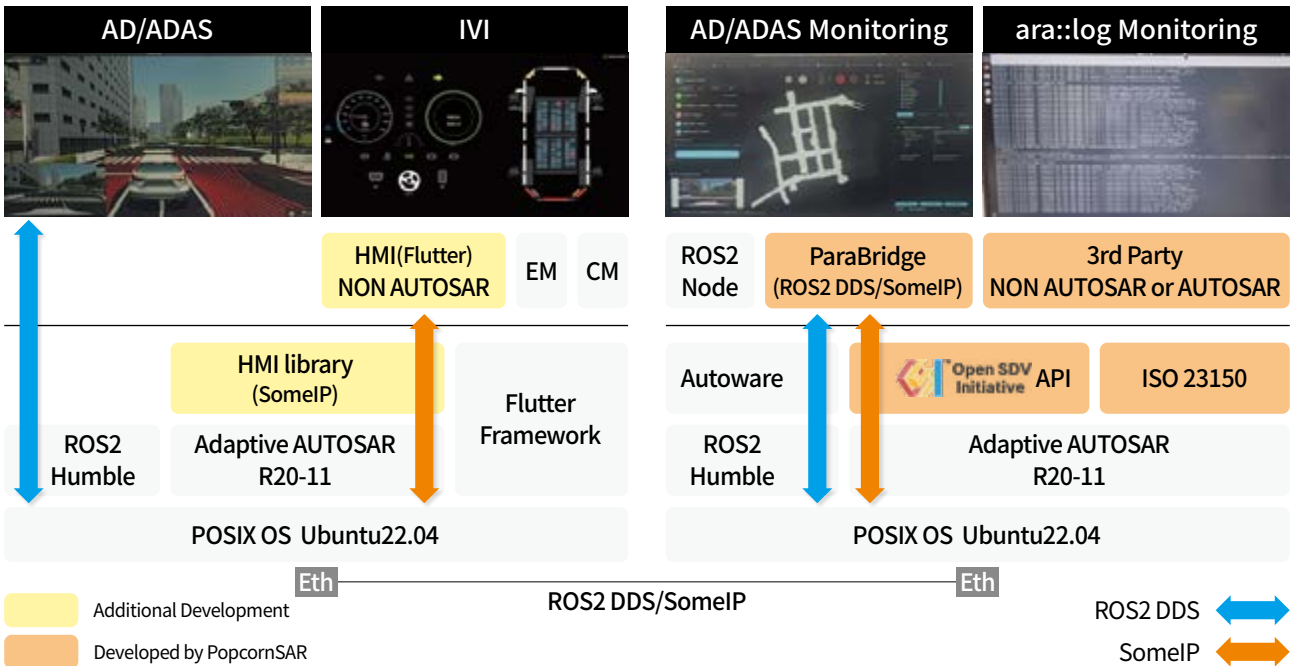
Next-Generation V2X Simulation Connecting Adaptive AUTOSAR and Autoware



This demonstration is an example of implementing a Cross-Domain integrated simulation between ADAS and IVI, based on the OSDVI (Open SDV Interface) standard API and Adaptive AUTOSAR R20-11 specifications.

Using PopcornSAR's AutoSAR.io and ParaBridge technology, the communication structure between ROS2 (Autoware) and AUTOSAR was made fully bidirectional and compatible, and the HMI supports real-time data exchange between AUTOSAR and Flutter-based non-AUTOSAR environments.

Furthermore, by utilizing DDS/SOMEIP protocol conversion to build an integrated simulation environment necessary for next-gen SDV architecture verification, we were able to safely verify real-time interactions between ADAS/IVI and the data flow inside and outside the vehicle.



Integrated AD/ADAS Development Innovation Lead by PopcornSAR

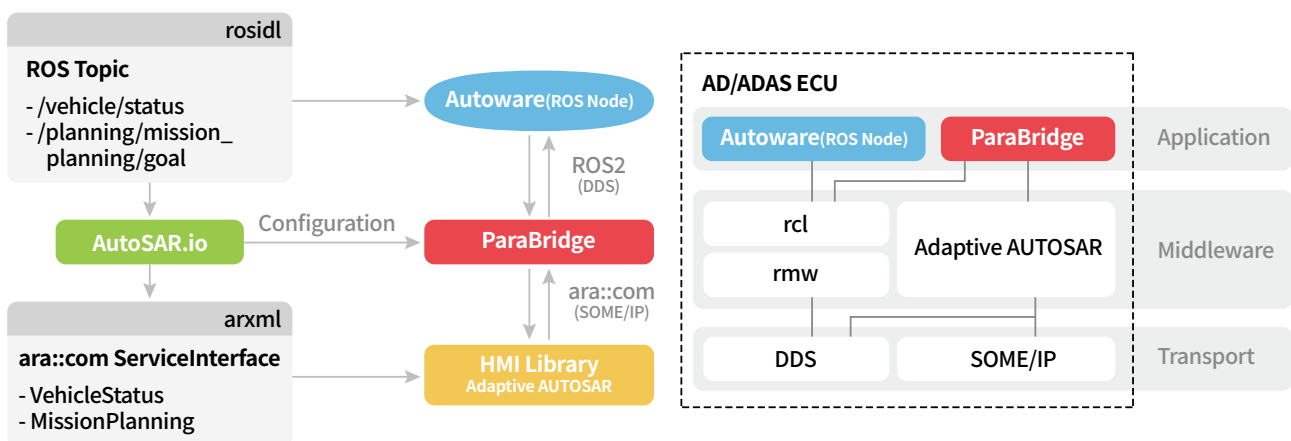
PopcornSAR has developed an integrated framework centered on ParaBridge and AutoSAR.io to achieve full interoperability between Adaptive AUTOSAR and ROS2 (Autoware). This solution resolves incompatibility issues between existing DDS (FastDDS, CycloneDDS, ara::com::dds) and seamlessly connects data linkage between ROS2 and Adaptive AUTOSAR based on SOME/IP and DDS. This supports the operation of autonomous driving, HMI, and logging systems as a single, integrated structure in the AD/ADAS development environment.

© Integrated Simulation Architecture

- **AD/ADAS Simulation** Generation of driving and perception data based on Autoware ROS2 Node
- **IVI Visualization** Linkage with Flutter Framework-based HMI (non-AUTOSAR) or Adaptive AUTOSAR HMI Library
- **ADAS Monitoring and Log System** ROS2 DDS/SOMEIP conversion via ParaBridge, compatible with ISO 23150 and OSDVI SDV API
- **3rd Party Monitoring Linkage** Data access and analysis possible even in non-AUTOSAR/ara::log environments

Direct communication between ROS2 and Adaptive AUTOSAR is impossible because their design architectures differ. Therefore, our company developed an intermediate module called 'ParaBridge' to enable mapping between respective APIs and Topics. This module allows for flexible linkage between Topics on Autoware (e.g., /vehicle/status) and Service Interfaces on Adaptive AUTOSAR (e.g., VehicleStatus).

In essence, ParaBridge comprehensively solves compatibility issues between DDS middlewares. As a result, ParaBridge handles data linkage between ROS2 (DDS) and AUTOSAR (SOME/IP), enabling Adaptive AUTOSAR and Autoware to mutually transmit/receive data for real-time control and HMI integration.



© Core Technology Configuration

• AutoSAR.io

Automatically converts ROS2 Topics (e.g., /vehicle/status, /planning/mission_planning/goal) into AUTOSAR ara::com ServiceInterfaces (e.g., VehicleStatus, MissionPlanning), easily realizing data linkage between the AUTOSAR system and ROS2. This enables real-time integration between ROS-based driving data and the AUTOSAR structure in an AD/ADAS development environment.

• ParaBridge

A Cross-Middleware Bridge that supports bidirectional communication between ROS2 DDS and AUTOSAR ara::com (SOME/IP). This technology resolves incompatibility issues between traditional DDS (e.g., FastDDS, CycloneDDS) and enables real-time data exchange between ROS Nodes and Adaptive AUTOSAR Applications within the AD/ADAS ECU.

• HMI Library (Adaptive AUTOSAR)

A library that can visualize vehicle status, perception information, route planning data, etc., in an AUTOSAR HMI or Flutter-based IVI environment. This allows for intuitive confirmation of not only AUTOSAR internal data but also information from ROS2 and non-AUTOSAR systems on a single screen.

Driving Mobility Innovation with SDV & AI

Building the Future of Automotive Software Together

Autonomous Driving Ecosystem

Collaborating with autonomous driving organizations and validation ecosystems



SDV Consortium

(Software-Defined Vehicle Consortium)
Global network for open standardization and data interoperability of vehicle software



Automotive Software Standards Partners

Advancing sustainable SDV architectures with key software standards and technologies



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