Software-Defined Vehicle Support and Coordination Project

D4.2 Recommendations for Building Block Realization

Author: David Helwig

October 2025

Deliverable	D4.1 Initial Recommendations for Building Block Realization
Work Package(s)	WP4 – Strategic recommendations
Dissemination Level	Public
Due Date	30.09.2025
Actual Submission Date	
WP Leader	Jan Kubovy | BMW
Deliverable Leader	David Helwig | Mercedes-Benz
Contact Person	David Helwig
Email	David.helwig@mercedes-benz.com

Document History			
Revision No.	**Date of the review**	**Name of the reviewer**	**Status of the document** ***(in progress, ready for review, released)***
0.1	26.09.2025	Bugar, Cuenot	

The project has been accepted for funding within the Chips Joint Undertaking (CHIPS JU), a public-private partnership in collaboration with the Horizon Europe (HORIZON) Framework Programme under Grant Agreement No. **101139749**

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of Contents

1 Executive Summary

This deliverable is an aligned recommendation, in which new or existing calls or funding schemes the prioritized modular building blocks backlog shall be implemented. This is the second iteration of this deliverable. Major updates to the previous version are described in 3.3.

2 Introduction

2.1 Introduction - Purpose of this Document

The purpose of this document is to recommend which of the suggested building blocks are developed where.

This is the final step of the Selection Process of building blocks. The first step is done in the work package 2 where the demands and potential Building Blocks are found. In work package 3 these are selected and refined and in this document from work package 4 these refined Building Blocks are assigned to new or existing projects and funding schemes. All of this happens in communication with the respective projects in case of the projects already existing.

2.2 Definitions

Table 1: Definitions, Acronyms, Abbreviations

Definitions, Acronyms, Abbreviations	Meaning
BB	Building Block
SDVoF	Software Defined Vehicle of the Future
HAL4SDV	Hardware Abstraction Layer for Software Defined Vehicle
CCAM	Cooperative, Connected and Automated Mobility
2ZERO	Towards Zero Emission Road Transport Partnership
SDV	Software Defined Vehicle
API	Application Programming Interface

2.3 Document Structure

This document is structured as follows:

- Section 1 describes the introduction with context for this document
- Section 2 as main body of the document identifies the related initiatives and projects in relation to SDV, proposes recommendations for Building Block in their allocation, and list remaining building block for future allocation.

2.3.1 Updates 2025

In the 2025 update, notable progress has been made across RIA projects. The building blocks are either already implemented or scheduled for implementation. Table 3[1] presents the current status overview.

Efforts to align with other OSS projects are ongoing and will be reflected in future versions of this document. The integration of building blocks from EU-funded initiatives follows the established processes defined by OSS integration projects such as S-CORE, ensuring rapid integration while maintaining high software quality standards.

Eclipse SDV intends to adopt the common architecture developed within the EU project HAL4SDV and initiate a new Eclipse SDV specification project. This architecture is already well aligned with the existing Eclipse S-CORE framework. The newly formed working group will continue to abstract and refine the architecture, enabling a fully interoperable setup.

[1] The table has been extracted from document “2025 TECHNOLGY ROADMAP” https://federate-sdv.eu/wp-content/uploads/2025/09/2025-SDV-TechnologyRoadmap-Whitepaper-ver-1.0-final.pdf

3 European Programs and Projects

This is a brief overview about some key European funding programs:

- **Horizon Europe** is a European funding program for research and innovation. It has a budget of €95.5 billion[3] to spend over a seven-year period (2021-2027). The program aims to tackle climate change and boost the EU's competitiveness and growth. It facilitates collaboration and strengthens the impact of research and innovation in developing, supporting, and implementing EU policies while tackling global challenges.

  Topics supported by Horizon Europe include

  - Health
  - Culture, Creativity, and Inclusive Society
  - Civil Security for Society
  - Digital, Industry, and Space
  - Climate, Energy, and Mobility
  - Food, Bioeconomy, Natural Resources, Agriculture, and Environment

  SDV is mostly allocated to Cluster 4 Digital Industry and Space, and especially in Cluster 5 Climate, Energy and Mobility

  Link: Horizon Europe - European Commission (europa.eu)

- **Chips Joint Undertaking** (Chips-JU) is a European tri-partite partnership that boosts the development and adoption of advanced nano-electronic chip technologies and systems manufactured in Europe. It was established in 2023 and has a significant EU, national/regional, and private industry funding of nearly €11 billion.

  The program aims to reinforce the EU's strategic autonomy in electronic components and systems to support future needs of vertical industries and the economy at large. It also seeks to establish the EU's scientific excellence and innovation leadership in emerging components and systems technologies and promote the active involvement of SMEs.

  Topics supported by Chips Joint Undertaking include

  - Microelectronics
  - Embedded Software
  - Smart Systems
  - Photonics
  - Edge Computing
  - Risc-V

- Software defined vehicle in the form of the SDVoF initiative

Link: https://www.chips-ju.europa.eu

- **EUREKA** is a long-term intergovernmental initiative that supports strategically important thematic R&D&I communities in close cooperation with national public authorities. It is the world's biggest public network for international cooperation in R&D and innovation, present in over 45 countries. EUREKA provides access to public funding for R&D projects through the ministry or funding agency in each country. EUREKA Clusters are mid- to long-term R&D&I ecosystems of large industry, SMEs, RTOs, and academia that collaborate on specific technological areas to bring the next generation of new products and services to the market. This long-term relationship between the R&D&I ecosystems and the public authorities is one of the assets of the EUREKA Clusters Program.

  Topics supported by EUREKA include

  - Digitalisation
  - Green Deal including Hydrogen for Green Energy
  - Circular Economy
  - Health

  Link: https://eurekanetwork.org

Two ITEA Cluster programs (ITEA and XECS) are described in the following but may be a bit less in scope for this project.

- **ITEA** (Information Technology for European Advancement) is a European strategic research program for the development of software-intensive systems and services. Established in 1998, ITEA is part of the Eureka R&D&I Cluster on software innovation. It enables a large international community of large industry, SMEs, start-ups, academia, and customer organizations to collaborate in funded projects that turn innovative ideas into new businesses, jobs, economic growth, and benefits for society. ITEA is industry-driven and covers a wide range of business opportunities facilitated by digitization. It pushes important technology fields like artificial intelligence, big data, simulation, and high-performance computing into concrete business applications.

  Topics supported by ITEA include

  - Smart Cities
  - Smart Communities
  - Smart Health
  - Smart Mobility
  - Smart Industry

- Smart Energy
- Smart Engineering
- Safety and Security

Link: https://itea4.org

- **XECS** is a Eureka Cluster specifically designed to accelerate the pace of sustainable industrial innovation in the Electronic Components and Systems (ECS) community. It is an industry-driven initiative designed to accelerate electronics RD&I by partnering with National Funding Bodies. XECS focuses on the critical area of sustainable digital transformation. XECS is open to all and is designed to help build a RD&I consortium, access funding, and manage collaborative projects. It provides exploitation and growth opportunities for all the partners involved. XECS runs calls on an annual basis, each call is guided by the ECS Strategic Research and Innovation Agenda and supported by countries across the Eureka network.

  Topics supported by XECS include

  - Sustainable Digital Transformation
  - Electronic Components and Systems (ECS)

Link: https://eureka-xecs.com

3.1 Initiatives and Projects Implementing Building Blocks from FEDERATE

3.1.1 HAL4SDV

The HAL4SDV project is an EU-funded Research and Innovation Action (RIA) project from the Chip-JU 2023 call on a mission to advance European solutions in software-defined vehicles and next-generation vehicles. HAL4SDV will enable software configuration that abstracts from vehicle hardware, paving the way for a "software-defined vehicle" approach for both safety-critical and non-safety-critical applications in future vehicles. It aims to pioneer methods, technologies, and processes for series vehicle development beyond 2030, driven by anticipated advancements in microelectronics, communication technology, software engineering, and AI.

Table 2: Relation of Federate Building Blocks and HAL4SDV Topics (initial draft based on the HAL4SDV proposal):

Federate BB	**HAL4SDV Topic**
SecOS	TA-BB D Security Orchestration: D02 Security Gateway Service
MWLayer: Standard Android VHAL	BB-A – HW/SW Abstraction: A04 Defragmentation of HW interfaces
MWLayer: Smart Charging Communication	Use Case: Battery charging management
Configuration: • Local Update Manager • OTA Master	TA-BB D Security Orchestration: D03 Cloud Connectivity
Platform Health Management: Distributed Health Management	BB-F – Integration, Testing, Simulation, Tools
Security: Intrusion Detection	TA-BB D Security Orchestration: D02 Security Gateway Service
Time: Automotive Edge Runtime	BB-A – HW/SW Abstraction: A07 Container/isolation for complex applications (like HMI)
Virtualization: Digital Twin	BB-F – Integration, Testing, Simulation, Tools: Virtualisation for vehicle subsystems
AppLayer: Standardization of Vehicle API	BB-B – API & Interfaces: VSS – Vehicle Signal Specification

AppLayer--> Standardized Architectural Patterns for Cross Platform Data Service Infrastructure	BB-A – HW/SW Abstraction: A06 Data Architecture for Automotive
MWLayer --> SOA	BB-C – Mixed-Criticality Integration Platform: C02 SoA for On-board integration SW environemnt

For explanation these are the HAL4SDV Building Block Activities

1. BB-A – HW/SW Abstraction
2. BB-B – API & Interfaces
3. BB-C – Mixed-Criticality Integration Platform
4. BB-D – Cyber Security Orchestration
5. BB-E – Development Process Tools
6. BB-F – Integration, Testing, Simulation, Tools
7. EN-G – Software Maintenance and Updateability
8. EN-H – Open-source
9. DEF-I – Mindset and Eco System
10. DEF J – Governance
11. TA-K: Use Cases

3.1.2 Eclipse S-CORE

Since the last iteration of this deliverable the Eclipse S-CORE project emerged, many of the building blocks can be realized.

Eclipse S-CORE is an open-source software platform designed to support safety-critical automotive applications. Developed collaboratively by industry leaders like BMW, Mercedes-Benz, and Accenture, S-CORE provides a modular, standards-based middleware that bridges the gap between operating systems and applications. Its architecture enables predictable, secure, and reusable execution environments across diverse hardware and ECU types, with compliance to ISO 26262 and ISO/SAE 21434 standards

3.1.3 Shift2SDV

The open architectures and building blocks of the Software-define vehicle middleware and API framework developed under this project shall aim at exposing the vehicle's features and functionalities in the form of standard modular services and APIs, simplifying the development and certification of in-vehicle and edge-cloud applications, simplifying the access to vehicle data, functions and resources, making vehicle upgrades easier,

simplifying the adoption of existing and new regulations, verification, validation and certification, and adding agility and speed to automotive engineering.

3.1.4 RIGOLETTO

RIGOLETTO is an EU-funded Innovation Action (IA) 2024 call. Its goal is to develop Scalable automotive processors, spanning from cost-efficient, real-time control to high-performance super-scalar application processors and hardware accelerators shall be developed for the automotive market, based on the RISC-V family.

3.2 Initiatives and Projects that Could Benefit from FEDERATE Building Blocks

3.2.1 SDVoF Initiatives

The SDVoF initiative is guided by the SDV Sherpa Governance Group (SDV-SGG) acting as a decision-making board, providing direction, vision and validating roadmaps. By fostering coordination among existing alliances and establishing close ties with EU initiatives related to an open automotive hardware and software platform, as well as initiatives on connected and automated vehicles or zero emission mobility, the SDVoF initiative aims to create a robust ecosystem. Additionally, where appropriate, open-source software initiatives will be seamlessly integrated.

3.3 Summary of applied building block realization

The following table describes the building blocks from the EU-projects, which are planned for integration into the first SDV SW integration project S-CORE as well as other open-source integration projects. The table contains information about the scope (feature) of the building blocks, the collaboration type and the milestone for the integration.

Table 3: Key Building Blocks & Planned Contributions from EU-projects to OSS initiatives

Building Block from EU-project	Target focus Area in OSS initiative	Intended contribution	(OSS) Project	Status (idea, in alignment, aligned, confirmed)	intentions for first contributions	Type of collaboration
A1 Sensor API		VSS sensor specifications	COVESA	in alignment	2026	Joint dev.
B1 Motion APIs		Additional actuator signals	COVESA	in alignment	Q4 2025	Req.alignment
	Chassis function standardization	Tool to the Eclipse Automotive API framework repository, integrating it into the Eclipse S-CORE ecosystem	Eclipse S-CORE	in alignment	Q4 2025 first MVP	New feature
C1 Plug & Charge	Platform API	Enhanced standards for Secure charging communication	Eclipse S-CORE	in alignment	Q4 2026	Joint dev. & potentialy New feature
		Discussion about collaboration towards OSS projects	HAL4SDV	in alignment		
D1 Multimedia API		Integration of driver monitoring and communication stacks	Automotive Grade Linux	idea	Q2 2026	New feature
		Extension of Android Automotive API for GAS-free applications	COVESA	In alignment	Q1 2026	Joint dev.
E1 In-Vehicle Communication Middleware	GenAI test environments	GenAI-empowered integration of simulated and testbench environments for evaluating open SDV stacks	Eclipse S-CORE	in alignment	Q1 2026	New feature
		Runtime configuration mechanisms for TSN-based vehicle networks	TSNConf	idea		

Building Block from EU-project	Target focus Area in OSS initiative	Intended contribution	(OSS) Project	Status (idea, in alignment, aligned, confirmed)	intentions for first contributions	Type of collaboration
E2 V2X Communication Middleware		define a common data model for vehicle signals	COVESA	idea		New feature
F1 Intrusion Detection, F2 Anomaly Detection, F3 Security and Safety API	Communication	requirements for a generic V2X interface	Eclipse S-CORE	in alignment	Q4 2026	
G1 Digital Twin		Extend communication middleware with a simulation binding for Digital Twin use cases	Eclipse S-CORE	in alignment	2026	Joint dev.
		extending configuration module to import parameters and variant sets	Eclipse S-CORE	in alignment	2026	Joint dev.
		integration of the formal modeling toolchain Dezyne into S-CORE's Bazel-based build and test workflow	Eclipse S-CORE	in alignment	2026	New feature
H1 SOVD	Remote diagnostics & OTA	focusing on implementations around the SOVD Gateway, Server, Client, Classic UDS adapter, and OTA updates	Eclipse Open SOVD	aligned	Q4 2025	Joint Dev.
I1 Microservice Management		extension of the embedded workload container orchestrator to support a new runtime and event handling	Eclipse Ankaios	idea	Q4 2025	Joint Dev.
I2 SDK: Library & Variant Management		tooling to provide developers with effective access to vehicle APIs and manage API libraries	Eclipse S-CORE	idea	2027	New tool
		tooling to check application code for correct API usage and vehicle compatibility	Eclipse S-CORE	idea	2027	New tool
J1 SDK: Data-Centric Access		VSS support for SystemState and VSS extensions for Fleet Management System (FMS)	HAL4SDV		Q4 2026	Joint Dev.

Managed DDS from UNIcar.Agil project	Communication	additional gateway in communication			tbd	New feature

4 Conclusion

This deliverable (D4.2) gives an overview on new or existing calls, projects and funding schemes within the SDVoF initiative. The document showcases, in which projects building blocks identified by FEDERATE, will be implemented. Therefore, the structure and building block categories are described. Furthermore, the document highlights projects, where the implementation of a prioritized modular building block backlog is promising. This document reflects the first iteration of recommendations on building block implementation. More projects for the implementation of building blocks will be showcased in future iterations.

List of Tables