



**Hardware Abstraction Layer for a European Software  
Defined Vehicle Approach**

**D8.7 – Initial Report on Standardization**

ZF Friedrichshafen AG

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## Abbreviations

<b>ASAM</b>	Association for Standardization of Automation and Measuring Systems
<b>COVESA</b>	Connected Vehicle Systems Alliance
<b>EC</b>	European Commission
<b>EU</b>	European Union
<b>GUI</b>	Graphical User Interface
<b>HAL</b>	Hardware Abstraction Layer
<b>HW</b>	Hardware
<b>IDL</b>	Interface Definition Language
<b>IEC</b>	International Electrotechnical Commission
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>IP</b>	Intellectual Property
<b>ISO</b>	International Organization for Standardization
<b>OEM</b>	Original Equipment Manufacturer
<b>OMG</b>	Object Management Group
<b>SAE</b>	Society of Automotive Engineers
<b>SDV</b>	Software Defined Vehicle
<b>SME</b>	Small and medium-sized enterprises
<b>SOAFEE</b>	Scalable Open Architecture for Embedded Edge
<b>SofDCar</b>	Software Defined Car
<b>SotA</b>	State of the Art
<b>SOTIF</b>	Safety of the Intended Functionality
<b>SOVD</b>	Service-Oriented Vehicle Diagnostics
<b>SW</b>	Software
<b>TA</b>	Transversal Activity
<b>TC</b>	Technical Committee
<b>TRL</b>	Technology Readiness Level
<b>UML</b>	Unified Modelling Language
<b>VSS</b>	Vehicle Signal Specification
<b>WP</b>	Work Package

## 1 Summary

### 1.1 Introduction: HAL4SDV (<https://www.hal4sdv.eu/>)

The HAL4SDV Project is the first in a series of SDV related projects funded by the European Commission Chips-Joint Undertaking and national funding authorities of the countries the partner organizations are resident. The project overall value amounts to € 64,5 Mio, the EC investment is € 17,8 Mio widely doubled by the national authorities.

The project is coordinated by Andreas Eckel, TTTech Computertechnik AG, Vienna Austria, leading a consortium of 50 partners and affiliated partners plus 10 associated partners. It consists of the leading European OEMs, Tier 1 suppliers, the major European semiconductor manufacturers, SMEs, academic partners, and foundations representing the European automotive industry and related academia (See Figure 1).



*Figure 1: The countries involved in the HAL4SDV Consortium*

The HAL4SDV project is structured in a matrix organization composed of 9 work packages (WP) following the classic V-Model Approach and a set of Transversal Activities (TA) that cover specific development domains according to Figure 2. The Transversal Activities are further structured by defining “Topics”, whereof the building blocks are deducted (see Figure 3).

The work packages are grouped in “green developments” denoting open-source, non-differentiating and non-safety-relevant developments and “golden developments” representing Intellectual Property (IP) related, differentiating and safety-relevant developments (see Figure 4).

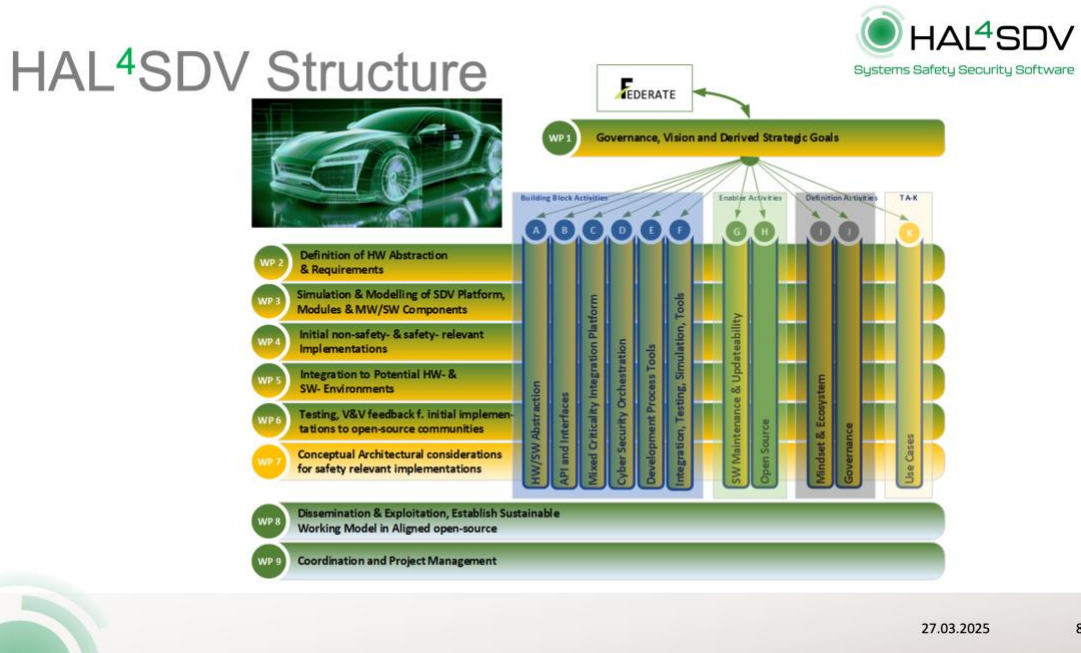


Figure 2: HAL4SDV structure

Building Block Activities					
<b>A HW/SW Abstraction</b> A01 HW Abstraction - Hypervisor A02 Middleware besides AUTOSAR Adaptive A03 Communication Middleware (DDS and other solutions) A04 Defragmentation of Interfaces A05 Interface Concept for Service Oriented and Signal-Oriented Functions A06 Data Architecture for Automotive A07 Container/isolation for complex Applications (like HMI)	<b>B API and Interfaces</b> B01 DSS - Vehicle Signal Specification B02 Efficiently Integrating SDV B03 Mapping for Internationalization B04 Plug & Charge according to ISO Standards available as Open Implementations	<b>C Mixed-Criticality Integration Platform</b> C01 On-board Integration SW Environment C02 SoA for On-board Integration SW Environment C03 Mixed-Criticality Timing and scheduling C04 Shared-Memory access for On-board Integration SW Environment C05 Virtualization Service for On-board Integration SW Environment	<b>D Cyber Security Orchestration</b> D01 Security Threat Analysis D02 On-board Security Service Gateway SW D03 Cloud Connectivity: Security Service Integration to On-board Integration SW Environment	<b>E Development Process Tools</b> E01 Linux Ecosystem for Safety E02 Memory Safe Languages for Critical Systems E03 Open tool for architecture-Modelling following a Model-based-systems-engineering Approach for Overall Vehicle Definition	<b>F Integration, Testing &amp; Simulation</b> F01 Tooling for Performance F02 Tool Interoperability in Automotive SW dev. Area F03 Software Testing on Integration - Level F04 Virtualisation for Vehicle Subsystems F05 Reprocessing / Replay Simulation
Enabler Activities		Definition Activities			
<b>G Software Maintenance &amp; Updateability</b> G01 Isolation of Applications G02 Sustainable Maintenance	<b>H Open Source</b> H02 OSS Blueprints for Compliance with EU Regulations (e.g.: cyber security)	<b>I Mindset &amp; Ecosystem</b> I01 Define and Show "Automotive Grade"	<b>J Governance</b> J01 Process Mapping: CRA Compliance with OSS J02 Supply Chains Open-Source Governance Model		

Figure 3: Structure of the Transversal Activities

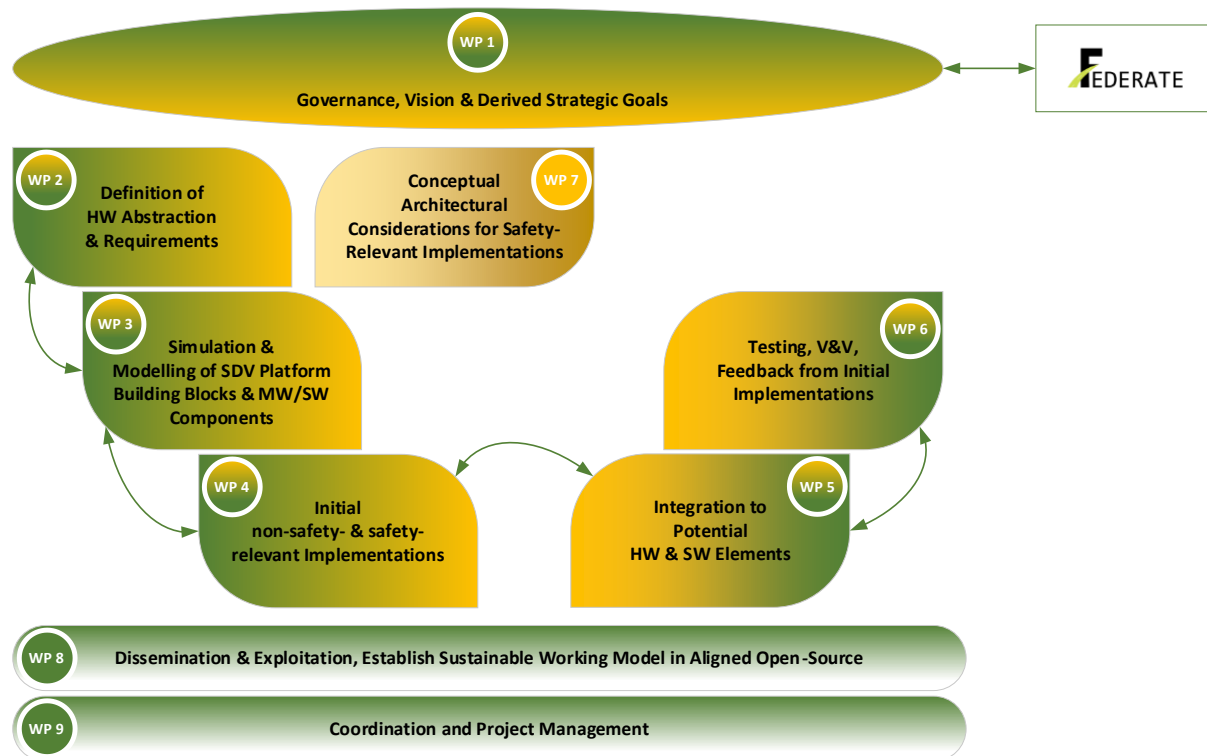


Figure 4: V-model-based Work Package approach

## 1.2 Executive Summary

This deliverable document, **D8.7 Initial Report on Standardization**, is aimed to provide a view into the current state of standardization landscape for reference architecture and implementations for hardware abstraction layer for SDV and to outline the approach to standardization followed by the HAL4SDV Consortium partners. The deliverable document is part of the activities performed in **WP8 Dissemination & Exploitation, establish sustainable working model in aligned open-source, Task 8.5 Standardization efforts**.

The report establishes the foundation and main directions in which HAL4SDV intends to contribute to the standardization landscape, such as adherence or contribution to International or European standards (e.g. ISO26262, COVESA, SOAFEE, IEEE), definition of a generic modular BB SW architecture, aligned with initiatives such as SOAFEE and COVESA VSS, and contribution to the open-source SW solutions.

The document is structured into 5 main sections, as described below.

Chapter [2](#) presents a comprehensive overview of the standardization landscape, outlining the primary objectives pursued in the HAL4SDV project to achieve standardization.

A summary of GAP analysis is considered in section 2.3.

Chapter [3](#) details the 3 main areas in which standardization activities in HAL4SDV are directed: related projects in the SDV ecosystem, open-source initiatives and additional related activities.

Chapter [4](#) provides a summary of the main standardization related activities planned to be addressed by HAL4SDV, including defined metrics used to evaluate progress.

Chapter [5](#) concludes with a summary of key findings related to the standardization topics addressed throughout the deliverable document.

## 2 Standardization objectives

To collect structured input from the HAL4SDV Consortium partners, a questionnaire was designed and distributed to the industrial partners involved in the project. The questionnaire followed 3 main directions: mapping of the experience and involvement of different organizations contributing in HAL4SDV project to the standardization landscape, evaluating the contribution of different partners to standardization activities and evaluating the open-source engagement.

The questionnaire also aimed to map the planning of future activities for standardization efforts, helping to coordinate the efforts across stakeholders for Year2 and Year3 of the project.

### 2.1 HAL4SDV standardization goals

1. Generic HAL4SDV SW architecture definition for SDV

Defining the SW architecture for SDV represents a shift from the traditional, hardware centric design to a centralized, SW driven development. HAL4SDV aims to define a unified hardware abstraction layer, enabling consistent interoperability across sensors, actuators and compute resources, and supporting a modular and scalable building block SW architecture, with support for both safety relevant and non-safety relevant applications.

The goal is reflected in the first identified objective of the project: **Objective 1 SDV platform SoA based architecture, serving non-safety & safety-related applications** [1]

2. Standardization of interfaces: COVESA VSS

HAL4SDV aims to adopt and extend the definitions of Vehicle Signal Specification, in support of definition of standardized interfaces for unified data access and interoperability between different systems and vendors.

3. Standardization contribution in open-source (COVESA, S-CORE, etc)

The above 2 goals are reflected in following project objectives

- **Objective 7: COVESA VSS and OSS SDV initiatives** [1]
- **Objective 3: Hardw. Abstr. Layer (HAL) developments - standardized interfaces to sensors, actors, compute resources and persistent storage, abstraction using hypervisors, HAL SW updates.** [1]

4. Adherence to safety and security automotive standards

## 2.2 List of standards targeted by HAL4SDV

Standard	Name	Description
ISO26262	Road vehicles functional safety	Standard provides a comprehensive framework for ensuring functional safety of electrical and electronic systems, tailored for the automotive industry with the main goal to minimize the risks associated with system failures that could lead to hazardous situations
COVESA (VSS)	The Connected Vehicle Systems Alliance	The Vehicle Signal Specification (VSS) is an open, standardized data model developed to unify and normalize vehicle data
ISO 21434	Road vehicles — Cybersecurity engineering	ISO/SAE 21434:2021 is the international standard for automotive cybersecurity engineering, jointly developed by the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE). It provides a comprehensive framework for managing cybersecurity risks throughout the entire lifecycle of road vehicles, from concept and development to production, operation, maintenance, and decommissioning
AUTOSAR	Automotive Open System Architecture	AUTOSAR defines a standardized layered SW architecture, providing scalable, standardized platforms (Classic and Adaptive AUTOSAR) with safety and security support
SysML	Systems Modelling Language	SysML (Systems Modelling Language) is a standardized modelling language based on UML designed specifically for systems engineering. It provides a way to visually represent complex systems—including hardware, software, data, processes, and personnel—using diagrams that help engineers and stakeholders understand, design, and manage system requirements and behaviour
ISO21959	Road vehicles — Human performance and state in the context of automated driving	ISO/TR 21959-1:2020 is a technical report that outlines foundational concepts related to human performance and state in the context of automated driving. It is part of the ISO 21959 series and was developed by ISO/TC 22/SC 39, which focuses on ergonomics in road vehicles
ISO21448	Road vehicles — Safety of the intended functionality	ISO 21448:2022, also known as SOTIF (Safety of the Intended Functionality), is an international automotive safety standard that addresses hazards arising from system limitations, rather than hardware or software failures. It complements ISO 26262, which focuses on functional safety due to faults, by covering risks that occur even when systems operate as intended
SOAFEE	Scalable Open Architecture for Embedded Edge	SOAFEE defines a cloud-native architecture tailored for automotive software-defined vehicles (SDVs). It brings together best practices from cloud computing with the stringent requirements of the automotive domain, such as functional safety, real-time performance, and security
A-SPICE	Automotive Spice	ASPICE (Automotive SPICE) is a process assessment model specifically designed for the automotive industry to evaluate and improve the development of embedded software and systems. It is based on the generic ISO/IEC 330xx and ISO/IEC

		15504 (SPICE) standards but tailored to meet the unique needs of automotive engineering
IEEE 1722	Institute of Electrical and Electronics Engineers Transport Protocol for Time-Sensitive Applications in Bridged Local Area Networks	IEEE 1722 is a standard that defines a Layer 2 transport protocol for time-sensitive applications—primarily audio, video, and control data—over bridged local area networks (LANs). It is a key component of the Audio Video Bridging (AVB) and Time-Sensitive Networking (TSN) ecosystems, enabling synchronized, low-latency media streaming across Ethernet networks
SOVD	Service Oriented Vehicle Diagnosis	ASAM SOVD (Service-Oriented Vehicle Diagnostics) defines an API for diagnosing and communicating with software-based vehicles. It is a flexible standard that provides a uniform access to the diagnostic content of HPCs and their related applications, as well as of classic ECUs.
ISO 12768-1	Intelligent transport systems — Automated Valet Driving Systems (AVDS)	ISO/DIS 12768-1 is a Draft International Standard developed by the ISO Technical Committee TC 204, focusing on Intelligent Transport Systems (ITS). Specifically, it addresses Automated Valet Driving Systems (AVDS).  This standard defines the system architecture, operation sequences, and communication interfaces for AVDS
Open Alliance TC18	Open Alliance Technical Committee 18 (TC18) Remote Control Protocol (RCP)	Open Alliance Technical Committee 18 (TC18) focuses on the development of the Remote-Control Protocol (RCP), a lightweight communication protocol designed to support the transition to zonal architectures and simplify in-vehicle networking (IVN) by promoting an All-Ethernet approach
ISO/IEC 19516:2020	OMG Interface Definition Language (IDL)	This standard defines the OMG Interface Definition Language (IDL), which is a descriptive language used to define data types and interfaces in a way that is independent of programming languages, operating systems, or processor platforms. It is primarily used in distributed computing environments to ensure interoperability between software components

Table 1: List of Standards applicable to HAL4SDV

### 2.3 Gap analysis into standardization

The current landscape of standards relevant to software defined vehicles present several critical limitations, from standards being outdated (e.g. ISO26262, ISO21434), having been developed for legacy automotive systems that do not reflect the architectural and operational demands of modern SDVs, to standards that lack comprehensive coverage of essential technological domains (e.g. COVESA VSS, IEEE 1722, Open Alliance TC18 ) or even complete lack of standardization (ISO 12768-1 – currently under development).

Addressing these gaps is essential to enable a cohesive and future-ready SDV ecosystem.

### 3 Standardization activities

This chapter describes the main directions in which standardization efforts from HAL4SDV are directed: fostering an integrated ecosystem through collaboration with related initiatives in the software-defined vehicle (SDV) domain; contributing to and aligning with established standards such as COVESA and ISO 26262; and actively engaging in the open-source community to promote shared development and innovation.

#### 3.1 Research projects

##### 3.1.1 FEDERATE (EU)

FEDERATE (Software-Defined Vehicle Support and Coordination Project) is a European coordination initiative under the SDVoF (Software Defined Vehicle of the Future) program. Its main goals are to:

- Unify stakeholders from automotive, semiconductor, open-source, and public sectors [2].
- Coordinate SDV-related R&D&I projects like HAL4SDV and Shift2SDV [2].
- Develop a shared roadmap, glossary, and vision for SDV development [2].
- Promote open-source collaboration and standardization across Europe [2].

FEDERATE proposes a modular building block (BB) architecture to support the development and evolution of SDVs. These building blocks are non-differentiating, reusable software components that can be shared across projects and HAL4SDV directly contributes to the FEDERATE building block repository.

##### 3.1.2 Shift2SDV (EU)

Shift2SDV is a Chips-JU funded research and innovation initiative, started in 1<sup>st</sup> of July 2025, with a duration of 36 Months. The project is strategically focused on the development of a HW independent, microservice-oriented middleware layer, with the aim to abstract HW dependencies and enable modular and scalable SW building blocks that can be reused across different automotive platforms. [3]

Similar to HAL4SDV, project addresses a combination of open-source building blocks and intellectual property solutions.

Shift2SDV and HAL4SDV will align in their standardization efforts. The HAL4SDV project provides hardware abstraction with standardized interfaces and modular building blocks. These components are designed to decouple underlying HW from SW applications, enabling portability and scalability.

Shift2SDV can build upon and extend the HAL4SDV outputs, incorporated into the middleware building blocks developed.

### 3.1.3 SofDCar (GER)

The SofDCar project is a major German initiative aimed at shaping the future of Software-Defined Vehicles (SDVs), structured into four main development workstreams: Data Loop, Re-Deployment, Digital Twin, and Demonstrator [4].

In the redeployment workstream, the Developments related to COVESA and ASAM standards were implemented. These developments will be further expanded and integrated into HAL4SDV and SHIFT2SDV projects.

In the project, VSS was utilized to demonstrate Counter Steer functionality on a Lotus Eletre demonstrator vehicle. While many standard signals were available in the VSS catalogue, certain required interfaces were not yet defined. To address this, custom signal definitions for the missing interfaces were created and successfully integrated into the demonstration setup. These custom interfaces, currently outside the standard VSS catalogue, will be refined and proposed as part of the HAL4SDV project, contributing to the ongoing evolution of VSS and supporting broader standardization efforts within the industry.

ASAM SOVD (Service-Oriented Vehicle Diagnostics) is a standardized approach developed by ASAM to modernize vehicle diagnostics by enabling service-based access to diagnostic data and functions. It aims to simplify integration, improve scalability, and support over-the-air diagnostics in connected vehicle environments [5].

In the SofDCaR project, ASAM SOVD was implemented to demonstrate the capabilities of service-oriented diagnostics in a real-world vehicle platform. All required interfaces were successfully developed in strict alignment with the specification, ensuring full compliance and interoperability across diagnostic systems. Although no direct contributions were made to the standardization process during this phase, the implementation served as a robust proof of concept, showcasing the practical applicability of SOVD in a connected vehicle environment. This work will be further extended and refined within the Shift2SDV initiative.

ISO/IEC 19516:2020 defines the Object Management Group (OMG) Interface Definition Language (IDL) version 4.2, a language-neutral specification used to describe data types and interfaces independently of programming languages, operating systems, or hardware platforms [6].

In Open Vehicle API framework, ISO/IEC 19516-compliant IDL files are used to define the interfaces between internal components, ensuring modularity, platform independence, and seamless integration across diverse runtime environments.

## 3.2 Open-Source initiatives

### 3.2.1 Eclipse SDV working group

The Eclipse Software Defined Vehicle (SDV) Working Group is a collaborative initiative within the Eclipse Foundation that aims to accelerate the development of open-source software platforms for automotive applications.

### 3.2.2 COVESA

COVESA (Connected Vehicle Systems Alliance) is a global, open, and collaborative technology alliance dedicated to accelerating the development and adoption of connected vehicle technologies.

ZF has initiated work on a set of foundational concepts that will be expanded and finalized in later stages of the project. The focus areas include defining a standard format (e.g., IDL) to capture run-time, data, and timing constraints; enabling conversion from the VSS data model into this standard format; enhancing VSS and developing standardized APIs for data, parameters, errors, safety reactions, and related aspects and minimizing redundant interfaces.

In parallel, a beta version of the VSS GUI tool is already available within the Eclipse Automotive API framework for VSS signal selection and creation. This tool will be further developed in subsequent phases to support function deployment and integration, while also being refined for enhanced usability.

Together, these efforts aim to establish best practices that ensure seamless integration across heterogeneous hardware devices, supported by interface standardization and the elimination of redundancy.

## 3.3 Other activities

### 3.3.1 Architecture compliance to safety and security standards (WP7)

Part of the work packages of HAL4SDV, work package **WP7** is dedicated to the definition of conceptual architectural solutions for safety and security relevant implementations in SDV SW architecture. The foundation work in **WP7** will support future projects in development and integration of safety relevant features.

In **WP7**, the definition of the generic HAL4SDV architecture that was the output of **WP2** is taken as a reference for further analysis and by applying methods compliant to safety (**ISO26262** “Road Vehicles – Functional safety”) and security standards (**ISO/SAE 21434** “Road vehicles – Cybersecurity engineering “), the base architecture is refined and enhanced with additional features.

One of the main challenges that was experienced in starting the analysis of relevant safety and security aspects of the SDV architecture, was to definition of a generic E/E architecture potentially applicable to any use-case in the SDV domain, and the core use-cases UC1 - Chassis/powertrain domain, UC3 - ADAS/Autonomous Driving and UC6 - Virtual HAL4SDV laboratory platform for simulation on vehicle level.

With this consideration, a simplified overall vehicle architecture, with the aim to support the main use-cases targeted for investigation in **WP7** was proposed as a starting point in the analysis.

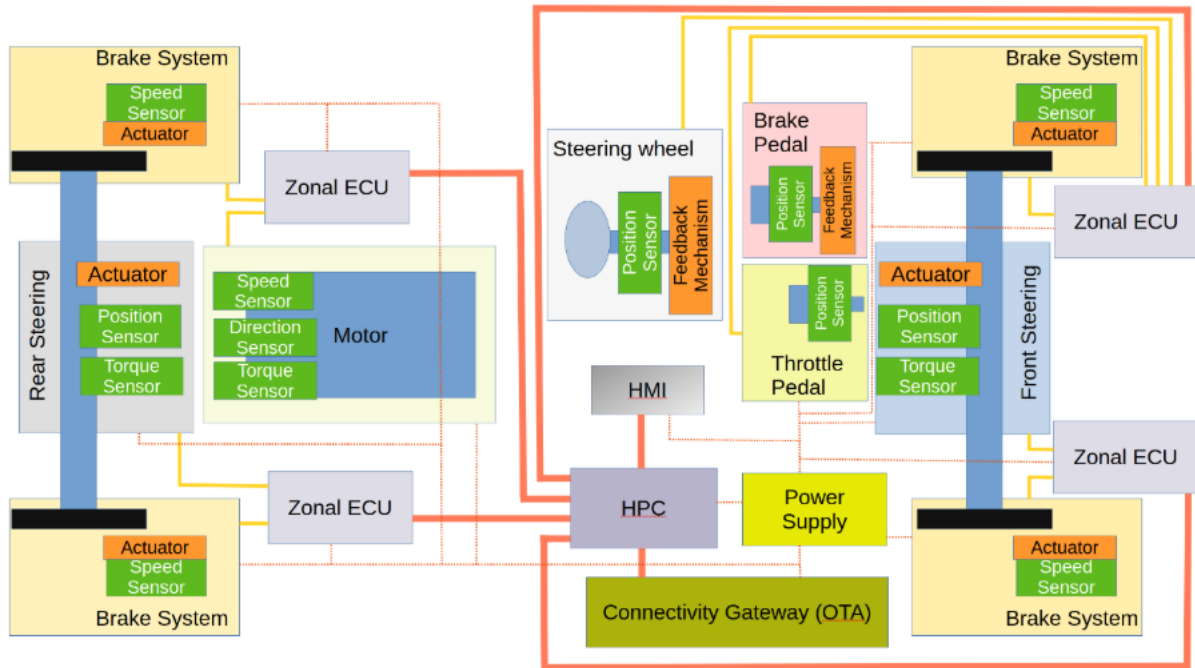


Figure 5: Generic E/E architecture diagram. The coloured squares limit the components, which may be altogether or scattered like the braking system. The lines indicate communication lines, with protocol not yet defined. The zonal ECUs will be considered all equal

Based on this generic E/E architecture, a hazard analysis for safety and threat analysis for cybersecurity considerations were performed, in line with above mentioned applicable ISO standards.

The most common hazards, affected components from the generic E/E architecture and affected vehicle functions were identified, categorized according to their severity, probability and controllability classes into different ASIL ratings, and the architecture requirements and affected building blocks of the reference architecture from WP2 were identified further.

In the figure below, an example is shown of how the identified hazards were decomposed into ASIL rated requirements and allocated to the different layers of the SW reference architecture from WP2 (in this example, the application layer is depicted). The process, the identified requirements and the allocation of requirements to the SW architecture layers are documented in detail into deliverable **D7.1 Architectural approach for safety-relevant application: Report on add-ons in the safety-relevant application domain for the HAL4SDV platform**.

Application	Safety		Non-Safety		Non-Safety		
	ASIL D	ASIL C	ASIL B	ASIL A	QM		
Application code should follow Misra guidelines and fully tested.	HAZARD-UC01-FS-0012	Applications should have a sanity check for preconditions/needed values and have reachable safe state when arithmetic fails	HAZARD-UC01-RS-0003	Implement a conflict resolution engine and enforce unique interface identifiers.	HAZARD-UC03-EB-0008	Integrate version control and validation checks for metamodel updates.	HAZARD-UC03-EB-0007

Figure 6 Example of safety requirement allocation to Application layer of the reference SW architecture

With this updated view of the architecture, the activities in WP7 will concentrate in the next year in defining selected safety relevant architecture features to a conceptual level and integration of such example features into the project demonstrators.

## 4 Plan of standardization activities

### 4.1 Standardization roadmap

Partner	Contribution	Applicable TA-XX	Applicable topic	Applicable standard	Standard intended usage
Robert Bosch GmbH	Signal-2-Service concepts for modern SdV	TA-BB-A	A05 B02	IEEE 1722	Extension
Robert Bosch GmbH	Remote control of peripherals in a zonal EEA	TA-BB-B	B02	Open Alliance TC18	Inspiration and Extension
Robert Bosch GmbH	SDV Architecture	TA-BB-A	C05, F04	SOAFEE Open Architecture	Inspiration and Extension
Robert Bosch GmbH	Signal Semantics (Motion, ADAS, etc.) Vehicle API, onboard and towards cloud	TA-BB-B	B01	Covesa VSS	Inspiration and Extension
CSW	Ensuring Functional Safety and Reliability, Enhancing Cybersecurity, Robust Middleware Architecture	TA-BB-A	A02	ISO26262 ISO21434	Inspiration and Compliance
CSW	API Versioning and Secure Communication	TA-BB-B	B02	ISO26262 ISO21434	Inspiration and Compliance
CSW	Advanced Middleware Feature, supporting Mixed-Criticality Applications, service-Oriented Architecture (SoA)	TA-BB-C	C02	ISO26262 ISO21434	Inspiration and Compliance
TTTech Auto AG	Mixed criticality integration platform (orchestration, workload management, application isolation)	TA-BB-C TA-EN-G	C01 G01	ISO26262	
TTTech Auto AG	Concepts for real-time communication middleware with TSN; Security functions for middleware	TA-BB-A	A03	ISO26262 IEEE (TSN)	
TTTech Auto AG	APIs for uniform application communication and shared memory communication	TA-BB-B TA-BB-C	B02 C04	ISO26262	

Unikie	Study and create demo for secure cloud connectivity for remote control of vehicle based on the ISO standard.	TA-BB-D	D03	ISO12768	Implementation
VIF	ComputingPlatformState	TA-BB-A TA-BB-B TA-BB-C	A01 B01 C01	Covesa VSS	Extension
ZF	Covesa enhancements to existing interface properties, extension of existing VSS to other interface types like errors, scheduling etc.  and implementation of GUI tool for signal creation and selection in synergy with Eclipse Automotive API	TA-BB-B	B-01	Covesa VSS	Inspiration and Extension
VALEO, 3DS , and others	Definition of a format to configure the execution monitoring	TA-BB-E	E03	New	Implementation

Table 2 : Standardization contribution to Tas.

Summary of expected partner contribution to standardization activities in HAL4SDV:

- Plans to extend Open1722 with IEEE 1722b features in 2025, followed by its application in implementing a remote-control protocol for zonal E/E architectures in 2026 (partner Robert Bosch GmbH)
- Active involvement in the revision of ISO 26262 (3rd Edition) through participation in ISO TC 022/SC 32/WG 08 (partner TTTECH)
- Contributions focus on safety-relevant middleware (TA-BB-A) and mixed-criticality systems (TA-BB-C) derived from HAL4SDV project work (partner TTTECH)
- Utilizing and making extension proposals to COVESA VSS for defining software architecture requirements within the HAL4SDV framework (partner ZF)
- Active engagement in the working groups responsible from development and finalization of ISO 12768 - Automated Valet Driving Systems (AVDS), with contributions expected throughout Year2 and Year3 of HAL4SDV project lifetime, even extending the duration of the project, until the standard is finalized and officially published (partner Unikie).

## 4.2 Standardization KPIs

KPI	Target value	Timeline	Involved partners
Number of standards bodies actively engaged	>2	By M30	<i>will be refined in future project stages</i>
Number of technical contribution proposals submitted to standards bodies	<i>will be refined in future project stages</i>	By M36	<i>will be refined in future project stages</i>
Number of WG participations	> 2	By M36	<i>will be refined in future project stages</i>
Number of open-source contributions (Building Blocks)	> 5	By M36	<i>will be refined in future project stages</i>

Table 3: KPIs

## 5 Conclusion

The initial phase of standardization activities within the HAL4SDV project has established a solid foundation for aligning project outcomes with emerging industry standards.

## 6 References

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