

Concept paper on an open European software-defined vehicle platform for the vehicle of the future

Executive Summary

This concept paper reflects on the **critical challenge of software for the EU's automotive industry** and on the **value of open European collaboration**. It is based on workshops and discussions organised by DG CONNECT with a 'Sherpa Governance Group' of representatives of many major European automotive OEMs and suppliers. Largely endorsed by the group's participants, it shows the ongoing convergence of views and areas for further discussions.

The shift to software-defined vehicles: a key challenge for the EU automotive industry

As vehicles become autonomous, electric, connected and service-oriented, hardware (HW) and **software (SW) are playing an increasingly important role** in managing their operations and enabling new features. In future "software-defined vehicles" electronics and SW will be more valuable than mechanical parts. Vehicle electronic architectures are becoming more centralised, fuelling the demand for next generation system on chip designs and high-performance processors, and redefining how software is built, integrated, and maintained. Enabling new functions through over-the-air SW updates raises new challenges. The SW layers (e.g., operating system, middleware) between HW and applications, including interfacing with the cloud, play a key role in this paradigm shift.

Automotive players are transforming themselves into software-defined companies but are facing some **difficulties with software development**. Software complexity is rising sharply with lines of code in a vehicle expected to grow from 100 million today to a billion by the end of this decade. Increased complexity of functionalities and sharing of computing resources across electronic control units, vehicle domains and the mobility and cloud infrastructures reduces the **software development productivity**, with redundant and non-value adding efforts to adapt to different platforms. This leads to delays and cost overruns for software projects. Additionally, the industry is facing a major **software talent shortage**. All these call for focusing more on modular software with improved maintainability and portability. The European automotive industry is facing **increased global competition**. Some new non-EU manufacturers have an advantage on software productivity as they adopted a software-driven approach from the outset. Large tech companies are entering the market and already dominate certain domains. Large non-EU semiconductor companies are offering integrated HW-SW platforms and have announced numerous automotive partnerships leading to vendor lock-in and dependencies. Hyper-scalers are expanding their power on consumer platforms into the vehicle. These transformations are putting the sovereignty and competitiveness of the European automotive industry at risk.

So far, **EU car companies have focused on developing their own technology platforms**, impeding efficiencies when such investments replicate efforts on elements that are not differentiating and visible to the customer. A **rising number of partnerships and alliances** across varying types of actors of the automotive and digital ecosystems shows a growing openness to join forces. They however do not cover systematically all the non-differentiating elements of the software stack and lack sufficient implementation. They would benefit from stronger cross-initiative coordination and governance.

Value and initial focus of an open European collaboration on vehicle software

In the context of the Chips Act, the European Commission is considering complementary but distinct initiatives to reinforce EU sovereignty and leadership in the automotive value chain on the vehicle of the future, addressing, on the one hand, an **open automotive HW platform**, and on the other hand, an **open software-defined vehicle (SDV) ecosystem** driven by European actors. The SDV initiative focuses on an **open and pre-competitive collaboration across European OEMs and suppliers on non-differentiating elements of the vehicle software stack**. The concept paper is describing the initial agreement on its scope and characteristics.

The SDV joint effort should support the development of **standardised SW building blocks and interfaces** in the vehicle and at its edge. Complemented by SW development and validation toolsets,

these shall be **used in evolving SDV architecture scenarios of OEMs and Tier1s**. They will facilitate the decoupling of SW-implemented functions from the underlying HW, helping to reduce dependencies and vendor lock-in. Becoming HW agnostic, however, does not mean becoming HW-ignorant: HW requirements must be defined from the SDV application perspective, and emerging HW-features must be taken advantage of for purposes of performance optimisation, security, etc.

The initial focus of the SDV initiative should be on interfaces between the cloud and the vehicle and towards high-performance integration platforms (domain controllers, central controllers, zone controllers) as well as other non-differentiating layers of the technology stack. In the longer term, common interfaces and building blocks could lead to a convergence between different SDV architectures. The initiative should adopt “code first” principles to create tangible outcomes that can be used for continuous testing, integration, and delivery by industry. Together with demonstrators and ecosystem building, **open-source code development** will become the foundation and a crucial success factor of the European SDV ecosystem and drive industry standards and agile and widespread adoption, as well as reduce time-to-market.

Whereas the European SDV initiative should be independent from specific hardware, it must be well co-ordinated from the outset with **European efforts under the Chips Act on supplying an open automotive hardware platform for the vehicle of the future**: Though being addressed in separate strands of a European vehicle of the future Initiative, the next generation HW architecture including processors with AI computing capacity must be driven by specifications responding to the needs of the applications under the SDV platform, e.g. autonomous driving functionality. Vice versa, the integration of emerging European high-performance HW should be well facilitated by the European SDV ecosystem. Compliance with applicable regulation related to data sharing, cyber security, product liability, functional safety, competition law and state aid provisions must be ensured. Considering that automotive companies operate at the global level, the international landscape must be considered to avoid creating a regional silo.

The European SDV initiative will reinforce the co-ordination and integration of different initiatives and alliances such as ECLIPSE SDV, COVESA, AutoSAR, SOAFFE and digital.auto. This will be achieved by identifying missing elements and **orchestrating distributed developments** through a governance framework, while complementing them by future-looking research, innovation, and piloting actions.

This concept paper presents the potential **path towards a European SW ecosystem for the vehicle of the future**, its scope and guiding principles, its open and pre-competitive collaboration set-up, and its role in outreach and broader collaboration. So far, the SDV initiative has received strong interest by participants of the Sherpa Governance Group across major European OEMs and suppliers. As a starting point, the Key Digital Technologies Joint Undertaking (KDT JU, to become the Chips JU soon, following the recent adoption of the Chips Act) under the Horizon Europe research and innovation framework, has thus launched two workstreams in February 2023. First projects are envisaged to start in late summer 2023:

(1) **Governance, co-ordination, and ecosystem building**: A co-ordination and support action shall define the scope, collaboration model and roadmap, and help incubate a developer ecosystem. It shall further support alignment with other private, national, and European initiatives, like the open automotive HW platform under the Chips JU and the CCAM and 2ZERO partnerships. Starting from the Sherpa Governance Group, it is targeting future engagement of senior managers to guide the initiative.

(2) **Development of an open European SDV platform and ecosystem**: As part of a layer-based approach, a first R&I action will support the development of building blocks in the complete scope of the SDV ecosystem, with a focus on the HW abstraction layers. This will create a baseline for joint developments, while the governance workstream will help identify priority areas for future actions under this workstream.

As a next step, endorsement of the above approach at highest possible level by OEMs in close co-operation with suppliers from Tier1s to IDMs, and with the European Commission acting as a neutral convener for joint efforts, is targeted.