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How software-defined vehicles are shifting gears: Insights from Valeo Brain's CTO

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Q&A with Valeo Brain

The emergence of software-defined vehicles (SDVs) is transforming the automotive industry by integrating advanced technologies, enhancing connectivity, and redefining the relationships between original equipment manufacturers and suppliers. SDVs leverage software to provide enhanced driving automation and improved user experiences, facilitated by advanced driver assistance systems and innovative vehicle interiors. The increasing reliance on data sharing between OEMs and suppliers is paramount, as high-quality usage data is vital for collaboration and requires an early alignment of data management systems.

One of the significant shifts in the industry is the need for long-term support for SDVs. This entails extending product life cycles and engineering capabilities beyond traditional norms, necessitating a more integrated partnership approach. As SDVs become more connected, manufacturers are exploring new revenue models, including subscription services and data monetization strategies. These models require ongoing relationships with vehicle users, who may not be the original purchasers, to ensure continuous software updates and feature access.

However, the path to SDV development is fraught with challenges, particularly regarding regulatory compliance and cybersecurity. Diverging regulatory frameworks complicate software architecture design, necessitating multiple solutions to meet varying requirements. Furthermore, as SDVs become increasingly reliant on connectivity, the need for robust cybersecurity measures becomes critical.

Valeo Brain Division, as a leader in this transformation, emphasizes the importance of open-source solutions and advanced technologies to address these challenges. By fostering collaborative innovation and focusing on long-term maintenance, Valeo Brain Division aims to enhance the reliability of safety-critical systems while adapting to evolving consumer demands and regulatory landscapes.

To delve deeper into these insights, we spoke to Joachim Mathes, chief technology officer of Valeo Brain Division.

Key takeaways:

- **Data sharing is key**: Access to high-quality usage data from customers is essential for collaboration between OEMs and suppliers. This requires early cooperation to align data management systems and interfaces, which is a shift from traditional practices.
- **Long-term support needed**: The development and maintenance of SDVs require a new approach to product life cycles, extending support and engineering capabilities for over a decade. This contrasts with traditional sourcing and development methods, necessitating a

more integrated and committed partnership approach.

- **Emerging revenue models**: As SDVs become more connected, manufacturers are exploring subscription services and data monetization strategies to generate recurring revenues. This requires a contractual relationship with vehicle users, who may not be the original buyers, to ensure ongoing software updates and feature access.
- **Regulatory challenges**: Diverging regulatory frameworks around data privacy and vehicle safety are complicating software architecture design. Companies need to create multiple solutions to comply with varying regulations, making automation and reuse across the software lifecycle critical for financial viability.

The following is an edited transcript of the conversation.

S&P Global Mobility: How is the rise of software-defined vehicles fundamentally altering the automotive industry's architecture, particularly in terms of the technological integration and data-sharing protocols that redefine the roles, responsibilities and interactions between traditional OEMs and their suppliers?

Joachim Mathes: Sharing access to usage data from end customers becomes crucial. This data needs to have the right granularity, quality and geographic spread. This requires cooperation at the system level early on, aligning the data pipeline and interfaces between the partners. We have to assume that requirements will increase, so data management systems need to evolve, while managing legacy products. Both aspects favor closer cooperation beyond a single project.

What do you see as the major challenges automotive OEMs face in developing SDVs, particularly in terms of managing multivendor software ecosystems and ensuring cybersecurity?

Similarly, we need to consider product lifecycles, which include the development phase as well as the full production period, plus an operations phase that covers multiple owners. As a consequence, we need to organize engineering support over more than 10 or 20 years. That includes tools, interfaces, bug-fixing capabilities, etc. This is clearly not how we have traditionally been sourcing and developing products. Valeo has evolved accordingly and is already actively engaged with OEMs in such programs.

Which advanced features and capabilities of SDVs, such as over-the-air updates, adaptive learning algorithms and enhanced connectivity, are currently driving interest among consumers and manufacturers? How do you anticipate these features will evolve in terms of technological sophistication and consumer expectations over the next five years?

Let's take a simplistic view: All SDVs will be connected. This allows upgrades over [the] lifetime, but also creates an attack surface that needs to be monitored and protected, as discussed. These two elements go together and establish a minimum level of capability. What is currently being worked on is how to create sufficient end-user benefits to ensure recurring revenues from software/services to pay for the cost of connectivity and engineering efforts post [start of production]. Such end-user features may, however, require a higher specification or more bandwidth, which adds another cost element. This balancing act is still being done, and it is the Chinese consumers that are currently driving the level of requirements.

What specific advancements has Valeo Brain achieved in developing open-source solutions for safety-critical systems within SDVs, and how does embracing an open-

source philosophy enhance collaborative innovation, reduce costs and improve the reliability of these systems?

Open source will be a key ingredient in finding solutions for the long-term maintenance, the standardization and stability of interfaces, and the re-use of assets. The industry has gained some experience through the large-scale adoption of Android/AAOS in the infotainment domain. On the other hand, there is little to no experience in how to manage safety-critical systems with [open-source software]. There are now some promising concepts on the table, and I am sure that new forms of cooperation and business models will allow the software ecosystem to combine the best of both worlds. This will require serious long-term commitment in order to take off, while many players hesitate to commit, as they lack a long-term perspective. We need to overcome this chicken-and-egg stalemate.

In what ways does Valeo Brain leverage advanced technologies and methodologies, such as predictive analytics and remote diagnostics, to address the challenges associated with long vehicle life cycles, particularly in ensuring seamless hardware and software updates that maintain system integrity and performance?

Valeo has developed a software framework that we call "vOS," which supports distributed computing over and dynamic load balancing across multiple SoCs [System on Chips] This includes a development environment and hardware simulation capabilities that leverage the capabilities of virtual validation provided by a highly scalable cloud infrastructure. You may have seen the announcement we made in partnership with [Amazon Web Services] at the CES. There, we also showed a modular central compute, a hardware cluster that includes a data backbone as well as physically replaceable cartridges into which we abstract the high-performance SOCs. We can therefore offer hardware upgrades by swapping cartridges, while vOS will assign the applications to the most suitable compute resources.

In light of the evolving expectations of end customers, what innovative technology-driven business models is Valeo Brain exploring, such as subscription services or data monetization strategies, to effectively balance the costs of SDV development with consumer demands for enhanced features and personalized experiences?

This perfectly fits into the picture that I have just portrayed. Indeed, recurring revenues are a key success factor for the SDV. The source of these revenues needs to be the person that uses the vehicle, which — I want to emphasize this — is not necessarily the person that originally bought it. In any case, they will need to have a contractual relationship with the vehicle manufacturer in order to receive the required security updates. This will be the channel both to get their consent on the usage of vehicle data as well as to offer them features and upgrades that justify the revenues. As these revenues will flow to the OEM, Valeo's focus is on offering the OEMs flexible licensing models, such as subscriptions to platform assets, data-sharing agreements, etc. We're even going as far as white box development with selected partners to allow deeper cooperation at the software/service level.

What are the primary technical challenges Valeo Brain faces in the software development life cycle for SDVs, such as ensuring agile methodologies and continuous integration/continuous deployment practices? How is the company addressing skill gaps in software engineering, data analytics and cybersecurity within its workforce to meet these challenges?

We have come a long way in the last few years, and upgrading our CI/CD tool chain has been as

important as upskilling our teams in certain areas. This is a permanent focus of our anSWer team, which we created in 2024 to integrate all Brain software activities into a single business unit that also manages our software factory. Partnering with specialist players in the ecosystem is another key success factor that we have leveraged to broaden our competencies.

How do you anticipate that evolving regulatory frameworks, particularly regarding data privacy and vehicle safety, will influence the design of software architecture and compliance strategies for SDVs in the automotive industry?

We have put in place all necessary mechanisms for GDPR compliance, and the impact on feature creation has been very limited. Similarly, we have successfully undertaken developments in China under the tight data regulations that have been enforced there. The concern I see is that the regulatory frameworks continue to diverge, forcing us to develop multiple solutions in multiple environments, taking into account very different constraints. This is all doable, but given the challenges to get reimbursed by end users for the efforts of software development, validation, and maintenance, we will need to achieve higher degrees of re-use across the industry and achieve unprecedented levels of automation across the SW [software] lifecycle to make this financially viable.

What emerging technological trends, such as AI-driven predictive maintenance, machine learning for autonomous driving or vehicle-to-everything communication protocols, do you foresee as pivotal in shaping the future of SDVs?

Automated driving is certainly a catalyst for the years to come. Look at the dynamic development of "navigate on pilot" systems in China, essentially hands-off driving from start to end of your journey, even through dense urban traffic. Consumers love it, and no one can afford to be left behind. The breakthrough has come from end-to-end AI models fed by fleet data. Still, these are all L2 systems. Considering how many Chinese OEMs have equipped their cars with Lidars, they soon will have massive amounts of high-quality 3D point clouds to further enhance the quality of their models. This will allow them to offer L3 and L4 features, as soon as the regulatory framework is put in place. As mentioned before, developing the system from a holistic perspective, including the connectivity requirements and the quality and granularity of the data required, is important to achieve an efficient and frugal model. This is also the path that we pursue at Valeo.

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