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Software-defined vehicles: Interview with Stellantis chief software officer

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How Stellantis is embracing SDVs

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Key takeaways:

- The shift to centralized computing is disrupting the business models of many players in the industry, including tier 1 suppliers who are now considering licensing software to car manufacturers for use on the centralized computer. This change in mindset and business approach within the industry has been noticeable over the past three years.
- Stellantis has made the decision to insource a significant portion of its software development to increase efficiency and have greater control over the code base. This allows for continuous evolution and improvement without the need for constant redevelopment. While each original equipment manufacturer focuses on developing its own code base, there may be a future movement toward market standards for common functions shared across vehicles.
- The automotive industry is shifting toward software-based alternatives for physical sensors in vehicles, e.g. internal cameras can be used to detect occupancy and trigger seat belt warnings, while AI-powered software algorithms have the potential to replace physical sensors and simplify the human-machine interface (HMI).

The software-defined vehicle (SDV) is a new buzz phrase in the car industry. It refers to vehicles that can enhance their capabilities through software updates, eliminating the need for physical part replacements.

SDVs use software to govern operations, incorporate new features and facilitate the integration of novel functionalities. This concept marks an advancement in the automotive industry, laying the foundation for autonomous driving and vehicle connectivity technologies.

The evolution of SDVs entails separating software and hardware development, like smartphones. OEMs are establishing “walled gardens” for applications. This shift encompasses continuous agile software development, heightened computing requirements for data processing, a modular service-oriented architecture and fortified security measures against cyber threats.

The automotive industry is rapidly advancing toward SDVs, with the promise of improved comfort, safety and customization. As collaborations between OEMs and tech companies flourish, SDVs present additional challenges such as cybersecurity risks and design intricacy.

The transition from domain to centralized architecture is also progressing, converting vehicles into mobile data centers. In this transformative journey, standards, collaborations and digital twin technology stand out as critical components, promising a future where software dictates the driving experience.

To delve deeper into this transformation, S&P Global Mobility spoke to Yves Bonnefont, chief software officer of Stellantis, who was appointed in January 2021. He has developed his career in strategic and entrepreneurial roles in the field of automotive and high tech. Before joining McKinsey, Yves had started his first tenure at PSA in manufacturing and project management. From 2001 to 2011, Yves was a partner at McKinsey. He served automotive as well as global high-tech clients with a focus on product development across three continents. He joined Groupe PSA in 2012 as corporate strategy executive vice-president. In this position, he contributed to Groupe PSA’s turnaround plan, including brand differentiation strategy, and created the Connected Vehicle

Business Unit that he held responsibility for until the creation of the Free2Move brand in 2016. In 2013, he was also appointed Citroën deputy CEO in charge of the DS product line. From 2014 on, he concentrated on the creation of PSA premium brand, serving as the first brand CEO for DS Automobiles. In January 2020, he was appointed executive vice president in charge of high-end brands development in the context of the merger preparation. He graduated from Ecole Centrale Paris.

The following is an edited transcript of the conversation.

S&P Global Mobility: What are the key factors driving Stellantis to develop SDVs?

Yves Bonnefont: SDVs are a significant trend in the automotive industry. This concept originated with smartphones, where the hardware provides the basic functionalities, but the specific features and capabilities are defined by the software applications installed on the device. This trend has now extended to the automotive industry, where the features and functionalities of vehicles are defined by software rather than hardware.

There are two major implications of SDVs in the automotive industry. Firstly, it simplifies software development by centralizing the control of various functions in the vehicle. This eliminates the need for coordination among numerous electronic control units, making the development process less complex.

Secondly, SDVs allow for over-the-air upgrades, enabling the vehicle to evolve and provide new features and content to users over time. This enhances the customer experience and allows for continuous improvement without requiring physical modifications to the vehicle.

Overall, SDVs offer both customer benefits and simplification benefits for car manufacturers.

Could you explain the architectural transformations that SDVs are undergoing, specifically the shift from domain architectures to centralized ECUs, and the potential

impact on vehicle operations?

Moving to a centralized computing system in vehicles has significant implications for consumers. With centralized compute, continuous upgrades and new functions can be easily implemented by accessing all the sensors and actuators in the vehicle. For example, the centralized system can detect the presence of living beings in the car, monitor temperature and adjust the climate control accordingly to ensure their well-being. This level of customization and adaptability is made possible by the centralized architecture.

From a supply chain perspective, the shift to centralized computing is disrupting the business models of many players in the industry. Previously, suppliers provided complete electronic control units (ECUs) with both hardware and software. Now, with the consolidation of software into the centralized compute, the number of ECUs is reduced, changing the dynamics of the industry.

Interestingly, tier 1 suppliers, who initially defended the traditional system logic, are now exploring new business models. They are considering licensing software to car manufacturers for use on the centralized compute, recognizing the need for collaboration and avoiding the duplication of development efforts.

This shift in mindset and business approach within the industry has been noticeable over the past three years.

Could you also provide some insight into the division of software development between Stellantis and your suppliers?

To increase efficiency and have greater control over software development, Stellantis has decided to insource a significant portion of its software development. This allows for continuous evolution and improvement of the code base without the need to constantly redevelop the basic layer. The trend of OEMs insourcing software is driven by the desire to concentrate R&D efforts on enhancing features, quality and performance, rather than continually reinventing systems with different tier 1 suppliers.

While each OEM is currently focused on developing its own code base, there may be a future movement towards market standards for common functions shared across vehicles. For example, managing headlamps or beam transitions could be standardized to reduce redundant development efforts. This second step of efficiency would involve the use of common routines and platforms that multiple OEMs can utilize, resulting in a smaller pool of solutions to choose from.

Ultimately, I would expect two steps of efficiency: reducing the need for system redevelopment and concentrating development efforts on customer-facing software and unique features. The industry may converge towards common standards while still focusing on differentiation in areas such as infotainment, autonomous driving, and user experience.

Do you see the behavior of the vehicle, which encompasses the coordination of powertrain, chassis, and vehicle dynamics, as a defining factor?

The behavior of the vehicle plays a crucial role in defining the characteristics and driving experience of different brands within Stellantis, such as Jeep and Dodge. For example, a Jeep is engineered for off-road capabilities and may have driving modes and suspension adjustments specifically designed for different terrain conditions. This aligns with the DNA of the Jeep brand, as customers choose Jeeps for their ability to tackle challenging off-road environments. On the other hand, a Dodge is known for its performance-oriented driving experience, and features like launch mode are

designed to provide a racing-like feel. These brand-specific tuning and features contribute to the unique identity of each brand and are likely to remain important factors in the differentiation of vehicles within Stellantis.

When you mentioned doing more software in-house, are you referring to taking over more of the platform, API, and upper-level stack, or also going deeper into the software stack?

When it comes to certain functions like headlamps, the basic operations such as turning them on and off or managing a matrix beam can be standardized at a lower level. However, at the application layer, there is room for brand-specific customization and enhancements. For example, a brand may want to create a unique welcome lighting feature that aligns with their brand identity. By standardizing the lower-level operations and drivers, OEMs can ensure consistency and compatibility across different vehicles, while still allowing for brand-relevant applications and customization at the application layer.

Are there any organizational challenges in developing SDVs?

The shift to SDVs has brought about several changes and challenges for OEMs. One major change is the need to separate hardware design and software design, which has led to the creation of distinct software engineering and hardware engineering groups within organizations like Stellantis. This organizational evolution ensures that each group has the necessary skills and expertise to focus on their respective areas.

Another important aspect is the management of over-the-air updates. OEMs must plan, validate and release these updates effectively. Additionally, decisions need to be made regarding the upgradeability of older vehicles. Similar to Apple's approach with older iPhones, there may be hardware limitations that prevent the installation of the latest software releases. Clear policies will need to be established to communicate these limitations to customers, ensuring they understand the reasons behind any feature limitations.

Overall, these changes and challenges are transforming the automotive industry and require OEMs to adapt and set new policies to meet the demands of SDVs.

Do you foresee any situations where hardware upgrades can be performed in the field?

The idea of upgrading vehicle components, such as headlamps, is continuously debated in the industry. However, one of the main challenges is finding economically viable solutions. In the past, when leading DS, there was an attempt to upgrade headlamps by introducing new LED modules. The design was carefully done to ensure physical compatibility with the previous headlamp design, allowing customers to upgrade if desired. However, the economic feasibility of such upgrades is still uncertain. While the concept of upgrading vehicle components is appealing, finding a sustainable and cost-effective solution remains a challenge in the automotive industry.

Did anybody upgrade?

When attempting to upgrade vehicle components like headlamps, the economic equation becomes challenging. In the case of DS, the price tag for upgrading headlamps was not very attractive to customers, resulting in low demand. Despite the significant improvement in the appearance of the vehicle, the cost of the upgrade outweighed its appeal. This example highlights the difficulty in finding economically viable solutions for hardware upgrades in the automotive industry.

Have there been any opportunities to decontent the intrinsic capability of components and systems due to new and evolving software capabilities?

As the automotive industry moves towards software-defined vehicles, there is a focus on replacing physical sensors with software-based alternatives. For example, instead of using a physical sensor in the seat to detect occupancy and trigger seat belt warnings, internal cameras can be used to sense the presence of occupants. This approach requires safety qualification for the camera, as it is a critical safety feature.

In addition, software algorithms powered by AI are being explored in various areas, including powertrain. These algorithms have the potential to replace physical sensors and enable new functionalities. While specific ideas may not be disclosed to competitors, one example is the use of AI in the cockpit to simplify the human-machine interface (HMI) and potentially eliminate the need for physical buttons. By understanding user intentions through AI, the need for physical interaction with buttons can be reduced.

These advancements in software and AI offer opportunities to enhance vehicle functionalities, simplify interfaces and improve the overall user experience.

Is the development of SDVs intended for your entire product portfolio, or is it primarily focused on BEV platforms or the higher-end segment?

The benefits of centralized architecture and consolidated ECUs apply to both electric vehicles (EVs) and internal combustion engine vehicles (ICEs). The simplification achieved through centralized architecture is the same for both types of vehicles. Additionally, the consolidation of ECUs in ICE vehicles brings cost savings, while in EVs, it enables more feature richness. Overall, centralized architecture and consolidated ECUs offer benefits across the board, regardless of the type of vehicle.

Could you tell us a little more about the type of security protection steps that are undergoing, specifically for those SDVs that will have deeper cloud connections?

Cybersecurity is an ongoing race between attackers and defenders. To ensure the security of software-defined vehicles, Stellantis has implemented a range of cyber measures. These measures include cyber analysis and diagnostic testing during the early stages of vehicle development, programs that encourage white-hat hackers to submit potential issues, continuous third-party penetration testing, and monitoring of traffic between vehicles and cloud servers to detect abnormal behavior in terms of volume and content. Additionally, measures are being taken to enhance cybersecurity in the realm of AI. This continuous addition of measures and testing is necessary to stay ahead of attackers, as they are constantly evolving. The goal is to keep racing against the attackers and maintain the security of software-defined vehicles.

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