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Multi-domain system modeling for software-defined vehicles

Frontload software considerations to accelerate automotive innovation

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Industry challenges

The automotive industry is undergoing a revolutionary, complex transition to software-defined vehicles. As designs evolve from primarily mechanical to deeply integrated with software, automotive engineering, manufacturing, servicing, and user experiences are significantly altered. While traditional vehicle improvements often occur in increments tied to the model year, software-defined vehicles present opportunities and demands for more rapid advancements.

When manufacturers incorporate software successfully, exciting new features can be introduced and updated without waiting for the next model year. But what happens when these complex features fail? Software-defined features allow for a better driving experience but can also lead to accidents and injuries when software and hardware are not fully integrated before deployment.

As you develop the next generation of vehicles, you need to choose the right features to incorporate today while also planning for the features of tomorrow. Design vehicle architectures with software needs in mind from the beginning to avoid extensive rework and fixes late in development. Adopt a collaborative model-based systems engineering approach to save time and money. Assess security and safety needs upfront, capture requirements in trustworthy engineering models, and optimize the vehicle lifecycle with a sustainable, efficient, forward-thinking development process.

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SDVs are substantially more complex and far-reaching than initial expectations, particularly for established automotive manufacturers deeply rooted in legacy practices."

Wards Auto

What do you need to do?

- Meet consumer demand for innovative features
- Ensure vehicle safety and security
- Keep vehicles updated throughout their lifecycles
- Create opportunities to add future functionalities

How can you get there?

- Collaborate across disciplines from the start
- Include requirements and targets in engineering models
- Consider software upfront when making decisions about hardware

Ensure performance, safety, and security in software-defined vehicles

Automobile manufacturers are responsible for ensuring their vehicles are safe to operate throughout their lifecycles, and they may be held liable for injuries and losses when they fail in that responsibility. While many new software-defined features are intended to improve the customer experience, they also add development complexity and risk. Adopting a model-based systems engineering solution that frontloads scalable software considerations improves decision-making about hardware. This allows you to assess vehicle performance, safety, and security more reliably across E/E (electrical and electronic), mechanical, and network architectures.

Meet consumer demands for innovative features

Today's automotive customers increasingly demand new, software-driven capabilities in their vehicles. They want ADAS (advanced driver assistance systems) features, autonomous capabilities, and advanced infotainment options. Like their smartphone experience, they want digital services integrated into their vehicles, including remote diagnostics and maintenance. However, moving from a conventional car to a complex automotive ecosystem requires significant changes in how you develop your vehicle's electronics and software architectures.

Drive vehicle safety and security

Regulatory bodies establish strict safety standards to ensure software behaviors don't endanger passengers, other road users, or the vehicle itself. These standards guide how software-defined features are developed, tested, and validated. Additionally, with the rise of software-defined vehicles and the mass collection of driving data by OEMs, cybersecurity has become critical to protect cars against unauthorized access and cyberattacks. However, when safety and cybersecurity requirements are captured upfront, you can avoid expensive, late re-engineering and reduce the risk of recalls.

Update vehicles throughout their lifecycles

Consumers are growing accustomed to software-driven products. Like their phones and computers, they expect manufacturers to update a vehicle throughout its lifecycle without taking a trip to the dealership to get it done. To lay the groundwork for future remote updates, you must have the tools to design electrical, electronic, and mechanical hardware architectures with the scalability to meet the software requirements of today and tomorrow.

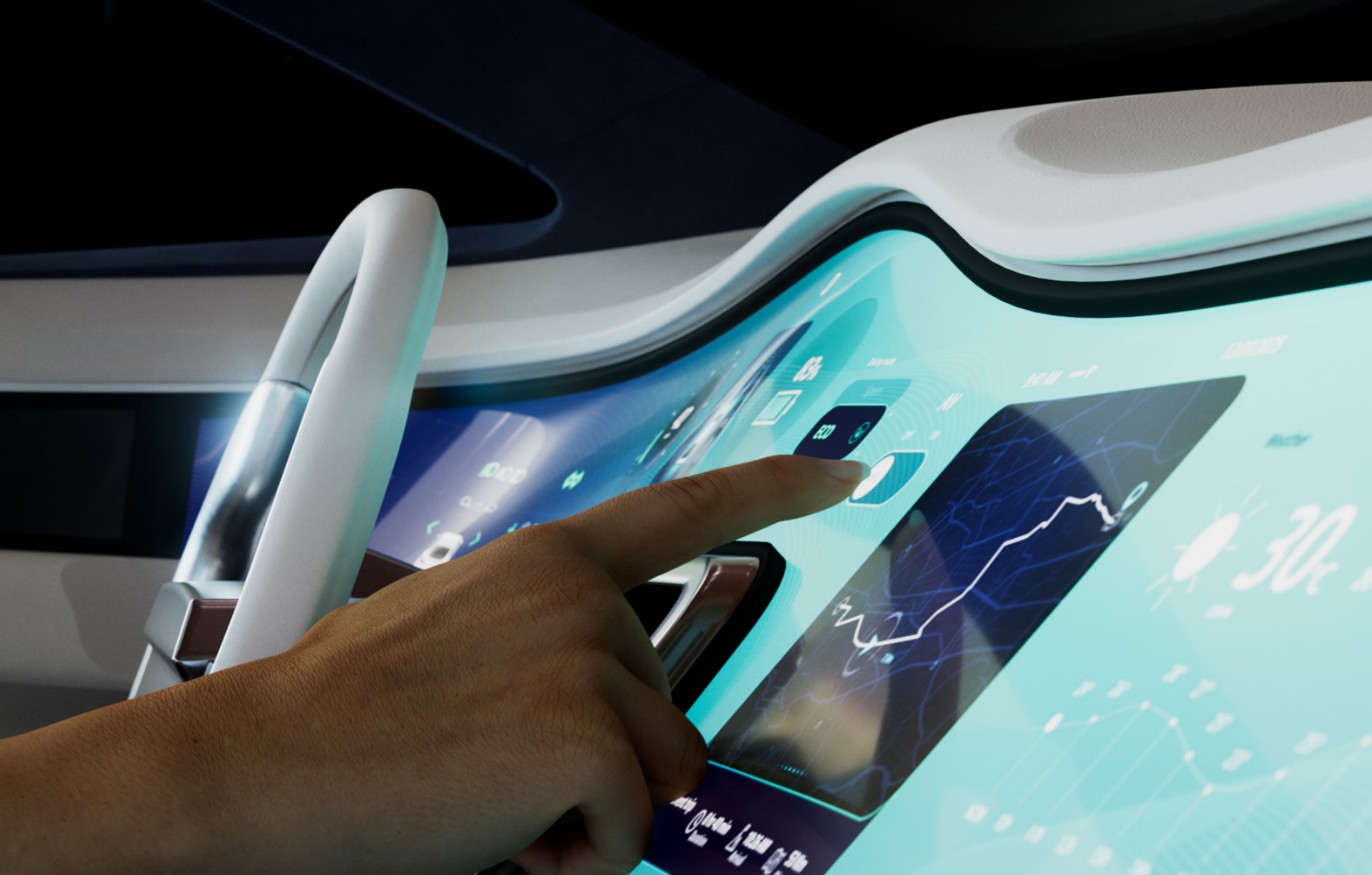## Create opportunities for feature monetization

A subscription-based service is a way for a company to achieve additional revenue beyond the number of products it sells. Additionally, a company's stock price often rises in response to subscription rollouts as the extra income contributes to assessments of company health. With Tesla at the forefront, many automakers plan to introduce new subscription-based features as software upgrades. To capitalize on these future opportunities, however, you must plan for feature updates by including the necessary hardware, sensors, and network capabilities in the original vehicle architecture.

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OTA and cybersecurity updates are becoming SaaS products that every vehicle will use throughout their lifetime."

EE Times

Deliver a feature-filled future with Siemens Software and Systems Engineering

With Siemens Xcelerator, our comprehensive software and systems portfolio powered by Amazon AWS, we help automotive companies deliver innovative software-defined features and vehicles for today and tomorrow. Multi-disciplinary collaboration and frontloaded design decisions enable you to develop next-generation vehicles with hardware scalability, adaptable architectures, system safety, and secure gateways for OTA (over-the-air) updates.

Improve efficiency with collaboration across domains

Selecting the most valuable features to incorporate begins with a complete understanding of the voice of the customer. With Siemens solutions, you can identify feature requirements upfront and share them across domains and stakeholders. Establishing this collaborative environment connects the input of all stakeholders from system needs to data-sharing to cross-domain simulation. Establishing this collaborative environment enables you to connect all stakeholder input, from system needs to data-sharing to cross-domain simulation, to start and stay integrated across the vehicle lifecycle.

Capture requirements in engineering models

Modern vehicles must be engineered for internal systems while meeting standards that ensure seamless communication and operation with a larger infrastructure. These complex requirements and operating conditions affect how features must be designed and implemented. Before a vehicle reaches the market, its features need to undergo rigorous testing and validation per regulatory guidelines. Even after the vehicle's sale, regulations might require manufacturers to provide software support, updates, and patches to ensure continued safety and performance. With Siemens Software and Systems Engineering, you can capture and update requirements in the trustworthy models that make up the digital twin to ensure compliance before physical prototypes are even built.

Frontload software modeling

Siemens solutions enable you to model software upfront and discover the most efficient architecture earlier. By including parameterized requirements across engineering models, you can ensure that your electrical, electronic, and mechanical hardware systems satisfy the software needs of today's features as well as those required for future updates.

About Siemens Software and Systems Engineering

With Software and Systems Engineering from Siemens, you can develop safe, cybersecure, compliant, high-performing software-defined automotive products. Multi-domain system modeling enables you to frontload software considerations while continuously checking for integration issues from the concept phase through development and into the field. This process accelerates development, avoids late engineering changes, maximizes functional reuse, and minimizes physical testing to help you innovate, update, and monetize software-centric features throughout the vehicle lifecycle.

For more information on Siemens Software and Systems Engineering visit siemens.com/sse or follow us on LinkedIn and Twitter.

Siemens Autonomous Vehicle Development.

Americas: +1 314 264 8499
EMEA: +44 (0) 1276 413200
Asia-Pacific: +852 2230 3333