AUTONOMOUS
VEHICLE TECHNOLOGY

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Collaboration essential for accelerating AV development cycles

Ali Osman Ors, Director, AI Strategy and Strategic Partnerships, ADAS & Automotive Processing, NXP Semiconductors, writes that many disparate technologies must work together as one to achieve true automotive AI.

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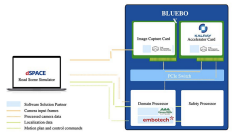

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It's widely understood that automotive OEMs and Tier 1 suppliers have a long way to go on the path to achieving fully autonomous vehicles (AVs). Despite their wealth of in-house technical expertise, it's also understood that they can't do it alone. With so many complex hardware and software disciplines and interdependencies in play, they're increasingly looking to third-party technology vendors to drive technology integration efforts that improve their workflow efficiencies and accelerate development times.

The sheer complexity of this integration effort would be hard to overstate. In the ongoing evolution toward Level 4 to 5 vehicles, advanced centralized compute architectures will govern the intelligence and real-time decision-making required for AI-enabled vehicles to ensure the highest levels of passenger and pedestrian safety. These vehicle "nerve centers" must be built from the ground up to meet stringent safety requirements, from development, to validation, to deployment.

Safety cannot be addressed as an afterthought in late-stage design cycles with retrofits to general-purpose processors and components originally targeted for consumer devices and cloud datacenter environments. True automotive-grade safety conformance must be engrained in the solution DNA from day one.

This effort requires close cooperation among automotive hardware and software technology vendors working in concert to help assure seamless integration at every level of the automotive compute architecture and the attendant supply chain. Automotive OEMs and Tier 1 suppliers are counting on this growing ecosystem of technology providers to converge on a common framework that prioritizes safety above all else on the pathway to vehicle autonomy. Ultimately, they need a clear, consistent development path from L2 onward, leveraging scalable embedded processing capacity and software resources that are proven compatible and will help to minimize major system redesigns in the years ahead.

A closely knit, collaborative vendor ecosystem could also provide OEMs and Tier 1s with a transparent view into each contributor's respective product roadmaps, which could allow an element of future proofing for ongoing development. OEMs and Tier 1s could, for example, onboard a processing platform that they could confidently map their software development efforts to, even as these efforts evolve in the coming years to encompass increasing levels of functionality. With software development representing about 70% of overall project costs for OEMs and Tier 1s focused on AV development, every effort should be made to help ensure that the value of their software development investments can be preserved for as long as possible.

Software openness and code portability are key to this effort. System designers shouldn't be locked into "black box" systems or proprietary development platforms that can restrict their design freedoms and/or limit their feature differentiation. With open, standards-based programming languages and development tools, designers are afforded the flexibility they need to meet their ambitious design goals with greater workflow agility and lower development costs.

Key enabling technologies

There are numerous technologies that must be brought to bear on the development path for fully autonomous vehicles. Each one plays an important role in its own right and will ultimately help to comprise a seamlessly integrated, holistic platform for current and future development efforts among OEMs and Tier 1s. Here we'll assess some of the key elements.

Massive processing acceleration: Machine learning, computer vision, and sensor fusion will play critical roles in next-generation AVs, and these compute-intensive functions are merely a subset of the processing workflows required. To increase overall neural-network computation capacity and boost the performance and responsiveness of automated driving perception systems, high-speed parallel processing becomes a key requirement for enabling the simultaneous execution of multiple independent threads to support time- and safety-critical compute functions.

Safety-certified real-time operating system (RTOS): For any AV development platform, the safety and integrity of the underlying operating system software is crucial to guarantee the safe and secure separation of critical applications from important but less essential passenger comfort and entertainment applications; a crash in the latter domain must never impact the onboard safety functionality. In addition, safe and secure virtualization and hypervisor support is also essential for hosting open-source environments and their less critical applications. Scalable run-time environments with secure partitions and multicore virtualization are critical.

Motion control and pathfinding: Motion-planning technology is essential for automating and planning complex vehicle maneuvers under demanding, high-speed driving conditions, enabling smooth driving trajectories and passenger comfort—with no compromises in passenger and pedestrian safety. This requires an advanced, physics-based solution that enables high-speed, automated decision-making based on all available positioning data relative to other vehicles and roadway infrastructure.

Precision traffic and sensor simulation: To help streamline development cycles, ADAS system designers need to simulate real-world driving and traffic scenarios to create verification, validation, and development environments in a lab or office setting. The ideal solution would support the creation of complex, virtual road networks, whereby designers can define sophisticated traffic maneuvers on virtual roads among static and movable objects such as traffic signs and pedestrians. This requires the emulation of physical sensors—radar, LiDAR, and camera—with hardware-in-the-loop (HIL) testing capabilities to accommodate complex ADAS systems.

Open-source software development: Deploying safe AVs at scale is a colossal undertaking that requires strong synergies between corporate development, government entities, and academic research. It also requires a vastly expanded ecosystem for AV technologies. Organizations like the non-profit **Autoware Foundation** are closing these gaps by initiating, growing, and funding open-source projects that enable self-driving mobility. Open-sourced software-stack contributions from members are fully open to everyone, and the group is developing software that is vendor-agnostic to any processor or system-on-chip, enabling an easier way to compare and contrast vendor offerings.

Central processing hub: All of the aforementioned tools, software, and hardware accelerators must ultimately reside within a unified testing and development platform that integrates ASIL-ready automotive-grade processors to enable optimized performance-per-watt and thermal profiles that can't be met with power-hungry, general-purpose processor cores. It must house the central compute and connectivity to accommodate vision, radar, and LiDAR signal paths while delivering the performance required to analyze driving environments—in the lab and on the road—to assess risk factors and govern the vehicle's behavior.

Accelerating progress

NXP Semiconductors strives to take a leading role in assembling and orchestrating the aforementioned supporting technologies that will be required to help OEMs and Tier 1s accelerate the development path toward fully autonomous vehicle functionality. This effort, demonstrated at CES 2020, is designed to enable the precise orchestration of automotive safety and compute capabilities—leveraging a range of development, testing, and validation efficiencies with a shared vision for the future of automotive safety.

Together with technology leaders like **Kalray**, **Green Hills Software**, **Embotech**, **dSPACE**, **Ansys**, and others—in coordination with non-profit organizations like the Autoware Foundation promoting open-source development initiatives—we are harnessing our efforts into a unified framework that ADAS and automotive AI system designers can trust for ASIL-grade quality and reliability, even as their designs evolve. The end goal is to help OEMs and Tier 1s minimize workflow and interoperability complexities—and associated costs—to help them innovate the future of AV technology.

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