ADLINK
LEADING EDGE COMPUTING

Level 4 Unlocked: Paving the Way for AI and High-Performance Computing in AVs

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For many years, autonomous vehicle (AV) developers and OEMs have put in the hard work of gaining expertise and solutions in Level 0 to Level 2 vehicle autonomy, wherein drivers retain manual control over most if not all driving functions. Around 2017, though, the AV industry reached Level 3 autonomy, wherein the vehicle could take over many driving tasks under certain road conditions, and ever since players have pushed hard to reach Level 4, in which vehicles assume all driving functions under certain conditions. The expected advantages of Level 4 are hard to overstate: dramatic reductions in accidents caused by human error, optimized routing that leads to lower traffic congestion, a host of new jobs in transportation support, lower carbon emissions for cleaner air, more productive commuting time, and much more.

However, the benefits of Level 4 come only after surmounting today's substantial AV technology challenges. Part of the problem involves having a multimodal range of sensors with sufficient fidelity for all expected conditions. Part involves devising mature, performant, and reliable software and algorithms able to handle an immense variety of scenarios and edge cases, many of which are difficult to predict and simulate during development. And underlying these two, arguably the most critical part of all, is hardware.

Demands for real-time responsiveness drive AV hardware platforms. CPU and GPU resources are obviously paramount, but bound to these are concerns around connectivity and data bandwidth, power draw, and thermal output. Such issues have dominated edge computing applications for years, but integrating AI into an extreme edge application like autonomous driving pushes software and hardware challenges to unprecedented levels.

ADLINK has specialized in rugged edge computing solutions, particularly in military and aerospace markets, for over a decade. Now, that accumulated expertise arrives in the AV market. With ADLINK's ADM-AL30 autonomous driving solution, developers at last have a compact, future-ready platform able to help them transition from Level 3 into the stringent and still-emerging requirements of Level 4.

AV Meets Reality

Social media clips of prototype AVs zipping around confined, controlled spaces might scoop up views by the thousands, but the reality of Level 4 on today's roads is more nuanced. As of this writing, there are no widespread Level 4 deployments in broad, everyday driving conditions. That said, the billions of proof hours across simulations and on-road pilot programs continue to mount.

On-road examples span from race driving challenges (a la ADLINK's participation in the 2021 Indy Autonomous Challenge) to Tier IV's fanfare solution, designed to simplify and accelerate the production of autonomous electric vehicles (EVs). With a scalable electrical/electronic (E/E) architecture and a redundant drive-by-wire module, fanfare customers can tailor autonomous capabilities with add-on components. Offering "white label" EVs empowers customers to commercialize these vehicles under their own brand names.

Recently, ADLINK and Tier IV collaborated in Japan and have so far completed over two dozen trials for that market. Japan is relatively stringent in its AV regulatory approvals, and this, combined with factors such as dense population, harsh weather, and narrow, congested roads, makes for a particularly challenging test environment. Progressing from Level 3 to Level 4 can take up to four years in some regions. Successful trials in Japan should bode particularly well for other efforts globally.

Currently, fanfare is already moving from testing into rollout. One of TIER IV's vehicle families, a compact, Level 4-compliant Minibus, are already on Japanese streets, with nine commercial vehicle designs slated for deployment throughout 2024. Tier IV and ADLINK expect to place many more units into service in the coming years, and that's only a start to the lineup expansion expected as third-party companies leverage fanfare for their own EV offerings.

Hardware at the Heart of Level 4

ADLINK's automotive driving platform, the ADM-AL30, embodies a host of feature and engineering enhancements specifically targeted at the needs of Level 4 solutions.

The brains and brawn of this computer are the Intel "Alder Lake-S" 12th Gen i7/i9 CPU and NVIDIA's RTX 4000 SFF GPU. Intel's 12th Gen chip plays a key role for AV designs owing to its hybrid processor microarchitecture. Employing distinct, multithreaded Performance-cores and Efficient-cores allows

developers to optimize their software for use cases such as low power consumption or boosted processing under particularly challenging conditions. In R&D and simulations, solution designers may need higher compute levels, such as for extra checking cycles. In deployment, emphasis may shift to low power for less EV battery draw. The developer might configure with an i9 during the former then, because the platform socket is pin-compatible across processors (and even 12th-to-13th Gen upgrades), switch to an i7 for the latter. This flexibility provides platform stability and lower costs throughout the development pipeline.

Similarly, the ADM-AL30's integration of NVIDIA's RTX 4000 graphics processor marks a significant improvement in visual processing performance and efficiency. The chip's "Ada Lovelace" architecture enhances autonomous by enabling real-time sensor fusion across a broad selection of increasingly high-fidelity camera, LiDAR, and radar inputs. The GPU processing of three- or even two-year-old AV platforms is not sufficient for today's sensor fusion needs, much less those of tomorrow's Level 4 demands.

This collaboration of Intel and NVIDIA enhancements for superior edge AI performance goes hand in hand with several other AV platform optimizations. For example, while the AL30 retains a pair of the 10G Base-T Ethernet ports common in prior AV computing designs, it also steps up to eight 1G Base T1 (Automotive Ethernet) ports. Base T1 features low cabling complexity (and thus lower cost and weight) as well as large data bandwidth, necessary for next-generation AV needs around imaging and high-resolution, real-time sensor data processing.

The AL30 also includes four CAN 2.0 and eight optional CAN FD ports. CAN bus delivers a formidable improvement over Ethernet for in-vehicle computing because of its simplified wiring, sophisticated error detection, scalability, durability, and ability to prioritize certain message types, such as braking and steering. All of this adds up to an AV platform capable of handling the vast data volumes and lightning-fast decision capabilities demanded by Level 4 requirements.

Beyond component-level innovations, the ADM-AL30 also benefits from ADLINK's extensive automotive computing design capabilities. ADLINK's manufacturing nexus hosts a range of AV engineering and production facilities. This includes manufacture in ADLINK's cleanroom facilities, notable for their no-touch autonomous robot transport processes, IATF 16949 certification, and cutting-edge testing equipment for meeting Tier 1 requirements. ADLINK places the highest priority on quality control and adheres to the latest ISO 16750, ISO 7637, ISO 26262, and other international standards pertinent to autonomous vehicle safety and excellence.

ADLINK and AVs: Reaching the Horizon's Edge

Fueled by advances across imaging, sensor fusion, machine learning techniques like Deep Reinforcement Learning and Generative Adversarial Networks (GANs), and more, global Level 4 autonomous vehicle (AV) deployment is finally coming into sight on the horizon. These developments enhance the accuracy of sensor data interpretation and decision-making in real time. Moreover, improvements in both intra- and extra-vehicular communications facilitate immediate responsiveness within and between AVs, and even with pedestrians. Past edge computing solutions are inadequate for these increasingly demanding needs, necessitating partners and platforms that anticipate future requirements.

ADLINK's ADM-AL30 delivers the most powerful and efficient mobile processing linked with the latest in automotive communications technologies. Alongside the best and most promising developers, the company works globally to foster, deploy, and improve state-of-the-art AV solutions. Few companies can match ADLINK's edge computing accomplishments. We encourage AV developers to capitalize on that expertise. Investigate ADLINK's AV portfolio and explore how it can help more quickly bring that distant Level 4 horizon within reach.

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