VEHICLE electronics

The monthly magazine for automotive electronics engineers

SDVs to generate $755bn hardware revenues by 2029

Software-defined vehicles (SDVs) are driving future automotive architectures, and are set to generate $755bn in hardware revenue by 2029, according to market watcher IDTechEx.

The industry is undergoing a foundational shift towards SDVs, where vehicle functionality, user experience and monetisation are governed increasingly by software rather than hardware.

Today's vehicles are moving beyond legacy ECU-based architectures interconnected by Can and Lin, towards centralised compute models built around high-performance compute (HPC).

Emerging central compute plus zonal topologies, as exemplified by BMW's upcoming Neue Klasse, Tesla's refreshed Model Y and Rivian vehicles, are driving this transformation forward.

The transition is propelled by bandwidth-intensive applications such as adas, infotainment and AI-enabled cabins.

Traditional Can-FD networks capped at 8Mbit/s are now inadequate, accelerating the adoption of 100Mbit/s to Gigabit Ethernet with time-sensitive networking.

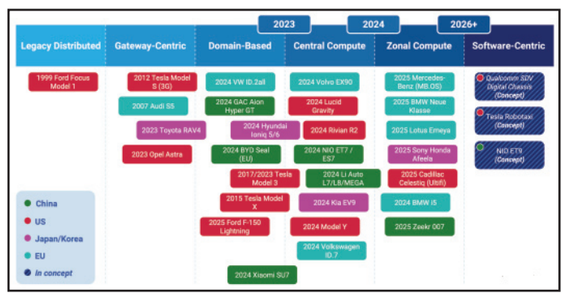
Simultaneously, automakers recognise economic and sustainability benefits: zonal wiring architectures reduce cable length by at least 30% and save kilograms of copper per vehicle.

Abstracting physical IO into logical services simplifies over-the-air (OTA) updates across sensors and actuators, while integrated solid-state power distribution supports 48V architectures, eliminating heavy fuses and mechanical relays.

Zonal controllers also streamline cyber-security management, diagnostics and future hardware expansions, consolidating multiple legacy gateways into fewer high-speed network trunks.

Chinese OEMs, including BYD, NIO and Li Auto, are rapidly deploying their own SDV offerings, emphasising central computing and extensive OTA capabilities.

Meanwhile, tech giants such as Nvidia and Qualcomm provide critical hardware underpinning these developments, offering AI-optimised SoCs that enable real-time AI inference directly within the vehicle.



SDV level chart: Major OEMs compared

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Schaeffler chooses OnSemi SiC mosfet

OnSemi is expanding its collaboration with motion technology company Schaeffler through a design win that leverages its EliteSiC line of silicon carbide mosfets.

These will power a Schaeffler traction inverter for an unnamed car maker's plug-in hybrid electric vehicle (PHEV).

EliteSiC is said to provide significantly lower conduction losses and better short-circuit robustness, enabling a compact, thermally efficient inverter design that enhances overall performance.

This silicon-carbide-based product is claimed to have lower on-state resistance to provide higher peak power than other SiC products in its class.

This helps Schaeffler deliver a traction inverter with longer driving range enabled by higher energy conversion efficiency, reliability for consistent operation with lower maintenance, and a form factor that improves flexibility in vehicle design.

"The traction inverter is at the heart of every electrified drivetrain, and OnSemi's EliteSiC plays a vital role in achieving the efficiency and performance targets that our customer demands," said Christopher Breitsameter from Schaeffler.

As automakers increasingly prioritise energy efficiency and performance, the industry is turning to more advanced hybrid architectures even in cost-sensitive EV platforms, a market traditionally dominated by IGBTs.

"As the exclusive silicon carbide supplier for this programme, OnSemi continues to strengthen its position as a trusted innovation partner for leading global automotive players," said Simon Keeton, group president of OnSemi's power group. "Our industry-leading silicon carbide semiconductor technology delivers unmatched efficiency, thermal performance and power density, key enablers for next-generation electric powertrain systems not only for battery electric vehicles, but also for plug-in hybrid platforms."

This builds on the existing long-term collaboration between OnSemi and Schaeffler, formerly Vitesco Technologies, extending the companies' multi-year collaboration and reinforcing their shared commitment to delivering high-efficiency electric mobility.

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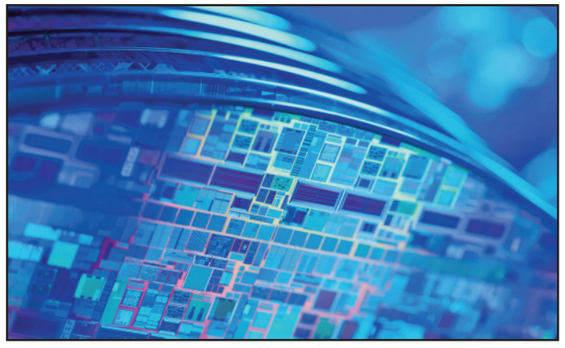


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SK Keyfoundry and Siemens kit opens 130nm process



Optimising analogue and mixed semi designs

Siemens collaborated with SK Keyfoundry to launch a 130nm automotive power semiconductor process design kit (PDK) exclusively for Calibre Perc software.

This marks a milestone as one of the first Korean domestic established node processes to provide not only schematic verification but also layout verification for interconnect reliability.

With this PDK, a wide range of Korean domestic and international fabless companies can leverage SK Keyfoundry's 130nm process to enhance the design optimisation of automotive power semiconductors, while doing more precise reliability verification.

The 130nm process has long been a stable choice in the analogue and power semiconductor markets. However, due to increasing complexity of the designs now using 130nm processes, achieving high-performance semiconductor designs has been difficult.

The PDK lets designers use Siemens' Calibre Perc software with SK Keyfoundry's process technologies, unleashing innovation and enabling design-stage verification that accounts for manufacturing constraints.

"We are thrilled to introduce the Calibre Perc PDK optimised for 130nm automotive power semiconductor processes in collaboration with Siemens EDA," said Ilsup Jin, senior vice president at SK Keyfoundry. "This PDK is designed to improve design efficiency and reliability, providing our customers with a competitive edge in developing high-performance automotive semiconductor products. Moving forward, we plan to continue to strengthen our partnership with Siemens."

SK Keyfoundry plans to expand its collaboration with Siemens by providing optimised designs and enhanced semiconductor manufacturing reliability, and by strengthening its competitive position in the foundry market.

"We are pleased to support this Calibre Perc PDK for 130nm processes, enabling highly reliable design verification in collaboration with SK Keyfoundry," said Junan Kim, general manager for Siemens EDA in Korea. "This is expected to help differentiate SK Keyfoundry in the power semiconductor and IoT markets. Siemens remains committed to expanding its collaboration with foundries so that they can leverage the latest EDA technologies regardless of the process nodes they are offering."

Tata and Synopsys MoU advances virtualisation

Tata Elxsi has signed an MoU with Synopsys to collaborate on automotive virtualisation.

The MoU was signed at the recent Snug India event in Bengaluru.

The aim is to provide customers pre-verified, integrated services that make it easier to design and deploy virtual ECUs for software development and testing in software-defined vehicles.

The collaboration brings together Tata's engineering capabilities in embedded systems and integration with Synopsys' virtualisation technology used by more than 50 automotive OEMs and tier-one suppliers to help reduce development complexity and cost, improve quality of software systems, and de-risk vehicle production timelines.

Together, the companies are already collaborating on programmes with several customers to enable vECUs, as well as software bring-up, board support package integration and early-stage software validation. These are being deployed across vehicle domains such as powertrain, chassis, body control, gateway and central compute, helping users simulate real-world scenarios, validate software early and reduce reliance on physical prototypes.

They will explore ways to scale and accelerate the deployment of electronics digital twins for multi-ECU and application specific systems.

QNX SDP 8.0 becomes foundation for Eclipse S-Core project

The QNX SDP 8.0 software development platform will be the foundational operating system for the Eclipse Foundation's S-Core safe open vehicle core project.

This should help accelerate the group's efforts to turbocharge automaker software-defined vehicle (SDV) development timelines and reduce costs in moving projects from research to production and onto roads.

The S-Core project is a collaborative open-source initiative under the Eclipse SDV Working Group. It brings together major automakers, suppliers and technology partners including BMW, Mercedes-Benz, Bosch, Etas, Qorix and Accenture to develop an open-source core stack for SDVs, specifically targeting embedded high-performance ECUs.

The first S-Core release (v0.5) will provide core functionalities including application orchestration, inter-process communication (IPC), and logging and persistency. To ensure these can be evaluated and deployed on a robust foundation, SDP 8.0 will be the supporting operating system for the initial reference platform.

This was made possible via the firm's recently launched QNX Everywhere initiative, which expands access to QNX's foundational software for non-commercial use, targeting students, schools, research organisations and OEMs for early prototyping purposes.

QNX Everywhere provides free access to SDP 8.0 for non-commercial use, with resources and on-demand training, easing embedded systems learning, experimentation and innovation.

"This milestone benefits OEMs by enabling easy and simple access to QNX 8 software for non-commercial use for advanced prototyping to accelerate development cycles," said John Wall, COO at Blackberry subsidiary QNX. "By enabling Eclipse S-Core and with support from a who's who of major automakers and tier-ones, we're thrilled to provide more developers with free access to QNX SDP 8.0, enabling them to build the future of automotive technology with confidence and efficiency."



R&S verifies Qualcomm NG eCall implementation

Rohde & Schwarz worked with Qualcomm to verify the implementation of NG eCall on the Snapdragon Auto 5G Modem-RF, in line with the most recent EN 17240: 2024 specification.

R&S's work with Qualcomm aims to enhance the safety and efficiency of emergency response systems in vehicles via testing.

Introduced in 2015, ecall, an automated vehicle emergency call system, has been mandatory for all new cars sold within the European Union since 2018. However, as 2G and 3G circuit-switched cellular networks become obsolete, emergency call systems will need to be adapted to 4G and 5G packet-switched cellular networks.

The European Commission has defined in its most recent regulation that NG eCall will be obligatory starting January 2026. This standard establishes guidelines for testing ecall systems over IP multimedia subsystem (IMS) networks, including 4G LTE and 5G NR technologies.

Consequently, to incorporate the NG eCall features in ecall modules, the automotive industry will require NG eCall testing.

The Snapdragon Auto 5G Modem-RF is a 5G automotive-grade platform that has paved the way for connected vehicles, delivering speed connectivity, positioning and support for V2X technology. Designed to meet the demands of modern telematics, it supports reliable connectivity, precise multi-band GNSS navigation and enhanced safety.

Through this joint effort, R&S and Qualcomm have verified the compliance of the Snapdragon Auto 5G Modem-RF's NG eCall functionality with the most recent ecall standards.

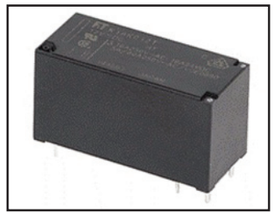


Automotive industry requires NG eCall testing

The verification process employed the R&S CMX500 mobile radio tester for NG eCall including voice and data transmission. This test, which was simulating a public safety answering point (PSAP), validated the compliance of the implementation at both ends with the EN 17240: 2024 standard. Moreover, the CMX500 supports 4G and 5G technologies, aiming to make it future-proof.

"We are pleased to have joined forces with Qualcomm on the verification of their chipsets' NG eCall implementation," said Juergen Meyer, R&S VP. "This collaboration sets a new benchmark for the future of emergency call services, providing the automotive industry a robust and dependable option to meet the latest ecall standards."

As a versatile tool, the CMX500 with the CMX-KA098 software option can be effectively used for NG eCall testing under realistic network conditions.


FTR-K1-AM relay

Relay factory

FCL Components' factory in Japan where it makes FTR-K1-AM relays for automotive chargers has been IATF16949 certified.

Many automotive makers around the world have adopted IATF16949 as a procurement standard.

The FTR-K1-AM is a power relay with a 20A, 277V AC carrying current, which meets requirements for the normal charging AC line of an electric vehicle or plug-in hybrid on-board charger. The relay is said to excel in vibration and shock resistance as well as long operation lifetime.

IATF16949 is a quality management system designed to improve the quality of automotive parts by preventing nonconformance and reducing quality variation and waste.

By using relays manufactured under this standard, automotive device manufacturers can ensure a certain level of quality starting from the component level.

Flux free and plastic sealed types are available.

Quintauris and Wittenstein partner on Risc-V

Quintauris, a company founded as a single source to enable compatible Risc-V-based products, has announced a partnership with Wittenstein High Integrity Systems (WHIS), a provider of safety-critical rtos.

This collaboration aims to strengthen the foundation for Risc-V high-performance and safety-certified real-time applications.

WHIS brings experience in designing and delivering safety-critical embedded software for different markets. Its SafeRtos safety-critical rtos is engineered to meet functional safety standards and deliver dependable performance under demanding conditions.

It has been independently certified by TÜV SÜD to IEC 61508 Sil 3 and ISO 26262 Asil D.

"Partnering with WHIS is a key milestone in our mission to build automotive-grade commercial ready Risc-V products," said Pedro López Estepa, head of market strategy at Quintauris. "Their deep expertise in functional safety and production proven rtos technology enhances the reliability and integrity of our reference architecture."

Through this partnership, SafeRtos will be available as part of the software powering Quintauris' future automotive reference platforms, helping developers and OEMs accelerate development with confidence in safety, performance and long-term support.

"Quintauris is laying essential groundwork for Risc-V adoption in mission-critical automotive applications," said Andrew Longhurst, managing director of WHIS.

The partnership is also said to reflect a shared commitment to open innovation, long-term toolchain support and the evolution of an ecosystem that can meet the rigorous demands of the automotive industry.

Turkish tractors go autonomous


This is Turkish farmer Numan Korkmaz. He and his family cultivate 140 hectares of rice paddies, but their work has been made easier with the XAG APC2 AutoPilot Console, which turns even aging tractors into smart, capable autonomous machines.

Turkey's has more than 1.5 million tractors, the largest fleet in Europe. Most of these machines are in the hands of family farms.

"We need to keep up with modern times in our sector," said Korkmaz. That meant investing in an XAG APC2, a decision driven by his goal to enable precision farming, achieve centimetre-level accuracy, and ensure orderly, safe work for daily operations.

The APC2 delivers hands-free steering and precision accuracy for a wide range of tractors. The tractor steers itself, even at night or on tough terrain for tasks such as sowing, fertiliser spreading and harrowing.

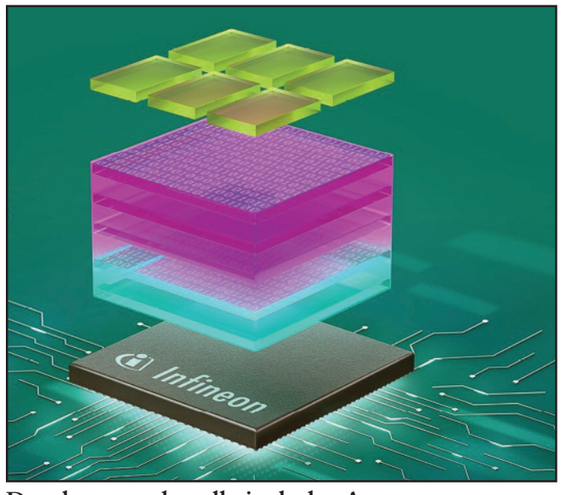
The APC2's RTK-based positioning is supported by inertial measurement unit sensors for terrain compensation, which instantly detect ground slope and keep the tractor on course. GNSS-based guidance reduces field overlaps and input use by six to ten per cent.

HighTec, Elektrobit and Infineon bundle Rust with Autosar Classic

HighTec EDV-Systeme, Elektrobit and Infineon want to accelerate software innovation in the automotive industry by integrating Rust applications with Autosar Classic basic software.

As ecosystem partners to Infineon's Drive Core for Aurix microcontrollers, HighTec and Elektrobit are delivering a development bundle. This joint offering includes Elektrobit's EB Tresos AutoCore software and HighTec's automotive-grade LLVM-based Rust and C/C++ compiler.

Specific to the Aurix TC4x families, HighTec and Elektrobit will offer a Drive Core software bundle that contains all tools and software in one package to get started with Rust and Autosar Classic.



Development bundle includes Autosar software and Rust compiler

Through this cooperation, software developers gain access to all they need in one package to take advantage of Rust's memory safety and performance for functional safety applications.

Rust's performance, reliability and memory safety make it suitable for modern automotive software. It directly addresses the growing demand for cyber security and functional safety driven by software-defined vehicles and regulations such as UN R155 and the EU Cyber Resilience Act.

By combining Elektrobit's Autosar Classic basic software with HighTec's ISO 26262 Asil-D-certified Rust compiler, developers can integrate Rust-based software components into Autosar environments. This enables a hybrid development approach, where new software written in Rust can operate alongside legacy C/C++ code, reducing risks while ensuring compliance with stringent safety standards.

The Drive Core software bundle includes microcontrollers and everything developers need to get started: EB Tresos configuration tool, Aurix TC4x MCALs, and examples and tutorials to develop Autosar software components in Rust.

EB Tresos now supports clean, efficient Rust development, reducing or eliminating the need for unsafe code. This integration provides developers with a robust tool chain that generates system-access code and enables static analysis through tools such as Rust's Clippy and automatic code formatting.

This enhances productivity while reducing the cost and complexity of developing safety-critical automotive software.

"By taking Rust to the Autosar Classic environment, Elektrobit continues to drive innovation in the automotive software industry," said Florian Bartels, system architect at Elektrobit.

HighTec's Rust and C/C++ compiler is built on LLVM open-source technology. It leverages the architecture-specific functions of the Aurix microcontrollers.

HighTec's compiler is known for its rapid build system and code optimisations, which accelerate the development and certification of safety-critical applications.

"Our partnership with Elektrobit empowers automotive customers to build safer and more efficient software," said Mario Cupelli, CTO at HighTec.

Infineon has a large microcontroller abstraction layer portfolio and embraces an ecosystem approach to growth. This is why it introduced Drive Core, a software bundle that provides a foundation for automotive software development.

"We believe Drive Core is a game-changer for the automotive industry, and we are excited to see HighTec and Elektrobit drive innovation," said Patrick Will, senior director at Infineon.



RA8P1 MCU enables edge AIoT applications

Renesas MCU enables Nota AI driver monitor

Nota AI is working with Renesas to deliver an optimised driver monitoring system (DMS) using its recently launched RA8P1 MCU.

By enabling AI to run efficiently on such compact processors, this collaboration brings scalable, real-time driver behaviour analysis to embedded systems, making intelligent safety features more accessible, even in size- and power-constrained automotive environments.

The RA8P1 has Arm Cortex-M85 and M33 cores along with the Arm Ethos-U55 NPU, enabling high-performance AI in a small footprint. Nota AI's DMS, optimised for RA8P1, achieves approximately 50frames/s real-time monitoring.

Powered by NetsPresso, Nota AI's proprietary AI model optimisation platform, the company delivers lightweight, deployment-ready models for a broad range of Renesas hardware. In addition to the RA8P1, Nota AI provides optimised AI for the RA8D1 MCU and RZ/V series microprocessors (MPUs), including the RZ/V2M, RZ/V2L and RZ/V2H.

Applications such as people detection, line crossing people counting and DMS have been implemented on RZ/V devices, demonstrating their readiness for real-world deployment.

"Our collaboration with Renesas integrates their advanced hardware expertise with our optimised AI technologies, unlocking possibilities for embedded AI," said Myungsu Chae, CEO of Nota AI.

Kaushal Vora, a senior director at Renesas, added: "Working closely with Nota AI demonstrates the RA8P1's potential to support advanced AI at the edge."

The RA8P1 delivers a CPU performance of over 7300 CoreMarks and AI performance of 256Gops at 500MHz.

It is manufactured on the 22ULL (22nm ultra-low leakage) process from TSMC. This process also enables the use of embedded magneto-resistive ram in the MCU, offering faster write speeds along with higher endurance and retention than flash.

"There is explosive growth in demand for high-performance edge AIoT applications," said Daryl Khoo, vice president at Renesas. "The RA8P1 devices showcase our technology and market expertise and highlight the strong partnerships we have built across the industry."

Renesas has integrated dedicated peripherals, memory and security to address voice and vision AI and real-time analytics. For vision AI, a 16bit camera interface is included that supports sensors up to 5Mpixel.

A separate Mipu CSI-2 interface offers a low pin-count interface with two lanes, each up to 720Mbit/s.

Multiple audio interfaces including I^2S and PDM support microphone inputs for voice AI applications.

Several Renesas projects and application notes are available to enable faster time to market. In addition, partner options are available to support development with the RA8P1 MCUs, including Nota AI's DMS and a traffic and pedestrian monitoring product from Irida Labs.

Tier IV partners Newmo to commercialise robotaxis

Open-source software specialist Tier IV and mobility start-up Newmo are working together to commercialise robotaxi services in Japan.

The Japanese government wants to have autonomous vehicles running in more than 100 locations by 2027 and is promoting the deployment of commercial robotaxi services, which are already operating in select cities in the USA and China.

Robotaxi bookings via ride-hailing applications account for 27% of rides in San Francisco. With international robotaxi operators starting to collect public road data in major Japanese cities, the collaboration between Tier IV and Newmo is aimed at advancing autonomous driving technology developed in Japan.

The two companies will work together to develop safe, reliable autonomous driving systems built around Autoware open-source software for autonomous driving. Tier IV's track record in conducting proof of concept tests under diverse environmental conditions will serve as a foundation for advancing commercial deployments of robotaxi services in Japan.

Tier IV will continue developing partnerships to accelerate the deployment of robotaxi services across Japan, supporting government efforts to establish autonomous public transit.

With more than 1000 taxis in operation and an established Japan-style ridesharing business in Osaka, Newmo plans to expand and commercialise robotaxi services.

"At Tier IV, we have dedicated ourselves to accelerating the deployment of autonomous driving through Autoware, collaborating with communities and partners worldwide," said Shinpei Kato, CEO of Tier IV. "Through this collaboration, we aim to establish a robotaxi service anchored in Japan and make it an essential part of the mobility infrastructure that supports local communities."

Newmo CEO Naoki Aoyagi added: "As Japan faces increasingly severe transportation challenges driven by demographic shifts, robotaxis will play a pivotal role in shaping next-generation infrastructure. At Newmo, we have leveraged our operational and technological expertise in local taxi and Japan-style ridesharing services to address mobility issues head-on."



Geotab provides fleet management for Merc

Mercedes-Benz connectivity services have been integrated with Geotab's fleet management platform for users across the USA.

This collaboration delivers seamless, factory-installed telematics that unify data from EVs and ICE vehicles within MyGeotab, providing fleet managers with enhanced visibility and actionable insights.

This integration allows for direct data transfer from Mercedes-Benz vehicles' factory-installed telematics hardware into MyGeotab, eliminating the need for additional aftermarket hardware installation. This not only saves time and money by avoiding vehicle downtime for installations but also streamlines operations for diverse fleets that include Mercedes-Benz vehicles.

Fleet managers using this will gain access to an array of tools and near real-time data at an enhanced frequency, including detailed GPS tracking, trip and activity reports, vehicle health diagnostics (such as battery, tyre and engine signals), EV charging status and fuel consumption. The platform also enables automated warnings for vehicle health and other critical alerts, empowering proactive decision-making.

Geotab's long-standing OEM telematics expertise, developed over ten years of collaboration with manufacturers, helps ensure this integration provides a robust, secure and ready-to-go connected vehicle experience.

It is compatible with most Mercedes-Benz passenger cars and vans in the USA from the 2019 model year onwards, including popular fleet vehicles such as the Mercedes Sprinter and eSprinter vans.

STM buys NXP mems business for $950m

ST Microelectronics is buying NXP's mems sensors business, focused on automotive safety products as well as sensors for industrial applications.

The $950m transaction comprises $900m upfront and $50m subject to the achievement of technical milestones.

This will complement and expand STM's mems sensors technology and product portfolio, unlocking opportunities for development across automotive, industrial and consumer applications.

"These highly complementary technologies and customer relationships, focused on automotive safety and industrial technologies, will strengthen our position in sensors across key segments in automotive, industrial and consumer applications," said Marco Cassis from STM.

Jens Hinrichsen from NXP added: "After careful portfolio review, the company has decided the business does not fit into its long-term strategic direction. We have agreed with ST Microelectronics that the product line will fit ideally into STM's portfolio, manufacturing footprint and roadmap."

The mems sensors portfolio to be acquired by STM primarily targets automotive safety sensors, both passive (airbags) and active (vehicle dynamics), as well as monitoring sensors for TPMS, engine management, convenience and security. It includes pressure sensors and accelerometers for industrial applications.

Mems technologies increasingly enable functionalities for safety, electrification, automation and connected vehicles. Mems inertial sensors in automotive are expected to grow at a faster pace than the broader mems market.

The business to be acquired generated about $300m revenues in 2024.

The expanded business will use STM's integrated device manufacturer model for mems, which involves every stage of development, from design and manufacturing to testing and packaging, enabling faster innovation cycles and flexibility for customisation.

The transaction will be financed with existing liquidity and is subject to customary closing conditions, including regulatory approvals, and is expected to close in the second half of next year.

Samsung switches MLCC focus to automotive

Samsung Electro-Mechanics is reshaping its business to focus on high-growth AI servers and automotive electronics in response to the rapidly changing landscape of the electronics industry.

Its core MLCCs (multilayer ceramic capacitors) business is expanding from its traditional role in IT sectors such as smartphones into industries such as AI servers, electric vehicles, adas and autonomous driving.

Driven by the spread of AI, rising EV adoption and the evolution of autonomous systems, the demand for MLCCs is expected to grow significantly. An EV requires about 20,000 to 30,000 MLCCs, and AI servers use more than ten times the MLCCs found in general-purpose servers.

Automotive MLCCs, which are critical to human safety, demand high-capacity, high-temperature (125 to 150˚C), and components that can handle voltage reliably up to 2kV. Samsung says its MLCCs can do that.

An MLCC stores electrical energy and supplies it stably to active components such as APs, CPUs and GPUs. It also filters noise between signals, thereby improving device performance and stability.

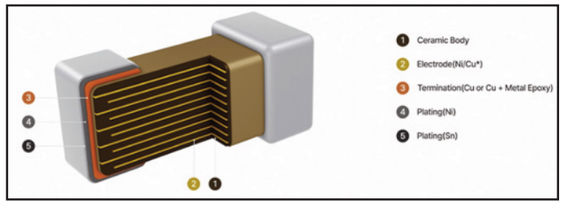
Sizes range from 0.2 by 0.1mm to 5.7 by 5.0mm, making many barely visible to the naked eye.

Despite small size, they house 500 to 1000 stacked layers of dielectric and electrode materials.

They are produced by printing and stacking thin layers of ceramic and nickel, then firing them at high temperatures. The performance of each depends heavily on what additives are mixed into the ceramic base.

Samsung began its MLCC business in 1988, and established a dedicated automotive production line in Busan, South Korea, in 2018.

Samsung plans to debut the world's first lidar-specific MLCCs this year.



Internal schematic of MLCC

ASA-ML alliance targets Japanese market

Microchip is working with Nippon Chemi-Con and NetVision to create an ASA-ML camera development ecosystem for the Japanese automotive market,

The ecosystem's camera module and development tools are based on Microchip's VS700 family of serialisers and deserialisers and should help Japanese OEMs speed ASA-ML adoption in adas applications.

An automotive industry transition is underway to replace proprietary camera connectivity with products based on the open and interoperable Automotive Serdes Alliance Motion Link (ASA-ML) standard driven by 150 member companies worldwide.

To simplify and accelerate the adoption of ASA-ML for adas, Microchip has partnered with camera module supplier Nippon Chemi-Con and video-testing provider NetVision to deliver the first ASA-ML camera-development platform of its kind.

This brings the standard's scalable high-speed asymmetric data rates to the Japanese automotive market while supporting critical hardware-based link-layer security to meet emerging automotive cyber-security regulations.

"We were first to market with an ASA-ML chipset through our acquisition of VSI, and now we have collaborated with pioneers like Nippon Chemi-Con and NetVision to deliver the first camera development ecosystem that reduces risk and speeds ASA-ML adoption for Japanese OEMs," said Kevin So, vice president at Microchip.

Nippon Chemi-Con's CDTrans camera module and NetVision's NV061 development emulation board are both based on Microchip's VS775S single-port serialiser-deserialiser device.



Microchip, Nippon Chemi-Con and NetVision create ASA-ML ecosystem

"We are excited to collaborate with an automotive semiconductor market leader like Microchip in offering Japanese OEMs another important first with our new CDTrans ASA-ML-based automotive camera module that is integrated with the VS775S serialiser," said Katsunori Nogami, managing executive officer chief with Nippon Chemi-Con. "We recognise the importance and benefit of open standards-based connectivity technologies like ASA-ML that automotive tier-one suppliers and OEMs need."

This collaboration is a key step in accelerating ASA-ML adoption for adas cameras in Japan's rapidly evolving SDV landscape. Combined with NetVision's well recognised camera test and emulation platform, the camera module should enable cross-vendor compatibility, future-proof scalability and a pathway beyond closed systems."

"Partnering with Microchip and Nippon Chemi-Con on this new ASA-ML ecosystem platform will help realise a standardised and scalable electrical-electronic in-vehicle networking architecture for Japan's SDV era," said Kenji Kudo, engineering department director at NetVision.

BMW, Ford, Volvo, GM, Continental, Bosch, Denso and Microchip along with numerous other semiconductor companies are among the dozens of ASA-ML members helping industrialise and promote ASA-ML adoption.

Cyber-security competition

Automotive cyber-security firm VicOne and engineering company Block Harbor have launched an online competition to help protect future connected vehicles.

The global Vehicle Cybersecurity Competition (VCC) will suit university students, those starting a career or those seeking to change careers.

It will take place online 22-25 August and 29 August to 1 September.

Participants in the capture-the-flag-style event will compete head-to-head in offence and defence scenarios mimicking real-world attacks and countermeasures on modern connected vehicles and software-defined vehicles (SDVs).

The competition winner will be sponsored to attend January's Pwn2Own Automotive in Tokyo.



Lucid and Nuro plan robotaxis for Uber

Lucid, Nuro and Uber have announced a premium global robotaxi programme created exclusively for Uber's ride-hailing platform.

Expected to launch later next year in a major US city, the robotaxi service combines the software-defined vehicle architecture of the Lucid Gravity, the scalability and capability of the Nuro Driver level-four autonomy system, and Uber's global network and dynamic fleet management.

This should deliver an integrated robotaxi experience developed for comfort, safety and scale.

Uber aims to deploy 20,000 or more Lucid vehicles equipped with the Nuro Driver over six years. The vehicles will be owned and operated by Uber or third-party fleet partners and made available to riders via the Uber platform.

"Autonomous vehicles have enormous potential to transform our cities for the better," said Dara Khosrowshahi, CEO of Uber. "We're thrilled to partner with Nuro and Lucid on this new robotaxi programme, purpose-built just for the Uber platform, to safely bring the magic of autonomous driving to more people across the world."

The first Lucid-Nuro robotaxi prototype is already operating autonomously on a closed circuit at Nuro's Las Vegas proving grounds.

As part of a deepening relationship with each partner, Uber plans to make multi-hundred-million dollar investments in Nuro and Lucid.

"This investment from Uber further validates Lucid's fully redundant zonal architecture and highly capable platform as ideal for autonomous vehicles, and our industry-leading range and spacious well-appointed interiors, as ideal for ridesharing," said Marc Winterhoff, CEO at Lucid. "This is the start of our path to extend our innovation and technology leadership into this multi-trillion-dollar market."

Jiajun Zhu, CEO of Nuro, added: "We believe this partnership will demonstrate what's possible when proven AV technology meets real-world scale. Nuro has spent nearly a decade building an AI-first autonomy system that's safe, scalable and vehicle-agnostic, proven through five years of driverless deployments across multiple US cities and states. By combining our self-driving technology with Lucid's advanced vehicle architecture and Uber's global platform, we're proud to enable a robotaxi service designed to reach millions of people around the world."

The robotaxi will leverage Lucid Gravity's technology, redundant electrical and controls architectures, and long range. Autonomy is enabled by the Nuro Driver, a level-four self-driving system that combines automotive-grade hardware and AI-powered self-driving software designed for reliability and cost-efficiency at scale.

The necessary hardware will be integrated seamlessly into the Lucid Gravity on Lucid's assembly line and will subsequently receive Nuro's software when the vehicle is commissioned by Uber.

With operations in 70 countries and an average of 34 million trips per day, Uber's platform has the scale to make the benefits of self-driving vehicles accessible and beneficial to people everywhere.

CLOUD ON WHEELS



Martin Wilson reports from the recent Aesin conference at the British Motor Museum

Electronics, software, AI and power all need to be incorporated into software defined vehicles (SDVs), and it is important such technologies are safe, sustainable and, from a business point of view, competitive, according to Gunny Dhadyalla, Aesin director, as he opened this year's Aesin conference.

On the same theme, Alex Mouzakitis, director at Jaguar Land Rover (JLR) and Aesin industry chair, said "competition will drive innovation and collaboration is a multiplier", adding partnerships were a key strength.

Angela Johnson, vice-president at Ricardo, stressed that automotive electronics were at the forefront of opportunities. She asked where were the biggest opportunities for automotive electronics and associated technologies such as software.

JLR director David Nesbitt outlined the company's strategy built around an evolving digital product platform, both energy and vehicle. With such architectural platforms, he talked about software enabled vehicles (SEVs) rather than SDVs. The approach builds flexibility into the platforms from day one to support development speed.

He said JLR recognised there were opportunities for using skills and knowledge from non-automotive fields. Along with that cross-fertilisation, JLR also sees the need to invest in technical capability.

A challenge for SEVs and SDVs is that connectivity is not always available. It means processing, especially the heavy demands of AI, cannot rely on the cloud. The vehicle must continue to work safely even offline. As a result, he said: "The car should be seen as a cloud on wheels."

In addition, cars are too complex electronically; reducing that means integration is hard. Tier-one suppliers cannot do it all in house, so the platform needs APIs to harness the platform's capability. Partners can then make elements of the overall system compliant by using the API. This provides opportunities in software, hardware, semiconductors and integration but car makers will have to take risks and manage them through collaboration.

Jeremy Flann, vice president at



Angela Johnson: Where are the biggest opportunities for automotive electronics?



Gunny Dhadyalla: Technology should be safe, sustainable and competitive



David Nesbitt: Opportunities for using skills from non-automotive fields

Green Hills Software, reiterated Nesbitt's point that reducing hardware complexity comes at the cost of more complex software. So there needs to be collaboration on standards.

He suggested that cyber resilience may not yet be an issue for cars, but will become more important. Software must focus on the architecture; development delays happen because safety, security and other critical problems are not solved early.

"The smart play is to spend more time at the beginning and not on remedial work at the end," he said.

In her role as trends manager for the UK's Advanced Propulsion Centre, Stephanie Morton provided analysis of car customer expectations changing from style and powertrain through current concern for functionality and connectivity providing personalisation and enhanced safety, to future experiential and customer-centric needs. For OEMs, considerations are that brand loyalty is declining, regional requirements differ, car ownership behaviour is changing, with an impact on the need for affordability and value retention. Those changes mean there is growing software complexity of around 10% per annum, and software already causes 20% of recalls. Key software trends for OEMs are the SDV, cyber security and centralised architecture.

Morton also agreed it was easier to resolve issues early in the development lifecycle, and failures were at interfaces.

Nesbitt felt there was a lot of talent in software, semiconductor skills and resources but it needed to be organised better.

Flann said software providers had to choose which chips to support. This diversity needed good software tools to support high values.

The question of open-source software was discussed, and it was felt it had its place but not if it became an orphaned branch; developers must contribute back and be part of the open-source community to get maximum benefit. Also, developers need clarity about why they are using open-source; it should not simply be about price, but to harness innovation.



Stephanie Morton: Easier to resolve issues early in development lifecycle



Stephan Janouch: Advocated collaborations and organisational models



Jeremy Flann: Cyber resilience will become more important

The sharing of knowledge with other sectors was considered important. Lessons could be learnt from other users of critical systems about certification and safety requirements. Nesbitt suggested there was much commonality with cars and domestic devices; the only difference being cars move. He stressed the need to collaborate globally.

Hardware is still needed by SDVs for centralised processors, infrastructure such as platforms and software architectures supported by base software. Integrating software from multiple sources, testing and the like is the hardest problem but offers the greatest opportunities.

Nesbitt said future collaborative approaches needed a common set of tools.

Stephan Janouch, technical marketing director at Green Hills Software, said the SDV was not a technical problem, but a "management thing". He discussed the issues around over-the-air (OTA) updates and pointed out that potential customers were "scared" of complex technology, data privacy risks and vehicle pricing and insurance.

He grouped the management challenges into vehicle architecture, cloud connectivity, software focus and the development process. He suggested three soft aspects. First was in-house versus external collaboration. Then the need for customer focus; is this what the customer wants and can handle, and how to differentiate through software? Finally, there were the social aspects of sustainability, changing jobs, supply chains and software maintenance.

As a result, he advocated for collaborations and organisational models as manufacturing moves from a hardware focus to software. It raises issues around maintenance, infrastructure, product development and choices around strategic- or project-based collaboration.

High-performance computing is part of the shift to SDVs, according to Leo Hendrawan, field analysis engineer at QNX. He suggested it was needed, along with abstraction, to manage system complexity and integration. Ideally operating

Women in stem



Nagham Saeed

The conference considered issues for women in stem roles. Nagham Saeed, associate professor at the University of West London, suggested the challenge was around leadership roles despite the many women in the field.

Sarah Casey from NXP Semiconductors suggested it was still a male dominated environment so there was a need for women to build a network, find allies and people they can trust. Reem Bashir from Horiba Mira felt she had worked especially hard to prove herself and was often not heard in meetings. She was fortunate she had a good mentor and team leadership.



Sarah Casey

Assemgul Kozhabek, post-doctoral research associate at Heriot-Watt University, is a computer scientist and agreed about the need for good support. She was pregnant during her PhD; it could have been an issue, but her male supervisor was supportive, and she had good support from her husband and colleagues.



Assemgul Kozhabek

The panel agreed it was important to engage at primary schools and with families who do not always share the vision of women as engineers and scientists. The aim was to inspire girls as early as possible.



Leo Hendrawan: Operating systems should use microkernels rather than monolithic architecture

systems should use microkernels, rather than a monolithic architecture, which simplifies certification and enables scalability in real time, making cloud integration key to SDVs.

There could be a move from function-specific hardware, redundant software stacks and integration bottlenecks to modular systems, shared resources and scalable design, believes Andy Birnie, VP of systems engineering at NXP Semiconductor.

Birnie sees the SDV as a platform for third-party add-ons, which gives access to others to provide additional value. He sees extra value coming from data, and not just in the car industry. For Birnie this means there is a need to rebuild foundations and for OEMs to provide a work platform and, in the future, the supply chain will be more of a supply web.

Asked about the lifecycle of the SDV and its implication for future classics, Birnie suggested it would be customer driven. Janouch pointed out operating systems tended to be stable so little maintenance was needed, and Hendrawan suggested they would be a mix of open-source and commercial.

Janouch said lessons could be learned from aerospace, and Birnie argued that some processors nodes and boxes might be partially updateable, but control processors should largely be treated as hardware.

Hendrawan felt the West focused more on security and safety than China, but China was changing so there was a growing opportunity there. Birnie reiterated his point about data being an opportunity but connectivity, especially the lack thereof, would be an issue. Janouch felt suppliers did not need big software teams to create something great. Integration will be an opportunity as will customisation such as linking a hire car to a personal vehicle, tuning them to today's use, for example a quiet family day out or a track day.

As Paul Newton, from Aston Martin Lagonda, said, it would be "just like our phones".

As an example, in the Sams (Sunderland Advanced Mobility



Andy Birnie: SDVs are platforms for third-party add-ons



Björn Fallnich: Using AI to improve productivity and outcomes



Reem Bashir: Protecting in car computing



James Dickie: Replacing rule-based software with AI



Andrew Banks: AI and machine learning in embedded systems

Shuttle) Experience, a trial of an autonomous PSV in Sunderland, UK, a three-time passenger said: "It's just a bus."

The project used a safety driver, but autonomy worked well, and it got better as the vehicle learned to cope with changing characteristics such as varying weight. It managed deviations from its lane to avoid parked vehicles and other obstructions on familiar routes but it needed to be trained on new roads before it could divert from its original routes.

AI

Björn Fallnich, head of international software at Edag Engineering, explained how it had adopted AI and machine learning to enhance creativity and capability of software engineers especially before the coding stage. It is using AI to improve productivity and outcomes; it started by training AI using its own data.

The result is that 60% of development is by AI but only 10% for code generation. AI is used to support developers, for example generating 30% of test cases. Developers must deal with the AI results and for code generation they use AI co-working with human developers; AI is a tool not a replacement for the human.

Andrew Banks, technical specialist at LDRA, raised the challenges of using AI and machine learning (ML) for embedded systems. It seems there are no current standards; he suggested the latest was IEC61508 but its implied definition of AI and its use for fault correction rather than decision making covers a wide range of technologies other than the current view of AI and ML. He suggested it appeared to reflect definitions from the 1950s. The definitions that exist do not agree and standards are based on deterministic systems.

Like others, Birnie suggested developers should not trust AI as it was difficult to prove correct behaviour. He challenged universities to research how to prove AI and machine learning in the context of critical systems that needed certification. Birnie too believed there was a need for a mitigating human guardian to determine whether AI output was appropriate, so it could be validated by existing methods. In the meantime, data from third-party black boxes using AI and ML should be considered "tainted". Mitigation, such as safety drivers or as with developers, is important.

James Dickie, sales director at Etas, talked about enhancing ECUs with Tiny AI, for example replacing rule-based software with AI for parking sensors. It needs data scientists to work with embedded systems processors to find innovations for handling neural networks on resource limited embedded systems.

Reem Bashir, cyber-security project engineer at Horiba Mira, explained her recent PhD work on intrusion detection systems and creating an evaluation framework in line with UN155 for protecting in car computing. This is timely as it is a looming problem.

• Aesin (Automotive Electronic Systems Innovation Network) is a UK initiative focused on the accelerated and advanced delivery of electronic systems in automotive applications and infrastructure.

FIBRE OPTICS

RELAX

Pablo Blázquez and Óscar Ciordia explain how fibre optics can improve high-speed networks for modern vehicle EE architectures

Vehicle Electronics

The automotive industry is on the verge of a technological revolution, driven by the need for faster and more reliable data transmission. As vehicles become autonomous with a higher amount and more powerful sensors, the demand for high-speed communication networks within the car is a key aspect.

The future of the automotive market is focusing on the necessity of higher bandwidths to handle the vast amount of data generated by sensors and ECUs, and a clear need of the development of advanced electrical and electronic (EE) and zonal architectures.

Obstacles

Currently, the automotive industry relies heavily on copper links for sensor and back-bone communication within vehicles. While copper has been a traditional choice due to its availability and cost-effectiveness, it presents significant problems, particularly in terms of electromagnetic compatibility (EMC). Engineers often face major EMC issues, which complicate the design process and can lead to interference with other electronic systems in the vehicle.

Moreover, copper-based communication is inherently limited by both distance and the bend radius of the cables, reaching a theoretical maximum length of 15m, or even shorter in practical implementations. These physical constraints restrict the flexibility of vehicle design and can impact the overall performance and reliability of the communication network.

The current state of copper-based technology typically supports data transmission speeds of up to 1Gbit/s, which is becoming increasingly insufficient as modern vehicles demand higher data rates to accommodate sensors and communication between very powerful ECUs.

As the automotive industry moves towards more connected and autonomous vehicles, the limitations of copper links are becoming clearer. This has led to a growing interest in alternative communication technologies that can offer higher speeds, greater reliability and improved EMC performance.

Optical communication present in automotive for more than 20 years with Most technology is also promising to address these problems. Now, using bend-insensitive and automotive-qualified multimode optical fibre, it provides the necessary infrastructure to support the next generation of automotive communication networks.

	Electrical cables	Optical cables	Fiber Advantage
Diameter	3.8 mm	2.0 mm	48% smaller
Minimum Bend radius	58 mm	< 14 mm	4x smaller
Bend Cycles	< 100's	> 2 million	10.000x better
EMC Challenges	HIGH	Negligible	Negligible EMI
Weight	25 g/meter	9 g/meter	3x lighter
Carbon Footprint	14 kg CO_2 eg/km	4.6 kg CO_2 eg/km	3x lower
Cost	$ 1.00/m to $1.40/m	$0.70/m to $1.00/m	30% to 50% lower cost @ 10 Gb/s

Optical fibre cables provide several technical, economic and sustainability advantages Source: Corning



As vehicles evolve into autonomous systems equipped with more advanced sensors, the need for ultra-fast in-vehicle communication networks becomes increasingly critical

Optical

Transceivers compliant with IEEE 802.3cz for automotive multi-gigabit optical communications over multi-mode glass optical fibre (MM-GOF) links can, as a single chip, support data rates of 2.5, 5 and 10Gbit/s and include bridging functionalities to enable the connectivity of sensors, displays and processors within the vehicle.

These transceivers enable links beyond 40m with up to four inline connectors over standard duplex OM3 MM-GOF at 10Gbit/s across the entire automotive temperature range. This ensures robust and reliable communication even in harsh automotive environments.

The same cables and connectors can be reused for higher bit rates (25 and 50Gbit/s, and higher in the future), making these systems future-proof for evolving automotive needs.

The transceiver guarantees the highest component-level EMC compliance without the need for any external components. This translates into a communications port with a small PCB area and a reduced bill of materials, eliminating the need for ESD protections, common mode chokes, EMI filters or DC blocks.

They allow the aggregation of different sensors' traffic into a single optical channel. Aggregation may be done at the sender or receiver side to enable zone architectures or reduce host interfaces, respectively.

Replication allows the transceiver to replicate the same information through different channels, such as the optical channel and the electrical serdes. Replication may be used to provide higher levels of redundancy for critical safety links or multi-screen infotainment arrangements.

Space

Over the past three decades, Nasa has incorporated fibre optic technology into its space missions. Since its initial application in 1978, this technology has demonstrated reliability, operating seamlessly throughout the duration of missions without failure.

Fibre optic systems offer several advantages over traditional electrical technologies for transmitting data between spacecraft subsystems, including simplified integration, reduced risk of EMI and EMC issues, and a significant reduction in overall weight.

One of the most notable benefits of fibre optics is the ease of integration, which reduces the time required for assembly and testing, thereby reducing costs.

Unlike copper cabling, connecting a subsystem to a spacecraft using fibre optics is a more straightforward and cost-effective process. Prior to integration, the transmitter's power output and the receiver's sensitivity are thoroughly tested, while fibre optic cables are prepared, polished and validated for performance.

Advantages

Additionally, fibre optics eliminate issues related to ground



Fibre optics provide advantages over traditional electrical methods for data transmission between spacecraft subsystems

loops that frequently arise in electrical systems. Different sections of a spacecraft often have slight variations in ground potential, which can generate unwanted currents between modules. Such issues may cause previously functional systems to malfunction or produce erroneous data. By removing conductive pathways between subsystems, fibre optics resolve these problems, simplify the design process and enhance system reliability.

Another advantage of fibre optic is their immunity to EMI and compatibility problems. Electrical systems rely on shielded cables and meticulous routing to mitigate interference, whereas fibre optics naturally do not emit or absorb electromagnetic energy. This inherent property eliminates concerns about capacitance, signal degradation or ringing, further streamlining the design process and reducing technical complications.

From a physical perspective, fibre optics offer a significant reduction in weight compared with traditional electrical systems. This advantage becomes particularly pronounced when fibre optics are integrated into a standard bus architecture, removing the need for numerous point-to-point custom connections.

For instance, a traditional 10kg electrical harness comprising numerous shielded twisted pairs can be replaced with a fibre optic bus weighing a mere 0.1kg. These weight savings are primarily achieved through the adoption of bus structures and, secondarily, the use of fibre optic cables.

Moreover, fibre optic systems provide exceptional scalability. The same infrastructure designed for a 1Gbit/s transmission rate can easily be adapted to support 100Gbit/s without the need for additional fibres or modifications to the underlying architecture, ensuring flexibility for future enhancements.

Globally, fibre optics have become the preferred choice for telecommunications, replacing copper-based systems due to their better performance and cost efficiency. This transition is also gaining momentum in the automotive industry, where pioneering technologies such as Most have been supplanted by standards such as optical Ethernet 802.3cz.

In the aerospace sector, optical technologies have already established a strong foothold. Modern protocols can leverage advancements from the automotive industry to overcome technical and economic barriers, paving the way for exponential growth in space exploration projects.



Modern protocols break technical and economic barriers, accelerating the future of space exploration



An advantage of fibre optics is seamless integration, thus streamlining system assembly and testing to cut time and reduce costs

Conclusion

As the automotive and aerospace industries continue to evolve, the need for high-speed data transmission within vehicles becomes increasingly critical.

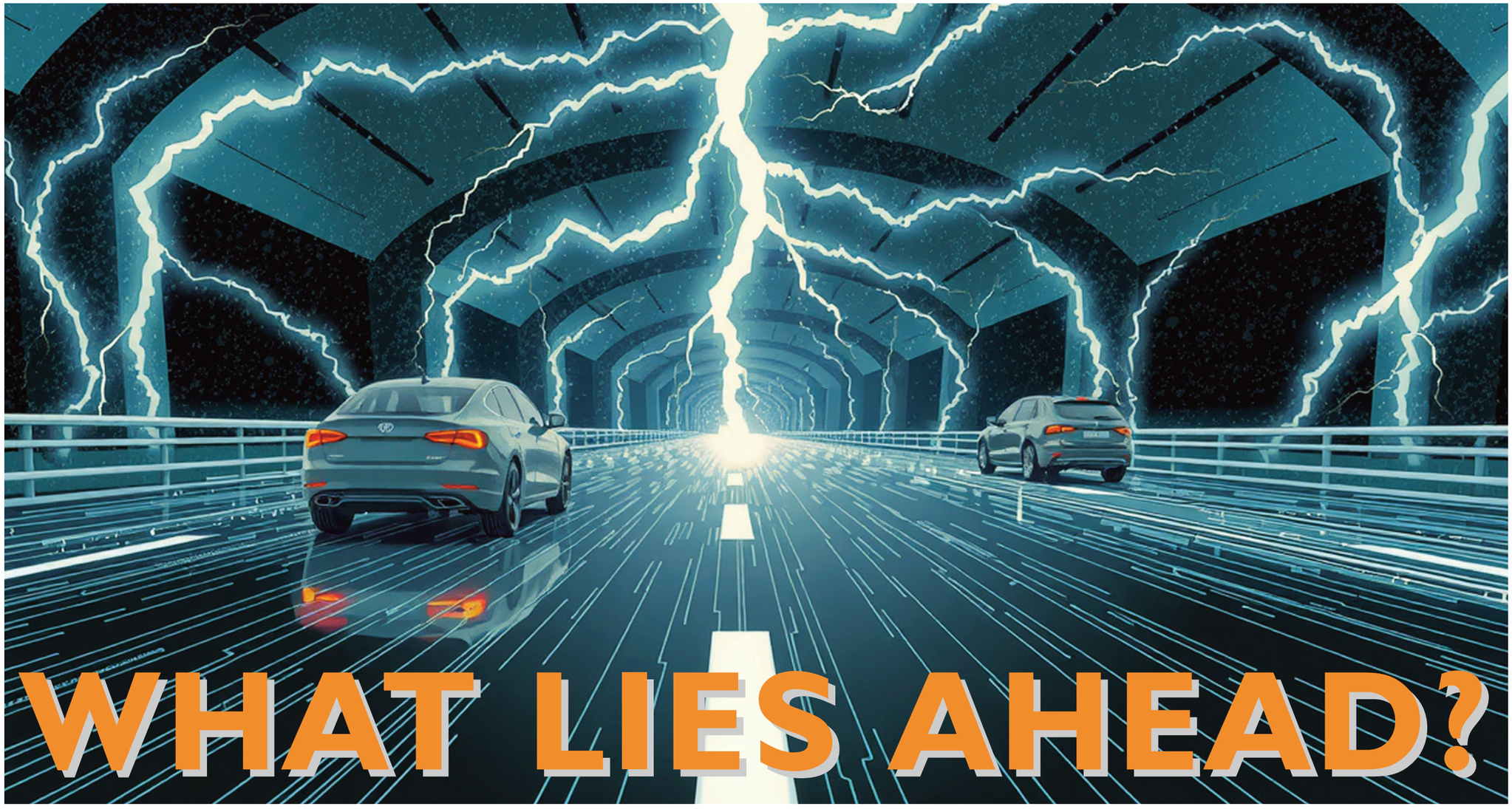
Transceivers based on IEEE 802.3cz represent a significant advancement in automotive communication technology, providing the necessary infrastructure to support future connected and autonomous vehicles.

By embracing 10Gbit/s speeds and beyond, the automotive market can a chieve the seamless integration of sensors, ECUs and other critical components, paving the way for zonal architectures that will support the future of mobility.



Pablo Blázquez is a business development manager and Óscar Ciordia is marketing and sales director, both of KD





WHAT LIES AHEAD?

Lily-Rose Schuett asks if invisible charging and personable cars are the future for automotives

Cars that wirelessly charge on the move, AI assistants to schedule in-vehicle meetings, and radar technology for advancing safety all boast the growing intelligence of automotive technologies. These latest technologies are bringing an engaging and forward-thinking future of driving into reality.

Hopping in and out of the car to plug in a charger soon may not be necessary with seamless and invisible charging for electric vehicles. Powerful coils fitted underground will be ready to provide energy to vehicles through magnetic resonance or inductive charging.

Parking up to do the shopping could mean an opportunity for the vehicle to charge without the driver needing to think about it, while smart grids can work alongside the vehicle's intelligence to balance the distribution of energy where needed.

Waiting for the car to charge up may also be eliminated, as cars could top up their batteries while on the move. Motorways could be fitted with charging zones so driving longer distances doesn't need to be a hindrance, and trips don't need to be planned around stopping for power.

Zero-emission driving will continue to be a target well into the future until all cars on the road are electric and give the environment a chance to breathe. The continuously developing Li-ion battery market is helping create the most efficient and safest electric vehicles.

Hydrogen

On-site electrolysers that produce green hydrogen fuel directly from water could make access to driving emission-free much easier. Hydrogen pipelines may also become more mainstream in the future to transport and deliver hydrogen fuel over extended distances for increased distribution. The potential range of fuel-cell vehicles of up to 1000km could also be revolutionary in extending driving periods without the need to refuel, though one day hydrogen canisters could be used instead of needing to locate a hydrogen pump.

Cleaner air to breathe in cities and a reduction in global transport emissions are two key benefits of emission-free driving. The increasing focus on sustainability, driven by developments in electric and fuel-cell vehicles, presents the future of driving as much more environmentally friendly and beneficial for the planet.

Car seats made from mushrooms and microbes could also become the latest trend in the spirit of growing sustainability, mimicking the feel, look and quality of regular leather while being much better for the environment. Upgrading the aesthetic of automotive interiors to enjoy long drives could therefore be guilt-free, achieved through more earth-friendly approaches.

Friendlier

Pre-ordering a coffee on the way to work could be done through the car, so it's quick and ready to collect without any fuss. Software-defined vehicles (SDVs) will enable passengers to engage with vehicles on a personal level, including the addition of AI as a digital assistant to facilitate biometric authentication

for payments.

Individual profiles can also be created by the AI assistant to memorise seat positions, climate preferences, favourite radio stations and colour preferences on the dashboard, allowing driving to become an instantly personalised and enjoyable experience.

The AI assistant feature will also be able to communicate with drivers when the car requires servicing, and where the nearest garage is on a preferred route, so the car's maintenance can be hassle-free for the driver.

Cellular connectivity will enable cars to complete over-the-air updates at night, ready for the morning commute. Connected car technology will also be a possibility, allowing for accurate, up-to-date driving maps as vehicles share information with each other about collisions or traffic jams en route.

Robots

Taking the car to be serviced could one day be a fun display of robots at work, with collaborative robots programmed to assemble dashboard components and maybe even carry out MoTs. Their ease of programming and flexibility could also see them welding and screwing car parts, or simply cleaning the car.

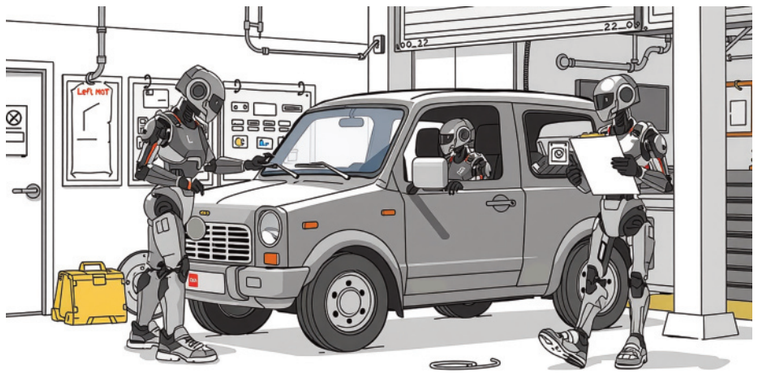
Autonomy

Cars taking themselves for a ride after dropping passengers off at their desired location may be a new reality with adas and autonomous driving systems. Vehicles could then return within minutes once summoned, like a chauffeur, showcasing the ease of movement that advancing automotive technology can bring.

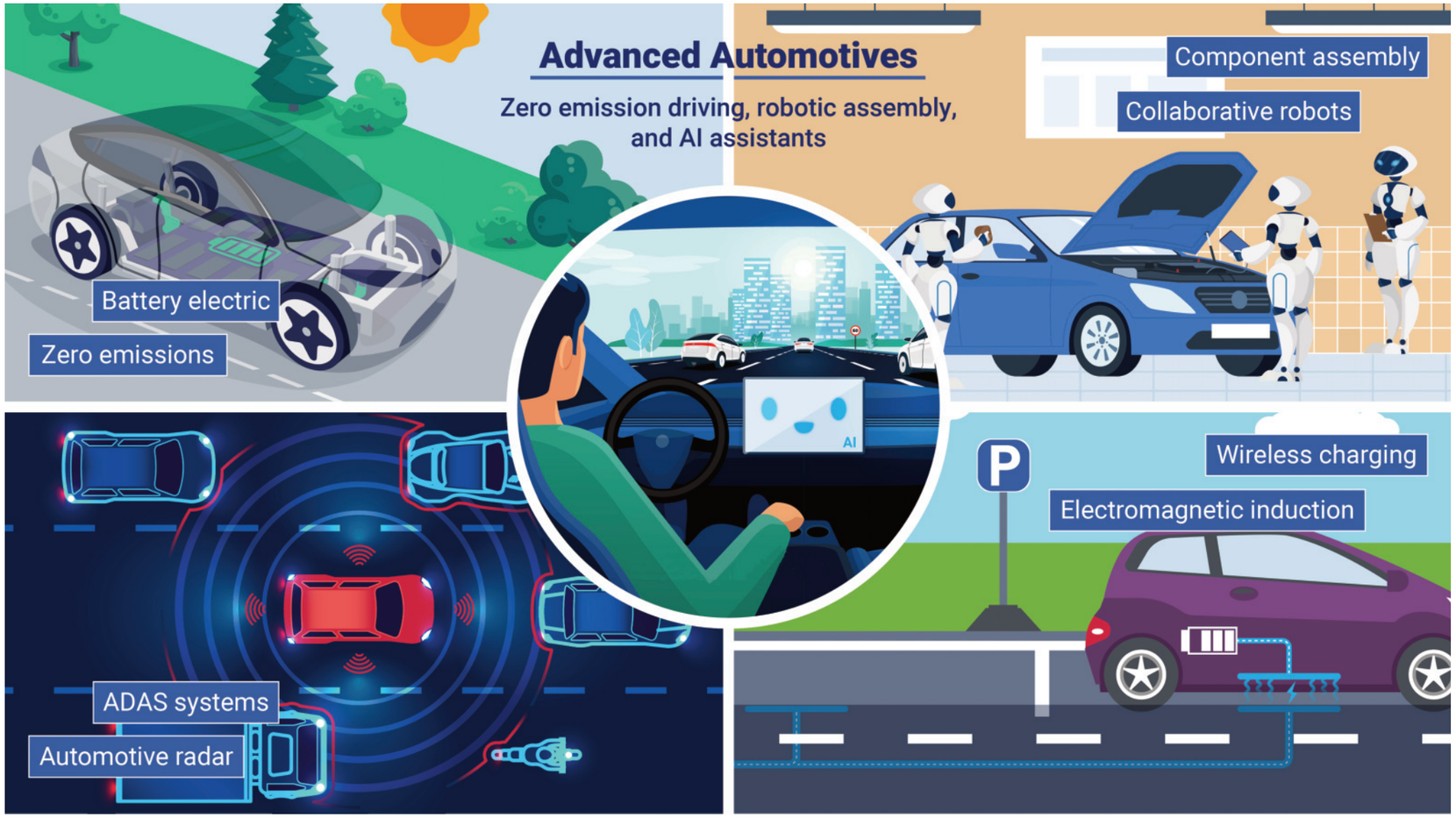
Cars will be able to navigate their own way around, knowing the streets like the back of their wheels with interconnectivity capabilities, with road-driving appearing to be synchronous and seamless.

For drivers who choose to remain behind the wheel, the windshield could become a holographic heads-up display, highlighting hard-to-see pedestrians or speed limits. As heads-up displays become more advanced in line with increasing vehicle autonomy levels, drivers can choose how much they want to engage with driving.

Taking the wheel for enjoyment and then dipping out to take a work call on the move could be done at the driver's discretion.



Cars could one day be serviced by robots



Technologies that can influence future driving

Radar

Automotive radars contribute significantly to autonomous driving, as they can keep vehicles in check and out of trouble while passengers enjoy the journey. Side radars have many jobs, including blind spot detection and lane change assist, which make sure nothing is advancing from behind or at the sides of the vehicle.

Reversing out of tight car parking spaces could also make leaving in a hurry less strenuous, as side radars can detect people or objects in close proximity.

Automatic emergency braking is also important in autonomous driving and uses front and side radars to detect whether people are on the road before the car has fully made a turn. This application demonstrates how different radars work together to achieve a shared goal, providing information back to the vehicle that can then communicate with the driver.

Safety

Falling asleep at the wheel won't need to be such a concern, as driver monitoring systems (DMS), which detect driver drowsiness, are expected to be required in all new vehicles by 2026. Occupant monitoring systems (OMS) could also be responsible for monitoring passengers' vitals, such as heart rate and breathing, or raising an alert when it suspects a child may be left in the car.

Both DMS and OMS will increase safety within vehicles so long journeys can feel less stressful, and parents can feel more at ease with young children in the back on hot days.

Detecting phone use, seatbelt engagement and attentiveness of the driver are possibilities for infra-red technology inside the vehicle.

Near infra-red systems can work in dark conditions, emitting their own light source to function, and can even gauge the alertness of drivers through sunglasses, so other passengers can relax knowing the driver is being taken care of.



Lily-Rose Schuett works for IDTechEx

PRODUCTION



clean UP

Elizabeth Norwood explains why no-clean doesn't always mean clean enough

No-clean fluxes and pastes were designed to streamline electronics assembly by cutting the need for post-solder cleaning. Because they leave behind only non-conductive, non-corrosive residues, they helped reduce cleaning steps, lower production costs and simplify processes.

This approach stays popular in many high-volume electronics sectors, however, in automotive applications – where assemblies face harsher conditions and higher reliability standards – residue-related risks are much more difficult to overlook.

Modern vehicle systems push electronics to their limits. Control units, power modules and safety systems are all packed with high-speed processors and compact multi-layered PCB assemblies (PCBAs). These assemblies run under extreme temperatures, often exposed to humidity, salt spray and vibration. And they are expected to work reliably for the lifetime of the vehicle, often in sealed systems that can't be serviced once installed. In these environments, the assumption that no-clean is always clean enough doesn't hold.

Residue

No-clean fluxes and pastes are designed to leave minimal residues, but the actual amount and distribution can be inconsistent. Factors such as

component density, board complexity and mixed-technology layouts all influence what's left after soldering.

On assemblies with fine-pitch components or tight gaps, residues can become trapped, particularly under low-standoff parts such as QFNs or BGAs. These residues may lead to leakage currents or electrochemical migration, especially in analogue, RF or high-impedance areas where trace contamination can affect performance.

While no-clean processes are allowed under IPC standards, manufacturers must ensure residues do not compromise the functionality or reliability of the assembly. In automotive applications, where reliability standards are particularly stringent and failures carry significant consequences, the allowable margin for error is extremely narrow.

What makes this more challenging is that issues caused by flux residue are often not immediate. They may pass inspection only to surface later after exposure to environmental stress, thermal cycling or voltage over time. These kinds of intermittent or latent failures are difficult to trace and expensive to resolve, especially once the assembly is coated or installed in the vehicle.

As a result, more manufacturers are cleaning no-clean assemblies selectively or across entire product lines where reliability risk is highest.



Vapour degreasing steps can be watched and recorded as part of process validation, which is increasingly important in sectors where compliance with regulatory standards must be shown

Inspection

Conformal coating is one of the strongest cases for cleaning no-clean assemblies. These coatings are used to protect PCBAs from moisture, dust, corrosive vapours and mechanical stress. But for coatings to work effectively, the surface underneath must be clean.

No-clean flux residue can cause problems with adhesion. Oily or waxy residues stop the coating from sticking properly to the board or the solder joints. Poor adhesion can result in delamination, trapping moisture or contaminants that undermine long-term reliability. Residues may also interact with coating during curing, leading to voids or cracking.

Inspection processes are similarly affected. Automated optical inspection (AOI) may misidentify residue as a defect, increasing false calls. In some cases, residue can obscure real solder joint issues. X-ray inspection can also be compromised, with residues distorting images or masking defects such as head-in-pillow or incomplete solder.

Assemblies free of flux residue enable more accurate inspection and more reliable coating outcomes, both critical in automotive electronics where traceability and validation are essential.

Cleaning

While no-clean stays attractive for its efficiency, many manufacturers now see cleaning as a way to manage risk. Cleaning adds a layer of control, helping reduce variability and improve consistency in downstream operations such as coating or inspection.

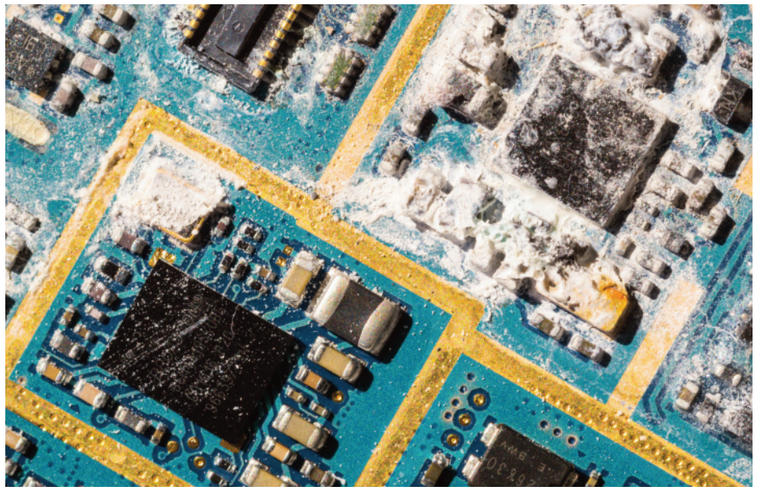
Some manufacturers clean only high-risk assemblies or before coating. Others clean all assemblies, particularly when production lines are shared across products. In either case, the goal is to keep consistent quality even when upstream variation exists.

Degreasing

Among available cleaning methods, vapour degreasing offers advantages in automotive manufacturing. Unlike aqueous systems, which require washing, rinsing and drying, vapour degreasing is a single closed-loop process where assemblies come out clean, dry and spot-free.

This method excels at cleaning tight gaps and low-profile components where water-based systems may struggle. It avoids introducing moisture, reducing corrosion or coating risks, and offers consistent, repeatable results with little manual handling, which is ideal for high-volume, high-spec environments.

Vapour degreasing systems also have a compact footprint, making them easier to integrate into space-limited or modular production layouts. Because vapour degreasing cleaning fluids are continuously distilled and reused, solvent consumption is low, and performance stays stable. This consistency supports compliance with the process controls, traceability and quality standards needed in automotive manufacturing.



Residues may lead to leakage currents or electrochemical migration that can affect performance

Fluids

Today's vapour degreasing fluids are a significant improvement over older chlorinated solvents. They are non-flammable, low toxicity and safe for most plastics, coatings and solder masks. They follow modern environmental standards and offer broad compatibility with automotive materials.

Crucially, these fluids are effective at removing difficult no-clean residues, including those from high-resin or lead-free formulations. Manufacturers can select fluids tailored to their flux chemistry without sacrificing compatibility or compliance. This flexibility is beneficial when cleaning is added to no-clean lines in a targeted or mixed-product environment.

Reintroduction

Adding cleaning to a no-clean process is not about reversing earlier efficiencies but about meeting tighter manufacturing and reliability requirements. As vehicle electronics become more complex and critical to performance, cleaning provides an added level of control.

It can reduce variability, help ensure compatibility with coatings and encapsulants, and improve the reliability of inspection methods.

It also offers a level of traceability.

Cleaning steps can be watched and recorded as part of process validation, which is increasingly important in sectors where compliance with regulatory standards must be shown.

As vehicles evolve with more electrification, automation and connectivity, electronic assemblies face growing reliability expectations. These systems depend on clean, stable electrical performance throughout the product lifecycle.

While no-clean processes streamline assembly and remain practical in many cases, high-reliability sectors such as automotive increasingly require added measures to reduce risk.

Vapour degreasing using modern cleaning fluids offers a controlled, scalable way to support no-clean strategies, helping manufacturers meet stringent standards for cleanliness, reliability and regulatory compliance in modern vehicle electronics.



Elizabeth Norwood is a senior chemist at MicroCare

PRODUCTION

PRODUCTION

Fadi Abro explains how additive manufacturing is accelerating the automotive industry's race to net zero



SHIFTING GEAR

Additive manufacturing delivers environmental and operational advantages to global car makers, allowing them to produce optimised parts efficiently and locally.

The automotive industry is accelerating to net zero, but there are more than a few bumps in the road. Despite publicly stated ambitions to reach that milestone by 2050, the OEMs and their suppliers must oversee a radical shift in manufacturing operations to reduce emissions from every aspect of the production process.

That challenge was highlighted in a recent report from consultancy BDO on the automotive sector. The Getting Ready for a Net Zero Future study revealed a high awareness of environmental responsibilities, with 93% of respondents believing the transition to net zero would be important for them in the long term. However, the report was laced with a tone of realism, with the respondents consistently noting the significant challenge ahead.

This sentiment is felt similarly across the rest of the automotive industry. And yet, there is hope. The BDO report indicated a



Joe Gibbs Racing dash insert

strong willingness to embrace and adopt new technologies on route to net zero. When questioned about where business investments would be focused for net zero initiatives, almost half said greater digital transformation.

Meanwhile, nearly a third of companies cited adopting green capital equipment and production. New manufacturing processes are clearly critical to greener automotive operations.

Sustainability

But what does that mean in reality? Which production-ready technologies can be deployed today to support the shift to net zero? Step forward additive manufacturing (AM). This transformative technology is finding increasing application among OEMs and the supply chain both as a prototyping and production tool as companies look to overcome problems such as the rising cost of materials and design restrictions from traditional subtractive parts production. The fact that AM also delivers multiple sustainability advantages makes it a compelling option.

So what are the sustainability advantages? The first is manufacturing closer to the point of consumption.

Car makers are well aware of the enormous carbon footprint of shipping parts by air or sea from halfway around the globe. By producing components closer to where they are needed, AM cuts down on those long-haul journeys and their considerable environmental footprint.

The decentralised nature of AM enables localised production, producing automotive parts closer to production lines.

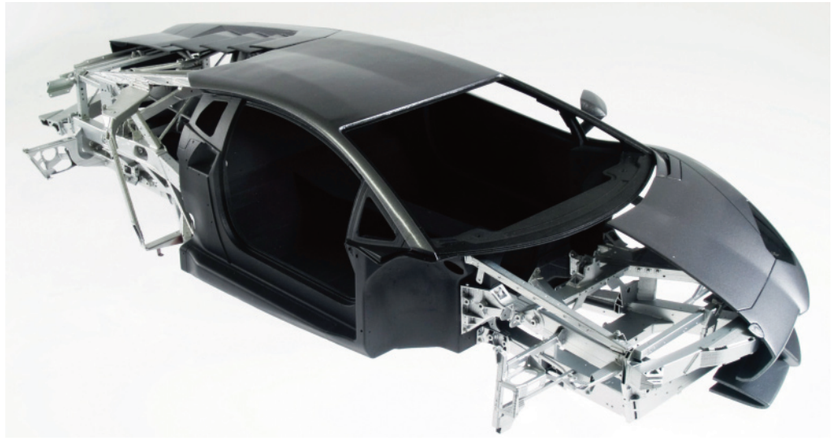
With AM, engineers and designers can create more intricate geometries and lightweight structures and consolidate them with innovative patterns that optimise performance and reduce waste. This approach translates to fewer resources consumed in parts production and fewer overall emissions.

Unlike traditional manufacturing, AM can cut down on waste and materials costs by up to 90%, producing items on demand with no moulds or excess waste. Decarbonising operations through AM requires time and resources for proper measurement, reporting and continuous improvement, but it is worth the effort as it offers efficiencies that traditional manufacturing methods, such as milling, simply cannot.

Automakers and suppliers can use AM to produce lighter, stronger components that improve fuel efficiency and reduce emissions.

Lighter components equal greater range, and this is a critical consideration for the more widespread adoption of electric vehicles. Furthermore, the design flexibility afforded by AM allows for consolidating multiple parts into single, complex structures, thereby enhancing overall vehicle performance.

AM also aligns with circular economy principles by reducing the need for inventory overstock. Traditional manufacturing often requires the production of surplus parts to account for potential demand, leading to overproduction and waste. In contrast, AM enables a just-in-time production model, where parts are produced as required, thus reducing excess stock and aligning with the reuse, redesign, repurpose and recycling ethos of the circular economy.



One-sixth scale FDM prototype of Lamborghini car

Additionally, using more sustainable materials in AM, such as bio-based thermoplastics, further bolsters the technology's environmental credentials.

Benefits

That's the sustainability case for AM in automotive. Other benefits are emerging, particularly around overcoming challenges of economies of scale associated with low-volume production that takes place with special editions and personalisation. Consumers are increasingly demanding vehicles tailored to their specific needs and preferences.

AM allows automakers to produce customised parts, enabling personalisation without compromising efficiency.

Meanwhile, the automotive aftermarket has emerged as a dynamic and growing market. AM is transforming this space by enabling the rapid production of customised accessories and performance parts.

From functional upgrades to aesthetic enhancements, this can provide a valuable means of differentiation in automotive.

With these factors in mind, it is no surprise that the AM market is growing at pace. A recent report states it will be worth an estimated $13.75bn by 2028.

Examples include Volkswagen using 3D printing machines to create complex multi-material PolyJet prototypes that mirror final production parts with up to 99% precision. This reduced the product development cycle by two months with full design freedom.



Roush 3D printed camera mount bracket

Meanwhile, Ford replaced a quarter glass alignment fixture with a fused deposition modelling (FDM) printed tool that was more ergonomic and lightweight. This approach meant weight savings of more than 15% and cost savings of 70% were achieved compared with traditional manufacturing.

Porsche has also used AM to fabricate on-demand customised spare parts, such as clutch release levers, using selective laser melting.

Finally, racing firm Roush Performance has deployed selective absorption fusion technology to print a grille camera mount design change late in the production cycle, reducing the cost by 94% and saving four months of time.

Future

In conclusion, the automotive industry has recognised that AM can help it navigate the journey to net zero through design flexibility, localised production, material efficiency, reduced energy consumption, and using repurposed, reused and recycled sustainable materials. It is also opening up use cases and streams of revenue through emerging approaches such as personalisation and customisation.

In short, AM is a genuine enabler of automotive innovation, delivering environmental and operational advantages that support a more sustainable tomorrow.



Fadi Abro is global automotive director at Stratasys

Diode controllers protect against reverse connections

Automotive-compliant 80V diode controllers from Diodes protect against reverse connections and voltage transients.

Typical applications include adas, body control modules, infotainment systems, exterior lighting and USB charging ports.

The controllers have all the features to implement an efficient and fast reverse polarity protection circuit. They also include a load disconnect function in case of overvoltage and undervoltage events.



With an 80V capability, they are suitable for all 12 and 24V batteries. This includes batteries in hybrid and battery electric vehicles, as well as the emerging 48V systems.

The ±80V rating is particularly relevant for the stricter overvoltage stress conditions associated with 48V systems.

Unlike ideal diodes with reverse current blocking features, these devices are suitable for applications where energy may return to the input supply.

However, they can also be configured as surge stoppers to protect overvoltage supply and downstream loads against unsuppressed load dump transients.

The controllers also support input voltages down to 3.2V, ensuring correct and reliable operation even during severe cold crank conditions, which can cause the battery voltage to drop significantly. Both devices share a peak gate turn-off sink current of 2.3A, enabling rapid turn-off of the external n-channel mosfets when required, say during overvoltage or undervoltage events.

When the charge pump is enabled, the operating quiescent current is 62μA, and 1μA in disabled mode. This reduces the overall power consumption of the system and reduces battery drain.

The AP74502Q has a peak gate source current, typically 60μA, which provides a smooth start-up with inherent inrush current control. This is advantageous in applications where limiting the initial current surge is important.

In contrast, the AP74502HQ has a higher 11mA peak gate source current, similar to earlier members of the portfolio. This stronger gate drive allows for a faster turn-on of the external mosfet, typically within 1μs.

They are available in the sot28 package with an operating temperature from -40 to +125°C.

Thermistor combines resin moulding with wire bonding

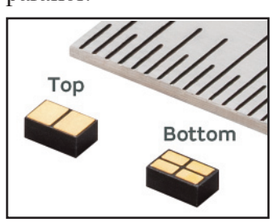
A resin-moulded thermistor from Murata has wire-bonding for enhanced automotive thermal feedback.

The FTI thermistor achieves resin-moulded design and wire-bonding compatibility in a single thermistor. The integration of these two technologies provides flexibility for designing and assembling PCBs, directly addressing the needs of EV inverters and DC-DC converters.

This eliminates the need for dedicated sensor mounting pads.

Leveraging proprietary external electrode bonding technology, the thermistor ensures reliable performance in harsh environments, with guaranteed operation up to +175°C for use in powertrains and other high-power modules.

By enabling precise and rapid temperature measurement directly adjacent to semiconductor devices, it allows for a reduction in temperature margins within a system's design. This means a power semiconductor's performance can be increased without over-engineering for excessive safety margins, creating opportunities to reduce the size of chips or the number of chips used in parallel.





Thin-film inductors

TDK has expanded its TFM 201612BLEA series of thin-film power inductors for automotive power circuits to higher currents up to 5.6A.

The two 2.0 by 1.6 by 1.2mm components have rated inductances of 0.33 and 0.47μH. Mass production began in July.

Inductors for power supply circuits must be compact, as they need to be installed within the limited space of ECUs. Reliability is crucial, for operating in harsh, high-temperature zones.

Compared with the conventional TFM-Alma series of the same size with an inductance of 0.47μH, this product achieves a 16% higher rated current of 5.6A and a 31% lower DC resistance of 22mΩ.

This helps reduce loss and improve efficiency for power supply circuits, enabling support for high-current applications within the same footprint as conventional models.

Upper operating temperature is +150°C.

Amps improve cockpit audio

Class-D automotive audio amplifiers from ST Microelectronics are for smart-cockpit applications. The HFDA80D and HFDA90D high-frequency automotive amplifiers complement the HFA80A analogue-input IC.

All the devices operate at a switching frequency of 2MHz to save PCB space and lower the bill of materials. Architectural innovations reduce the package pin count and external components.

The ICs deliver four 27W output channels from a 7 by 7mm exposed-pad-up LQFP48 package.

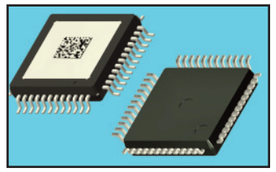
With their digital inputs, they ease integration, simplify design and save space by eliminating analogue conversion. The devices are said to increase audio clarity and elevate efficiency above the typical value for this type of device.

Configured and fully addressable through their I²C bus interface, they deliver high output power for in-car infotainment audio applications. Also featuring low audio-processing latency, they can be used in active noise and road-noise cancellation applications.

To handle the automotive electrical environment, the amplifiers are immune to pop and tick noise caused by battery variations and switching transients. The spread-spectrum modulation ensures native Cispr 25 class V compliance.

Diagnostics include in-play open-load detection, overcurrent protection, short-to-V_{cc} or ground on start-up, output diagnostics, and thermal warnings.

By including a digital admittance meter, as well as a load-current monitor in the HFDA90D, the amplifiers let designers customise the diagnostics as well as ensuring speaker linearisation.

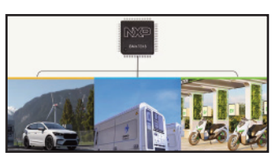


Li-ion battery cell controller has 18 channels

An 18-channel Li-ion battery cell controller from NXP is for EV high-voltage battery management systems (BMS), industrial energy storage and 48V BMS.

The BMx 7318 and 7518 IC family is based on an architecture that uses dedicated analogue-digital converters (ADCs) per channel.

The IC family meets automotive Asil-C and industrial Sil-2 functional safety certifications.



The family's chip architecture halves the need for external components, lowering costs for OEMs and tier-one suppliers by combining EMI immunity and a robust bulk current injection design.

It integrates analogue front-end, battery junction box and gateway functions into one chip, such as an I-sense or SPI2TPL bridge. And it supports semi-centralised BMS architectures.

The design achieves independence of the cell sampling channel, avoiding crosstalk and improving filtering accuracy. It supports a flexible layout of up to 18 cells and has an all-channel parallel balancing capability up to 150mA, supporting up to +125°C ambient temperature, with a single channel reaching up to 300mA, improving battery balancing efficiency.

A 5μA low power mode meets the needs of long-term storage and overseas transportation, and a dedicated hardware alarm pin speeds response to overcurrent events.

LED enables individual control for in-cabin lights

A tricolour LED from Vishay provides luminous intensity to 2800mcd at 20mA for interior automotive lighting, RGB displays and backlighting.

With separate anode and cathode connections for the red, green and blue LED chips inside its 3.5 by 2.8 by 1.4mm PLCC-6 surface-mount package, the automotive-grade VLMRGB6122 enables individual control of each chip, making it possible to realise every colour within the colour room defined by the gamut triangle area inside the CIE 1931 space through colour mixing.

With its wide colour range, the LED is for ambient lighting, switch illumination, status indicators and dashboard signal and symbol illumination in automobiles; large-format, full-colour message and video display boards; backlighting in consumer devices, home appliances, medical instruments and telecoms equipment; and accent and decorative lighting.

For these applications, the device uses the latest high brightness AlInGaP and InGaN technologies to deliver 70% higher brightness than previous-generation products in a package with a 22% lower profile.

Temperature range is from -40 to +110°C, which is 25°C higher than standard products, and Class B1 corrosion robustness. The LED is AEC-Q102 qualified, offers a moisture sensitivity level of three, and withstands ESD up to 2kV for red and 8kV for blue and green in accordance with JESD22-A114-B.

RoHS-compliant, halogen-free and Vishay Green, the device is compatible with IR reflow soldering and categorised per reel for luminous intensity, colour and forward voltage.





Clip-bonded package improves BJ transistors

Nexperia has expanded its bipolar junction transistor (BJTs) portfolio with 12 MJD-style BJTs in clip-bonded FlatPower (CFP15B) packaging.

The MJPE-series addresses the demand for more power-efficient and cost-effective designs in industrial and automotive applications.

Compared with traditional DPak-packaged MJD transistors, MJPE-parts in CFP15B are said to deliver board space savings and cost advantages without compromising performance.

The portfolio includes six automotive-qualified (MJPE31C-Q) and six industrial-grade types (MJPE44H11), with V_{CEO} ratings of 50, 80 and 100V, and collector currents of 2, 3 and 8A.

Both npn and pnp variants are available.

These BJTs complement Nexperia's CFP portfolio, which already includes Schottky and recovery rectifier power diodes, another step towards standardising footprints across multiple product categories streamlining PCB design and simplifying supply chains.

Used in diverse applications such as power supplies for battery management systems (BMS), on-board chargers in electric vehicles and backlighting for video displays, the CFP15B-packaged BJTs maintain equivalent thermal performance up to +175°C operation for automotive applications while offering a 53% smaller soldering footprint.

Furthermore, the clip technology of the CFP-15B package supports mechanical robustness while enhancing the electrical and thermal performance of these devices.

Modern CFP packaging technology, designed for multilayer PCBs, can offer equal electrical performance in a smaller footprint, helping reduce part and overall system costs.

Roof-mount unit integrates 18 antenna elements

A compact, multi-function combination roof mount antenna from Taoglas is for connected vehicle fleets across emergency services, utilities and commercial sectors.

The Patriot series integrates up to 18 antenna elements in one low-profile enclosure, delivering robust multi-network connectivity while reducing vehicle roof clutter and simplifying installation.

Originally developed for the Ford Interceptor, the existing vehicle OEM antenna can simply be replaced with the Patriot, while keeping the original antenna functionality, but also adding multi-radio connectivity.

This reduces the need for new holes to be drilled in the roof of the vehicle, simplifying and reducing installation time and cost.

Supporting 5G and 4G cellular (600 to 6000MHz), with both dual-band GNSS (L1 and L1/L5) and secondary GNSS (L1), wifi (2.4, 5.8 and 7.1GHz), SDARS (2.3GHz), and LMR and Tetra (380-400MHz and 700-900MHz), the series enables concurrent broadband, navigation, telemetry and voice services.

A dedicated whip element with full P25 VHF, UHF and 700-900MHz support is available in various lengths to meet frequency requirements.

Built on a flexible, scalable platform, the patent-pending Patriot can be tailored to application needs.

The full 17- and 18-in-one configurations are available now, with additional variants offering combinations of up to 18 integrated elements to follow based on requirements.

This modular approach lets organisations match antenna performance and connectivity to their operational needs while maintaining a consistent, proven mechanical design.

The rugged IK08- and IP69K-rated housing is 205mm long and 180mm wide with variable whip height between 60 and 164mm. It fits neatly between roof ribs, using the existing OEM mounting hole.

A custom-engineered foam gasket forms the seal between the antenna and the curved vehicle roof, for a seamless, secure and interference-free installation.

The aerodynamic design enhances aesthetics while reducing wind resistance. Black, white and other colours are available to match vehicle exteriors.

Signal performance across all supported bands has been engineered for optimal gain, isolation and efficiency. Cable types, lengths and connector options are customisable.



Editor and Publisher:
Steve Rogerson
editor@vehicle-electronics.biz

Advertising Manager:
advertise@vehicle-electronics.biz

Web Site Manager:
Martin Wilson
admin@vehicle-electronics.biz

Published by: Vehicle Electronics Magazine, 72 Westwood Road, Nottingham NG2 4FS, UK

Web site: vehicle-electronics.biz
Twitter: @velectronicsmag

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