VEHICLE electronics

The monthly magazine for automotive electronics engineers

VW in quest for AI ideas

Volkswagen has set up a separate company to identify artificial intelligence (AI) opportunities and bring them into the group.

The vehicle maker is looking at infotainment and navigation applications, speech recognition, extended vehicle functions, and the deep integration of digital ecosystems in the car.

These, it says, will bring benefits to customers, which is why it has established AI Lab, a company that will act as a globally networked competence centre and incubator.

AI Lab will identify product ideas for the group, and coordinate them internally. As the need arises, this will also include collaboration with the tech sector in Europe, China and North America.

By adopting this approach, VW intends to simplify collaboration with technology companies with a view to making optimum use of the innovation potential and speed of the AI sector.

"We want to offer our customers genuine added value with AI," said Oliver Blume, Volkswagen CEO. "We aim to link external digital ecosystems with the vehicle, creating an even better product experience. Collaboration with technology companies is crucially important for us."

VW sees considerable potential in high-performance speech recognition and services that connect users' digital environments with the vehicle. Extended vehicle functions include AI-optimised charging cycles for electric vehicles, predictive maintenance and the networking of vehicles with infrastructure, such as smart homes.

AI Lab will not manufacture production models, but will serve as an incubator for the group. The company will identify product ideas connected with AI and then develop promising concepts with partners to produce early prototypes.

AI Lab will have a team of AI experts and will work closely with all the brands.

"With AI Lab, we are combining technological expertise, flexibility and speed in collaboration with external partners," said Michael Steiner, R&D head at Volkswagen. "This will be crucial in the highly dynamic AI sector."

Exploratory talks on the first products are already underway with international tech companies.

Oliver Blume

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Renesas acquires Altium to increase collaboration

Renesas has acquired electronics design company Altium for approximately ¥888bn.

Renesas will use the acquisition to establish an integrated and open electronics system design and lifecycle management platform that allows for collaboration across component, subsystem and system-level design.

The acquisition brings together Altium's cloud platform with Renesas' portfolio of embedded technology, combining processors, analogue, power and connectivity.

The combination will also enable integration with third-party vendors across the ecosystem to execute all electronic design steps seamlessly on the cloud.

The platform should deliver integration and standardisation of various electronic design data and functions and enhanced component lifecycle management, while enabling seamless digital iteration of design processes to increase overall productivity.

This can bring faster innovation and lower barriers to entry for system designers by reducing development resources and inefficiencies.

"Development processes continue to evolve and accelerate," said Hidetoshi Shibata, CEO of Renesas. "Our vision is to make electronics design accessible to the broader market to allow more innovation through a cloud-based platform."

Altium will continue to be led by CEO Aram Mirkazemi as a wholly-owned subsidiary of Renesas.

"I strongly believe that electronics is the single most critical industry to building a smart and sustainable world," said Mirkazemi. "Renesas' visionary leadership and commitment to making electronics accessible to all resonates strongly with Altium."

Altium's began in 1985 in Australia as one of the world's first PCB design tool providers.

AI makes lorry driving safer

Connected transport firm Geotab has been working closely with fleets to tackle ongoing safety difficulties, and has announced fleet safety tools driven by data intelligence, predictive collision insights and AI.

The Geotab safety centre incorporates an AI-driven tool that helps fleet and safety managers find and manage problems in fleet performance. They can then focus their time on coaching and making operational decisions based on objective data, predictive collision analytics and peer fleet benchmarking.

This builds on the safety tools available from Geotab, which include its risk event reports, safety scorecard, video telematics, asset tracking, active insights, data connector, SDK and marketplace risk management.

"We understand the gravity of safety concerns in the transportation industry and are proactively taking steps ahead utilising the power of quality data and AI," said Sabina Martin, vice president at Geotab. "We're not just providing visibility into risks, we're helping companies predict and prevent them."

Cruise updates software after AV accident

Cruise has paused all driverless, supervised and manual AV operations

Robotaxi firm Cruise has updated its software following a report into an accident in San Francisco in October in which a pedestrian was seriously injured after being dragged two metres by an autonomous vehicle, see *Vehicle Electronics*, November 2023, page one.

The incident started when a hit-and-run Nissan driver struck a pedestrian and launched her into the path of a Cruise AV, which struck her. The AV, determining the collision to be a side impact with the pedestrian rather than frontal, pulled forward two metres and dragged the individual.

General Motors subsidiary Cruise hired engineering consulting firm Exponent to analyse the incident.

It found that leading up to the initial collision between the Nissan and the pedestrian, the AV accurately detected, classified and tracked both the pedestrian and the human-driven vehicle.

Secondly, the subsequent collision of the AV with the pedestrian was caused by the individual being launched into the AV's path of travel by the human-driven vehicle.

Thirdly, the AV incorrectly classified the collision with the pedestrian as a side-impact collision, which led the AV to perform a subsequent pullover manoeuvre to the outermost lane instead of an emergency stop.

In addition, while not a leading cause of the pullover movement, a semantic mapping error that failed to recognise that the AV was already in the outermost lane was a contributing factor.

The pedestrian was seriously injured in the incident and led to California suspending Cruise's driverless permit.

Cruise has voluntarily paused all its nationwide driverless, supervised and manual AV driving operations to take time to examine its processes, systems and tools and improve how it operates.

A separate report by Quinn Emanuel Urquhart & Sullivan accused Cruise's leadership of an us-versus-them mentality with government officials in the days following the incident.

This led to nine individuals leaving Cruise in December, including leaders from legal, government affairs, commercial operations, and safety and systems. In addition, Cruise's CEO, chief product officer and vice president of communications have since departed.

US consultancy offers ADB testing

Dynamic Research has developed capabilities for adaptive driving beams (ADBs) as the latest legislation from the National Highway Traffic Safety Administration (NHTSA) allows the technology to be used in the USA.

ADB lets a vehicle's high beams be used continuously as the system automatically adjusts the direction and intensity of the beam to prevent glare for surrounding traffic. This improves visibility for the driver and better illuminates vulnerable road users.

NHTSA has revised its headlight standard so vehicles in the USA can be equipped with ADB technology. This has been accompanied by a test procedure to evaluate the performance of these headlights.

"OEMs that have invested in ADB technology will be keen to exploit it in the US market and we have already seen a significant increase in demand for ADB testing in the region," said Nadine Wong, Dynamic Research director.

Dynamic Research has introduced test capabilities, including in-house designed lighting and sensor rigs, to conduct the dynamic test procedure at its test facility in California. The vehicle under test is precisely driven through a series of turn radii and speeds using AB Dynamics driving robots.

High growth forecast for driver automation

In 2030, 69.3% of all new passenger vehicle sales will have an SAE driving automation level of two-plus or higher, according to ABI Research.

The automotive industry, with major suppliers in artificial intelligence (AI), high-performance compute, mapping and location intelligence, is investing heavily in the development and deployment of assisted and autonomous driving.

In its latest whitepaper, ABI Research explains the broad spectrum of applications that will support drivers to drive more safely, take on specific tasks on the driver's behalf, or ultimately entirely replace drivers through the automation of the entire driving process.

"Different autonomous applications vary in features and the level of driver involvement," said James Hodgson, research director at ABI Research. "Some demand constant supervision, while others permit manual, visual or cognitive disengagement. Active safety systems offer limited support, keeping the driver fully in control. In contrast, driverless vehicles eliminate the need for human operators by handling all driving tasks autonomously."

Therefore, he said, the industry should adopt a scalable approach to their active safety, semi-autonomous and fully driverless applications.

"Maximising the re-use of components between different feature and disengagement combinations will yield many benefits," he said.

The whitepaper is called: "A scalable approach to adas and autonomous driving." It discusses the core role of safety rating agencies in making cars safer and driving the adoption of active safety.

"Overall, the only feasible approach to delivering on feature-rich and unsupervised automation is to construct today's supervised autonomous applications on an architecture that has the potential to scale by adding technologies that will replace the supervisory role that human drivers play today," Hodgson said.

R&S helps Autotalks verify 5G-V2X chipsets

Rohde & Schwarz and Autotalks collaborated to verify the world's first 5G-V2X chipset using the capabilities of the R&S CMP180 radio-communication tester.

Autotalks used test expertise and equipment from R&S to verify the performance of its third-generation V2X chipsets. The Tekton 3 and Secton 3 were verified using the 5G-V2X capability of the CMP180 radio-communication tester.

Fabless semiconductor company Autotalks is working with R&S to ensure the correct operation of 5G-V2X. This will let it provide the entire ecosystem with the latest V2X technology, a step on the path to enhancing vehicle communications and realising the safety and efficiency benefits of autonomous driving.

The tester is a non-signalling platform for wireless devices supporting cellular and non-cellular technologies. 5G-V2X test capability has been recently added, meaning the complete range of V2X technologies supported by Autotalks' chipset was able to be tested using one instrument.

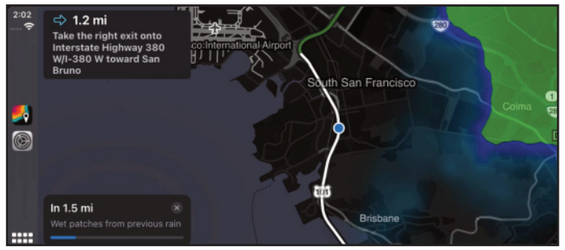
The single-box tester comes with two analysers, two generators and two-times-eight RF ports, plus the possibility to scale up by stacking several testers. This makes it suitable for simultaneous measurements of different technologies and devices in R&D and mass production.

The chipsets support all four V2X sidelink communication standards: LTE-V2X, IEEE 802.11p (DSRC) and the new 5G-V2X and 802.11bd.

These chipsets not only support 5G-V2X operation but can accomplish this while operating another radio technology. This means, for example, in Europe, where 5G-V2X is expected to be launched first, DSRC can be supported in parallel.

"Validation is a critical step in the product development cycle and a condition to an interoperable ecosystem," said Amos Freund, vice president at Autotalks.

R&S CMP180 radio-communication tester



MyRadar on Apple CarPlay

MyRadar forecasts weather on CarPlay and Android Auto

MyRadar, an app with more than 15 million active users, is putting its road weather forecasting technology on the road with the launch of CarPlay and Android Auto versions.

In addition to MyRadar's availability on phone platforms, MyRadar has also been added to Android's early-access programme to allow for the app to be offered in cars with Google built-in.

"We are excited to offer our users our proprietary road weather forecasting system, called RouteCast, directly through their vehicles," said Sarvesh Garimella, MyRadar's CTO. "Just because it's snowing doesn't mean the snow will stick to the road, and RouteCast uses not just atmospheric conditions, but surface data and road characteristics to improve safety and awareness for drivers."

With RouteCast, drive times are calculated, aligning forecasted conditions with future locations. In addition to over 15 atmospheric weather variables, the API delivers road temperature, cross-wind alerts and ten unique surface condition hazard classes for every point along the route.

Forecast updates are generated every 15 minutes for each point, route segment or connected vehicle GPS location for full continental US coverage. MyRadar also provides optimal departure time based on expected weather along the route.

MyRadar is also working with organisations to integrate with trucking and logistics fleets. When used with the MyRadar Windows app, RouteCast can help operations centres track vehicles and send optimised routes to drivers to reduce the risk of delays or incidents as a result of severe weather.

MyRadar's weather radar and weather warnings are included in the free version of the app. With the paid version, users gain access to RouteCast.

Arrow expands design centre in Egypt

Arrow Electronics and its engineering services company Einfochips have expanded their automotive centre of excellence (CoE) in Egypt to help customers develop automotive products.

The CoE helps with connected, autonomous and electrification technologies in the automotive industry.

The complexities associated with adopting such emerging technologies, including lack of in-house engineering talent with new age skills, stringent cyber-security compliances and intricate high-voltage designs, can cause problems.

With this in mind, Arrow's recent acquisition of Avelabs, an engineering services provider for the automotive industry, expands this CoE's capabilities.

Headquartered in Cairo, with offices in Germany and Michigan, Avelabs helps automotive OEMs and tier-one suppliers accelerate product development, with its expertise in Autosar, functional safety and cyber security.

With the enhanced capabilities, the CoE aims to let innovators navigate the complexities of automotive electronics design.

"The migration towards electric, autonomous and connected vehicles will accelerate electronic content in automobiles, as well as automotive engineering services spend," said Rick Marano, president of Arrow's global components business. "The automotive CoE in Egypt, augmented by our acquisition of Avelabs, complements and expands upon our existing engineering services provided by Arrow and Einfochips. This will further strengthen our value proposition for our customers and suppliers in the transportation segment."

Verge gives sight to flagship motorbike

Electric superbike maker Verge Motorcycles has updated the hardware and software of its flagship TS Ultra model.

The motorcycle now has six cameras and high-resolution front and rear radars.

In November, the company unveiled its Starmatter software and intelligence platform with four different elements: automatic over-the-air (OTA) updates, sensor technology, artificial intelligence and a human-machine interface (HMI). This package has been completed with the Starmatter machine vision.

"Verge is making riding even smarter and safer, for example by improving the rider's ability to observe the environment and the functions of the bike with the help of artificial intelligence and machine learning," said Verge CTO Marko Lehtimäki. "The TS Ultra's new cameras combined with the software update make it the world's first motorcycle equipped with the sense of sight, advising the rider and acting as a whisperer while riding."

With the updated hardware and software, the bike analyses the environment and notifies the rider, for example, of a vehicle approaching from behind or if it changes lane.

The display on top of the tank is larger than before, which makes it easier to use. The Starmatter Dash display and user interface change the way the rider interacts with the bike.

The dash makes managing essential functions easier and more intuitive. It informs and warns of potential hazards and it displays the image from the rear-view camera when the rider uses the turn signal.

TS Ultra motorcycle with updates

Aston Martin Formula One gets SentinelOne security

The Aston Martin Formula One team has extended collaboration with its official cyber-security partner SentinelOne to leverage its AI-powered products to run securely on and off track.

The company has been working with Aston Martin since it returned to Formula One in 2021.

The team is extending this collaboration in a multi-year agreement that sees SentinelOne at the heart of the team's efforts to drive safety, security and success on and off the track at the AMR Technology Campus.

Aston Martin Aramco will use the SentinelOne Singularity platform, to improve its approach to cyber security and keep its operations secure in an ever-evolving threat landscape. The same technology has been used in the Aston Martin Lagonda since 2018.

Data are the lifeblood of Aston Martin, and the team handles vast amounts across a sprawling and complex infrastructure. To stay competitive, all these data must be fully secured.

SentinelOne delivers AI-powered security that allows the team to see around corners and act on its data to protect every endpoint, IoT device and cloud workload with intelligence and speed.

SentinelOne is Aston Martin security partner

"Cyber criminals today move fast and, with SentinelOne as our official cyber-security partner, we can move faster to protect ourselves," said Clare Lansley, chief information officer at Aston Martin. "SentinelOne provides Aston Martin with a powerful platform that is a game-changer, as our team pushes the limits of performance."

Sally Jenkins, chief marketing officer at SentinelOne, added: "We are pleased to bring two world-class brands together and build on the successful partnership with Aston Martin. AI has opened the door to a new and increasingly sophisticated set of threats to the enterprise, and cyber criminals are using it to execute attacks with unprecedented speed. As their official cyber-security partner, we can put the team in pole position and take their security to new levels."

Denso, Sony and Toyota fund TSMC fab

Denso, Sony and Toyota are funding a second manufacturing fab for Taiwanese chip maker TSMC in Japan.

The companies are investing in Japan Advanced Semiconductor Manufacturing. (JASM), TSMC's majority-owned manufacturing subsidiary in Kumamoto prefecture, Japan, to build a second fab, which is scheduled to begin operation by the end of 2027.

Toyota will also take a minority stake.

Together with JASM's first fab, which is scheduled to begin operation in 2024, the overall investment in JASM will exceed $20bn with support from the Japanese government.

Construction of the second fab is due to start later this year.

With both fabs, the Kumamoto site is expected to offer a total production capacity of more than 100,000 30.5cm wafers per month for automotive, industrial, consumer and HPC applications.

The capacity may be adjusted based on demand. With both fabs, the site is expected to create 3400 high-tech jobs.

Eatron and WMG algorithm estimates battery life

Eatron Technologies and WMG at the University of Warwick have developed an approach to estimating accurately an electric vehicle battery's remaining useful life, helping unlock additional performance and range, and increase safety.

Developed with funding from the Faraday Institution, the Viper project combines WMG's electrochemical models with Eatron's cloud battery management and integration expertise to deliver remaining useful life (RUL) estimates that are more than 90% accurate.

The condition and performance of a battery change as the cells within it age. If this natural degradation is not monitored closely, it can lead to cell failures.

Traditional RUL estimates often rely on simple voltage-based analytics that may miss complex failure conditions, potentially risking the safety of consumers, while others that err on the side of caution may result in perfectly healthy battery packs being rendered unusable.

By accurately predicting a battery's RUL, it becomes possible to extract more performance and longevity without compromising safety.

"Unlocking the hidden capacity of a battery has the potential to increase an EV's usable range and extend its lifetime," said Eatron CEO Umut Genc.

The technology can be embedded in an automotive-grade battery management system (BMS) or deployed across a cloud-based platform, which is particularly appealing for fleet applications.

In addition, when an automotive battery is redeployed into its second life, it can be accompanied by an accurate picture of its health in the form of a battery passport that negates the need for expensive testing and increases the breadth of its operating window.

Infineon and GF sign multi-year supply deal

Infineon and GlobalFoundries have announced a multi-year supply agreement for the Aurix TC3x 40nm automotive microcontrollers as well as power management, connectivity and security products.

The additional capacity will contribute to secure Infineon's growth from 2024 to 2030.

Infineon and GF have been partnering since 2013, developing automotive, industrial and security semiconductor technology and products.

At the centre of this collaboration is a reliable embedded non-volatile memory (eNVM) technology that is suitable for mission-critical automotive applications while meeting the safety and security requirements for vehicles.

Infineon's flagship Aurix microcontroller family already drives the transition in the industry towards autonomous, connected and electrified vehicles.


Niels Anderskouv

"With this long-term agreement, Infineon further strengthens the supply of semiconductors that are driving decarbonisation and digitalisation," said Rutger Wijburg, chief operations officer of Infineon. "As demand continues to accelerate for automotive applications, our goal is to deliver high-quality microcontrollers with enhanced connectivity and advanced safety and security. Our Aurix microcontrollers are a key ingredient for dependable electronics as we move towards a world with all-electric, all-connected, user-centric, autonomous cars."

Niels Anderskouv, chief business officer of GF, added: "Our collaboration with Infineon delivers differentiation and innovation in automotive spanning two continents, and this long-term agreement provides Infineon with additional manufacturing for a more resilient supply chain."

UL grants Microchip cyber-security certification

Underwriters Laboratories (UL) has awarded Microchip certification to the ISO/SAE 21434 road vehicle cyber-security engineering standard.

Designing with certified security products can help tier ones and OEMs prove cyber-security risk management compliance.

ISO/SAE 21434 sets requirements for road vehicle cyber-security risk management processes. These requirements help regulate automotive products across the product lifecycle from concept through design, production, maintenance and decommissioning.

The specification has 45 security categories or work products, each of which specifies requirements that encompass all aspects of designing electrical and electronic systems for road vehicles, from ICs and software to firmware and libraries.

It also confirms that a certified corporate cyber-security management system is in place.

Stakeholders involved in the product lifecycle are required to complete cyber-security training and meet designated qualifications.

A threat analysis and risk assessment methodology is also incorporated at multiple stages of the product lifecycle.

"Security is a core pillar at Microchip and the ISO/SAE 21434 certification is proof of our dedication to maintaining high standards in automotive cyber security," said Matthias Kaestner, corporate vice president at Microchip. "Our customers can be confident that Microchip is a trusted security advisor with the appropriate expertise to guide them through their automotive cyber-security design journey."

Those using ECUs that incorporate Microchip's security products, designed in the ISO/SAE 21434 certified process framework, can be relieved of reviewing thousands of pages of process documentation to determine compliance.

HUD works whatever the weather

First International Computer (FIC) has developed an augmented reality (AR) head-up display (HUD) to help drivers pay more attention to the road.

Based on laser beam scanning (LBS) technology, the AR HUD can work in various conditions, including direct sunlight, night, cloudy, heavy fog and even on a rainy day.

The LBS technology features high contrast, high brightness and low power consumption.

It provides a high-resolution image with a field of view (FoV) angle from 6 to 42 degrees and a virtual image distance (VID) of 3 to 50m.

Seven algorithms are designed to integrate with the road and traffic environment, combining the virtual and the reality together to make driving safe and convenient.

In addition to navigation, vehicle speed, vehicle information and adas information, the HUD includes driver monitoring and driver behaviour systems.

The trucks can adapt swiftly and safely to various road conditions

Gatik integrates Goodyear tyre intelligence in self-driving trucks

Autonomous logistics company Gatik has integrated Goodyear tyre intelligence technology into its autonomous driving system.

Gatik's autonomous fleet, consisting of Class 3-7 box trucks, has made strides in enhancing the safety, accuracy and overall performance of autonomous vehicles (AVs).

Goodyear Endurance RSA tyres and Goodyear SightLine technology help Gatik advance the safety and overall accuracy of its fleet operations, while improving delivery uptime and reliability.

This year, Gatik plans to implement the intelligent tyre technology into a significant portion of its autonomous fleet across the USA and Canada.

"Being the vehicle's only contact point to the road, the tyre can play a pivotal role in enabling the vehicle to react like a driver would," said Chris Helsel, senior vice president at Goodyear. "By providing real-time insights through intelligent tyre data, we can support Gatik's autonomous driving system to become even more safe, reliable and efficient."

Through on-road testing in various real-world driving scenarios, tyre intelligence data regarding road conditions and tyre health have helped Gatik advance its AV controllers with insights about accurate cornering, braking stiffness, rolling resistance and tyre load.

These data, which are communicated between SightLine and Gatik's autonomous driving system through a real-time feedback loop, have enabled Gatik to yield numerous performance enhancements, including the ability to adapt swiftly and safely to various road conditions, even when the mass or payload of the truck varies by delivery.

"The real-time data derived from intelligent tyre technology not only enhance the safety and predictability of our autonomous vehicles, but also enable us to maintain high levels of efficiency, reliability and delivery uptime throughout our operations," said Gautam Narang, Gatik CEO.

The companies have partnered to test the technology at Goodyear's San Angelo, Texas, proving grounds.

Gatik wants to ensure its autonomous vehicles are tested extensively in a safe, closed course environment for common and unusual road scenarios, including traffic lights, road signs, evasive manoeuvres, tight turns, collision avoidance, precise lane keeping and minimum risk stopping distances.

Goodyear and Gatik plan to incorporate predictive road condition monitoring into the autonomous driving system.

Automotive semiconductors to see 12% CAGR

The global automotive semiconductor market is expected to see a CAGR of 11.97% from 2022 to 2028, according to Research & Markets.

Leading vendors include Bosch, Continental, Infineon, NXP, Denso and Renesas.

IGBTs and silicon carbide (SiC) devices are critical for efficient power conversion and energy management in electric vehicles.

However, the shortage of semiconductors is a significant problem affecting the industry.

Continental enables two-stage face recognition access control

Continental is enabling face authentication for two-stage access control based on biometric user recognition from cameras mounted externally on the vehicle's B-pillar and invisibly behind the driver display console.

Thanks to biometric face authentication, the vehicle opens and starts as soon as it detects a registered user. It detects attempted deception thanks to liveness detection from Trinamix, a provider of biometric technology and a subsidiary of Basf.

So as not to spoil the design of the vehicle interior, Continental has positioned the camera behind the driver display console, which enables a frameless screen surface.

A camera with biometric authentication in the interior checks whether the person in the driver's seat is authorised to start the vehicle. Other digital services, such as a payment function, also have this feature.

The high-contrast OLED display has been adapted so the optical components can detect people through the pixels of the activated display. The integrated sensors include the functionality of reliable attention and fatigue detection.

"For us, user experience is defined not only by functional and technical aspects, but also by aesthetic appeal," said Continental's Boris Mergell.

Facial authentication also makes it possible to open the driver's door without a key or other means. Thanks to Trinamix, the vehicle can be unlocked solely by authentication of the driver.

A camera in the B-pillar not only checks the visual match with a known user, but also allows for the recognition of real skin. Double authentication in the exterior and interior protects against theft and makes it possible, for example, to grant family members access to the car at any time, while preventing children from starting the engine.

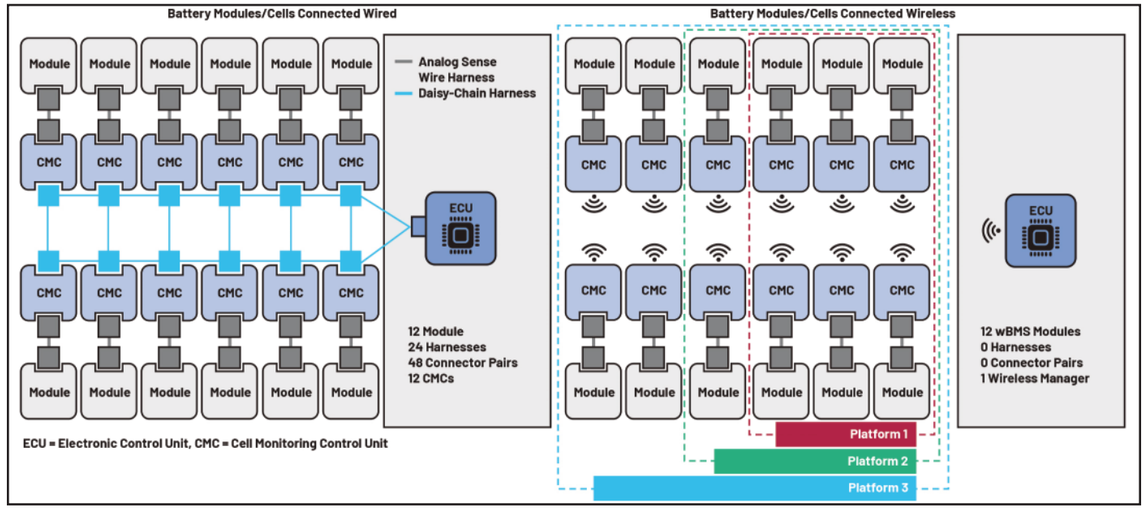
The technology can distinguish real skin from AI-generated images

An additional display in the B-pillar lets the user interact with the vehicle. In addition to unlocking the doors, the charging progress of an electric car can also be displayed on the exterior as the user approach the vehicle.

When not in use, the display, which is seamlessly integrated into the B-pillar, is not visible and can be thus integrated into the design concept. This means the In2Visible technology developed by Continental is also being used in vehicle exteriors for the first time.

"Transferring our technologies from the interior to the exterior is a logical next step if this allows us to incorporate additional safety aspects and convenience functions," said Mergell. "By extending our UX portfolio to the exterior, vehicle manufacturers and end users will benefit in equal measure from intuitive new interaction options."

Distinguishing real skin from other materials prevents the vehicle from being unlocked using a realistic mask, AI-generated images or similar.



Multicomponent wired BMS network (left) and simpler arrangement using wBMS technology (right)

ADI builds EV battery data ecosystem

Analog Devices (ADI) is working with OEMs, tier-ones, battery makers, energy utilities and other stakeholders to build an information ecosystem from EV battery data that has never before been possible.

The combination of forward-looking government policies, technological advances and the automotive industry's commitment to sustainability are forces to accelerate mass market EV adoption. Yet EVs are still not affordable for many, while for others their perceived value is unclear.

Government economic policies can support the EV agenda to a point but, with innovation in electrification technology across transportation and the energy grid, business services can lead the way in breaking down the remaining barriers to EV adoption.

ADI's Recharge portfolio of electrification options is empowering the automotive value chain, including car and fleet owners, OEMs and tier-ones. Recharge includes options for battery technology, on-board chargers, power management and isolation technology.

Central to this is ADI's battery management system (BMS), including hardware and software drivers and tools, that supports over-the-air updates and achieves cybersecurity qualification.

Both wired and wireless operations are supported with ADI's networking protocol. This not only enables OEMs to scale EV designs to their fleets, but it also brings secure intelligence at the edge to the battery cells.

It transforms the battery pack into a software-defined platform, and the vehicle into a secure, connected, edge node.

ADI is helping forge an ecosystem where the value chain can leverage real-time battery data insights and deploy innovations that will drive better outcomes for EV vehicle and fleet owners by improving the lifetime value of the battery, and the EV's operational performance.

Intelligent sensors at the battery cells gather data wirelessly into a central management platform, which presents the processed insights to the BMS ECU.

ADI provides a production-grade software block from where the insights can be accessed, and the platform can be reconfigured via simple APIs.

The first and most critical IC connected to the cells is ADI's seventh-generation cell monitoring sensor. This adds features that enable data insights. It can accurately analyse the battery charging state and health.

The IC's embedded software controls the sensor operation and processes the data to feed ADI's insights algorithms. These algorithms generate insights that can be used for applications such as fast charging and increased range, by estimating the state of charge (SoC) more accurately.

Algorithms fuse the processed data from multiple edge nodes to create battery pack and vehicle-level insights.

DRIVER ASSISTANCE

SECURITY LESSONS

Jill Britton explains how to secure software code development for driver assistance systems

More than a quarter of automotive software developers are working on advanced driver assistance systems, or adas. This demonstrates that these systems have become the norm on many modern road vehicles, whether as standard or optional extras.

However, the critical role adas plays in improving road safety also brings the need to ensure these safety-critical systems are reliable, safe and secure.

That must start with adhering to stringent standards and processes.

Adas depends highly on software development, which is known to be one of the leading causes of vulnerabilities that can subsequently cause system malfunction or malicious cyber attacks. So, it is essential the software development process considers security in all phases, as these vulnerabilities can be introduced at any time. For example, this may be during code development or the introduction of third-party libraries.

Buffer overflows are a major cause of security vulnerabilities, as they can lead to code corruption or software being read from or written to memory locations outside the buffer boundaries. Another example is where an attacker uses an input validation flaw to inject code that is then interpreted as code, leading to changes in how the programme is executed.

Challenges

The most common software programming languages used by adas developers are C and C++, but these bring their own challenges. They provide more room for innovation, but that also brings more scope for interpretation. Even developers with many years of experience may accidentally introduce errors that can become security risks.

Another difficulty is software is becoming increasingly complex and diverse going beyond the drivetrain to manage IoT connectivity and infotainment. These systems are increasingly interconnected, especially with the trend towards having several systems on the same ECU.

There are also specific requirements to meet for adas categorisation based on levels of automation, where each level brings a further level of complexity and subsequent demanding requirements. Level zero is no driving automation, not even lane-keeping assistance or cruise control. In contrast, level five is full driving automation – the autonomous vehicle.

Standards

While these are major problems, established methods can assist software developers, including standards such as ISO 26262, which addresses risk-based functional safety for electronics and electrics in vehicles, including adas components.

ISO 26262 identifies processes required throughout the lifecycle and includes automotive safety integrity levels (asils). These measure the risk of each component and the processes that must be followed during development

Safety of the intended functionality, or sotif, is covered in ISO/PAS 21448, another

DRIVER ASSISTANCE

standard applicable to adas and usually applies to adas level one. Sotif covers safety hazards resulting from functional insufficiencies, other system limitations or potential misuse by the driver. For example, the sensors on a vehicle fail to identify an icy road and therefore not take the correct action.

Another relevant standard is ISO 21434, which focuses on security, unlike the previous two safety-focused standards. It addresses cyber-security risks in electronic systems of road vehicles across the whole software lifecycle, from development to decommissioning, and encourages a culture of security at all levels.

ISO 21434 is becoming more important and widely used within automotive development as was seen in a recent automotive survey where more than three quarters of participants expect to comply.

Guidance

These standards have specific requirements for software compliance, which are best served by the use of coding standards. In fact, ISO 26262 and ISO 21434 require the use of a coding standard, although they do not specify which one but do give examples of Misra and Cert.

Coding standards are sets of guidelines that draw on the expertise and experience of industry experts, helping provide their peers with best practices that assist in making code safe and secure. In practice, they can identify and eliminate vulnerabilities while code is being written.

For instance, a coding standard rule might say something like ‘do not form or use subscripts or out-of-bounds pointers’, which will ensure that an input buffer cannot overflow.

Probably the most popular coding standard in the automotive industry and in embedded software generally is Misra, covering software development for critical systems written in C and C++.

Both Misra C and Misra C++ were updated in 2023 to provide guidance for the latest versions of the languages.

Another potential candidate for adas is Autosar C++14, initially designed to be used with the Autosar Adaptive platform for connected and autonomous vehicles with a focus on safety.

Software development must consider security in all phases

Software is becoming increasingly complex and diverse

As far as security is concerned, the Cert coding standards are widely used in multiple industries and cover C, C++ and Java plus the latest addition of Android.

In addition to enforcing coding standards, vulnerability checking is an essential part of secure software development, as new vulnerabilities may be found at any time. CWE lists are a useful resource for the types of weaknesses that may result in vulnerabilities.

Enforcing

However, coding standards can take time to apply manually, creating unwanted additional workload for development teams. This is why an increasing number (over 40% according to an automotive survey) also use static analysis tools. These software applications run in the background while code is being written, looking for violations of coding standard rules and then raising alerts if any are found.

Beyond being used to support coding standards, static analysis tools help developers understand what clean code is, leading to better software development practices and higher-quality code in general.

Of course, testing code later in the software development process is standard practice and an essential part of delivering software that is robust, safe and secure. However, identifying vulnerabilities and coding standard violations at an earlier stage gives developers early feedback and is also typically less costly and time-consuming to fix than at a later point.

Commitment

Developing code for adas requires creating a security-focused culture. This means making everyone aware of their role in mitigating security risks and providing regular training, giving developers appropriate tools and involving them in the selection process.

A security-first culture also needs to be top-down, with senior management backing the need to give development teams help. Increasingly, this means investing time and effort into automating as much of the software development lifecycle process as possible so developers can focus on creating great code, knowing the software they are developing is reliable, safe and secure.

With software in adas becoming more complex and codebases larger, plus the increasing interconnection with components in road vehicles, now is the time to put foundations for secure best-practice software development in place.

Jill Britton is director of compliance at Perforce

DRIVER ASSISTANCE

Wayne Lyons discusses how data for adas are aggregated through processing and distribution

DATA STREAM

DRIVER ASSISTANCE

Advanced driver assistance systems (adas) are known to deliver multiple benefits including reduced driver stress and fatigue and improving road safety. Systems such as automated parking and traffic-jam assist make journeys more comfortable, while others such as forward collision warning, automated emergency braking and automated emergency steering can help avert road-traffic accidents.

The sensor fusion concept is widely acknowledged as an enabler of adas within the automotive sector. A driver of this is the amount of innovation in vehicle-based systems such as radar, lidar and camera technology.

These systems and the huge volumes of data they produce must be brought together to provide a single source of truth.

Arguably, the description of sensor fusion is an oversimplification. Building a complete system that communicates with the driver and interacts with the vehicle involves more than sensors and systems talking to each other. It is more helpful to view this process as data aggregation through processing and distribution.

Ultimately, adas requires all the signals captured from sensors on the vehicle to be pre-processed, shared with a single processing architecture, and aggregated to create actionable outputs and commands.

Multi-sensor

Adas relies extensively on sensors such as radar, lidar and cameras for situational awareness. While 77GHz radar provides object detection and motion tracking, lidar is used for high-resolution mapping and perception, and hence generates many data points per second.

Video cameras, for their part, are mounted in various parts of the vehicle and continuously generate multiple channels of high-resolution image data to provide forward, rear and surround views.

Various additional sensors are often used, including temperature, moisture, speed, GPS and accelerometers, depending on the features the system is intended to provide.

Focusing on the camera as an example, image processing is applied at the pixel level to enhance image quality and extract object information. Features such as surround view depend on further video processing with graphic overlays.

On the other hand, collision avoidance systems process sensor data to characterise the environment around the vehicle, such as identifying or tracking lane markings, signs, other vehicles or pedestrians.

Systems such as lane-keeping assist and autonomous braking or steering need to detect threats and subsequently may generate a warning or take over control of the vehicle to help avoid an accident.

When implementing adas, a typical approach is to use a combination of customised parallel hardware to process sensor data, hosted in an FPGA or asic, while characterising the environment and making appropriate decisions are typically performed in software. The software tasks may be partitioned between a DSP for object processing connected to characterising the environment, and a microprocessor for decision-level processing and vehicle communication.

With a multi-processor system-on-chop (MPSoC) it is possible, for example, to integrate a complete adas imaging flow from sensing through environmental characterisation in a single device. Leveraging the various processing engines available, and the chip's high-bandwidth internal interfaces, designers can partition the processing workloads optimally between hardware and software.

DSP workloads can be handled either in hardware, using DSP slices, or in software using a processor.

This flexibility lets developers optimise the design to help eliminate data flow bottlenecks, increase performance and provide efficient use of device resources. MPSoC integration also enables savings in costs and power consumption.

Saving power is especially valuable going forward, as extra adas is mandated, more sophisticated infotainment is desired, and electric vehicles depend on efficient use of battery energy to increase driving range.

Along with power efficiency, the chief concern for adas engineers is reducing latency. The need for low latency to deliver high levels of functional safety and driver experience – as well as low power consumption requirements – makes adas applications inextricably bound to the capability of the silicon hardware.

Single-chip strategy

One example of a system created using this single-chip approach is Aisin's automated park assist (APA) that combines signals from four surround view cameras and 12 ultrasonic sensors.

By also using high-accuracy machine-learning models, this APA can understand and react to the dynamic environment around the vehicle. It can support autonomous control of the steering, brakes, transmission and speed to deliver smooth hands-free parking.

In concept, adas combines information from various sources to improve perception and decision-making. Using multiple sources of data lets the system derive richer information that can enhance the safety and performance of the driver assistance features. This provides the foundation for the system's ability to detect and track objects, identify potential hazards, and make informed decisions for adaptive cruise control, lane-keeping assistance and automatic emergency braking.

Techniques such as early fusion are also gaining interest with AI accelerations to combine sensors and supplement the synchronised data stream with object lists and other information.

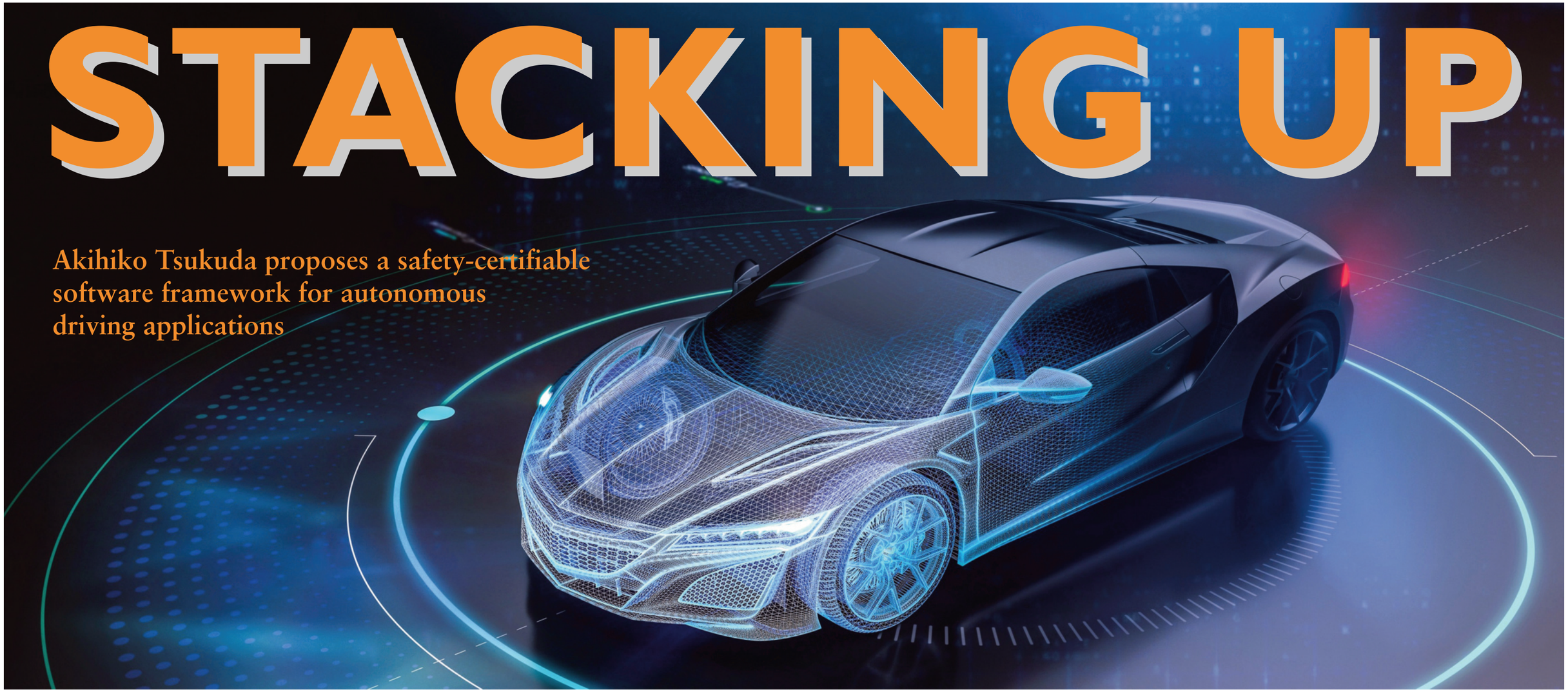
Efficient aggregation and processing of multiple streams of sensor data have a critical role in enabling more reliable and sophisticated autonomous driving capabilities.

By leveraging flexibility to partition the data processing workloads optimally between hardware and software, with the added flexibility of configurable hardware accelerators in logic such as DSP slices, designers can increase system performance while also reducing costs and power consumption.

Wayne Lyons is director of automotive at AMD

SOFTWARE TOOLS

STACKING UP



Akihiko Tsukuda proposes a safety-certifiable software framework for autonomous driving applications

A software stack that facilitates development of autonomous driving applications must also support real-time determinism for functional-safety certification.

The roadmap towards higher levels of driving automation promises greater road safety and comfort for drivers and passengers through reduced driver workload and more consistent driving standards. The ultimate goal is full autonomous driving, from the beginning to the end of each journey.

As car makers and tier-one suppliers pursue this objective, vehicle electrical and electronic architectures are evolving towards an increasingly sophisticated and software-defined model.

Stack

To enable autonomous driving, the software stack must support a diverse set of functions including gathering data from lidar, radars, cameras, GNSS receiver, inertial measurement units (IMUs) and other sensors mounted on the vehicle. It must also cater for localisation, combining appropriate sensor information with high-precision map data to determine the precise location and orientation of the autonomous vehicle, and handling other sensor data to provide perception including detecting, recognising and tracking objects such as vehicles, bicycles and pedestrians, as well as traffic signals and signs.

The software must also support planning, which involves using perceptual information to calculate the path of the vehicle along the desired route and avoid any obstacles, as well as using the planning information to generate precise vehicle control signals such as steering angle, braking and acceleration. It also needs to manage the vehicle interface, to distribute the control signals as commands to various subsystems, and mapping using high-precision 3D map data.

Developers may attempt to bring up a stack that comprises all these elements independently, although this can be labour-intensive, time-consuming and expensive. Building on an existing platform can be more efficient and cost-effective.

The Autoware software framework is an example. Open-source and developed on the ROS robot operating system, Autoware provides a stack that is already proven in various platforms such as autonomous industrial vehicles for transporting goods within factory sites or cargo areas.

Compared with the public roads, these are relatively predictable and controlled environments in which Autoware has been able to demonstrate safe operation. Other use cases have included driverless shuttles and taxis, which operate in more complex environments that place greater demands on the

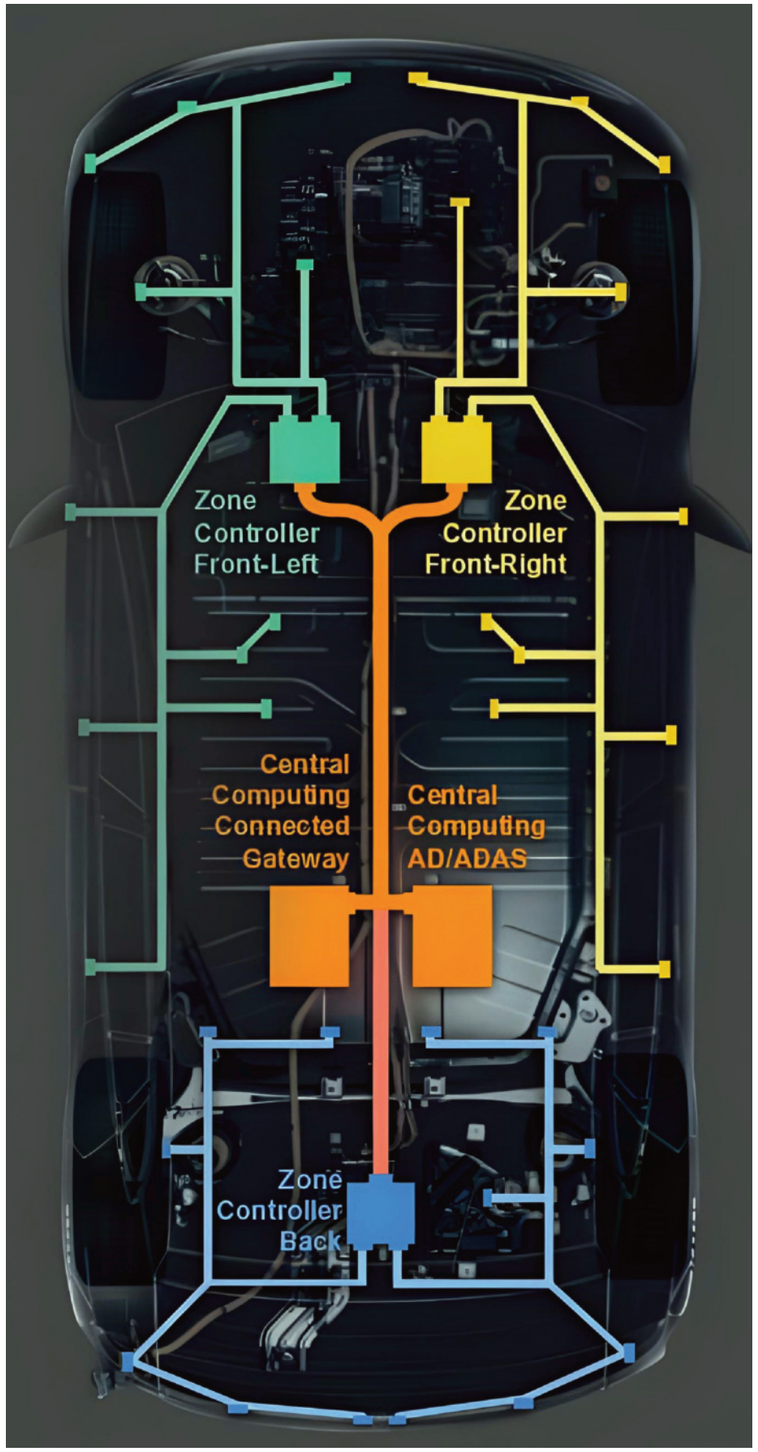


Fig. 2: Vehicle architectures are evolving towards a sophisticated software-defined model

software's perception and planning modules.

Framework

ROS is a middleware framework that comprises software libraries and tools that run on top of Linux as the core operating system. The base software is open source and comes with an extensive ecosystem that includes frequent updates with bug fixes and improvements.

ROS enables developers to write robot control applications to run on Linux and is already widely used for robotics and autonomous systems. Moreover, it is sufficiently robust to handle managing an autonomous road vehicle and provides features that simplify the development, integration and control of the various software components necessary for autonomous driving.

Key strengths of ROS as a framework for autonomous driving include its modular architecture, which allows functionalities, such as perception, planning and control, to be developed as separate modules or nodes. Support for message passing between nodes lets these functions communicate with each other, allowing for better organisation and management of complex autonomous vehicle systems.

In particular, message passing ensures efficient and reliable communication needed for real-time data sharing, which is essential for tasks such as obstacle avoidance and path planning.

ROS also provides ready-made drivers and packages for a wide range of sensors, which can simplify the integration of lidar, cameras, radar, GPS and other sensors used for perceiving surroundings.

Autoware, also developed on Linux, leverages these aspects of ROS and provides dedicated planning, control algorithms and sensor fusion techniques. For example, Autoware uses an improved 3D slam (simultaneous localisation and mapping) module, as well as a specific ROS topic set.

Linux offers various strengths for autonomous vehicle applications. It is compatible with a wide range of standard hardware components. Using Linux allows developers to leverage off-the-shelf hardware and drivers, making it easier to build and test autonomous vehicle systems. Users can also take advantage of the large ecosystem of tools, libraries and development resources, which simplifies software development and accelerates innovation.

However, although real-time patches are available that can provide determinism for many autonomous vehicle tasks, Linux is not a real-time operating system. It is not certified for automotive functional safety and regulatory compliance. For this, a deterministic safe Posix rtos is recommended.

Some autonomous systems use a hybrid approach, combining a general-purpose operating system such as Linux with an rtos for specific, time-critical tasks. This allows developers to balance the need for real-time performance with the flexibility of a full-featured operating system. However, this can be difficult to achieve and requires expertise to complete the integration.

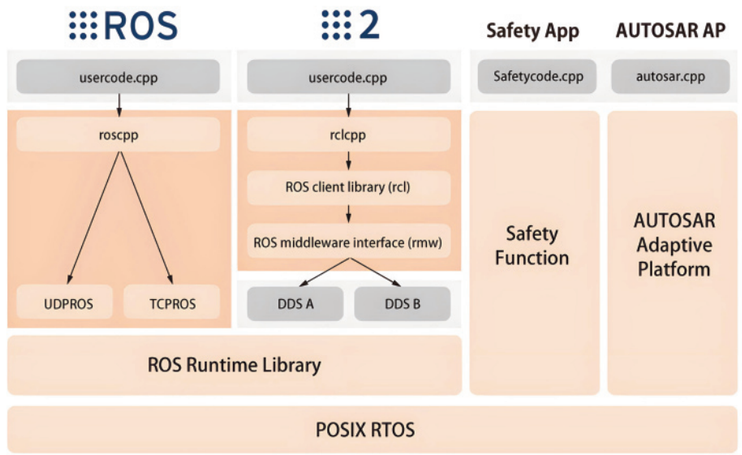


Fig. 1. Software framework that facilitates autonomous vehicle development and helps satisfy functional safety requirements

The answer is to combine ROS with a safety rtos, creating a platform that enables seamless integration of Autoware applications with safety certification, see Fig. 1.

This proposed framework for ROS aims to simplify real-time performance and safety configurations and simplify porting from Linux pre-developments to rtos mass production. It tackles important integration challenges that would face any project aiming to create a robust and deterministic platform for functional safety applications.

These include optimising rtos kernel drivers, resource allocation and bottleneck analysis, and code corrections to permit the rtos, ROS and Autoware environments to interact as desired.

Conclusion

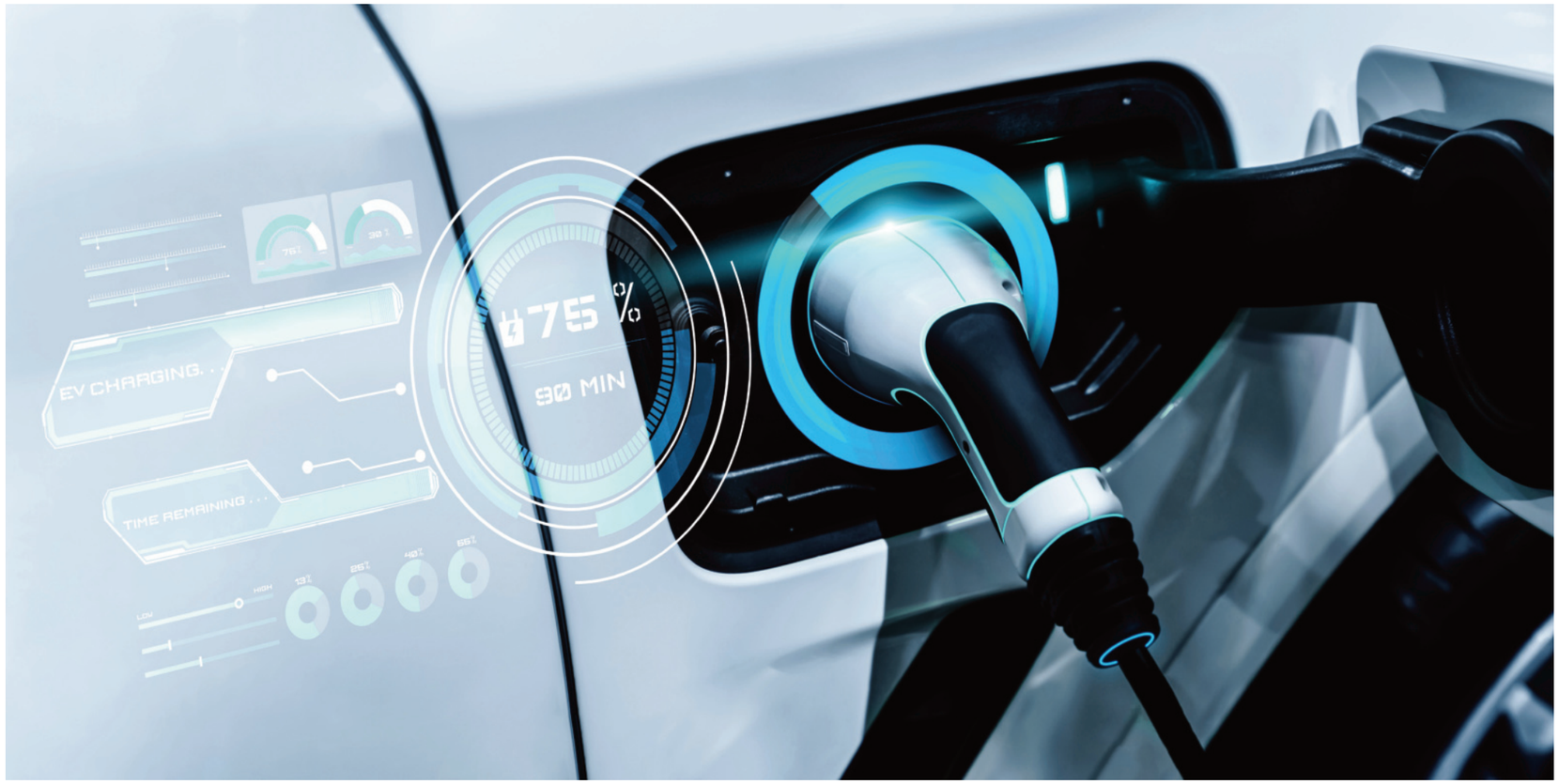
Autoware is designed for autonomous vehicle applications and provides a software framework that saves developers bringing up their own stack from scratch. This approach can accelerate development and save project and certification costs.

Autoware and ROS satisfy many of the requirements for autonomous driving although there are shortcomings, particularly in relation to aspects of the vehicle that must comply with functional safety requirements.

Integrating ROS with a Posix-compliant safety rtos overcomes those shortcomings and ensures deterministic response. It bypasses the integration difficulties and allows development to begin immediately leveraging the proven features of the Autoware stack, permitting faster time to market and facilitating functional-safety compliance.

Akihiko Tsukuda is executive officer for software engineering at ESol

POWER TECHNOLOGIES



GOING CONTACTLESS

Joel Sylvester looks at why contactless on-cell monitoring could be the next step for automotive battery design

Within any modern electric vehicle (EV) the most complex singular design element is the battery pack. As a critical element of the powertrain, it accounts for a large amount of a vehicle's development effort and on average represents around 40% of the total production cost.

It also directly impacts a car's performance, range, weight, charging time and overall safety.

Engineers developing EV battery systems must carefully balance a complex matrix of factors to ensure vehicles are safe, including sufficient range, charging performance and weight. Wider factors, such as industry compliance and ease of production and battery reuse, must also be considered.

Creating a battery pack is challenging, made more difficult by rigid battery pack architecture and consumer demands, with vehicles constantly striving to improve capacity, charging times, cost-efficiency and weight.

What is clear is for many engineers there is a willingness to embrace a significant step change in the underlying battery architecture if it can help overcome persisting challenges, and one emerging option that is looking to fulfil this opportunity is cell-based monitoring.

Design

Modern EVs operate at 400 or 800V with the total battery pack voltage determined by the number and configuration of the cells, as well as the chemistry and individual voltage. Within a high-voltage battery, the cells are grouped into modules.

For example, a typical 400V pack might consist of 96 cells organised into eight modules, with each containing 12 cells.

In terms of packaging, a module is an enclosure frame designed to encase a fixed number of cells with the primary purpose of shielding them from external factors such as impact and vibration, and allowing the connections for the power output and monitoring instrumentation.

During the vehicle's lifecycle, the modules within the battery pack must be carefully balanced and monitored to ensure they operate efficiently and reliably. To achieve this, a battery management system (BMS) communicates with an individual management board on each module.

These boards are used to monitor voltage and temperature of the module, helping determine factors such as the state of health (SoH), state of charge (SoC) and state of function (SoF). All these factors are crucial for maintaining safety, and estimating charge times and EV range.

As these boards need to be physically connected to the cells within the module, extensive sensor wiring for the voltage and temperature measurements must be carefully run across the modules.

Once assembled, the battery pack's BMS is the critical component that ensures safe and efficient operation. It is connected with complex wiring harnesses to the numerous module boards, voltage, current and temperature sensors, maintaining constant communication to ensure the pack remains balanced and within its operating conditions.

Architecture

While existing BMS architectures work well, they force a modular architecture onto the battery pack designer. The 96-cell 400V pack referred to earlier is common because it neatly divides into eight 12-cell modules, or six 16-cell modules, but the architecture cannot efficiently adapt to 100 cells.

It is the same story with temperature sensors. As these are typically installed per module, this can create a delay in detecting a potential thermal incident. For designers to increase the performance and safety of existing designs, one route being proposed is to shift from module-based to cell-based monitoring, but with potentially upwards of 100 cells in an EV this would demand excessively heavy and bulky volumes of wiring, increasing the vehicle weight and reducing safety.

The alternative for cell-monitoring being pursued by the automotive industry is wireless or contactless architectures.

Wireless options from manufacturers such as Texas Instruments and Analog Devices rely on far-field radio communication between the cells and the BMS itself, whereas contactless options as shown in Fig. 2 communicate using a secure near-field network connecting to the BMS.

With these approaches, the embedded chip on each and every cell provides localised temperature and voltage measurement, and the number of wires, associated PCBs and connectors is significantly reduced, lowering the system weight as well as removing some of the larger fire risks. The lower component count during manufacturing not only accelerates the battery pack assembly process but also

Fig. 1: Typical battery pack prior to assembly within a vehicle

mitigates risks and opens up opportunities for increased automation.

Scalability

Flexibility, scalability and modularity are key cornerstones for modern automotive OEMs and the industry excels at the intelligent reuse of parts to reduce production costs. The automotive industry is built around modular and reusable chassis and components.

Modifying the chemistry, system voltage or the quantity of cells or modules in current battery packs poses a significant design challenge.

This requires extensive adjustments to wiring looms, fuses and connectors, along with recertifying the pack, despite most components remaining unaltered.

Unlike traditional methods, contactless options let engineers easily modify battery capacity or switch chemistry without affecting the physical control architecture. Therefore, applying the technology across entire vehicle ranges could help significantly reduce battery pack development effort, reducing the vehicle's production cost.

Opportunities

Increasing the available battery energy and therefore range is a considerable technical challenge, but a shift from module monitoring to cell monitoring can help.

With cell level monitoring, the vehicle's electronics are provided with highly accurate and detailed information of each cell's behaviour and lifetime status. Engineers can use this insight to enhance the system's performance with confidence, unlocking more potential from each cell without compromising reliability.

The enhanced use can result in an extended battery longevity, while the implementation of cell monitoring can significantly improve battery safety. With continuous round-the-clock monitoring of individual cells, rather than modules, through a well-designed wireless or contactless system, the BMS can promptly address cell-level issues, surpassing the capabilities of a conventional EV setup.

For the consumer, this shift in design can provide them with vehicles with greater system use, that charge quicker, drive further and are lighter.

Circular

The adoption of electric vehicles is primarily driven by sustainability, yet the batteries themselves raise questions regarding end-of-life management.

Fig. 2: Cell monitors fitted to EV cells

In general, electric vehicles are more susceptible to performance decline compared with other types of large-scale battery installations as renewable energy storage options. Consequently, even after the electric vehicle's lifespan has ended, the battery pack's cells retain usefulness for alternative applications that place less emphasis on peak performance and energy density. But the transition from an EV to second use is far from simple. To ensure EV cells are suitable for reuse, engineers must be confident in their performance and safety.

Last year, to help with this transition, the European Battery Regulation 2023/1542 was approved by the European Council. The aim of the regulation is to improve the sustainability and safety of batteries, by introducing a battery passport – a digital signature designed to store the battery's history and current health.

Although an improvement, there are still faults in capturing only battery level information that can lead to potentially incorrect evaluations of individual cells. Equally, once the pack is divided into modules and cells, the digital information is separated from the physical device.

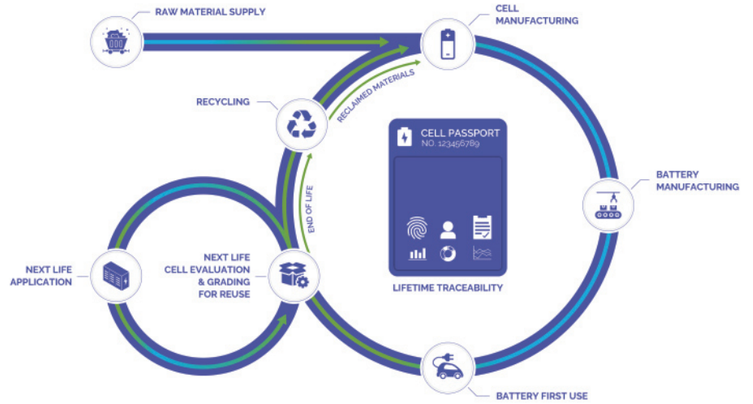


Fig. 3: Cell-level passports can help streamline the transition into next life applications

This is another area where the shift from module level to cell-based monitoring can have a significant impact. Through cell-based monitoring, every cell is assigned a passport that tracks its history from manufacturing to second use assessment, see Fig. 3.

This simplifies and enhances safety during the transition, as the cell's complete history and viability for reuse are stored on a physically attached chip.

In terms of a circular economy, contactless cell monitoring simplifies the transition to second or even third use, saving more cells from being unnecessarily scrapped and increasing the safety of the entire initiative.

Conclusion

EVs play a critical role in reducing global emissions and are proving incredibly successful, but they are not free from technical challenges that must still be overcome. The demands of the consumer will always persist, and there is still room to reduce vehicle costs, while factors such as range, charging performance and vehicle weight can also be improved.

Although the current battery architecture is suitable for automotive engineering, teams are actively seeking ways to overcome existing problems to enhance EV battery design. This is not only beneficial for the end user but also for production facilities and future second and third use applications.

When examining contactless or wireless offerings in contrast to fully wired options, it becomes evident that these alternatives have the potential to become the next generation of EV and high-voltage battery design.

Joel Sylvester is chief technical officer at Dukosi

DIGITALISATION

Software-defined vehicles are paving the way to future mobility, says Nand Kochhar

The automotive and transportation industries are in a period of turbulence, transformation and opportunity. New technologies, consumer demands, environmental pressures and a changing workforce are pushing companies to reinvent fundamental aspects of the business.

This includes developing more advanced and capable vehicles, new revenue sources, better customer experiences, and changing the ways in which features and functionality are built into vehicles.

This push to bring increasingly advanced mobility to market is changing the composition of the automotive sector. Vehicle electrification has continued to see growth in the USA and around the world. The USA is expected to achieve a record in electric vehicle (EV) sales, with EVs accounting for an estimated nine per cent of all new vehicle sales in 2023. The growth in EVs is also spurring production growth in vehicles and batteries as companies look to respond to the demand for advanced, green transportation.

Software defined

Electrification is only one part of a broader change in the nature of the automotive and transportation

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industries for workers, customers and businesses. Electrification is a subset of a larger progressive shift in the automotive and transportation industries from the physical or mechanical to the digital.

Consumer appetite for advanced vehicle features is higher than ever and buying decisions today are increasingly based on the innovative electronic and software features in the vehicle. These include in-cabin comfort and convenience features, such as smartphone-infotainment integration, adas and increasing levels of vehicle automation.

The popularity of these features and functions represents the arrival of a paradigm in the automotive industry, built on the capabilities of software and electronics systems. As these features become more desirable, the mechanical specifications and capabilities of the vehicle recede in importance in the buying decisions of vehicle shoppers.

Highly aware of this trend, automakers are shifting the focus of their vehicle development programmes. Traditional mechanical systems remain important, but programme time, budget and resources are moving increasingly towards the development of vehicle software and bespoke electronics. In concert, the availability of powerful and ever affordable integrated circuits and faster in-vehicle data networks has enabled automakers to evolve in-vehicle software.

What used to be low-level embedded applications are rapidly developing into sophisticated vehicle-level operating systems or software platforms upon which various higher-level functions can be built.

With these software platforms at their disposal, engineering teams have increasingly elected to root various vehicle functions in software. Today, that results in vehicle platforms relying on software to control all or most of their features and functions, even seemingly basic ones such as steering systems or climate control. This is what has come to be known as the software-defined vehicle (SDV).

Moving forward, the SDV is the bridge in vehicle evolution between EVs and autonomous vehicles (AVs) of the future. Particularly for self-driving systems, the SDV provides a foundation for several critical technologies, including integrated adas and control systems, faster in-vehicle data networks, and the ability to update vehicle software remotely, commonly called over-the-air or OTA updates.

In the USA, EV sales are projected to reach their highest share of new vehicle sales ever (Getty Images/Maskot)

Transformation

The automotive and transportation industries are on the precipice of a major transformation in both the products they create and how they manage the vehicle across its lifecycle. The SDV is the first step of this transformation, laying the groundwork for further innovation in the future, notably in the form of vehicle automation and, possibly, true transportation-as-a-service business models.

While great opportunity exists in the future, the road there is impeded by several obstacles. These include growing vehicle complexity, labour shortages in engineering and manufacturing, and a persisting unease around the resiliency of global supply chains.

Innovation in vehicle design, production and lifetime support, and business models, will help the industry overcome these challenges and facilitate the arrival of more efficient and exciting mobility.

Digital transformation can let companies enable and accelerate innovation across departments and functions to address the pressures of the immediate future and beyond. Companies that build and execute a long-term digitalisation plan will evolve beyond connecting data into higher level functions such as automation of data management and eventually the closed-loop optimisation of vehicle platforms, software, manufacturing and more through generative artificial intelligence (AI) technologies.

Stages

There are five major stages of digitalisation shown in Fig. 1: configuration, connection, automation, generative design and closed-loop optimisation.

Most automotive companies in digital transformation today are generally entrenched in the first two stages of this process of maturation. These stages are configuration, or the switch from a document-based to a model-based data framework, and connection, which focuses on breaking down siloes that isolate model-based data.

These two stages vastly improve the traceability and accessibility of data throughout the organisation, helping increase process efficiency, improve engineering flexibility and enhance results even on aggressive project timelines.

Configuration and connection represent a critical threshold of digitalisation maturity for automakers as they undertake the development of the SDV. These stages lay the foundation for connected engineering of multiple vehicle domains, robust traceability and design management through software and systems engineering (SSE) methods, and the cross-domain verification and validation of vehicle systems.

These capabilities will enable engineering teams to co-develop hardware, software and mechanical systems, ensuring the increasingly important software systems are well integrated with the rest of the vehicle, particularly in safety-critical scenarios.

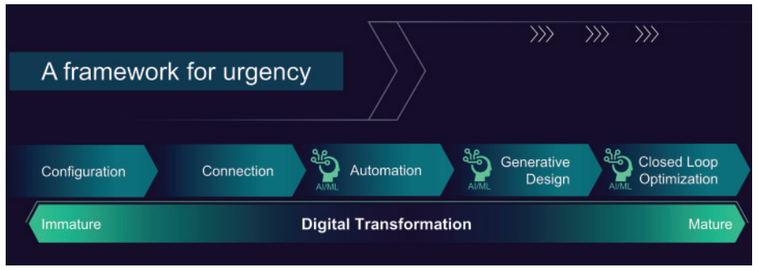


Fig. 1: The digital transformation journey includes five key maturity milestones

However, realising the full potential of the SDV and continuing progress towards even more advanced transportation modes will demand that manufacturers pursue higher levels of digitalisation – automation, generative design and closed-loop optimisation. These stages rely on the growing power of AI to transform engineering processes, enabling each engineer to accomplish tasks that once required several.

This all begins with the automation of mundane tasks that are necessary but deliver incremental value to the products or company at large. Over time, more complex tasks will be completed automatically, eventually leading to the generation of multitudes of complete vehicle designs. This is stage four, generative design, and is based on the ability of AI systems to create new designs based on company data.

Ultimately, companies will also be able to implement generative AI design technology in a closed-loop process of generation, evaluation, iteration and selection of an optimised design.

Future

As software-defined vehicles become the norm in the automotive industry, those firms that succeed will be the ones that embrace digitalisation. To be clear, the five stages of digital maturity are a framework to help automakers determine their path as they look to the future of vehicle development, manufacturing and support.

Details will change from company to company, and the steps taken to overcome acute pressures will vary. Yet, automotive and transportation companies that embrace a holistic and long-term digitalisation journey will overcome the roadblocks on the immediate horizon and establish a strong foundation for future endeavours in smart, connected and automated vehicles.

Nand Kochhar is vice president of automotive and transportation at Siemens Digital Industries Software

LET'S GET PHYGITAL

Christopher Keating discusses what's holding the transport and logistics industry back from becoming a digital leader

Transporting goods from A to B requires close collaboration between shippers, carriers, logistics service providers and recipients. In many ways, how these stakeholders interact with each other and conduct day-to-day operations has remained largely unchanged for the past decade or more. After all, the industry often still relies on phone conversations, lengthy email chains, paper documentation and manual reporting to coordinate the smooth movement of freight.

But with a raft of digital technologies now available, this is no longer the best approach. Companies could be much more efficient if they embraced phygital – the seamless integration of physical and digital systems – to enhance their operations.

So, what's holding the industry back from integrating the physical and digital worlds? And where could companies see meaningful gains from adopting a phygital approach?

Old habits

Technologically speaking, much of the logistics transportation industry is stuck in the past, operating a patchwork of disparate technologies combined with legacy paper-based processes.

Why? Well, put simply, old habits die hard. Archaic import and export rules – for example countries stipulating the use of physical stamps to authenticate and authorise documents – have, until recently, forced companies to continue using paper. Meanwhile, a lack of universal standards for digital options means that companies have taken vastly different digitalisation trajectories over the past decade. This results in siloed tech stacks that can't communicate with each other, making it hard for companies to understand accurately their order and capacity situation and see whether processes are flowing seamlessly, among other challenges.

Digital technologies are available for logistics

The answer is a standardised approach to digitalisation based on a collaborative network, rather than companies working in isolation. Also known as a platform approach, standardisation provides the foundation for a phygital future, enabling the creation of a transportation network spanning the entire industry. By connecting shippers, carriers, logistics service providers and other stakeholders, companies can simplify communication and slash manual administrative work.

A collaborative approach also enables data-driven decision-making, with companies benefiting from a vast pool of insights that helps all parties get ahead. In the short term, companies can use these data combined with a high level of automation to reduce dwell times, optimise yard operations and more. On a long-term basis, it can be used to train AI models to create tools for autonomous procurement or quotation, real-time ETA and everything in between.

Challenges

Embracing a phygital approach won't just help shippers and carriers enhance overall efficiency, it's also crucial to helping the industry tackle emerging challenges.

Decarbonisation is arguably the greatest of these, as companies face pressure from governments, end users and fellow industry participants to slash carbon emissions. Sustainability is now impacting the bottom line, with shippers increasingly contracting carriers based on their sustainability credentials, offering extended freight contracts to environmentally responsible firms, and even paying a premium for lower carbon transport.

Decarbonisation isn't just about investing in expensive, cutting-edge technologies. Companies can make significant progress by implementing digital tools that enhance visibility into existing inefficiencies. With real-time data, they can reduce empty mileage, tackle lengthy dwell times, train employees on sustainable driving practices and combine transport modes to reduce emissions.

Phygital seamlessly integrates physical and digital

Again, this is more effective when done collaboratively. For instance, it's much simpler for carriers to reduce empty mileage by finding a return load if they're operating as part of a wider network rather than in a silo. All they have to do is inform the network when they've delivered their shipment, and wait for a match from a shipper looking for available capacity.

Another challenge currently facing the industry is the ongoing driver shortage, caused by an ageing workforce and increased demand for logistics services. With driver recruitment set to remain a persistent challenge, shippers and carriers must put their people first. This means taking tangible steps to lessen the administrative burden on drivers and reduce time spent waiting in yards, at ports and in traffic, as well as using tools and technologies to alleviate process-related stress .

To do so, shippers and carriers must first understand where there's room for improvement. Digital tools can play a crucial role, with companies increasingly turning to real-time insights to uncover hidden inefficiencies and improve visibility by tracing deliveries. In particular, shippers and carriers can make significant efficiencies within the warehouse loading and unloading process, and by automating time slot and yard management processes. This can reduce waiting times from hours to minutes, freeing drivers to spend more time on the road.

Way forward

So, should the logistics transportation industry prepare for a phygital future? In short, yes. Companies already have all the necessary digital tools at their disposal, but success hinges on selecting and implementing them intelligently.

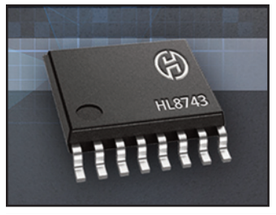
When companies embrace a true phygital approach, they can forget about optimising individual processes, and look holistically at improving their entire system. By embracing platform-based technologies to enhance their physical operations, they can be more efficient, improve visibility and make better decisions. This will help reduce costs, improve efficiency and meet customer demands, especially when tackling rapidly evolving problems such as decarbonisation and personnel issues.

Christopher Keating is senior vice president of Trimble Transportation

Precise current sensing for LDOs

AEC-Q100 grade-one qualified automotive single and dual-channel high PSRR LDOs from HMI include precise current sensing, and capabilities designed to operate with an input voltage from 4.5 to 40V.

With 45V load dump protection at the power input pin, the HL8743 provides power to the low-noise amplifiers of the active antenna through a coaxial cable with 350mA per channel current.



Each channel provides an adjustable output voltage from 1.5 to 20V through a resister divider on the feedback pin.

The different variations of the device provide diagnostics through the current sense and nERR pins. It can also serve as a general-purpose LDO.

To monitor the load current, a high-side current sense circuitry provides a proportional analogue input to the sensed load current, and the accurate current sense allows the detection of open, normal and short-circuit conditions without the need for further calibration.

The current sensing function is versatile and can be multiplexed across channels to conserve analogue-to-digital converter resources. Additionally, each channel features the flexibility to establish an adjustable current limit using an external resistor connected to an individual LIM pin.

Features include thermal shutdown, short-to-battery protection on the output and reverse current protection, and each channel has internal inductive clamp protection of the output during the inductive switch off.

The integrated reverse polarity diode eliminates the need for an external diode.

It comes in a 16-pin HTSSOP PowerPad package and is for infotainment active-antenna power supplies, surround-view camera power supplies and high-side power switches.

Power inductors reduce DC resistance

Automotive-grade power inductors from Murata have 0.33μH and 0.47μH values for powertrain and safety equipment.

Compared with the firm's DFE2MCAH_J0 series, the 0.33μH part sees a reduction of 38% in DC resistance to 18mΩ along with a 31% increase in rated current to 5.1A for the same temperature rise.

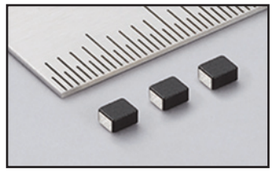
Rated current for a specified inductance drop is 64% higher at 6.9A.

In addition, this product realised 40V of withstand voltage, and this is in a 0806 case size with an operating temperature of -40 to +155˚C with current derating.

The metal alloy inductors leverage the firm's advances in material and manufacturing technology to achieve a combination of quality and performance.

This makes the parts suitable for applications such as adas and in-vehicle infotainment.

The high DC current rating and low power dissipation of the DFE2MCPH_JL, complemented by a high impulse voltage rating, make them suitable for low-loss filtering and energy storage in power converter applications.



Metal oxide varistor stops transient surges

A metal oxide varistor (MOV) from Littelfuse provides transient surge protection in automotive electronics, electric vehicles (EVs) and other applications.

The SM10 complies with AEC-Q200 and can withstand operating temperatures up to +125˚C.

The repetitive surge capability handles up to 40 pulses of 6kV, 3kA.

Dimensions are 15.7 by 8.5 by 14mm and it is suitable for automated SMT PCB assembly processes.

Voltage rating is from 130 to 625V AC.

Applications include automotive electronics, electric vehicles and charging stations.

They are available in tape and reel quantities of 300.

Trench mos design structure reduces diode recovery time

A 100V breakdown Schottky barrier diode (SBD) from Rohm suits power supply and protection circuits in automotive, industrial and consumer applications.

SBDs are increasingly being used, particularly those with a trench mos structure that provides lower V_F than planar types, enabling higher efficiency in rectification applications.

One drawback of trench mos structures, however, is they typically feature worse reverse recovery time (t_{rr}) than planar topologies, resulting in higher power loss when used for switching.

In response, this SBD uses a proprietary trench mos structure that simultaneously reduces both V_F and I_R, which are in a trade-off relationship, while achieving a claimed class-leading t_{rr}.

The proprietary design of the YQ series achieves a t_{rr} of 15ns that reduces t_{rr} loss by around 37% and overall switching loss by 26% over general trench-type mos products, contributing to lower application power consumption.

The structure also improves V_F and I_R loss compared with conventional planar type SBDs. This results in lower power loss when used in forward bias applications such as rectification, while providing less risk of thermal runaway.

As such, they suit sets requiring high-speed switching, such as drive circuits for automotive LED headlamps and DC-DC converters in electric vehicles that are prone to generate heat.

The trench mos structure is created by forming a trench using polysilicon in the epitaxial wafer layer to mitigate electric field concentration. This reduces the resistance of the epitaxial wafer layer, achieving lower V_F when applying voltage in the forward direction.

At the same time, during reverse bias the electric field concentration is reduced, decreasing I_R. As a result, the series improves V_F and I_R by around 7% and 82%, respectively.

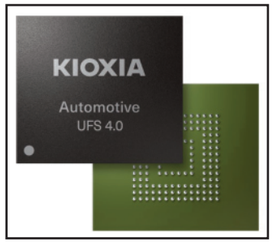
Embedded flash memory

Kioxia is sampling UFS universal flash storage embedded memory devices for automotive applications, including telematics, infotainment and adas.

Compared with its previous 512Gbyte device, the products approximately double sequential read speed and increase sequential write speed by around 40%, enabling applications to take advantage of 5G's connectivity benefits such as faster start-up times and a better user experience.

The version 4.0 devices integrate the company's BiCS 3D flash memory and a controller in a Jedec-standard package.

They incorporate Mipi M-Phy 5.0 and UniPro 2.0 and support theoretical interface speeds of up to 23.2Gbit/s per lane or 46.4Gbit/s per device.

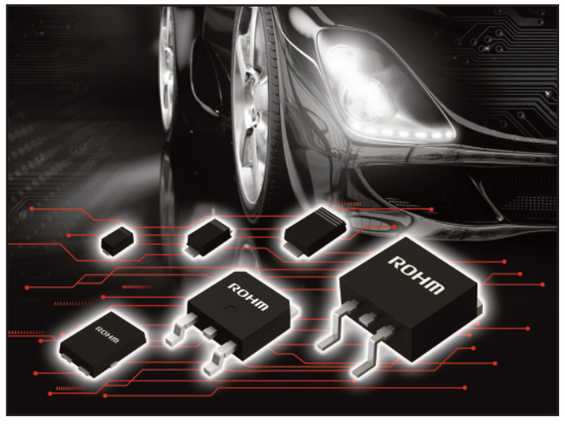


UFS 4.0 is backwards compatible with UFS 3.1.

They support high-speed link start-up sequence features, enabling link start-up – M-Phy and UniPro initialisation sequence – between device and host to be performed at an HS-G1 rate A of 1248Mbit/s.

This is expected to reduce the time for link start-up by around 70% compared with the conventional method.

Available in capacities of 128, 256 and 512Gbyte, the devices support a wide temperature range, meet AEC-Q100 grade two and offer reliability capabilities for increasingly complex automotive applications.



Smart switches provide protection

Automotive-compliant, dual-channel, high-side power switches expand Diodes' Intellifet self-protected mosfet portfolio.

The ZXMS82-090S14PQ, -120S14PQ and -180S14PQ intelligent switches deliver high power within a compact footprint while providing roust protection and diagnostic capabilities.

The series is for driving 12V automotive loads, such as LEDs, bulbs, actuators and motors in automotive body control and lighting systems.

They all have a dual 41V n-channel mosfet array with onboard circuitry that protects against short circuits, manages inrush currents and safeguards against overvoltage conditions including load dumps.

In addition, the switches provide overtemperature protection with auto-restart, plus protection against electrostatic discharge damage. Loss of ground and reverse polarity protection can also be implemented with the aid of a few external components.

A dedicated current sense pin provides precise analogue current monitoring of the outputs and fault indication for short-to-battery, short-to-ground and open-load detection.

They provide smaller footprint alternatives to relays, fuses and discrete circuits, and are form, fit and functional equivalents for existing power switch devices where improved product supply is needed.

They are qualified to AEC-Q100, manufactured in IATF 16949 certified facilities and support PPAP documentation.

They come in the thermally efficient SO-14EP package.

Serdes aids long-vehicle connectivity

A serdes from Valens Semiconductor is said to offer industry-leading bandwidth and link distance for long vehicle sensor connectivity.

Long vehicles have suffered from a lack of visibility due to the complex technical challenge of long-distance connectivity in a rough EMC environment.

The VA700R enables 4Gbit/s at up to 40m, while supplying power and bi-directional control over the cable. It provides the connectivity on which visibility options can be designed for drivers.

Containing the VA-7021R serialiser and VA7004R deserialiser, it combines bandwidth and link distances for applications such as surround view and rear-view visibility for medium and long vehicles.

The serdes will support high resolutions, including for up to 8MP (4K) cameras operating at 30 frames per second. It is also bit-accurate, making it applicable for adas.

Demonstrations are available today and engineering samples are slated to be released in mid-2024.

Multilayer inductors

Multilayer inductors from TDK are for automotive audio bus (A^2B) applications.

The KLZ2012-A comes in a 2.0 (L) by 1.25 (W) by 1.25mm (H) package.

A^2B technology is designed to reduce the weight of cable harnesses consisting of a wide variety of telecommunication buses.

The inductor supports operation from -55 to +150˚C. Thanks to the conductive resin of the external electrode, it is durable against mechanical stresses and thermal shocks.

As A^2B is a differential signal interface, it needs to reduce variability in nodes.

The series achieves inductance tolerance of ±8% or less within the same lot, contributing to the reduction of spurious harmonics generated by variability in inductance.

Inductance is 3.3μH ±20% at 2MHz. DC resistance is 0.2Ω ±30%. Rated current is 350mA maximum.

Applications include sensors and audio lines.

Switching regulator suits camera modules

A step-down switching regulator from Ablic operates at 5.5V with a 1A output, and is for use in automotive camera modules.

The S-19954/5 comes in an HSNT-8(1616)B package at 1.6 by 1.6 by 0.41mm. It is also available in a gull-wing type HTMSOP-8 2.9 by 4.0 by 0.8mm package.

While the circuit configuration of conventional switching regulators requires five or more external components, this has integrated feedback resistance and phase compensation circuits to set output voltage, which makes it possible to configure an application circuit using just one small coil and two capacitors.

A power good function monitors the output voltage of the IC and ensures it stays within the normal range; if the output voltage deviates from the specified range, the function raises an error flag to notify the microcontroller.

It is PPAP capable and planned for compliance with AEC-Q100 grade one.

Conversion efficiency is 95% at an input voltage of 4V and an output voltage of 3.3V.

It is available with either PWM control (S-19954) or PWM-PFM switching control (S-19955).

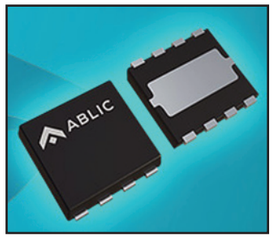
The proprietary PWM-PFM switching technology with PFM control is capable of delivering constant voltage output from V_{out} without excessive ripple voltage.

Input voltage is 2.7 to 5.5V and output voltage 0.8 to 3.3V. Output current is 1A. Oscillation frequency is typically 2.25MHz.

V_{out} pin voltage accuracy is ±1.5% from -40 to +125˚C.

It has over-current, thermal shutdown and short-circuit protection functions.

Applications include secondary power supplies for automotive devices and camera modules.



Satellite positioning chip meets AEC-Q100

A satellite positioning chip from Airoha has passed AEC-Q100 grade-two reliability qualification tests for automotive applications.

The AG3335MA has also been integrated with its parent firm MediaTek's Dimensity Auto platform.

Grade-two certification covers a temperature range from -40 to +105˚C.

The satellite positioning chip supports the five major global satellite systems, and NavIC.

It contains an Arm Cortex-M4 processor and has 4Mbyte embedded flash memory. Interfaces include uart, I^2C, SPI, PWM and ADC.

This chip has a professional-grade GNSS receiver measurement engine with a satellite tracking sensitivity of -167dBm and a cold boot positioning time of 25s.

The signal frequency support capability lets it simultaneously receive and process signals from all visible satellites in the sky. This capability ensures accurate positioning in all weather conditions and addresses problems such as adverse weather and complex road conditions faced by vehicle drivers.

Update to measurement and calibration software

With version 22, the Canape measurement and calibration software from Vector supports protocols of new vehicle architectures with HPC platforms and zone ECUs.

All data are also recorded in the software-defined vehicle (SDV) thanks to the support of the protocols.

For adas and autonomous driving projects, logging extensions offer data acquisition at up to 6Gbyte/s.

With this version, Canape supports vehicle-relevant protocols such as DDS, DLT and Some/IP, which are used to access internal data from HPCs and zone ECUs. In addition, data are captured via the Asam standard CMP capture module protocol.

With the logging extensions, Vector offers a scalable option. These are based on automotive PCs from the VP6000 and VP7000 families and record data at up to 6Gbyte/s.

Regardless of the size of the overall system, a Canape licence is all that is required.

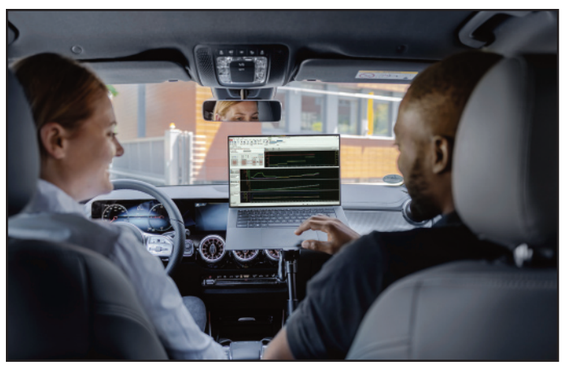
Large amounts of data must be stored, especially in adas and AD projects.

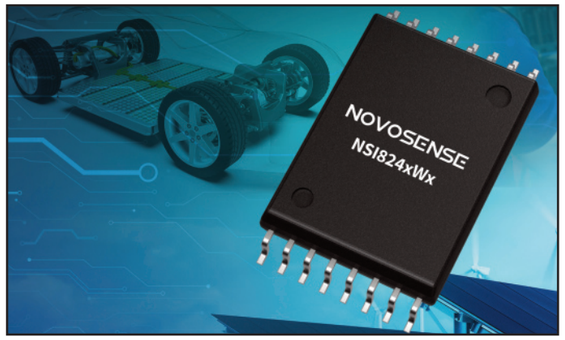
A measurement consists of a large number of measurement files that are written by recorders one after the other and by several recorders in parallel.

With the measurement data concept, the user views the large number of measurement files as an overall measurement. Measurements are thus displayed clearly and processed efficiently at the same time.

• Vector is also offering embedded software for ECUs that meets the highest safety requirements according to ISO 26262 and goes far beyond the usual market standards.

The software is suitable for autonomous driving and x-by-wire systems.





Digital isolators protect at speed

Digital isolators from Novosense are quad-channel devices that provide the performance and protection for automotive applications.

The NSI824xWx isolators provide protection and level shifting in applications from solar inverters to industrial and electric vehicles.

UL1577-qualified for safety, the wide-body automotive-grade isolators combine EMC performance with protection against system-level ESD, electrical fast transients and voltage surges.

Each device offers an insulation voltage up to 8kVrms, chip-level ESD HBM protection to ±8kV and common-mode transient immunity up to 200kV/μs.

The isolators are available with options for four forward channels, three forward and one reverse channel, or two forward and two reverse channels.

Default output state on power loss can be set to low or high. Channel speeds up to 150Mbit/s are supported, while an input voltage of 2.5 to 5.5V simplifies level shift operations by ensuring compatibility with many digital interfaces.

A power consumption of 1.5mA per channel at speeds of 1Mbit/s helps designers meet system efficiency targets.

The devices use an adapted capacitive isolator technology in which the digital signal undergoes modulation by an RF carrier generated on the transmitter side and is then demodulated on the receiver side. Subsequently, the signal is transmitted via a capacitive isolator and demodulated on the receiver side.

The devices come in an SOWW16 package, can support 15mm creepage distance and operate from -55 to +125°C.

Four-channel video decoder enables surround viewing

A four-channel video decoder from Renesas can let automotive cameras be used in economical surround-view applications.

The Automotive HD Link (AHL) lets low-cost cables and connectors transmit HD video.

The RAA279974 video decoder processes four input sources simultaneously, making it economical for surround-view and multi-camera uses.

AHL technology uses a modulated analogue signal to transmit video. The frequency is therefore ten times lower than digital transmission options at around 37MHz versus more than 3GHz, making it robust against noise and enabling transmission distances from 20 to 30m with UTP cables and standard connectors.

Existing standard-definition analogue video cables and connectors can also be used.

UTP cables not only reduce cost but are easier to route through the vehicle and offer lighter weight to improve energy efficiency. Digital links such as serdes require heavily shielded cables and high-end connectors that cost significantly more than those for AHL and may require replacement after five to seven years.

AHL can be paired with R-Car automotive SoCs, RH850 MCUs, automotive PMICs and analogue components to implement safety features in virtually any vehicle.

AHL supports resolutions from VGA up to 720p/60 or 1080p/30 to implement non-standard vertical resolutions rather than just the TV video standard 16:9 resolutions.

Mipi-CSI2, BT656 and DVP inputs and outputs provide flexible interfaces to support various image sensors. Mipi-CSI2 output with virtual channel allows four channels of video to be sent over a single data bus interface to the SoC.

AHL does not require compression as with Ethernet, so there is no latency in the video.

It requires only 27MHz crystal clock, with internal PLLs able to generate the clock frequencies for higher resolutions.

AHL has passed BCI and Cispr 25 EMC and EMI testing using UTP cables,

Samples and evaluation boards are available. There is also a camera kit bundle evaluation system that includes four AHL cameras integrated with an encoder.

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