VEHICLE electronics

The monthly magazine for automotive electronics engineers

Chip shortage changes to glut

The semiconductor shortage that has plagued the automotive industry for much of the past two years may soon be turned on its head, says in-vehicle connectivity pioneer VNC Automotive.

The lack of chips critical for high-tech features could suddenly become a glut.

"It's ironic that the very situation that triggered the shortage for much of the automotive industry should be driving the recovery, now that it has become reversed due to the prospect of recession," said Tom Blackie, CEO of VNC Automotive.

Disruptions in the supply chain caused by a series of disasters at critical production plants were compounded by a huge increase in demand for electronic devices as the pandemic took hold and working-from-home became the default for many.

However, with a global recession on the horizon and a cost-of-living crisis beginning to bite, consumers have been quick to rein in their spending.

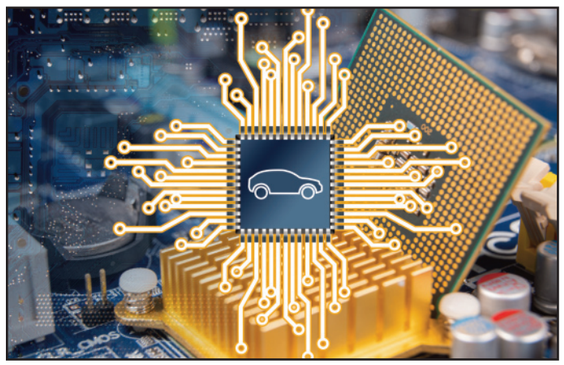
Instead of upgrading to the latest smartphone or ordering a new laptop on credit, buyers are choosing to hang on to their existing devices for longer.

This fall in demand for consumer goods has freed up production capacity throughout the supply chain, from chip fabs through to logistics, and the automotive industry has been quick to take advantage.

"In fact, such has been the speed of the shift to oversupply that we are regularly approached by chip suppliers asking if we'd like to increase our orders," said Blackie.

Industry analysts have reported an increase in cancellations from producers of white goods, which are now more technology-heavy, as well as manufacturers of more complex devices such as tablets and smartphones.

Vehicles have become more sophisticated, connected to a wider digital ecosystem and increasingly defined by their software, and this thirst for computing power has led to a convergence that has seen traditional IT players such as Intel and Nvidia cultivate a key position in the automotive world.



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Renault and Google extend SDV partnership

Renault and Google have expanded their partnership aimed at designing and delivering the digital architecture for a software-defined vehicle (SDV).

The two partners will develop a set of onboard and offboard software components dedicated to the SDV and will grow synergies and use cases related to the group's move-to-cloud strategy.

The collaboration on cloud computing, initiated in 2018, is accelerating with the creation of a digital twin, a virtual twin of the vehicle with artificial intelligence (AI) capabilities, for an easier and continuous integration of services into the vehicle and the creation of onboard in-car services and offboard applications.

The group plans eventually to transform its entire operational model to the cloud.

"The complexity of the electronic architecture of cars is increasing exponentially, driven by the sophistication of the functionalities and services expected by customers," said Luca de Meo, Renault Group CEO. "Equipped with a shared IT platform, continuous over-the-air updates and streamlined access to car data, the SDV approach developed in partnership with Google will transform our vehicles to help serve future customers' needs."

He said this would increase residual value and after-sales retention, which were two key drivers of its financial performance, and help Renault roll out new services.

Sundar Pichai, CEO of Google, added: "Our collaboration with Renault has improved comfort, safety and connectivity on the road."

Shape-shifting car strikes gold



Shape-shifting technology helped electric mobility start-up City Transformer win Gold in the 2023 German Design Awards.

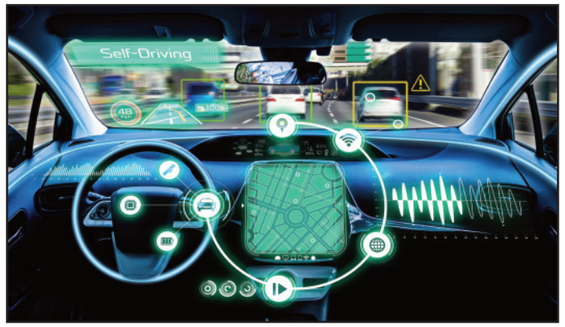
The Israeli marque's first production model, the CT-1, has a shape-shifting chassis to provide the manoeuvrability and easy parking of a motorcycle, coupled with the safety, comfort and performance of a car.

The two-seater all-electric microcar can transform while in motion from 1.4m wide where it is capable of 90km/h on open roads, to just 1m wide to allow it to manoeuvre through heavy traffic and park easily in smaller spaces. Compared with an average, full-sized electric vehicle, it is twice as energy efficient, 75% smaller in weight and footprint, and saves 80% in battery weight.

Since concept creation in 2017, City Transformer has raised more than $20m in investment in Israel, Singapore, Canada and the USA, with an additional $100m expected in 2023.

Segula Technologies in France is the car maker's main engineering development partner. It also has an agreement with Bosch Software to collaborate on development.

Blaize and KT sign AIoT MoU



Blaize and KT create AIoT for self-driving cars

Blaize has signed a multi-year memorandum of understanding (MoU) with Korea Telecom (KT).

The collaboration brings AIoT edge device technical development cooperation for autonomous driving, robotics and mobility AI vision surveillance management.

Blaize and KT intend to coordinate, promote and support the advancement of manufacturing and services requirements of AI development and education for on-device technology for AI market creation in Korea.

The MoU should bolster their united relationship and foster a more robust channel for exchanging views on AIoT edge device manufacturing requirements.

KT plans to expand the development of on-device AI products at the terminal end that can reduce data usage and implement various functions to strengthen the AIoT business that combines AI and IoT technology.

For this, Blaize's tightly coupled software and small form factor, low power, and high-speed data processing hardware deliver an end-to-end efficient, usable AI edge workflow that should help KT expand its AIoT efforts.

Through collaboration with development hardware partners such as Blaize, KT plans to commercialise special terminals and services, such as intelligent IoT routing equipment, micro-mobility services incorporating AIoT technology, and AIoT autonomous driving logistics transport devices for use in distribution, logistics and smart factories.

"Our expanded collaboration with KT in AIoT edge business advances our shared understanding of technical development in some of the key Blaize markets of automotive, mobility and smart vision," said Dinakar Munagala, CEO of Blaize. "We look forward to further extending Blaize hardware and software, serving the 5G+, MEC and cloud-based AIoT markets."

Infineon and Stellantis MoU improves SiC supply

Infineon and Stellantis have signed a non-binding memorandum of understanding as a first step towards a potential multi-year supply cooperation for silicon carbide (SiC) semiconductors.

Infineon would reserve manufacturing capacity and supply CoolSiC bare-die chips in the second half of the decade to Stellantis tier-one suppliers.

The potential sourcing volume and capacity reservation have a value of more than €1bn.

"We firmly believe in electromobility and are excited to develop partnerships with leading automotive companies like Stellantis that make it a part of people's everyday life," said Peter Schiefer, division president of automotive at Infineon.

Infineon and Stellantis are in talks about delivering the CoolSiC Gen2p 1200V and CoolSiC Gen2p 750V chips for electric vehicles under Stellantis brands. This would let Stellantis build vehicles with longer ranges and lower consumption, and support the company in its efforts to standardise, simplify and modernise platforms.

In 2024, Infineon's new fab for SiC technologies will start manufacturing in Kulim, Malaysia to complement existing capacity in Villach, Austria.

- Mercedes-Benz has adopted OnSemi's SiC technology for traction inverters.

OnSemi's VE-Trac SiC modules increase the efficiency and lower the weight of the all-electric Mercedes-Benz Vision EQXX's traction inverter, extending the vehicle's range by up to 10%.

The EV completed a 1202km trip from Stuttgart to Silverstone, holding the record for the longest distance travelled on a single charge.

The Vision EQXX consumes less than 10kWh of energy per 100km.

This was achieved by a benchmark drag coefficient of 0.17, light design, reduced rolling resistance and the use of a battery that stores 100kWh in 50% less space and with 30% less weight than comparable batteries.

LG and Altair develop AI validation for car parts

LG Electronics and Altair, a provider of computational science and artificial intelligence (AI), have jointly developed an AI validation platform that delivers reliability verification for vehicle components.

Integrating this digital transformation technology into the development process allows LG to provide infotainment to global automakers with higher quality and reliability.

Until now, the process for developing such vehicle components relied entirely on physical testing and all test results were manually validated. LG's recent digitalisation of testing and verification should provide gains not only in cost and time-efficiency, but also in terms of data and product reliability.

Able to predict and measure product performance accurately from the earliest stages of the design validation process, the platform uses a machine-learning algorithm to perform time series analysis, data analysis visualisation and various functions that further enhance LG's component verification system.

The detailed reports produced by the AI validation platform cover vehicle component development testing and support for automatic data transition, and should let the company assess the quality of yet-to-be-commercialised products with a higher precision.

Through continued, cooperation between LG and Altair, the platform is expected to secure a product reliability rate of 90 per cent or higher.

The platform can conduct multiple tests, analyse the results of those tests and provide performance indicators.

LG plans to expand the implementation of AI technology from product planning to mass production.

Eun Seok-hyun, president of LG's vehicle component division, said: "Our new AI verification platform is a meaningful digitalisation case for the automotive parts business, where reliability is of the highest importance."



NXP and Delta sign MoU to develop EV technologies

Delta Electronics and NXP have signed a memorandum of understanding (MoU) to develop traction inverter and power conversion for electric vehicles.

Delta will use NXP's automotive technologies and its expertise in functional safety and security to enable architectural innovation and platforms for vehicle electrification.

The two have unveiled a joint laboratory focused on accelerating electrification offerings and developing real-time applications based on NXP's S32Z and S32E processors and S32K39 microcontroller for safety processing, domain and zonal control, EV control, and smart actuation.

Along with innovations in vehicle architecture and adas, and the expansion of software-defined vehicles, electrification is one of the industry's key innovation drivers.

There are still fundamental barriers to widespread EV adoption that include high battery production costs, limited driving range and lengthy charging times.

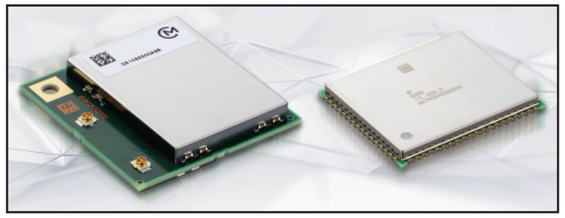
NXP's S32 automotive platform and its electrification portfolio aim to reduce these technical barriers, helping OEMs and tier-one suppliers address these challenges.

"The scope of the collaboration with NXP is centred on advancing its traction inverter and power conversion platforms," said James Tang, Delta vice president.

NXP EVP Ron Martino added: "We are excited to join forces with Delta to continue the global automotive industry's push to electrification."



From the left: NXP's Elton Tsang, senior sales director, TingWei Li, senior VP, and Ron Martino, and Delta's James Tang, Simon Chang, COO, and Sherry Xue, deputy general manager



Autotalks V2X enables Murata communications

Murata has been cooperating with vehicle-to-everything (V2X) communications firm Autotalks to introduce technology that will facilitate progression towards cooperative safety and higher levels of automated mobility.

This has let Murata introduce a wireless module portfolio through which direct vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications can be supported.

It will feature Murata's type 2AN wireless module for use in host-less configurations. Where there is a built-in host, the type 1YL can be employed instead.

Both these automotive-grade units are based on Autotalks' Craton 2 and Secton V2X chipsets.

The modules can support V2X software stacks from numerous vendors.

Users can choose which of the two V2X communication standards – DSRC or C-V2X – they want to use. Consequently, they can address different geographic regions with the same module through software configuration.

Example use cases include early detection of unseen hazards and traffic prioritisation and speed control through V2I roadside infrastructure. Other potential use cases include accident response and updates on road conditions.

Murata's V2X modules have already been selected for integration by a major vehicle maker. Car models equipped with these modules are expected to be on the road by early 2024.

"Drawing on Autotalks' advanced technology, alongside our acknowledged expertise in the wireless domain, this unique platform represents a major step forward in enabling vehicles to cooperate on the road through V2X communication," said Toshifumi Oida, director at Murata. "The broad array of possible use cases supported will lead to dramatic improvements in road safety and reduce traffic congestion."

Vodafone sets up 5G for Porsche test track

Vodafone has established a 5G hybrid mobile private network (MPN) at Porsche's Nardò Technical Center (NTC) in southern Italy to help develop intelligent and connected vehicles.



Vodafone 5G connecting Porsche test circuit

The Porsche centre can now offer its customers a real-time communication network, which promises reduced delays, wider bandwidth, improved security and reliability, and faster deployment time for the integrated development and validation of intelligent and connected vehicles for the global automotive industry.

"At our proving ground in Nardò, we are committed to constantly push technologies to the next level so our customers can successfully meet the increasing demands of future mobility," said Peter Schäfer, CEO of Porsche Engineering. "With the new 5G network, NTC offers its customers now an even better infrastructure to develop and test intelligent, autonomous and connected vehicles."

The mobile network infrastructure enables 4G and 5G coverage throughout the testing centre, which occupies an area of over 700 hectares in the Apulian region and has more than 20 tracks for high-performance testing.

With Vodafone 5G, NTC aims to let its customers develop and validate business-critical applications, from new connectivity, vehicle-to-infrastructure, vehicle-to-vehicle and highly automated driving functions to self-driving vehicles.

The MPN has a hybrid infrastructure, using a private network integrated into Vodafone's public mobile network. Thanks to this design, both private and public coverage is provided at the same location.

Thus, the local population can benefit from the availability of the fast 5G public network and at the same time NTC can make use of a private network that guarantees standards in data security.

NTC also offers its customers a high-performance 1Gbit/s connection. This allows a fast and direct connection to the cloud, enabling a globally networked cooperation and more efficient data-driven engineering.

"5G mobile private networks can act as a springboard for companies by enabling them to evolve the way they do business," said Vinod Kumar, CEO of Vodafone Business. "In Nardò, MPN technology enables a facility that resembles an actual smart city, with coverage that is seamless on and off campus for the next generation of applications that will transform transportation and mobility."

Automotive Grade Linux updates platform

Automotive Grade Linux (AGL) has announced the latest code release of the AGL platform, UCB 14, also known under the codename Nifty Needlefish.

Developed by AGL member companies, the Unified Code Base (UCB) is open-source software that can serve as the de facto standard for infotainment, telematics and instrument clusters.

It has been updated to the Yocto Long Term Support release 4.0.x (Kirkstone). App framework updates include templates for HTML5 and Flutter apps.

UCB 14 includes an operating system, board support package, middleware, application framework and application APIs.

Multi-application support and reference apps are available in Flutter.

Web Application Manager (WAM) updates support WebOs OSE version 2.15 and Chromium 91.

"We are very excited to incorporate support for new technologies like Flutter, which will make it easier to develop apps for AGL," said Dan Cauchy, AGL executive director.

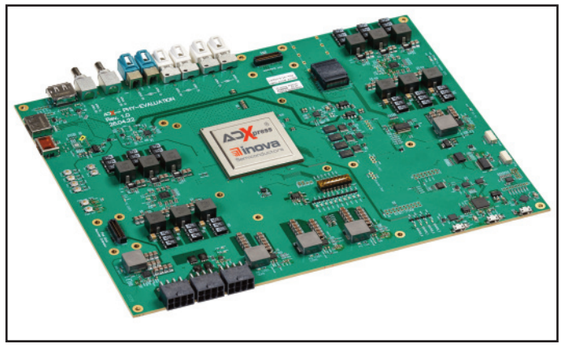
Inova architecture speeds data transmission in vehicles

With Inova Semiconductors' ADXpress automotive data express architecture, all raw sensor data can be transmitted via sensor-specific, virtual data paths with deterministic latency to one or more evaluation units.

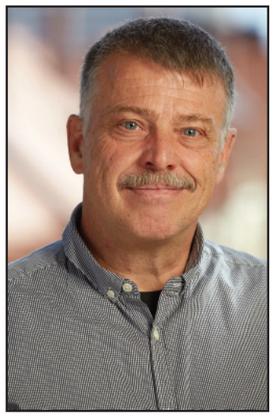
The sensors can be connected to an ADXpress node via PCI Express, Ethernet or SPI, whereby the data transfers are currently carried out electrically with 30Gbit/s, or with optical media, with four at 24Gbit/s each.

The data rate is essentially only limited by the physical layer medium and the capability of the technology node.

"With ADXpress, one can rightly speak of a new dimension of connectivity in vehicles, as the familiar point-to-point or point-to-repeater concepts can be replaced by much more integrable and flexible topologies," said Roland Neumann, CTO of Inova Semiconductors. "This also opens up new possibilities in all aspects of sensor data fusion for adas and AD. The number of displays that can be controlled and their maximum resolutions will continue to increase significantly."



ADXpress is for high-speed data transmission



Roland Neumann

The technology bundles different data paths on a serial 30Gbit/s data link, as already used in Apix, the firm's automotive pixel link. Unlike Apix, however, ADXpress is a universal mass data transport system that electrically transmits any type of data, whether pixel, Ethernet or sensor data from camera, lidar and radar.

This opens up possibilities in terms of network architecture and topologies. Among other things, this allows new approaches to the implementation of video interfaces, for example via PCI Express.

The technology is based on virtual data paths, which are realised by transmitting data cells of constant size. All cells take the same path through the network.

Unlike IP, where a packet can reach its destination via a different path than previous and subsequent packets, with ADXpress latency and jitter are constant on a virtual path.

Virtual data paths based on data cells have the advantage that multiplexing, repeating and duplicating can take place on the layer processing the data cells independently of the service.

Particularly with multiplexing, it is possible to control or steer the bandwidth allocation and the latency of the individual data paths.

The 128 virtual data paths of the ADXpress only consume bandwidth when user data are actually being transmitted.

Generic application adaptation units for burst and stream data implemented in hardware enable software-free packaging and de-packaging of continuous (radar, lidar and video) or burst-oriented data (PCI Express, Ethernet and SPI) into a uniform cell format. This allows burst and stream data to be combined with particularly low latency.

This, in turn, enables simultaneous bundling of a large number of interfaces across multiple functional units due to the bidirectional structure of ADXpress.

These features enable universal network topologies that can be adapted to any conceivable interface.

Visteon uses AWS cloud to connect cars

Visteon is using the cloud capabilities of Amazon Web Services (AWS) to deliver its AllGo connected car technology.

The connected services are expected to deliver value for manufacturers, vehicle app developers and consumers.

The collaboration uses multiple AWS technologies across IoT, storage and compute categories.

CGD and IFPEN collaborate on GaN inverter

Fabless, clean-tech semiconductor company Cambridge GaN Devices (CGD) is working with French public research and training organisation IFP Energies Nouvelles (IFPEN) to develop an automotive inverter using GaN devices.

The partnership combines two complementary areas of expertise.

IFPEN understands the automotive market and its performance targets, and it possesses a strong position in inverter and software development, with knowledge of the algorithms and equipment required.

CGD's GaN technology has resulted in industry's first easy-to-use and scalable 650V GaN HEMT family.

"Technological innovation is central to all IFPEN's activities," said Giorgia Longobardi, CEO of CGD. "Therefore, we are particularly excited that IFPEN has chosen CGD's ICeGaN GaN HEMTs in this new automotive inverter design. IFPEN also shares CGD's belief that close partnerships with key players are essential to the success of any project, so we are proud to be part of this programme."

The ICeGaN H1 single-chip e-mode HEMT devices can be driven like a mosfet, without special gate drivers, complex and lossy driving circuits, negative voltage supply requirements, or additional clamping components. They need no cascode structure, complex multi-chip configurations or thermally-complex integrations.

Instead, they are a single chip with embedded proprietary logic that enables the coupling with standard gate drivers or controllers.

Devices are reliable, suitable for demanding application environments as found in the automotive market.

"This partnership with CGD is a key element for our future activities in power electronics for e-mobility, specifically for next generation of inverters where a technological step is required to reduce size and increase power density levels while challenging the cost," said Gaëtan Monnier, mobility director at IFPEN. "We count on the cooperation with this young and dynamic, extremely innovative company to address the ambitious challenges critical to the future of e-mobility industries."



Gaëtan Monnier and Giorgia Longobardi

Cetecom opens RF test lab in Silicon Valley

Cetecom has opened an automotive experience laboratory (AEL) in Silicon Valley to act as a proof-of-concept lab for automotive application testing in a simulated environment.

The project will help automotive engineers validate component-level hardware designs during the HIL phase. With early access to test equipment, automotive application teams can reduce design time, saving development costs and getting their product to market more quickly.

"Our established presence in Silicon Valley enables us to keep our finger on the pulse of the connected automotive industry," said Praveena Anand-Kumar, managing director of Cetecom. "Cetecom's AEL will be providing an innovative environment for engineers to design and develop automotive components alongside our experts and testing partners, to get their products to market faster."

Also involved in the project are wireless test equipment company Anritsu and DSpace.

"We are witnessing a revolution in the connected automotive space," said Adnan Khan, director of technology at Anritsu. "Through proper testing in the AEL, the entire ecosystem can gain confidence in their products even before specifications are standardised."

Cetecom's wireless specialists will be on-site, providing guidance on how to use the test equipment and consulting services.

The AEL will house Anritsu's 5G test equipment and DSpace's software simulation for telematics control unit tests.

Li Auto banks on U-Blox positioning

Chinese electric vehicle maker Li Auto is using the U-Blox Zed-F9K high precision dead reckoning module to provide lane-level accurate positioning data for the assisted driving system in its L9 six-seat SUV.

Launched in June, the Li L9 comes with a full-stack, self-developed Li AD Max smart driving system with navigation on adas functionality.

Designed for complex road conditions, the driving assistance system recognises traffic lights, pileups and hard shoulders, and features adaptive cruise control, lane keeping, automatic merging, intelligent speed adjustment, automatic ramp entering and leaving, and visual parking functions that require an accurate positioning system.

The GNSS technology platform provides the location accuracy required to enable several of these features. Designed to serve mass market industrial and automotive applications, the F9 platform combines multi-band GNSS technology with dead reckoning and high precision algorithms, and is compatible with various GNSS correction data services to achieve accuracy down to the centimetre level.

The F9 delivers a fast time to first fix by using multi-band (L1, L2 and L5) GNSS signals to provide robustness against interference and errors caused by ionospheric effects. By concurrently receiving signals from four GNSS constellations – GPS, Glonass, Galileo and Beidou – it increases the availability of precision positioning even in difficult urban environments.

Using a multi-band real-time kinematic (RTK) correction service and an embedded RTK algorithm, the platform can achieve centimetre-level accuracy with an RTK update rate of up to 20Hz.

Built-in jamming and spoofing detection systems protect against intentional and unintentional interference.

Dead reckoning technology based on inertial sensors extends performance to otherwise challenging urban environments.

"It is always rewarding when an innovator such as Li Auto puts their trust into U-Blox and our F9 high precision GNSS technology platform to enhance the capability of their Li AD Max smart driving system," said Hamilton Chen, country manager for China at U-Blox.

• Li Auto is using intuitive gesture control in its cars with a 3D camera that integrates the Melexis MLX75027 VGA resolution time-of-flight (ToF) sensor.

It is being used in the infotainment system of the Li L7, L8, L9 and Li One premium SUV models.

With 307,200 pixels, VGA resolution, the sensor maps user gestures directly to the system's large, full-colour display to ensure flawless user control.

With high sunlight immunity, the sensor ensures consistent performance in all ambient conditions.

"This is an important cooperation that strengthens the position of our ToF sensors in the Chinese market," said Gualtiero Bagnuoli, marketing manager for optical sensors at Melexis. "Our expertise in this technology places Melexis at the forefront of in-cabin sensing, which is ideal for functional-safety and security-related applications in addition to these novel and intuitive gesture controls we have developed with Li Auto."



Li L9 uses smart driving system



ECar X developed the digital head unit

Here powers Smart connected vehicles

Smart is to use Here connected vehicle services and its software development kit (SDK) to power its latest compact SUV.

The all-electric Smart #1 has been available for pre-order in France, Germany, Italy, Netherlands, Portugal, Spain and Switzerland since October, and will be available for pre-order in Austria, Belgium and the UK from the beginning of 2023.

The car will use Here's map data, real-time traffic, and PoIs including on- and off-street parking information. These services will be delivered via mobility tech company ECar X, which developed the digital head unit for the SUV and co-developed the smart operating system with Smart.

With traffic congestion as the main challenge for urban drivers, Smart has equipped all its #1 models with Here's real-time traffic information. This service provides detailed information on traffic congestion and potential road hazards.

Coupled with parking data, it helps drivers plan more efficiently by providing ETAs that take into account the time it takes to drive and to park. It shows drivers where they are most likely to find available on- and off-street parking.

The service delivers information on pricing and restrictions, such as maximum parking duration, as well as no parking and loading zones. It is powered by historical and near real-time data coming from a partner network ecosystem, including vehicle sensors.

Smart is using the SDK to create a mobile companion application that allows users to locate their vehicle's position as well as nearby EV charging points.

Anritsu tests and simulates automatic valet parking

Anritsu has developed a test and simulation environment for automated valet parking (AVP) working with DSpace and Apposite Technologies.

Valet parking is a service in which a professional parking attendant parks drivers' cars at large-scale parking facilities and commercial facilities, mainly in Europe and the USA.

AVP enables this parking to be done automatically, without any driver in the vehicle.

AVP Technical Report v1.0 was released by the 5GAA in June 2022, and a wireless communication type-two operation scheme linked with parking garage infrastructure and users' smartphones was proposed.

AVP is being developed as an autonomous driving use case that can be deployed in the short term. AVP type-one autonomous driving vehicles require expensive high-performance computing and sensing, while type-two communication-cooperative vehicles do not require such installations, reducing vehicle costs and making implementation easier.

Since type-two requires reliable end-to-end communications, a test system must evaluate QoS management and impairment effects in the IP layer. The wireless connectivity also needs to be evaluated.

The test set up a digital-twin environment incorporating virtual and real devices. This allows the system tests and certification required to improve the reliability of type-two to start before the actual devices are available.

Automotive OEMs, tier-one suppliers and mobile network operators have shown interest in the demonstration, and Anritsu plans to continue developing this simulation environment.



Virtual vehicle receives commands across 5G and is automatically driving in a parking lot

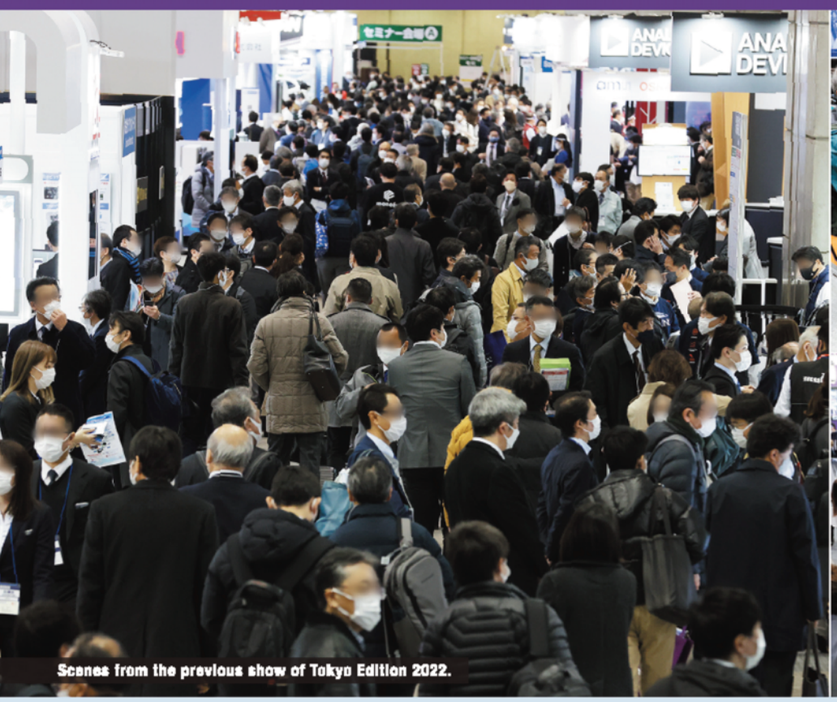
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Basic and Rohm partner on SiC

Chinese firm Basic Semiconductor has signed an agreement with Rohm to develop SiC power devices for automotive applications.

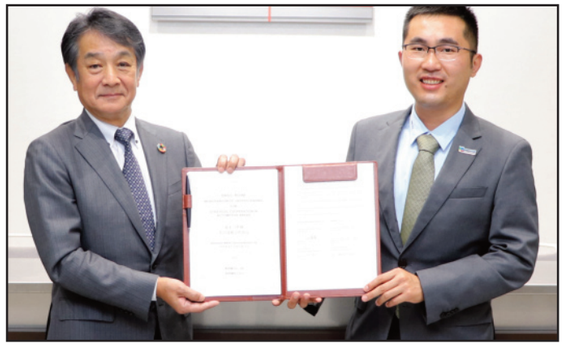
The two companies plan to improve the performance of SiC power devices and develop higher performing, more efficient and reliable SiC devices for new-energy vehicles.

The first step involves supplying onboard power modules that leverage the combined technologies to several major automakers for use in electric vehicle powertrains.

Going forward, both firms will contribute to technological innovation in the automotive sector by accelerating the development of power technologies centred on SiC.

"Amid the undergoing technological revolution of new energy vehicles, the emergence of SiC power devices stands out as the key to improving electric drive efficiency," said Weiwei He, general manager of Shenzhen Basic Semiconductor. "Basic Semiconductor's early involvement in the automotive SiC power module business has led to breakthroughs in both product and market development."

Isao Matsumoto, Rohm CEO, added: "As the role of semiconductors in the automotive market continues to grow, Rohm will strive to manufacture high-quality products that can create a safe, secure, environmentally-friendly society."



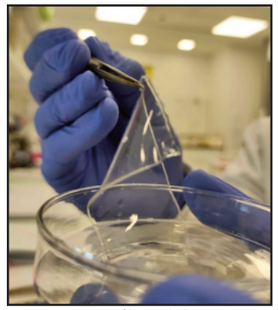
Isao Matsumoto (left) and Weiwei He

• ST Microelectronics and Soitec have announced the next stage of their cooperation on SiC substrates, with the qualification of Soitec's SiC substrate technology by STM planned over the next 18 months.

The goal of this cooperation is the adoption by STM of Soitec's Smart-SiC technology for its future 200mm substrate manufacturing, feeding its devices and modules manufacturing business, with volume production expected in the midterm.

Solid-state batteries decade from mass production

Mass-produced solid-state batteries are still at least a decade from mass production and global automotive manufacturers should consider interim technologies in the medium term, such as semi-solid batteries, according to Doron Myersdorf, CEO of StoreDot.



StoreDot flexible solid-state electrolyte

Solid-state-batteries promise cost-effective fast and safe charging batteries, with high energy densities, however they remain a work in progress, and still face significant challenges before they can be manufactured at scale.

A solid-state battery uses solid electrolytes instead of liquid or polymer gel electrolytes found in current technologies such as lithium-ion or lithium polymer batteries.

"It's crucial that leading battery developers like StoreDot give global automotive manufacturers a realistic and hype-free roadmap for the introduction of extreme fast-charging batteries," said Myersdorf. "Right now, despite some of the bullish claims by our rivals, all-solid-state batteries are still at least ten years away. They are certainly no silver bullet for any vehicle maker currently developing fast charging electric vehicle architectures."

He said a more practical step was the introduction of semi-solid-state batteries which his company is targeting for mass production by 2028.

These, he said, would be safe, high performing cells that could achieve 160km of charge in three minutes.

"They have the additional benefit of requiring a simpler and less challenging manufacturing process than all-solid-state," he said.

TEST & MEASUREMENT

IS IT SAFE?

Howard Chang explores how manufacturers can ensure their autonomous vehicles are safe and meet relevant standards

Baidu robotaxi service will use the Apollo RT6

Vehicle Electronics

Industry boundaries are changing. The increasing dominance of IoT and AI technology in daily lives mean traditionally demarcated industrial sectors are combining. Technology companies and vehicle manufacturers are both now working on the next generation of connected vehicles but, without sufficient expertise in both fields, ensuring safety and compliance can be challenging without the right testing.

The driverless car – autonomous vehicle (AV) – is here. In July 2022, Chinese search engine and AI company Baidu announced the introduction of a robotaxi service in 2023 that uses a vehicle, the Apollo RT6, with a detachable steering wheel. In the USA, Amazon subsidiary Zoot has revealed its robotaxi vehicle meets the highest US safety crash standards and Google's Waymo plans to offer a driverless ride-hailing service in San Francisco. It is already carrying employees in electric SUVs without human backup drivers.

Benefits

A connected car is one cognisant of the world around it via access to the internet and, often, a wireless local area network (WLAN). It can access data, send data, download software and patches, and communicate with other IoT devices.

Connected technology is making travel safer by shifting the focus from crash survival to avoidance. The makers of the Apollo RT6 state it will have the driving capability of a person who has been driving for 20 years. However, unlike a human, this ability to leverage experience will not diminish with tiredness or distraction.

AV technology also offers the possibility of cost reductions for consumers. One study suggests insurance premiums could be halved. In part this is due to fewer accidents and, in combination with this, could lead to overall savings of $1tn.

Some commentators are now predicting that with growth in robotaxis expected to hit 6300% between 2030 and 2040, this new technology will soon be the cheapest way to travel, with costs as low as $0.16 per kilometre, compared with $2.20 for a traditional US taxi.



SUV testing in a vehicle OTA chamber

Another benefit is greater resource efficiency. Elon Musk, when announcing Tesla's self-driving robotaxi, stated the typical passenger car was only used for 12 hours per week. The rest of the time it is idle, parked.

One of the advantages of an AV for consumers is that it could be used between 50 and 60 hours a week. Families would need fewer vehicles as one car might be enough for all car journeys. In the case of the robotaxi, the reduced cost of travel would make this option preferable for consumers, thereby reducing the amount of time vehicles sit idle.

AVs also reduce congestion. The American Society of Civil Engineers estimates people waste 6.5 billion hours a year sitting in traffic but if even as few as five per cent of vehicles were autonomous this could be significantly reduced.

Other benefits include reduced CO_2 emissions, lower fuel consumption, travel time reductions, lower transportation costs, and more efficient use of parking.

Currently, these benefits are theoretical but with many companies and countries now moving ahead with the introduction of robotaxis, it won't be long before everyone begins to see the advantages of AVs.

Challenge

How do you create a vehicle that functions well, meets statutory regulations regarding safety and performance, and which customers want?

It is noticeable that the companies at the forefront of this technological shift are not traditional players in the automotive sector. Instead, they are technology companies with experience in capturing and harnessing data. However, they do not have a history of designing and manufacturing vehicles. Equally, traditional vehicle manufacturers often lack the necessary experience in data manipulation to create safe AVs.

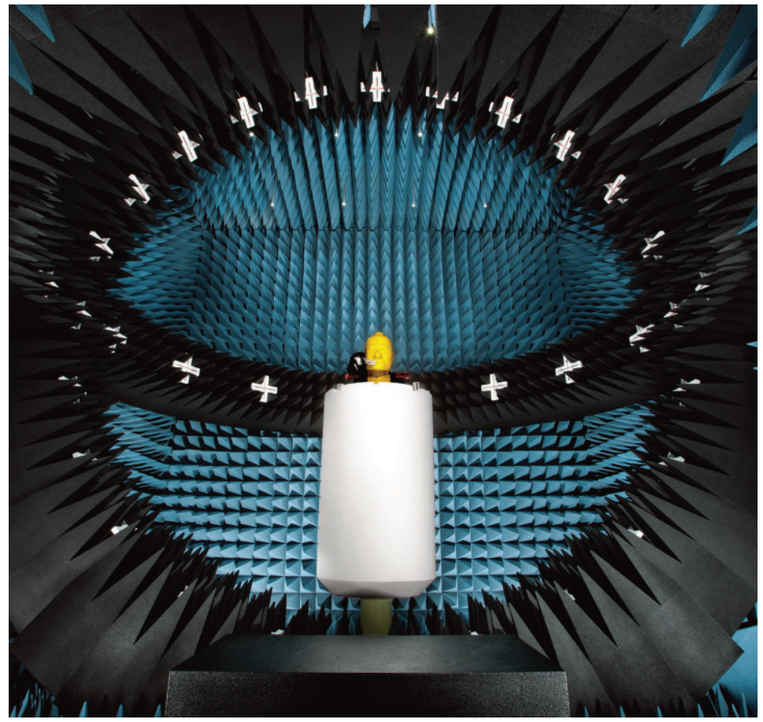
The key to success is full-vehicle over-the-air (OTA) antenna performance. Since all AVs require 4G or 5G mobile communication and V2X (vehicle-to-everything) technologies to enable them to meet their full potential, ensuring the quality of OTA antenna performance is a critical challenge for manufacturers.

Products will only improve and be approved if they are rigorously tested. Consumers and regulators are naturally concerned about travel without a human driver and so it is only through successful trials that this reticence will be broken down.

In August 2022, the drive towards AVs took a major step forward when two Chinese cities approved driverless taxi services – the first places in the world to make this decision.

OTA testing

In the end, a product is trusted because it is tested. To succeed in this competitive hybrid market, manufacturers must deliver cars that conform to defined standards and which create trust in the mind of the user.



Typical OTA test system for antennas

Full-vehicle OTA antenna testing ensures functionality, performance and reliability. Test conditions mimic real usage scenarios with results that closely resemble actual vehicular antenna performance. Testing includes adjustments for both the influence of the vehicle's body and interference from other in-vehicle electronic devices, ensuring functionality in all situations.

In a dynamic market, where companies are moving out of their traditional sectors, high quality testing by experts who understand the field and industry standards is the best way to ensure consumers trust and adopt this new technology.

Comprehensive testing services are available that cover electromagnetic compatibility (EMC) for electrical, electronic and electromechanical components, with tests embracing environmental simulation, functional safety (ISO 26262), battery testing, materials and failures analysis, and tests to ensure compliance with regulatory requirements.

Finding the right option will ensure antenna performance and user experience, helping manufacturers and developers deliver safe, desirable products that meet consumer demand.



Howard Chang is technical manager for SGS Connectivity & Products

SIMULATION & MODELLING

IN MOTION



Motion control is a challenge for electric and autonomous vehicles, explains Christophe Bianchi

Vehicle Electronics

The 21st century has seen enormous technological change within the automotive industry, bringing about the potential for leaps in areas such as sustainability and safety. As these considerations continue to put themselves at the forefront of the mind of governments and organisations across the world, producers are continuously putting more resources into the innovating of electric and autonomous vehicles.

Often this involves improving performance and motion control across varying vehicle models.

The growing pressure to meet lofty climate and safety goals means engineering teams throughout the automotive industry are working to overcome many challenges including more cost-effective battery designs, more efficient powertrains and more robust electronics architecture.

But how can the dynamics of complex structural vehicles continue to evolve to keep up with an industry undergoing tremendous change? To continue to drive the industry forward, real-world testing and simulation must work together to meet consumer demand.



Engineers are working on more cost-effective battery designs

Autonomous vehicles

In the UK alone, self-driving vehicles are set to be worth nearly £42bn by 2035, showing the steep trajectory this development is on

The task of motion planning and control of an autonomous vehicle is full of complexities and challenges. Autonomous driving systems rely on sensors and embedded software for localisation, perception, motion planning and execution. Fully autonomous driving systems are algorithmically designed, allowing them to be trained to make safe journeys.

Motion planning in autonomous vehicles consists of global planning, which is the route from source to destination alongside local path planning. Deep learning, combined with machine learning, is being used by today's top automotive engineers to implement a fully automated control loop. Essentially, the loop is comprised of what behaviour the vehicle is planning (motion planning), what the vehicle observes (perception) and how the vehicle will complete the plan (execution). This control loop is executed in a cyclical fashion allowing the vehicle to respond to ever-changing environmental surroundings.

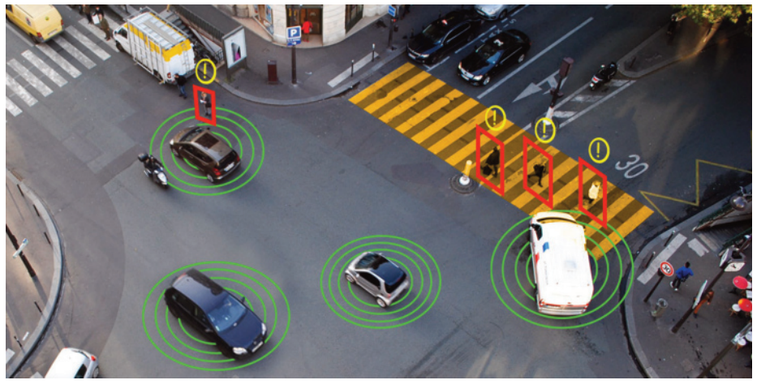
This is defined by control logic, which is generated and coded to safety and security standards. Engineers verify this code by breaking down the overall vehicle architecture to guarantee safety for each of the components.

Extensive simulation is used by engineers to verify the safety of these complex algorithms used for perception, motion planning and execution. To do this, many different objects and events are arranged to create difficult scenarios that challenge both autonomous driving systems as well as human drivers.

For example, graffiti on road signs can affect the system's ability to read, often challenging perception. Simulation can test variables and variations in deep learning models using extensive content libraries that enable the creation of unlimited driving scenarios on virtual roads, giving valuable data. Training these algorithms requires extremely large sets of data that must be accurate and true to physics, and generated by simulation leveraging access to immense resources from cloud computing.

Progressing from level-three to five autonomous driving will rely on the ability for the car to communicate with other vehicles and surrounding infrastructure. It must be able to do this constantly with very low latency while ensuring cyber security.

The only way to achieve this is through simulation and validation using digital mission engineering, an approach where the complete mission of a vehicle within its complex environment is fully modelled with true-to-physics accuracy on a very large set of scenario and edge cases.



Simulation analyses how vehicles behave in real world scenarios

Future

Worldwide sales of EVs are rapidly increasing, growing by 46% in 2020 and by 160% in the first half of 2021. Strategy Analytics found that 40% of all cars sold across the globe in 2027 will be electrified, rising to over 95% by 2050.

EVs have the potential to impact energy, climate and transport.

This rapid change is coupled with increased demand for centralised networking architectures to power control systems for vehicle dynamics and car motion. Electrification introduces engineering challenges that mix a large set of physics: behaviour, safety and performance of EV batteries, which combines electrochemical, thermal, electrical, electromagnetic, mechanical and fluid (air or liquid cooling) physics, all of which interact with each other.

The relatively recent emergence and rising popularity of these EVs brings about many considerations. In their production, key performance metrics include body design, the energy system and optimising all components at a system level.

For example, the motor drive system, which consists of the motor, power converter and control, is an essential aspect for engineers and designers as it has a significant impact on the performance of the vehicle.

Due to EVs being a research priority in the industry, it has been crucial for there to be many significant advancements in areas such as machine learning, computer technologies and motor drive control engineering. If the next generation of leaner and greener cars is to meet market demand, flexible and scalable software will play a major role.

Simulation

Multi-physics simulation gives companies the ability to predict, analyse and explore how vehicles will or won't behave in real world scenarios. Based on the fundamental principles of modelling, physics, mathematics and computer science, simulation gives engineers the power to see how motion control capabilities will behave. Perhaps even better, it can drastically reduce the need for costly physical testing.

For motion control improvements, simulation software allows designers and engineers to tap into millions of different test scenarios to run advance testing, within seconds. In the sphere of autonomous and electric vehicles, there is an increasing focus to make design more efficient, powerful and reliable, all while reducing overall vehicle weight and size.

It is therefore pivotal that sophisticated and complex engineering trade-offs must be analysed in the early stages of design, before development costs have been invested to maximise their potential.

Autonomous and electric vehicles are the future. However, although huge leaps forward have been made, it is clear it will be an incredibly difficult and complicated journey to get to the point where they are ubiquitous throughout society, changing the way we live our lives.

To continue progressing, simulation must be used extensively throughout the industry, to validate design, keep costs down and reduce time to market. Only with simulation can this dream become a reality.



Christophe Bianchi is chief technologist at Ansys



Specialists gather to show how 5G standalone network slicing improves quality for automated driving

Deutsche Telekom, BMW, Valeo, Ericsson and Qualcomm have completed the world first demonstration of an automated driving application supported by 5G standalone (SA) network slicing with controlled network features for quality of service (QoS).

Reliable network connectivity is a prerequisite for many emerging automotive use cases. In trials, the partners explored how 5G SA network slicing with different QoS features support end-to-end automotive use case scenarios.

Network slicing is a key feature of 5G SA. Slices can be tailored to applications and use cases with different QoS requirements in terms of performance, security or latency. Using the user-equipment route selection policy (URSP) feature, the device was able to select and connect dynamically to multiple slices simultaneously.

In addition, a network API, which exposes network capabilities, was used to request a defined QoS level from the network. This was requested via a quality on demand (QoD) network API.

The tests showed the capability of all these features combining to meet the QoS demands of mission-critical applications under various network load situations.

"The BMW group sees the activities in the telecommunications industry with 5G as a central enabler for many innovative automotive features and also for automated valet parking [AVP]," said Nicolai Martin, senior vice president at BMW. "It is crucial that several industries work closely together to offer the customer a valuable benefit. The aim is to build a standardised and interoperable AVP ecosystem. BMW welcomes activities in the telecommunications industry especially the Camara project. This is an important enabler for future services."

Claudia Nemat, board member at Deutsche Telekom, added: "Deutsche Telekom is excited to be part of this activity to demonstrate the capabilities of advanced network features like 5G network slicing with integrated APIs to meet the quality of service demands of automotive use cases."

She said the close cross industry collaboration was an enabler for future services.

Ericsson provided the end-to-end network for a successful proof of concept.

"We continue to support realisation of use cases using network slicing and exposure capability to monetise 5G network investment for communication service providers," said Eric Ekudden, SVP at Ericsson.

Enrico Salvatori, Qualcomm SVP, said the company used its long-established expertise in 5G and wireless innovation to enable features such as 5G network slicing for reliable interoperability and improved QoS.

Communications between infrastructure and vehicles are a safety-critical element. AVP, developed with BMW and tested with Deutsche Telekom, relies in part on Valeo software embedded in the car and installed in the parking infrastructure itself.

"Testing 5G interfaces jointly with Deutsche Telekom convinced us of the performance of cellular networks," said Marc Vrecko, business group president at Valeo. "To make mobility safer and smarter, Valeo has integrated adas into one of the main focuses of its innovations."

Network slicing

In February 2022, Deutsche Telekom in cooperation with BMW and Valeo announced first tests for QoS using the QoD feature as a network API. The API was successfully tested for the AVP use case and the results were presented at Mobile World Congress in 2022.

At the same time the Camara initiative was announced by the GSMA. The initiative consists of network operators, technology vendors, cloud providers, OS vendors and application developers. It aims to standardise network APIs globally. QoD was the first network API standardised in the Camara initiative.

Proof of concept

An increasing number of automotive use cases require reliable mobile network connectivity. Use case examples are safety related features, remote control functions, such as remote door opening and closing, and assisted and automated driving features.

The partners set out to test and explore whether and how to offer QoS features in future network deployments. The tests were performed at Deutsche Telekom testing facilities in Berlin Winterfeldtstraße.

The test environment, which is based on Ericsson 5G SA technologies, includes, for example, QoS support based on network slicing features as well as network APIs. In this trial, BMW and Valeo contributed with mission critical use cases for automated driving using the Snapdragon Auto 5G modem-RF from Qualcomm with network slicing features to support interoperability testing.

Deutsche Telekom, BMW, Valeo and Ericsson collaborated to design the trial setup and test cases.

Features

The tests demonstrated the high value of QoS for achievable bandwidth, stability and latency. The partners showed how 5G SA network slicing supported an end-to-end automotive use case with application grade connectivity enabled by three key QoS features in the operator network – network API, network slicing and URSP.

With the network API, a mission-critical application makes an ad hoc request for an improved network performance via the QoD API in an enhanced mobile broadband (eMBB) slice. The trial showed how the application could request and receive the network performance via the API to meet its QoS requirements even in congested network situations.

In the tested scenario, mission-critical data were transmitted via a high-quality slice, while non-mission-critical data were transmitted via an eMBB slice. The trial's measurement results showed that for congested conditions, where many users are sharing the limited resources of the mobile network, the automated driving function was consistently served with the necessary bandwidth resources.

In a mission-critical scenario, the URSP was used to enable network slice selection on the device side according to network slice availability on the network side. The results demonstrate that application traffic from different applications can be handled by multiple slices in parallel.

For example, mission-critical application traffic is transmitted via the high-quality slice, while non-mission-critical application uses the eMBB slice.

ON THE ROAD

LONE RANGER



A look at the technology powering Ford Pro's Ranger Platinum pick-up

Vehicle Electronics

Ford Pro has revealed the high-specification Ranger Platinum pickup, raising luxury to a new level in the Ranger family.

The Platinum joins the line of Europe's best-selling pickup at the pinnacle of the on-road range. Exterior detailing and finishes enhance the Ranger's already characterful design, matched by a stylish and contemporary leather-trimmed cabin.

Ford's 240PS 3.0-litre V6 turbodiesel engine and a drivetrain engineered for refinement combine to deliver smooth, effortless performance for cruising, as well as exceptional torque for confident load carrying and towing up to 3500kg.

"The Ford Ranger has set the standard for performance, versatility and capability in the pickup segment, and now it's setting the standard for luxury," said Hans Schep, general manager for Ford Pro in Europe. "The stunning new Platinum will suit customers who appreciate the level of comfort and technology from high-end road cars, but who rely on the toughness and all-round productivity that consistently make Ranger Europe's pickup sales leader."

Order books for Ranger Platinum are open. Production of the new model is scheduled to begin in March 2023, with the first customer deliveries scheduled from late spring.

Luxurious

Ranger Platinum is available exclusively in five-seat, double cab specification, and powered by Ford's 3.0-litre V6 turbodiesel engine – also featured in luxury SUVs and the F-150 pickup in North America – producing 240PS and 600Nm of torque.

Power is delivered through the Ranger's electronically controlled full-time all-wheel drive system, combined with Ford's ten-speed automatic transmission with adaptive shift scheduling and mounts re-engineered to reduce noise and vibration.

The result is refined, responsive performance regardless of conditions, and a maximum braked towing weight of 3500kg. The vehicle also offers the same load-carrying ability as all Ranger pickups, including a payload exceeding one tonne.

The Platinum exterior builds on the muscular and functional styling of the Ranger pickup family with added sophistication.





A portrait touchscreen controls Ford's Sync 4A infotainment system

The new model sits above the high-series Wildtrak, which accounted for 60 per cent of outgoing Ranger model sales in Europe.

A unique grille and silk chrome finish for the Platinum's exterior highlights help deliver a striking first impression, supported by new 51cm machined-face alloy wheels with high-gloss ebony detailing. Further premium touches include a soft-close tailgate, privacy glass and signature daytime running lights within the matrix LED headlamps. Standard roof rails add a purposeful look and extra practicality.

Inside, the Platinum blends a luxurious leather-trimmed cabin with clever technology designed to make life easier.

The driver and front passenger benefit from premium perforated and quilted leather seats with ten-way power adjustment, heating and cooling functions, and stylish contrast stitching. Open-grained dark maple wood textures continue the opulent design, and ambient interior lighting helps create a calming atmosphere.

Technology

The high-tech cockpit is defined by dual 30.5cm screens; a full digital cluster replaces the traditional gauges ahead of the driver, alongside a portrait touchscreen controlling Ford's Sync 4A infotainment system.

Ranger Platinum also features an eight-speaker Bang & Olufsen audio system and wireless device charging as standard.

Connectivity is delivered by a standard FordPass Connect modem, which enables multiple modules to be wirelessly future-proofed via Ford Power-Up software updates that can improve the vehicle over time.

In addition to the comprehensive adas on Ranger Wildtrak, the Platinum series also has active park assist with park out assist, blind spot information system with cross-traffic alert and trailer coverage, lane change warning and aid, and a 360-degree camera as standard equipment.

Ranger range

The Platinum series tops the widest ever range of Ranger pickup variants available from Ford Pro and, in addition to the high-performance Raptor and Wildtrak models that are already on sale, buyers can now also order the rugged XL trim for the single or double chassis cab, and XLT, available in double cab only.

These iterations feature no-nonsense specifications to suit commercial users such as those in construction, forestry and the emergency services.

PREDICTIONS

READY FOR 2023

James Jeffs looks at the autonomous vehicle trends and milestones in 2022 and predicts what to expect in 2023

They may not be ubiquitous yet, and the day-to-day advantages that they will start to provide may not be noticeable, but automated technologies across the automotive industry are starting to come of age.

The robotaxi industry is beginning to see more small commercial deployments. Autonomous trucks are on the cusp of real-world use, and next-generation sensor technologies are being deployed on vehicles that are for sale.

Robotaxis

The biggest news from 2022 in the world of robotaxis is commercial services have come online in San Francisco. This is a major milestone the industry has been working towards for some time, but it is unfortunately not as exciting as it initially sounds.

Cruise was the company to reach this point in San Francisco first. Its journey has been quite long and is littered with other smaller successes.

It began in October 2020, when Cruise was awarded a driverless testing permit by California DMV. This meant it could run the vehicles without anyone on board, not even a test driver. In June 2021, it was given permission to start offering rides to San Franciscans without a safety driver on board. These were free rides and had no paying customers, an important distinction.

The big step came in September 2021 when both Waymo and Cruise were awarded a driverless deployment permit. The final part of the puzzle would be gaining permission to operate a commercial service from California Public Utilities Commission, which was awarded to Cruise in June 2022.

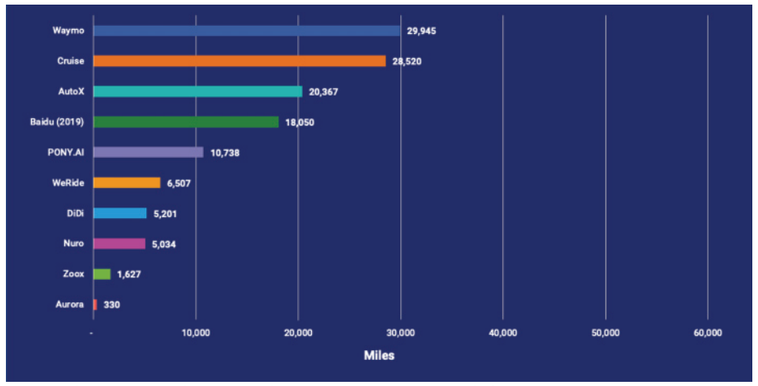
People may think they can now turn up in San Francisco and hop into a driverless robotaxi without a second thought. While this may be true on paper, it is quite limited in practice.

Only 30 vehicles, out of Cruise's fleet of approximately 150 vehicles, are allowed to be used. The vehicles are limited to 48kmph, the service can only operate between 10pm and 6am, and only a small part of the city can be used – not the transportation revolution hoped for, but a step in the right direction.

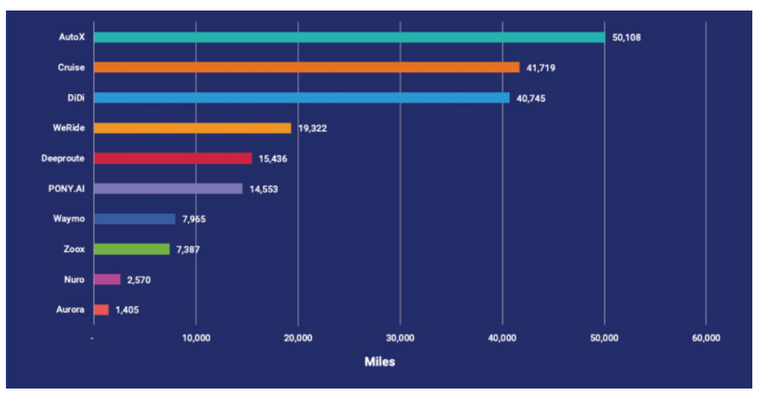
Cruise hopes to prove competence and expand its testing parameters over the coming months and years. Perhaps though, the real question is, what has happened to Waymo?

Waymo has been at the forefront of the autonomous vehicle race for some years, but in 2021 this changed.

A metric called miles per disengagement can assess the progress and maturity of the autonomous car players. The metric is the number of miles a player such as Waymo completes in a year divided by the number of times a safety driver must intervene with the autonomous system, taking back control.



Top players, miles per disengagement, California DMV, 2020



Top players, miles per disengagement, California DMV, 2021

In practice, this suggests the average number of miles that an autonomous vehicle can complete before coming across a situation with which it might not be able to deal.

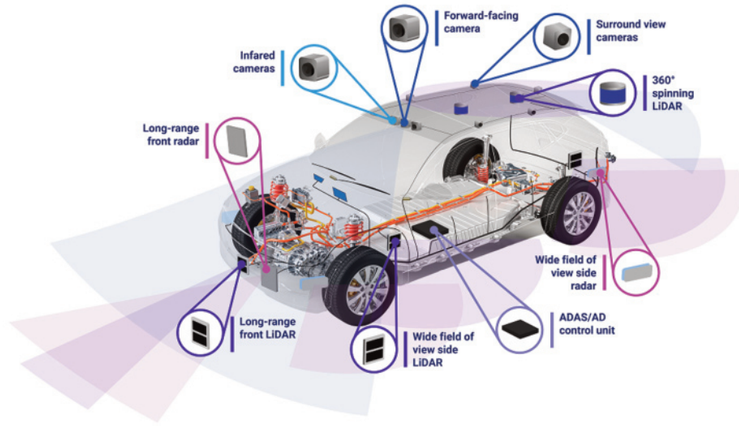
The two charts show how Waymo slipped from being the leader in miles per disengagement to ranking seventh.

Waymo's performance slip came as it ramped up its testing in San Francisco, whereas previously, it had favoured less challenging, more suburban environments. This slip in performance might be related to the fact that Cruise had started a limited service in San Francisco. However, Waymo is now eyeing a deployment in Los Angeles, which generally has a slightly more robotaxi-friendly road network than San Francisco.

Besides the slipping in its own ranking, Waymo's performance reduction from nearly 30,000 miles per disengagement down to just shy of 8000 has a knock-on effect on the industry.

Looking at the average performance of the top three players to assess how the industry is developing, since 2015, this number has been growing exponentially and predictably. With Waymo's regression in 2021, the average for the top three has not grown as expected. As a result, the timeline for further deployments is likely to be pushed back a little. Hopefully, Waymo can get back on track this year, and see another year of significant growth.

Outside of the USA, China has also been ramping up its autonomous robotaxi deployments. Baidu, Pony.ai and AutoX have been making some significant progress. Baidu and Pony.ai conduct significant testing in Beijing and, like Cruise and Waymo, have limited commercial robotaxi services.



Some of the technologies changing the face of automotive

Baidu and Pony.ai were given permission to start a robotaxi service with no driver behind the wheel in April this year, with one slight catch. Their services must still have a supervisor present in the vehicle, presumably sitting in the front passenger seat. They will also be restricted to a set number of cars, operating hours and geofencing.

Baidu will be able to operate ten cars between the hours of 10am and 4pm, while Pony.ai will only have four cars operating between 9am and 5pm, both operating in an area of 60 square kilometres.

AutoX has been growing its robotaxi service in Shenzhen for over a year and now has a service area nearly three times the size of Baidu and Pony.ai's in Beijing at 168 square kilometres.

Roboshuttles

This new and exciting future mobility option is fast becoming not so new, not so exciting, and possibly soon confined to history. The concept of a roboshuttle-powered future is that these small, shared vehicles will be able to operate more flexibly than a bus, thus, offering more diverse routes and some working on an on-demand basis.

These vehicles first emerged decades ago but were restricted to running on isolated roads with embedded guidance systems. From a functional perspective, they were comparable with a very cheap but slow autonomous train with very limited capacity.

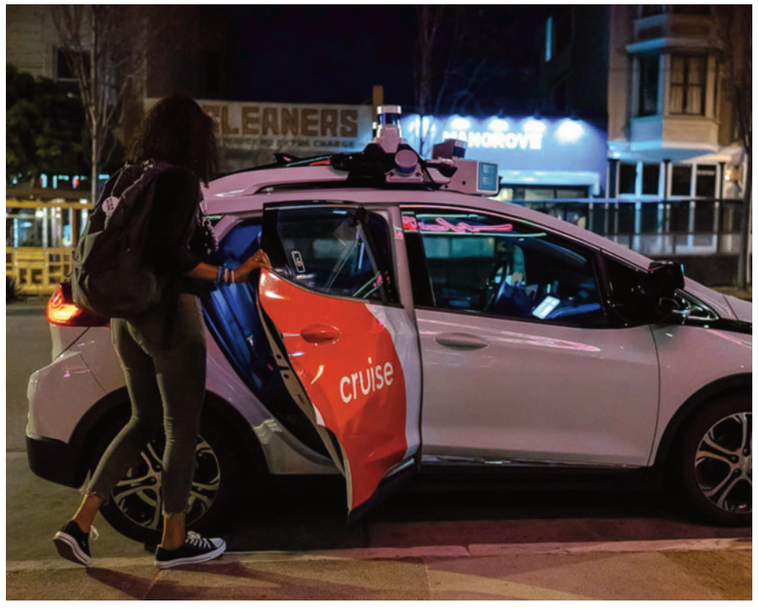
The modern open-road version has been around since the early 2010s. The pioneers in this industry are EasyMile and Navya, two French companies with similar vehicles and funding of around €100m each.

Over the years, they have supplied around 200 vehicles each to different companies, transport agencies and other mobility stakeholders that are interested in trialling the technology. The problem is that after many years of trials, they appear no closer to

deploying a commercial, fully developed, roboshuttle service. Even more concerning is interest in these vehicles seems to be on the decline, with the number of companies actively working on roboshuttles appearing to have peaked.

Notable companies such as Local Motors have been forced to close their doors, while others such as Continental and Bosch have shown concepts in the past but then gone quiet on the topic.

Not only are the number of active companies declining, but there is also evidence that suggests some key players might be struggling. Navya's is a leader in the industry, but its sales have been declining since 2018. Some of this is undoubtedly attributed to the global Covid-19 pandemic, but that would not explain the fall in 2019, and some recovery would be expected by now. It may show in the 2022 financial results that this has now happened for roboshuttles, but these vehicles have major hurdles and fundamental flaws that need to be overcome for them to prosper.



Cruise was awarded a driverless deployment permit

Roboshuttles will share the challenge of robotaxis in proving that autonomous technology is mature enough to be trusted with the lives of its passengers. On top of this, they also battle more fundamental regulations governing what constitutes a road-worthy vehicle. This is the problem of homologation.

The problem is, in most regions, a vehicle needs a long list of features and engineering criteria to be signed off as road worthy. This list includes things such as seat belts, a minimum number of wheels, brakes, lights and so on, things that make cars safe.

But roboshuttles tend to be missing some key features from this list since they have been designed from the ground up to be driverless. The most obvious omissions would be the steering wheel, pedal controls, rear-view mirrors and speedometer. This creates friction.

Even if the autonomous technology could be 100% signed-off today, the rules of the road would still likely prohibit these vehicles from being commercially used. There is progress though.

Nuro, specialising in driverless deliveries, has been pushing for changes to allow their driverless pods to operate on the road. One result of this is that the US NHTSA recently put a rule change in place that meant driverless vehicles not carrying people did not require seatbelts and airbags. Progress!

However, this is only a small step towards commercially operational driverless goods delivery vehicles in the USA. There could be a long road ahead for roboshuttles to get all the law changes that they require.

Despite this pragmatic pessimism, there is still some hope for roboshuttles. Two key activities that point to for reasons to be optimistic are Cruise's intentions with the Origin and ZF's acquisition of 2getthere.

Cruise is one of the leaders in the robotaxi race and is part of General Motors. Its original concept is a mix between a robotaxi and roboshuttle. It looks like a roboshuttle but has a comfortable cabin for six people rather than a utilitarian cabin for mass transport. It is also designed to travel at full motorway speeds rather than the pedestrian shuffle of most roboshuttles. These differences are mostly irrelevant though.

What is important is that GM has the might and sway to influence the NHTSA and get the changes it needs to commercialise the Origin with its non-conventional, non-homologated design.



Baidu has permission for a robotaxi service with no driver behind the wheel

Furthermore, it is actually in a position to scale up production when it eventually gets the green flag. It also helps that Cruise is arguably the most mature and most successful of the robotaxi players, perhaps trading blows with Alphabet's Waymo.

ZF does not have the same might and sway as GM, but it is a leading tier-one supplier with production capabilities and revenue in the tens of billions. In 2019 it acquired 2getthere, a roboshuttle manufacturer that has worked on off-public roadways for many years. At that point, the difficulties of roboshuttles would have been well known, so this would have been a calculated bet by ZF, one that it likely thinks has a future.

Trucks

Autonomous trucks or lorries have quickly become one of the most exciting autonomous prospects over the past year. One of the key developments and milestones in the field occurred in December 2021 when field leader TuSimple completed an 128km journey across Arizona with an empty cabin and zero human intervention.

The reason to get excited about this is all the conditions are right for this industry to explode in the coming years.

First, there is a measurable and known driver shortage in the USA, Europe and China. A few factors drive this, key ones being an aging driver population without the necessary pipeline of replacements, the massive growth in ecommerce, and the need for more freight on the road.

Secondly, there is a significant overlap between the capability of today's autonomous technology and the demands of the environment in which the vehicles will operate. The first deployments will likely be between distribution hubs separated by vast stretches of interstate. This eliminates lots of the more challenging scenarios for autonomous vehicles, such as pedestrians, stop signs, unprotected left turns, turning right on red lights, and other situations that rely on human judgment.

Finally, autonomous trucks can bring a significant increase in productivity. Many of the journeys across the USA take several days for humans to complete due to daily driving time limits. Autonomous vehicles will not be subject to this and have the potential to half the delivery time for journeys over a certain distance.

There is a need to increase fleet capacity, which driverless trucks could do. The operational design

domain is within reach of what autonomous technologies can achieve, and there is the prospect of significant productivity uplift per truck with autonomy. It looks like the stars are aligning for autonomous trucks, and expect to see announcements of the first commercial driver-out routes coming online in the next one to two years.

Radar

The big news in the world of automotive radar is that consumer vehicles began shipping with 4D imaging radars early in 2022; 4D imaging radars bring a significant performance boost compared with the previous generation of radars with a 16 times increase in resolution.

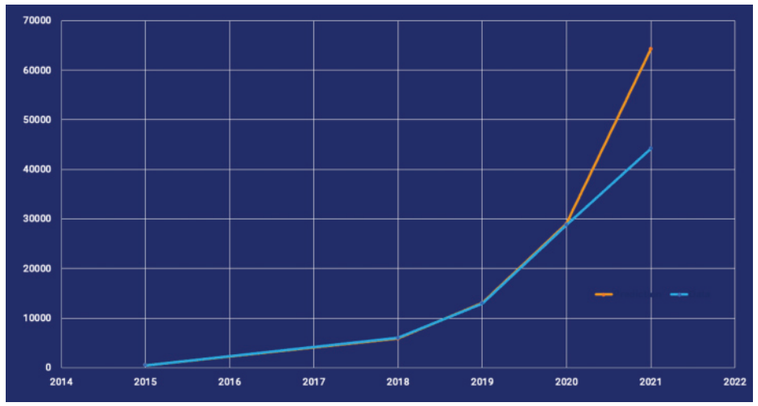
The conventional tier-one suppliers achieve this by using four radar chips rather than the one in incumbent models. For the consumer, this will translate to smoother, more effective adas features, improving their experience and, most importantly, improving the functionality of safety features such as automatic emergency braking.

So far, vehicles that have been fitted with 4D imaging radars include the BMX iX, which uses the ARS540 model from Continental, and the Chinese Feifan R7, which uses a model from ZF.

Away from the conventional supply chain, some start-ups are getting closer to deploying their 4D imaging radars, and these have some even more exciting tech. They can be thought of as the next generation beyond those being supplied by Continental and ZF today.

The most exciting ones are from Israeli firm Arbe and Texas-based Uhnder. While the established tier-ones are now adopting cmos technologies with 40 to 45nm transistor sizing, these start-ups are blazing ahead with a 22nm process for Arbe and a 28nm process for Uhnder.

These smaller transistor sizes allow for more imaging potential to be crammed onto a smaller chip with some incredible results. Uhnder can get the same resolution with one chip as Continental and ZF do with four, while Arbe brings a tenfold increase in resolution above Uhnder, Continental and ZF.



Miles per disengagement

These gains in performance are fantastic, but the start-ups need to establish a route to production and deployment and, thankfully, they have.

In October 2022, Arbe announced it had partnered with Veoneer, which is planning to develop radars using Arbe's reference design. Veoneer says it aims to have pre-production versions of these new 2K 4D imaging radars ready by mid-2023.

Uhnder, though, is going to be entering the market even sooner. Its radar chip will be bought to market by tier-one supplier Magna under the product name Icon. The Icon will be deployed on the upcoming Fisker Ocean, which was due for its first deliveries in November 2022.

The 4D imaging radars are a big step in enabling higher-performing autonomous features for consumer vehicles. However, another technology is also arriving, which has been touted as a game changer for years but has simply been too expensive. Lidar has finally reached a price point where OEMs are prepared to start integrating it, and there has been a flurry of model adoption announcements in 2022. Thus 2023 could then be the year of the lidar.

Lidar

Lidar is not a new technology. It is not quite as old as radar, but it might be surprising to learn it has been around since the 1960s.

The first versions were simple and initially used for ranging applications in aerospace and defence. As the development and applications increased, lidar grew the ability to measure angles and velocity and produce detailed 3D maps, but the equipment was costly.

The benefits for automotive were clear in the 2000s. It could offer the abilities of radar at a much higher resolution. However, until recently, it was simply too expensive for widespread adoption across the automotive industry.

The last year or so seems to have been a turning point for lidar, with more OEMs announcing models that will be equipped with the technology.

Volvo will be using Luminar along with Chinese OEM SAIC. Continental and Denso are shipping on Toyotas and Lexus. The Audi A8 carries a Valeo, as do some Mercedes. BMW has chosen Innoviz, as has Volkswagen, and the list goes on.

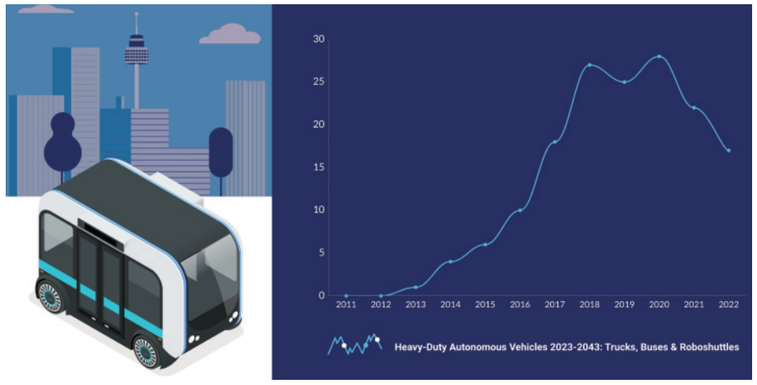
These examples are mainly premium vehicles so far; however, the automotive industry has a well-demonstrated trickle-down effect, with flagship technologies spreading down the price points over a period of five to 15 years.

With the automotive industry's current focus on safety and the benefits that lidar has been promising, this trickle-down effect might look more like a gush than a trickle.

Predictions

With all the excitement over the past year and the promise for the future, here are three predictions for 2023.

First, robotaxi service expansion. There are now a small handful of robotaxi services coming online in the USA. Next year this will grow. It is unlikely that many new cities will go online; a few will, but the services in existing cities will grow, particularly Cruise in San Francisco, which will be a key service of which to keep track.



Number of active roboshuttle companies

Secondly, commercial driver-out autonomous trucking will enter a trialling phase. In 2023, the first commercial autonomous truck routes without a driver behind the wheel will go online. This will likely start with a single route, perhaps Tucson to Phoenix, as demonstrated by TuSimple. However, a handful of routes and companies will be online by the end of next year.

Thirdly, there will be more level-three vehicles in Europe enabled by higher performing radar and lidar. So far, there has only been one true level-three car on the market, the Mercedes S-Class. However, its level-three functionality could only be used in Germany.

The Honda Legend was also level-three certified in Japan, but only 100 were made available.

In 2023, more OEMs will be looking to deploy level-three vehicles such as BMW, Stellantis and perhaps more Mercedes models. Additionally, the UK and some European countries will likely allow level three to be used on their roads. In Germany, there may be the level-three speed limit increase from 60kph to 130kph thanks to a UNECE regulation change coming into effect in January.

Level three in the USA and China is harder to predict as the relevant governing bodies have not been as forthcoming or transparent as UNECE on a plan to make it happen. These regions have some of the most pioneering OEMs; they pushed the bounds of what is possible and are lobbying for more regulation around higher automated level deployments. It will not be long before deployments are seen.

All things considered, there is lots to look forward to in the automotive world going into 2023.



James Jeffs is a technology analyst at IDTechEx

Cmos transceiver mmic for radar

Infineon has announced the Rasic CTRX8181 transceiver mmic for automotive radar.

This is the first in a series of 76 to 81GHz radar mmics based on 28nm cmos technology.

The improved signal-to-noise ratio and linearity of the transceiver provides high system-level performance and resilience.

In addition, the easy-to-use radar transceiver simultaneously offers a scalable platform for different sensors including corner, front and short range, along with flexibility for software-defined-vehicle architectures.

This enables 77GHz automotive radar applications at reduced development costs.

The device was developed to ISO 26262 safety standards and comes with four transmit and four receive channels. It increases the standard module range by up to 25 per cent from 250 to more than 300m.

The higher RF-channel count with improved linearity also enables 33 per cent higher vertical or angular resolution to allow a better separation between different objects such as pedestrians next to cars. These features contribute to the development of radar modules for all applications, from corner radar to high-resolution radar.

The in-chip digital phase-locked loop (PLL) allows faster ramps for better range resolution and fast fly back times. This reduces power consumption and enables better accurate speed information required to separate objects at similar speeds.

This also allows a free configurable ramp without compromising phase noise making the radar robust and reliable in different scenarios.

It prepares it for interference robust frequency schemes, such as the compass method.

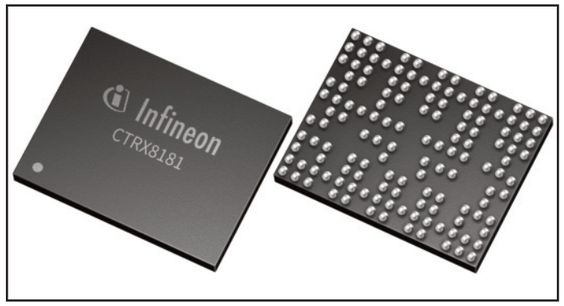
The CTRX family can be combined with the firm's radar-specific Aurix TC3x and upcoming TC4x microcontrollers, both with integrated signal processing units and non-volatile memory for on-chip programme code storage.

The Aurix chipset and CTRX improve reliability for radar function in bad weather conditions.

System partitioning gives vendors the flexibility to offer full processing capabilities in the radar but allows different architectures such as pre-processed data streaming over 100Mbit/s or 1Gbit/s Ethernet with little effort.

The splitting also allows the selection of appropriate mmic and microcontroller for target applications to enable scaling to support various cost and performance requirements.

The connection to the MCU is established via LVDS or CSI-2.



Shunt resistors help reduce size

The LTR10L wide terminal shunt resistor from Rohm is for applications in automotive, industrial and consumer sectors.

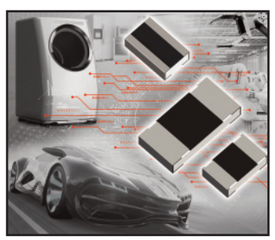
The firm has also added the MCR10L and MCR18L general-purpose MCR series shunt resistors.

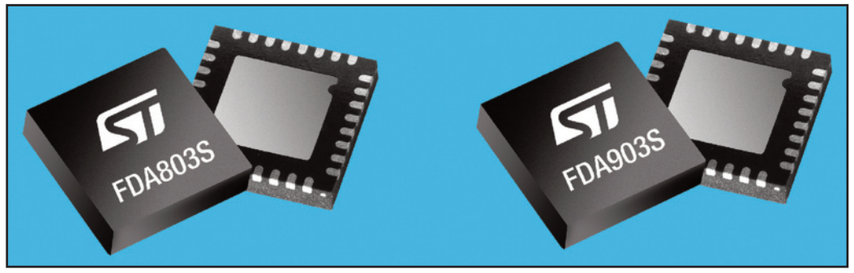
The LTR10L delivers a claimed highest rated power and best-in-class temperature coefficient of resistance (TCR) in a 1.25 by 2.0mm device.

Rated power is 1W in a 0508-size package, 88% smaller than some products. And ±0.5% resistance tolerance has been achieved, with best-in-class TCR and anti-sulphuration characteristics.

These features make them suitable for applications exposed to harsh conditions, including automotive LED headlamps that demand high accuracy current sensing along with long-term reliability.

The MCR10L and MCR18L general-purpose shunt resistors use an improved element structure and materials to increase rated power to 0.5 and 0.75W, respectively, over their conventional MCR series rated power of 0.25W. Higher rated power enables the same performance in a smaller size.





Audio amplifiers suit ecall and telematics

The FDA803S and FDA903S are single-channel fully differential 10W class-D audio power amplifiers in ST Microelectronics' FDA (fully digital amplifier) family.

They are for automotive applications such as ecall, telematics and wherever an audio channel needs to reproduce human voice, music or warning messages at a standard output power level of up to 10W.

The amps integrate an I²S front end, digital core, 24bit digital-to-analogue converter with 100dB resolution, and class-D PWM output stage.

The integrated digital audio processing ensures high sound quality within a compact circuit footprint. Feedback within the chip, before the external L-C output filter, simplifies the circuit design and saves space.

With full I²C configurability and in-play diagnostics that include clipping detection, thermal warning, overcurrent protection and open-load detection, both amplifiers can reduce external components and bill-of-materials costs.

The FDA903S additionally integrates a real-time load-current monitor, allowing self-diagnostic capability compatible with the demands of functional-safety applications up to Asil A.

Both come in QFN32 5 by 5mm exposed pad-down packages that enable a compact digital design without the need for a heatsink.

They have an I²S digital input and a time-division multiplexing (TDM) interface. They can be configured for sampling frequencies between 8 and 96kHz to optimise performance with various audio sources.

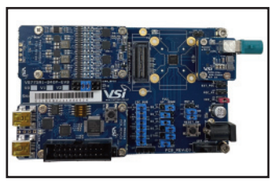
The lower sampling frequencies, from 8 to 32kHz, help designers save memory space in applications such as warning tone generators.

The Eval-FDA903S evaluation board gives designers a jump-start to audio projects based on either device.

Serdes meets ASA standards

A commercial serdes from VSI complies with the Automotive Serdes Alliance (ASA) standard.

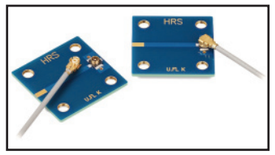
The VS775 provides data transmission up to 16Gbit/s so the ECU can quickly process high-resolution image data collected by image sensors, especially in electric and autonomous vehicles.



It provides a commercial camera link semiconductor offering that can resolve the bandwidth concerns when using high-resolution image sensors in autonomous vehicle designs.

In addition to high-speed data transmission performance, the chip can reduce power consumption by half.

Its compact size means it is optimised for electric vehicles and automotive camera modules with limited space.



Coaxial connector

A coaxial connector from Hirose has gold-plated contacts for corrosion resistance and peeling strength using four ground contacts for shock and vibration resistance.

The U.FL(K) is designed to have a long operational life in harsh environments.

Combining a profile of 2.5mm with high-frequency, the connector is for automotive applications including antennas, AVN (audio, video and navigation), camera modules, telematics and more.

The footprint helps designers reduce the size or add more functionality in the same space.

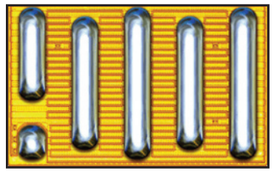
It has a low voltage standing wave ratio (VSWR) of 1.6 maximum from DC to 8GHz.

Measuring 3.0 by 3.1mm, it is pick-and-place compatible. A clear tactile click confirms correct mating.

GaN fets boost efficiency and reduce size

Two 80V AEC-Q101 qualified GaN fets from EPC are said to offer designers smaller and more efficient options than silicon mofets for automotive 48-12V DC-DC conversion, infotainment and lidar for autonomous driving.

The 80V, 6mΩ EPC2204A delivers 125A pulsed current in a 2.5 by 1.5mm footprint and the 80V, 3.2mΩ EPC2218A delivers 231A pulsed current is a 3.5 by 1.95mm footprint.



Both are suitable for applications with requirements for high power density including 48 to 12V bidirectional converters for mild hybrid cars, 24 to 48V DC-DC in cars and trucks, and for infotainment, lighting and adas.

Lower gate charges and zero reverse recovery losses allow operation at 1MHz and beyond.

For 2 to 4kW, 48 to 12V converters, GaN devices allow five times the frequency of silicon mosfets. Also, with a quarter of the inductance, inductor size and losses are reduced allowing 40% higher current per phase and up to half of the phases for lower cost and half the size.

Despite the smaller size, efficiency increases up to 98%, more than 2% higher than mosfets.

For lower power DC-DC, such as in infotainment applications, GaN allows for operations at 2MHz and above to avoid interference and enable a smaller size.

The fast-switching speed of GaN, with sub nanosecond transitions and the capability to generate high current pulses in less than 3ns, allows for longer range and higher resolution in lidar for autonomous driving, parking and collision avoidance.

CFP packaged diodes include 650V units

Nexperia has expanded its portfolio of clip-bonded FlatPower (CFP) packaged diodes for industrial and automotive applications.

The latest additions include four 650V, 1A parts available in CFP3 and CFP5 packages for use in onboard chargers (OBC) and inverters for electric vehicles, power converters, PV inverters, and power supplies in industrial applications.

Standard products include the PNU65010ER (CFP3) and PNU-65010EP (CFP5) while AEC-Q101 qualified products include the PNU65010ER-Q (CFP3) and PNU65010EP-Q (CFP5).

These rectifiers provide a trade-off between fast soft switching behaviour and low forward voltage drop to help reduce power losses in high-frequency applications.

Their small CFP footprint saves board space compared with SMA/B packaged devices, enabling high-density designs without compromising on electrical performance.

These 650V diodes are already being used in several designs of tier-one automotive and industrial suppliers.





Snap ferrites

Snap ferrites have helped establish Würth Elektronik's renown as an EMC specialist.

Now the firm is launching another line of retrofittable interference suppression products with AEC-Q200 qualification, as required for the automotive industry.

The WE-Car-Tec series snap ferrites feature a NiZn core material. They suppress electromagnetic interference in the frequency range from 1MHz to 1GHz.

The internal security locking system prevents unauthorised removal from the cable.

Thanks to the key technology, the ferrite is reusable making it suitable for test and measuring purposes in the EMC laboratory.

Each packaging unit comes with a WE-Star-Key to open the snap ferrites.

The products are available in four sizes for cable diameters from 3.5 to 8.5mm.

The plastic housing is UL94-V0 classified. Operating temperature is from -50 to +105°C.

Six-axis sensor monitors motion

A six-axis inertial sensor from Panasonic provides installation freedom and additional functionalities, and is Asil-B(D) compliant.

The gyro and accelerometer 6DoF sensor is available in a wettable flank QFN package.

This housing benefits from an edge that forms a step. The solder creates a reliable connection in the throat of this step to improve soldering quality and achieve error-free assembly for automotive electronic stability control, ABS brakes, traction control, navigation, head-up display (HUD), driver-assist and comfort, and off-highway automated guided vehicles.

A key application is to detect motion of a vehicle in harsh vibration circumstances, for example when a car suddenly leaves the road.

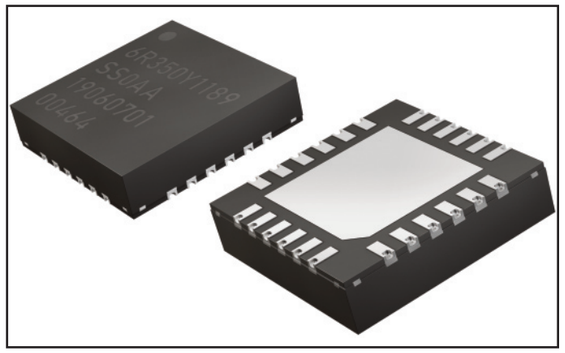
Then the sensor uses data to adjust the torque of the motor and the braking force to achieve a safe vehicle status.

The sensor has already been implemented to support radar and lidar applications in cars. It detects the motion of the vehicle and the radar and lidar system uses the motion data to compare the obstacles detected in previous and current scans.

Also, the sensor supports the calculation of the position of a vehicle if GNSS signals are blocked, such as in tunnels.

In AR-HUD systems, the sensor detects the movement of the car and can adjust the position of the AR-HUD beam with markers so the driver can read it in an optimal way. Another comfort-related feature is the possibility to adjust the suspension of the car, using the six-axis output that can detect the state of the vehicle and cabin.

The device can be used in road cars, motorcycles and scooters. Autonomous driving buses can use the six-axis output to calculate if the vehicle is on the predefined path. Autonomous forklift applications will benefit from checking if goods have fallen off. This also applies for other machinery on the doorstep of autonomy such as lawn mowers, railway trains and compactors.

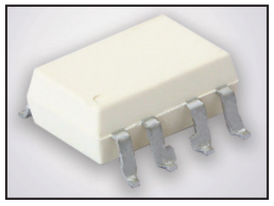


Linear optocoupler speeds response times

An AEC-Q102 qualified linear optocoupler from Vishay has an isolation voltage of 5.3kV rms.

The VOA300 provides a response time said to be five times faster than competing devices while delivering transfer gain stability of ±0.005%/°C typical and a single-ended output for flexibility.

The device consists of an AIGaAs infra-red LED irradiating an isolated feedback diode and an output PIN photodiode in a bifurcated arrangement.



The feedback photodiode captures a percentage of the LED's flux and generates a control signal that is used to servo the LED drive current, while the output PIN photodiode produces an output signal that is linearly related to the servo optical flux created by the LED.

The time and temperature stability of the IO coupler is ensured by using matched PIN photodiodes that accurately track the output flux of the LED.

The single-ended output can be directly connected to an amplifier stage or an analogue-to-digital converter.

The optocoupler is designed for galvanically isolated current and voltage measurement in electric vehicles, including on-board charger, traction inverters and DC-DC converters.

Data transfers are at 1.4MHz for these applications, while its fast response time enables quick detection of voltage and current ripples for battery cut-off mechanisms (e-fuses) that protect passengers and vehicles.

The linear optocoupler offers IO capacitance of 1pF typical, gain linearity of ±0.25%, and power consumption of less than 15mW. Operating temperature is up to +125°C.

Dual-channel device decodes USB protocols

Diodes is addressing USB PD 3.1 SPR, PPS and QC protocols using an automotive-compliant, dual-channel decoder.

The AP43776Q USB type-C protocol decoder supports USB power delivery (PD) 3.1 standard power range (SPR) and programmable power supply (PPS) as well as Quick Charge QC5 fast charging protocols.

It also supports legacy battery charging (BC) 1.2 and is optimised for multi-port automotive USB device charging.

A built-in microcontroller has 12kbyte of one-time programmable rom, plus a multi-time programmable rom resource tool.

Each PD 3.1 port is PPS compliant, with a 3.3 to 21V output voltage with 20mV/step and 50mA/-step adjustment. They enable independent charging output voltages for power use optimisation.

An I²C interface enables inter-chip communications with DC-DC controllers and converters in the charging system. This simplifies the control loop and lowers overall component costs.

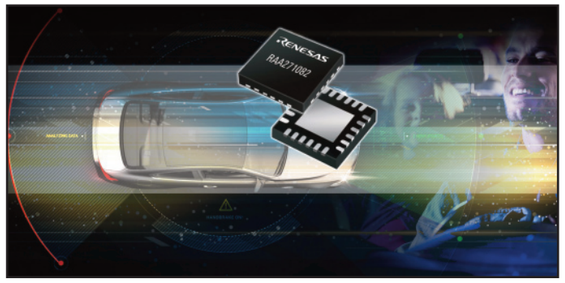
Using the uart interface, two separate AP43776Q devices can be connected, so smart power-sharing may be conducted across all four of their combined USB ports.

Besides managing power negotiation attachment procedure, it enables DisplayPort over USB-C by detecting USB type-C alternate mode and driving a suitable USB-DP mux. This facilitates the carrying of video data over the system's USB connection.

It is AEC-Q100 grade-one qualified, manufactured in IATF 16949 certified facilities, and PPAP capable.

A 20-pin W-QFN4040 wettable flank package format has a 4 by 4mm footprint.





ISO 26262 PMIC powers cameras

A power management IC (PMIC) from Renesas is for automotive camera applications.

The RAA271082 is an ISO 26262 compliant multi-rail power IC with a primary high-voltage synchronous buck regulator, two secondary low-voltage synchronous buck regulators, and a low- voltage LDO.

It has four overvoltage and undervoltage (OU-UV) monitors, I²C communications, configurable general-purpose IO pin, and a dedicated reset output and fault indicator.

To meet Asil-B metrics, it includes a second independent reference for OV-UV monitors, built-in self-test at power-up, independent OV-UV monitoring, and continuous CRC error checking on internal registers and I²C communications.

It is a companion for the firm's AHL automotive high-definition link technology that lets car manufacturers deliver high-definition video using low-cost cables and connectors.

The PMIC simplifies power supply design for automotive camera applications requiring functional safety compliance, modules that include surround view and satellite, rear-view, driver monitor, and e-mirror.

It supports the power requirements of almost any combination of image sensor, image signal processor and encoder technology, while supporting direct-from-battery as well as power-over coax supply.

It can also be used for 16 and 32bit automotive MCUs.

The device provides 1A output capability per switching regulator to support the growing power demands of automotive image sensors. And it supports general-purpose vehicle MCUs with integrated reset generation, watchdog timer and programmable GPIO.

Versatility from latch and switch

A universal programmable three-axis latch and switch from Melexis is for relative position and speed sensing.

It provides magnetic flexibility and pitch independent dual outputs that can be set as speed, pulse or direction.

With its EMC and ESD performance, this standalone PCB-less device can save space and cost for automotive and industrial applications.

The MLX92351 pre-programmed and MLX-92352 programmable are quadrature output devices, which accurately determine rotational speed and direction in motor systems.

The 90˚ phase shift between the two outputs provides pitch and air gap independence, resulting in magnetic design simplicity. They add flexibility by outputting any two-fold combination of x, y and z magnetic axes in the form of speed, pulse or direction.

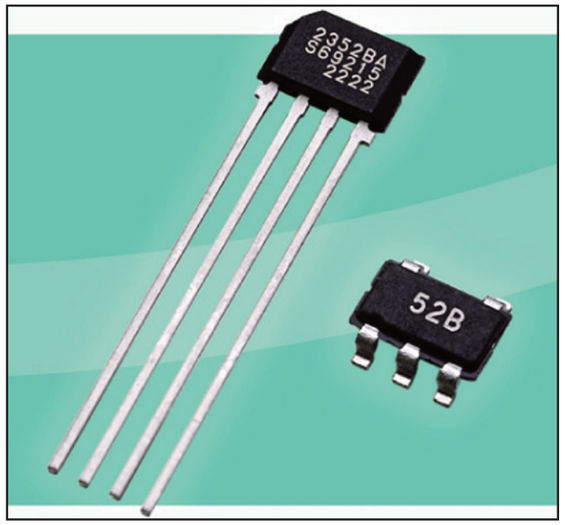
There is the option to set independent magnetic thresholds from ±0.5 to ±40mT.

The silicon-on-insulator (SoI) technology achieves 15kV HBM ESD, 8kV system ESD and high EMC robustness.

They operate from 2.7 to 60V at junction temperature of +175°C.

The last-state feedback function at start-up makes sure the motor system never misses a turn.

The MLX92352 has eeprom programmability and can set any of the three axes to any output independently. It suits linear speed and direction control, incremental rotary encoding for e-bikes, fan and pump motor indexing, and detecting dual linear and angular position.



The MLX92351 is supplied pre-programmed, while the MLX92352 has end-of-line programmability to compensate for the modules' mechanical tolerances in production.

The devices come in either VA package (PCB-less) or in a standard TSOT package (SMD). An automotive version is AEC-Q100 qualified and supports Asil integration as per ISO 26262.

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