VEHICLE electronics

The monthly magazine for automotive electronics engineers

Aptiv and Hyundai launch autonomous driving venture

Euisun Chung (left) and Kevin Clark ink the deal

Aptiv, formerly Delphi, and Hyundai Motor are forming an autonomous driving joint venture to advance the design, development and commercialisation of SAE levels four and five autonomous technologies.

The joint venture will begin testing driverless systems in 2020 and aims to have a production-ready autonomous driving platform available for robotaxi providers, fleet operators and automotive manufacturers in 2022.

Hyundai and Aptiv will each have a 50 per cent stake in the venture, valued at a total of US$4bn.

Aptiv will contribute its autonomous driving technology, intellectual property and 700 employees focused on developing scalable autonomous driving. Hyundai affiliates – Hyundai Motor, Kia Motors and Hyundai Mobis – will contribute $1.6bn in cash and $0.4bn in vehicle engineering services, R&D resources and access to IP.

"This partnership further strengthens Aptiv's industry-leading capabilities in the development of advanced driver assistance systems, vehicle connectivity and smart vehicle architecture," said Kevin Clark, president of Aptiv. "Hyundai Motor Group's cutting-edge engineering and R&D capabilities make them our partner of choice to advance the development of a production-ready autonomous platform."

The venture will be led by Karl Iagnemma, president of Aptiv Autonomous Mobility, and headquartered in Boston, USA, with technology centres in the USA and Asia, including Korea. Hyundai and Aptiv will each appoint an equal number of directors.

"The new joint venture marks the start of a journey with Aptiv towards our common goal of commercialising autonomous driving," said Euisun Chung, executive vice chairman of Hyundai Motor. "The combined capabilities of Aptiv, a leading global technology company, and our group, a global OEM, will create invaluable synergy to lead the autonomous driving landscape."

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Misra guides safety arguments

Coding guidelines group Misra has released guidelines for automotive safety arguments. The guidelines provide clarity on how to develop safety arguments in line with existing standards, with a view to justifying that the risk associated with an automotive system is within industry norms.

Types of evidence to support the argument are suggested, as well as advice on application.

Though absolute safety, the absence of all risk, is infeasible, particularly for complex vehicle systems involving embedded electronics and close interaction with human users, conformity with safety and quality standards and guidelines is necessary.

Engineers have an obligation to investigate and communicate the level of risk associated with their systems and services, and are expected to produce and explain the evidence for the safe design and use of these systems. A key part of this is explicitly justifying why the available evidence is sufficient and trustworthy.

The concept of safety cases has been widely adopted across the automotive industry and beyond. Most definitions of safety cases are centred on two concepts: evidence and argument.

Current safety standards are generally good at providing detailed guidance on the different types of evidence that are recommended for meeting the compliance and safety requirements. However, there has been a lack of practical guidance on how safety arguments are developed, reviewed and maintained for automotive applications.

The new guidelines provide a more holistic framework through which to develop safety arguments, with practical guidance and examples.

"Without a well-developed safety argument, the evidence can become a lengthy, hard-to-navigate, list of documents," said David Blackburn, Misra chair. "In more safety-mature industries, such as aviation and defence, safety arguments have been adopted to great benefit. Done well, they can knit together all the documentation into a logical, robust justification for product safety."

The concepts apply to safety standards in all industries and are illustrated by application to ISO 26262: 2018.

Vehicle Electronics takes silver at AutoSens

Vehicle Electronics landed the silver award for most engaging content at last month's AutoSens event in Brussels.

"It is really good for a young magazine such as ourselves to be recognised for the work we are doing," said Vehicle Electronics editor Steve Rogerson, pictured fourth from the right in the middle row with the other award winners.

The award ceremony was held at the Atomium in Brussels and featured guest speaker Steve Mould, a comedian and scientist.

A full report on AutoSens starts on page 13.

Vauxhall network implements e-call and live navigation

Vauxhall has revealed Vauxhall Connect, a network service that gives emergency calling, live navigation and remote control features, will work with the MyVauxhall app, and is available on all new Vauxhalls from this month.

If the airbags or seatbelt tensioners are deployed in an accident, an emergency call is automatically made from the Vauxhall Connect service. If this receives no answer, the service sends details of the accident to the rescue services, including the time and place of the call, as well as the direction of travel. An e-call can also be made by pressing the red SOS button.

The service can report a breakdown call, connecting drivers to the Vauxhall mobility service, and passing on key information such as a location with vehicle diagnostics data. Drivers can access their vehicle status via the MyVauxhall app, including mileage, average fuel consumption, service intervals and other reminders.

An emergency call can be made by pressing the red SOS button

The remote control function allows for the locking and unlocking of doors from the user's smartphone. Drivers can sound the horn or activate the lights with this, as a useful way to find the car in a busy car park. With electric models, users can check the charge status of the car, and pre-programme charging times, climate control or heating via the app.

On the road, the service provides live navigation information displayed via the colour touchscreen for beating traffic jams. Real-time traffic data are factored into route planning, meaning delays can be quickly detected and avoided.

The system suggests alternative routes and calculates a new arrival time, also providing information such as fuel prices, parking spaces and points of interest on the route. Electric models will be loaded with the availability of charging points.

It will be available as an optional extra on all Vauxhall models, and is included as standard on Vauxhall models equipped with Multimedia Nav and Multimedia Nav Pro infotainment systems, and on the Corsa-e and Grandland X Hybrid 4.

Blackberry and JLR expand

Blackberry and Jaguar Land Rover have expanded their partnership in developing the car maker's vehicles to include artificial intelligence and machine learning technologies.

Leveraging Blackberry QNX and Cylance, the companies are working on transforming vehicle safety across a range of capabilities, including predictive software maintenance and cyber-security threat protection.

Also, Blackberry's cyber-security consulting services can identify security vulnerabilities in connected and autonomous vehicles, across the full software library used in a vehicle

"Jaguar Land Rover and Blackberry share a common objective in bringing the most intelligent vehicles to reality," said Sir Ralf Speth, Jaguar Land Rover CEO. "I am delighted that our partnership with Blackberry continues to go from strength to strength, a company whose technology innovations uniquely address the expanding safety needs of the automotive industry."

John Chen, CEO of Blackberry, added: "Blackberry is a trusted partner of the automotive industry because of our heritage and innovations in secure communications. We are pleased to be Jaguar Land Rover's chosen partner for safety-certified technology, as we advance artificial intelligence and machine learning technologies to transform automotive safety."

Jungo optimises driver monitoring for R-Car SoC

Jungo's CoDriver driver monitoring and cabin sensing software has been optimised and made available for the Renesas R-Car SoC. This should help OEMs introduce NCap compliant in-cabin sensing.

A driver monitoring system (DMS) detects a driver's condition such as distraction, drowsiness, emotion and position.

Already in vehicles that embed adas features and support up to level-two automated driving, where the driver is always in control of the car, a DMS alerts the driver when being distracted. With conditional automation at level three, it is considered essential to determine at all times whether the driver can take control of the vehicle.

In addition, occupant classification systems are being adopted to detect the presence or absence of passengers, monitor the passenger's condition, and take measures against leaving children behind in the car.

CoDriver uses deep learning, machine learning and computer vision algorithms to detect in real time the driver state using driver facing cameras. It also supports in-vehicle full detection technology with functions such as counting of the number of occupants, detection of seat belt wearing or detection or observing of critical medical conditions.

CoDriver supports the entire R-Car SoC range, leveraging embedded computer vision and CNN accelerators, where available. R-Car devices integrate multiple, heterogonous cores, enabling applications to execute tasks simultaneously and achieve computer vision at low power consumption.

"CoDriver is software optimised to realise high-precision driver and cabin monitoring software," said Jungo CEO Ophir Herbst. "In addition to the integration benefits by pre-porting on the R-Car SoC platform, the market entry has been eased through efficient power consumption and cost effectiveness, offering the leading in-vehicle sensing for quick adoption."

Renault alliance picks STM for SiC power

ST Microelectronics has been chosen to supply high-efficiency silicon-carbide (SiC) power electronics by the Renault-Nissan-Mitsubishi Alliance for on-board chargers (OBCs) in upcoming electric vehicles.

Renault-Nissan-Mitsubishi plans to use the SiC power technology to build more efficient and compact high-power OBCs that will increase the attractiveness of electric vehicles for the users by cutting battery-charging time and enhancing driving range.

STM will provide design-in support to help increase OBC performance and reliability. The Swiss company will also supply associated components, including standard silicon devices.

The OBCs with STM's SiC are due to enter volume production in 2021.

"As the pioneer and global leader in zero-emission electric vehicles, our objective remains to be the number one provider of mainstream mass-market and affordable EVs around the world," said Philippe Schulz, Renault-Nissan-Mitsubishi Alliance VP. "The small size, light weight and high energy efficiency we can achieve using STM's SiC technology in our OBC, combined with the increased battery efficiency, will enable us to accelerate the adoption of electric vehicles by reducing charging times and extend the range of our EVs."

EVs need an OBC to handle charging from standard roadside charge points, when a dedicated home-charging system or super-charger is not available. The time to recharge is determined by the OBC power rating and the units in today's EVs have ratings between about 3kW and 9kW.

Renault-Nissan-Mitsubishi has already created a 22kW OBC for the Renault Zoe model, which can fully recharge the battery in about one hour. By upgrading the OBC to leverage the efficiency and size of STM's SiC mosfets and rectifier diodes, Renault-Nissan-Mitsubishi can reduce the size, weight and cost while increasing energy efficiency.

The Renault Zoe uses a 22kW OBC

"SiC technology can help the world by reducing dependence on fossil fuels and increasing energy efficiency," said Marco Cassis from ST Microelectronics. "STM has successfully developed manufacturing processes and established a portfolio of qualified, commercialised SiC products also in automotive-grade version. Building on our long cooperation, we are now working with Renault-Nissan-Mitsubishi to realise the many advantages SiC can bring to EVs. Moreover, this commitment helps ensure success by increasing the economies of scale to deliver superior-performing SiC-based circuits and systems that are also cost-effective and affordable."

Elektrobit opens software lab in Berlin

Elektrobit has signed a long-term collaboration agreement with Daimler-subsidiary MBition and opened a software laboratory in Berlin.

MBition selected Elektrobit to design and implement the software for the next Mercedes-Benz telematics systems. Drivers will benefit from user experience features developed by MBition.

"Having Elektrobit with its profound experience in Berlin close to our office in Berlin helps us tremendously to develop software for our future Mercedes-Benz cars," said Gregor Zetsche, CEO at MBition.

The office is close to the Technical University in Berlin. Elektrobit's focus is the development of automotive-grade software for high-performance computing to bring automated and connected cars to the road.

"In Berlin, Elektrobit is able to bring innovative software products to the automotive industry in an ambitious environment abundant with bright minds," said Gregor Zink, managing director of Continental-subsidiary Elektrobit.

Foretellix opens M-SDL to ecosystem

Israeli start-up Foretellix has opened its Measurable Scenario Description Language (M-SDL) to the adas and autonomous vehicle (AV) ecosystem and contributed the language concepts to the Association for Standardisation of Automation & Measuring Systems (Asam) standards committee.

M-SDL is said to be the first open language that addresses multiple shortcomings of today's formats, languages, methods and metrics used to verify and validate vehicle safety.

Foretellix also announced its M-SDL partners programme, providing a mechanism for industry feedback and refinement of M-SDL.

Members include AVL List, Volvo, Unity Technologies, Horiba Mira, TÜV SÜD, Automotive Artificial Intelligence, Metamoto, Vector Zero, Trustworthy Systems Lab of Bristol University, and Advanced Mobility Institute of Florida Polytechnic University.

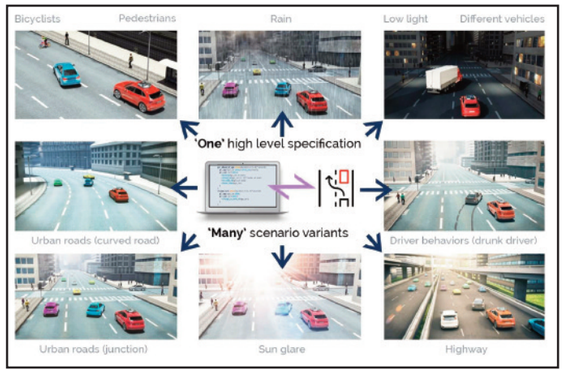
Safety methods and metrics based on quantity of kilometres driven in simulation and road testing, the number of disengagements and/or traditional test coverage are insufficient, non-scalable and not easily shared or reused.

In addition, due to the autonomous uncontrollable behaviour of AVs and traffic, developers cannot be sure their tests are actually orchestrating desired scenarios or evaluating test coverage as intended.

Finally, none of these techniques offer adequate mechanisms to identify previously unknown hazardous edge case scenarios nor aggregate coverage metrics across all virtual and physical testing platforms.

By opening and contributing M-SDL, tool vendors, suppliers and developers will be able to use a common, human readable, high-level language to simplify the capture, reuse and sharing of scenarios, specify any mix of scenarios and operating conditions to identify previously unknown hazardous edge cases, and monitor and measure the coverage of the autonomous functionality critical to prove AV safety, independent of tests and testing platforms.

"The ability to achieve measurable safety of AVs is still being limited by a lack of standards, methods and metrics that inhibit reuse and sharing, are insufficient and/or non-scalable," said Ziv Binyamini, CEO of Foretellix. "We believe in an open ecosystem and open standards, and are actively supporting Asam in its efforts to create an open language standard."



One M-SDL scenario specification can represent many scenario variants

LG and Unity partner on simulation

Artificial intelligence engineers in the LG Electronics Silicon Valley Lab are working with machine learning experts at Unity Technologies to develop simulation software that will help autonomous vehicle developers accelerate system training for safer driverless cars.

The collaboration leverages LG's AI expertise with skills at Unity, creator of a real-time 3D development platform.

Unity Simulation enables the running of multiple instances of a Unity product at scale. Supported by Google Cloud's infrastructure, Unity Simulation lowers the barrier to train, test or validate products and services in a 3D environment.

Computer-vision-oriented applications for the automotive industry are particularly compelling, according to Danny Lange, Unity Technologies VP of AI and machine learning.

Autonomous vehicle developers running the SVL on Unity Simulation will be able to accelerate the training of their systems by running multiple scenarios in parallel. With Unity, the simulator can create digital replicas of real-world environments with accurate sensor models to train autonomous vehicles across multiple scenarios.

Danlaw connects vehicles in New York

Danlaw's V2X technology is driving a connected vehicle project in New York.

Danlaw develops connected city products where communication technology and sensor data converge to enable traffic management and safety applications. This makes it possible to implement in-vehicle warning systems, traffic signal prioritisation and other road management initiatives.

In 2015, the New York Department of Transportation (DoT) began developing its vision for a safer and more intelligent traffic environment by establishing a connected vehicle project.

This project seeks to manage vehicle speeds and reduce crash frequency and severity by deploying V2X technology, including vehicle-to-vehicle and vehicle-to-infrastructure communications.

The bustling intersections and populous pavements of New York pose a significant challenge to maintaining safe and efficient roadways. To provide drivers with critical safety information and driving advice such as forward collision warning and left turn assist, the project team chose Danlaw to supply AutoLink ASD aftermarket safety devices.

These use a secure variant DSRC to transmit safety messages between vehicles and infrastructure. AutoLink was selected based on its interoperability with all vehicle types and existing infrastructure, as well as Danlaw's ability to accelerate the project's deployment by providing on-site technical support.

The AutoLink ASD can manage New York's urban canyon environment, in which GPS accuracy is hindered by tall, densely packed buildings. AutoLink is integrated with the Cohda Wireless V2X stack and applications, including its V2X-locate technology, to enable lane-level positioning accuracy in urban canyons where GPS alone is insufficient.

"We look forward to the connected vehicle deployment in New York City, which will be a driving factor in creating a safer transportation environment," said Mohamad Talas, director of ITS management for the pilot project. "Our participation in developing the CV model for such a complex urban environment has provided us with the opportunity to be at the forefront of this technology, facing challenges, gaining experience and accomplishing our goals."

AutoLink is installed inside participating taxis, buses, DoT fleet vehicles and other service vehicles. After completing the DoT's operational readiness demonstration and supplying an initial quantity of 4100 AutoLink ASDs, Danlaw is poised to scale to high volume production.

AutoLink ASD was awarded OmniAir Consortium certification earlier this year, ensuring it is compatible with the 8000 vehicles and 400 roadside units involved in the New York pilot.

Danlaw technology is connecting New York service vehicles

Etas and NI get green light for joint venture

Anti-trust authorities have approved the creation of the automotive test joint venture between National Instruments and Etas. The company, Etas NI Systems, will be fully operational by the start of next year from its Stuttgart headquarters.

It plans to employ 50 people and scale for growth. NI and Etas each own half of the venture, which will aim to establish a deeper partnership between the two companies with decades of experience in the automotive test industry.

The aim is to help automotive suppliers and vehicle makers achieve shorter design cycles, reduced test times and a faster time to market.

"With the formation of Etas NI Systems, a milestone has been reached for improving the test and validation of software in automotive electronics, including electronic control units and sensors, to meet current and future customer requirements," said Friedhelm Pickhard, chairman of Etas. "With NI and its complementary component portfolio, strong brand, high-quality products and cultural fit, we have found a strong partner."

The joint venture will design, build and service pre-integrated hardware-in-the-loop (HIL) systems to help users in the rapidly evolving automotive sector shaped by electrification and adas. It will combine NI's software-defined platform and IO capabilities with Etas' expertise in developing and integrating HIL systems.

"The strength, domain expertise and global footprint of the NI and Etas teams create a unique opportunity to broaden the reach to customers and help them solve the development challenges in the automotive industry," said Eric Starkloff, NI president and chief operating officer. "We have made great progress towards getting our partnership operational and look forward to meeting customer needs."

Jaguar unveils development centre

Jaguar Land Rover has unveiled facilities at its Gaydon site in Warwickshire that are said to be one of the UK's most sustainable non-domestic buildings and the country's largest automotive creation and development centre.

The site forms part of Jaguar Land Rover's Destination Zero mission, an ambition to make societies safer and healthier, and the environment cleaner. The focus is on achieving zero emissions, zero accidents and zero congestion.

Gaydon is home to almost 13,000 engineers and designers who are developing vehicles. The centre is also creating future autonomous, connected, electrified and shared mobility technologies.

The site is four million square metres, and the new facility delivers more than 50,000m² of additional workspace designed to encourage collaboration throughout the entire vehicle development process from sketch to showroom.

Infineon partners Nichia to develop micro-LED matrix

Nichia and Infineon are working together to build a high-definition micro-LED matrix for adaptive driving beams.

Automotive lighting as an important safety and popular design feature in vehicles has evolved rapidly in the past years. Now, Nichia and Infineon Technologies have started a collaboration to add further momentum to this evolution.

Together, they are developing a high-definition (HD) light engine with more than 16,000 micro-LEDs for front light applications. Unlike current HD products, the device will provide high resolution light to the entire field of view of the driver.

"Our new LED matrix light will offer a resolution about 180 times as high as that of comparable solutions on the road today," said Kanji Bando, head of Nichia's R&D centre. "This will pave the way for new and improved safety features and enhance driving comfort."

For example, HD light can be used to warn the driver of hazards by highlighting people or objects on the roadside. It can project markings on the road, for example, to help the driver navigate through a construction site. And established features such as the glare-free high beam or bending lights run more precisely and smoothly.

The HD light engine will employ micro-LED technology from Nichia and a driver IC from Infineon.

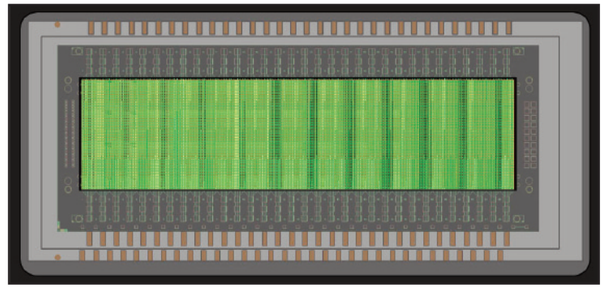
"Our chip will control and diagnose all 16,000 micro-LEDs individually," said Andreas Doll, vice president at Infineon. "In addition to the safety benefits, our new solution will also significantly increase energy efficiency because it allows us to turn on only those LEDs actually needed for a light pattern."

Current micro-mirrors turn on all LEDs and deflect surplus light.

The light can also contribute to reducing design and production complexity for car manufacturers. At the same time it increases the driver's ease of use.

Left-hand and right-hand drive configurations have different lighting requirements, for example. With the HD light engine, the necessary adaptions could be programmed digitally in the factory or activated by the driver as a function on demand.

The production launch of the light engine is planned for 2023.



Nichia and Infineon's light engine will use 16,000 micro-LEDs

Ansys and Autodesk bring lighting simulation to virtual prototyping

Engineering simulation firm Ansys and design and manufacturing software provider Autodesk are collaborating to help automotive companies combine visual design review and regulatory compliance validation in a connected workflow.

The alliance will connect Autodesk's automotive 3D visualisation and virtual prototyping software with Ansys' physics-based lighting simulation, so car makers can complement hyper-realistic visualisations of vehicle interiors and exteriors with accurate lighting simulation.

"We are excited to collaborate with Autodesk to bring automakers our gold-standard lighting simulation," said Eric Bantegnie, Ansys VP. "This collaboration represents a win-win scenario for both companies but, more importantly, for our joint customers who are looking to rapidly take advantage of industry megatrends like next-generation autonomous driving and electrification."

It uses Ansys lighting simulation with Autodesk VRed to bring physically accurate interior and exterior lighting simulation to the studio, so designers can preserve original intent while enhancing design, visualisation and simulation workflows.

Built raises $33m to turn construction equipment into autonomous vehicles

Built Robotics has closed a $33m series B round led by Next47, the global venture fund backed by Siemens, to help transform construction equipment into autonomous robots. This brings Built's total funding to $48m.

The Californian company has also announced over $100m in customer commitments for its autonomous construction products.

Built Robotics will use the capital to scale its fleet of autonomous robots, expand into new construction verticals and develop tools to support the next generation of equipment operators.

TJ Rylander, partner at Next47, has joined Built's board of directors.

"We're excited to be partnering with Built Robotics on this significant milestone," said Rylander. "They have proven market appetite and demand for the technology and have deployed working robots with leading construction companies around the country. We believe Built is poised to lead this market and catalyse deployment of this technology across construction applications."

Built's technology transforms construction equipment including excavators, bulldozers and skid steers into fully autonomous robots. The utomated guidance systems can be installed on existing equipment from any manufacturer, while still maintaining complete manual operation capabilities.

Funding helps Built create autonomous machines

The upgraded equipment can perform common tasks fully autonomously, such as digging trenches, excavating foundations and grading building pads. The autonomous fleet can be managed via a web-based platform, which allows remote equipment operators to supervise the robots.

Equipment upgraded by Built Robotics has operated for over 7500 hours with a perfect safety record – equivalent to 560,000km of testing for self-driving cars.

"The shortage of qualified labour is an industry-wide challenge right now, and finding skilled workers is even more difficult on large-scale remote infrastructure projects," said Noah Ready-Campbell, CEO of Built Robotics. "Our robotic equipment is able to shoulder some of the load by assisting with basic, repetitive tasks, freeing up human operators to focus on more complex activities."

Built Robotics' technology combines sensors such as GPS, cameras and lidar with software, and the systems can be installed on standard equipment from any manufacturer.

Synopsys helps NSitexe hit first-pass silicon

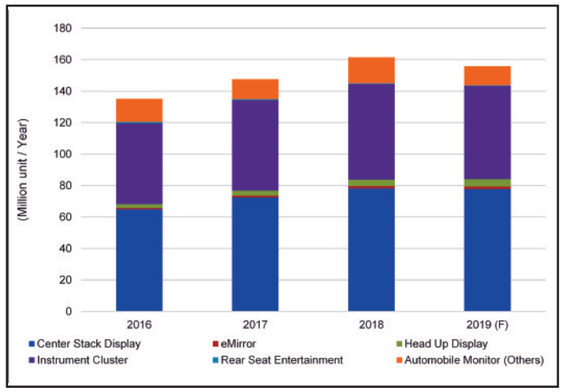
NSitexe has achieved first-pass silicon success for its data flow processor (DFP)-based SoC test chip for autonomous driving by using Synopsys design, verification and IP products.

The DFP architecture combines a CPU and a GPU for processing large and complex datasets, allowing for parallel data management, and enabling application-independent capability with power-efficient parallelism and quality.

Level-four and higher autonomous driving vehicles need to adapt to the environment, to control the vehicle and to conduct synchronised communications with the cloud. Various technologies are necessary to develop these functions while maintaining reliability and safety.

Synopsys virtual prototyping provides early access to silicon chips and virtual ECUs, allowing software development and testing to start up to 12 months before hardware is available.

"Our integrated EDA, silicon-proven IP and software security and quality are widely used by industry-leading companies in automotive, AI, networking and mobile applications," said Kimio Fujii, president of Synopsys in Japan.



Vehicle TFT LCD shipments by application from 2016 to 2019

USA-China trade war hits automotive monitor market

Collateral damage from the ongoing trade dispute between the USA and China is spreading, with the market for TFT LCDs used for automotive monitor displays declining for the first time in ten years, according to IHS Markit.

Global shipments of TFT LCDs used for automotive monitors are set to decline to 156 million units in 2019, down five per cent from 2018.

The trade clash has taken a toll on China, which in August saw a slowdown in growth in industrial production, fixed-asset investment and retail sales. Retail sales were particularly impacted by the slowing growth in automotive.

"After the currency crisis of 2008, the market for TFT LCDs used for automotive monitors entered the fast lane, with annual shipments rising to 162 million units in 2018, up from 18 million in 2009," said Hiroshi Hayase, senior director at IHS Markit. "However, shipment growth has hit the brakes in 2019 as China's economy is facing an increased risk of recession due to the trade uproar. Increased US tariffs on Chinese cars and automotive components are causing the market to suffer its first downturn in ten years."

Automotive monitors are gaining acceptance due to the steady expansion of electronic controls in cars, covering areas including safety, convenience, entertainment and energy-savings.

Monitor equipment areas include centre stack displays with navigation, multifunction monitors in instrument clusters, head-up displays and rear seat entertainment.

LSat licenses IMSE tech from TactoTek

LS Automotive Technologies (LSat) has licensed design and manufacturing rights for TactoTek injection moulded structural electronics (IMSE) technology.

The agreement includes rights to use TactoTek proprietary intellectual property and technology transfer that enable LSat to design and manufacture IMSE parts in Korea and globally.

LSat is a vehicle electronics manufacturer in Korea with strategically located manufacturing operations to serve global customers.

"IMSE is cutting-edge technology that supports the design innovation that our customers want while being environmentally friendly because it uses clean, additive manufacturing processes and significantly reduces plastics use," said Hyo-Cheol Lee, vice president at LSat.

TactoTek develops, industrialises and licenses IMSE technology that combines printed electronics and electronic components within single piece, seamless 3D injection moulded structures. Surface finishes range from plastics to elegant natural materials, including wood.

The company packages its technology for licensees in two products, IMSE Designer for IMSE part design and IMSE Builder for IMSE part mass production, testing and quality assurance. For automotive markets, TactoTek licensees mass produce IMSE parts.

"We are honoured that LSat has embraced our IMSE technology," said Jussi Harvela, TactoTek CEO.

"LSat is well-known for its technology leadership and process excellence, and those attributes support the quality and total cost efficiency that will propel their success with IMSE."

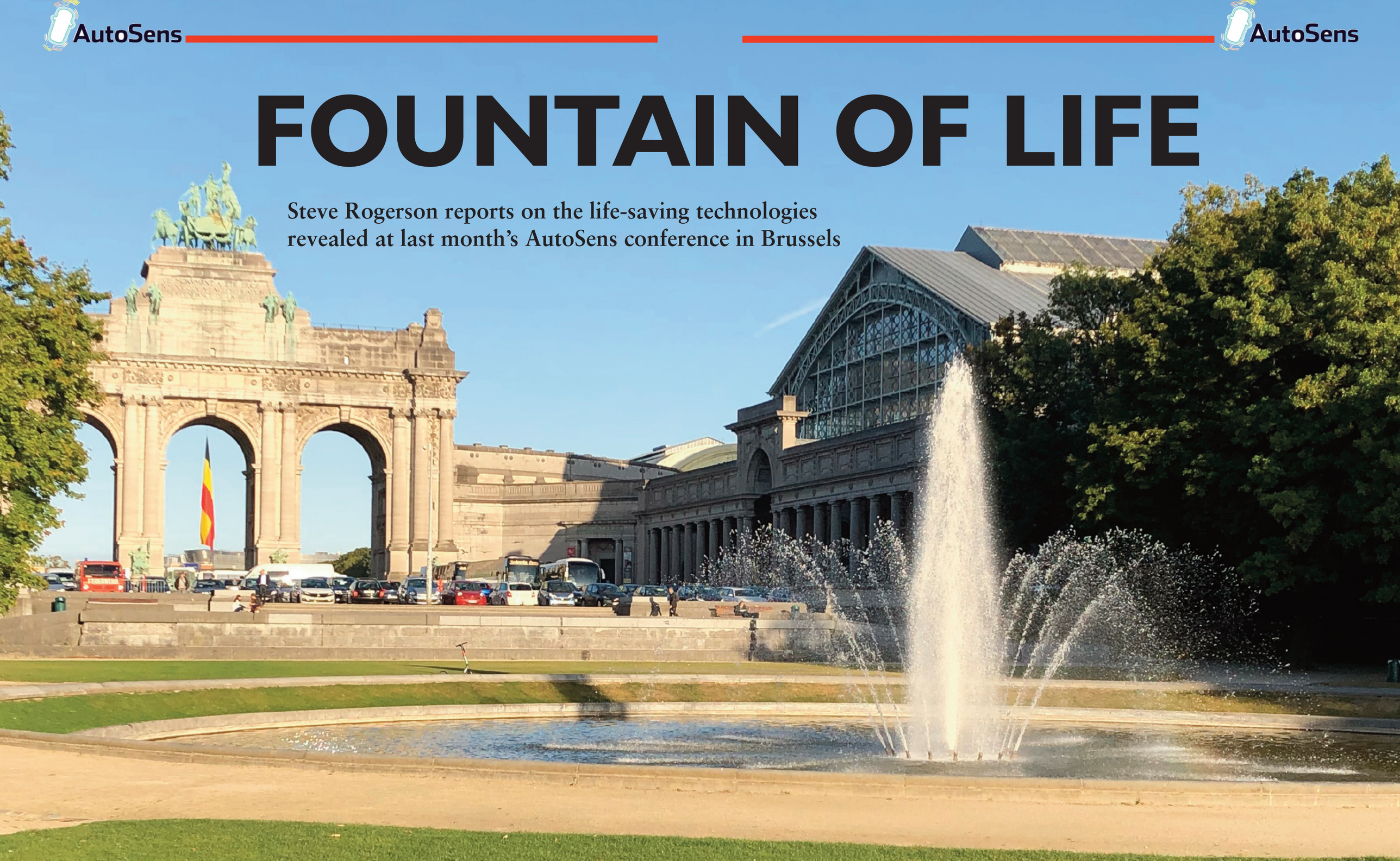
TactoTek supports IMSE licensees with a hands-on technology transfer process. This should help ensure that licensees are successful with the technology.

"We are very pleased with the rigor of TactoTek's IMSE technology validation methodologies," said Kyoung-Choon Kim, LSat chief strategy officer. "Based on TactoTek's technology, we believe LS Automotive can lead the HMI new product market and meet proactively the needs of global customers."

AutoSens

FOUNTAIN OF LIFE

Steve Rogerson reports on the life-saving technologies revealed at last month's AutoSens conference in Brussels



Staying awake

The dangers associated with falling asleep at the wheel are massive. Driver drowsiness is a major cause of accidents. That is why the interest in driver monitoring systems is growing. If the car can detect a drowsy or inattentive driver, it can create alerts that either wake the driver up or urge them to take a break.

One company working on this is Phasya, a spin off from the University of Liége.

Clémentine François: "There is an interest in monitoring the state of the driver."

"We do the software for monitoring physical and cognitive states," said Clémentine François, Phasya's chief scientific officer. "We want to improve the safety of people interacting with equipment and cars."

The technology monitors eyes, face and heart rate that can show levels of drowsiness, stress, distraction, cognitive load and mind wandering. All these can reduce reaction time and decision-making ability, thus increasing the risk of errors.

"This means there is an interest in monitoring the state of the driver," said François. "If you detect a problem, you can suggest actions to improve safety depending on the state of the driver."

These can include advising the driver to take a nap, sounding an alarm or relaxing sounds, or other stimulations.

"This can also enhance well-being and the user experience," she said. "We can change conditions inside the vehicle such as air conditioning, lighting, music and so on."

The first part of the technology is sensors, such as cameras in the dashboard to take images of the face. Seat sensors can get other data from the driver such as heart rate.

"We develop software to analyse the data to detect the state of driver and passengers," said François. "There are low-cost sensors in automotive, so we adapt what we do to the type of sensors. The sensors need sufficient resolution and sampling rate and must be continuous and robust. You need accurate data. This is a big challenge in the automotive industry. We can measure from five to ten levels of drowsiness."

She said, though the company used ocular and cardiac parameters, the eye was the best indicator of the level of drowsiness.

"We are also hardware agnostic," she said. "We are using off-the-shelf sensors but we are open to partnering with other companies that develop the hardware."

She said automotive was the main focus and each car maker and tier one had their own camera systems, so it was important to develop something that worked universally.

OnSemi showed an in-cabin monitoring system

Barend van Liempd, programme manager at Imec, the Belgian research and development centre, said the organisation was also looking at in-cabin monitoring but not just for health but for hand gesture control. His talk focussed on using radar, specifically at 145GHz.

"We are looking at acute driver health hazards such as heart attacks, epileptic instances, unconsciousness and so on," he said. "It can also be used for doing a daily heart check-up."

And the technology can detect if a child or infant has been left in the car. Horrifically, around 50 children die every year in the USA from heatstroke caused by being left in the car.

For non-contact driver monitoring of heart rate, Imec carried out initial tests using 8GHz UWB radar and FMCW (frequency modulated continuous wave) radar with 500MHz bandwidth on a car moving at 120km/hr. Researchers managed to extract average heartbeat despite car vibrations.

However, they have now moved to 145GHz radar in a laboratory set-up. Early results suggest beat-to-beat heart rate variability measurements are possible measuring from behind the driver.

"This can indicate fatigue and give warning of a heart attack," said van Liempd. "The next step is trying it with a real driver in a car."

California-based computer-vision start-up Eyeris is using artificial intelligence for its in-cabin monitoring, but is more concerned with the interior of self-driving cars.

"Once you have autonomy, the car becomes a living space," said Modar Alaoui, CEO of Eyeris. "The focus thus switches from the driver to the occupants. Today, everyone is focused on exterior perception, but it is the interior perception that will last the longest."

In the cabin, there are three elements to focus on, he said. These are people, objects and surfaces.

"We are creating deep neural networks using computer AI to understand human behaviour, object localisation and surface classification," he said.

The company has collected data sets using a 2D camera over five years of people of different shapes and sizes riding in vehicles.

"Safety is the baseline of everything we do," he said, "followed by comfort and convenience. And we are looking at services too for the future passenger economy."

The company initially used a GPU to fuse all the neural networks together using multiple cameras.

"Then came the new types of AI chips, so we started looking at that market," he said. "We then started working with On Semiconductor and Ambarella."

At the show, On Semiconductor featured a complete in-cabin monitoring system inclusive of driver and occupancy monitoring functions.

Barend van Liempd: "We are looking at acute driver health hazards."

Modar Alaoui: "Safety is the baseline of everything we do."

The demonstration included multiple sensor types – the AR0144AT 1Mpixel global shutter image sensor and three 2.3Mpixel RGB-IR image sensors.

This multi-camera system uses Ambarella's CV2AQ SoC that processes real-time RGB-IR video and integrates Eyeris' AI software performing complex body and facial analytics, passenger activity monitoring, and object detection.

Driver and occupant monitoring applications require the ability to capture images in variable lighting from direct sunlight to pitch black conditions. With NIR response, the RGB-IR cmos image sensor technology provides full HD 1080p output using a 3.0μm backside illuminated and three-exposure HDR. Sensitive to both RGB and IR light, the sensors can capture colour images in daylight and monochrome IR images with NIR illumination.

"Depending on vehicle configuration, we can leverage up to six cameras," said Alaoui. "I don't think one camera will ever be enough but we will leave that to the vehicle designers."

Vincent Racine with the Westfield shuttle

Shuttle use won't stem car growth

Even though more than two million ride-sharing shuttle vehicles are expected to be deployed by 2025, the number of cars on the road worldwide will still double to around two billion by 2040, believes Vincent Racine, product line manager for LeddarTech.

"There will always be a need for personal cars," said Racine. "These shuttles will be for the first or last mile. They will transport people from the parking lot to where they want to go."

The lidar technology company shared its stand at the show with Westfield Technology Group, a UK provider of driverless shuttles. It was also showing its Leddar Pixell, a recently introduced 3D flash lidar powered by the LCA2 Leddar Engine.

Leddar Pixell can detect pedestrians, cyclists and other obstacles in the vehicle's surroundings and is suitable for perception platforms that are developed to ensure the safety and protection of passengers and vulnerable road users (VRUs).

The Leddar Pixell is a detection cocoon for autonomous vehicle deployment and has already been adopted by over a dozen autonomous vehicle providers in North America and Europe.

It benefits include dependable object and VRU detection, full-coverage over 180˚ field of view, no dead zones or blind spots, solid-state design with no moving parts, and an IP67 enclosure with impact-resistant windows and automotive-grade connectors.

Racine said collisions between VRUs and vehicles cause half the road traffic deaths worldwide.

"In urban environments, autonomous systems need to detect different types of road users," he said. "There are various sensor technologies such as camera, infra-red, radar, GPS and lidar. Lidar can create blind spots up to ten metres from the vehicle. This is where the vulnerable road users are."

The Leddar Pixell technology is said to solve this problem and has been designed for urban shuttles.

The 3D flash lidars are placed on the front, back and sides of the vehicle with each sensor having a 180˚ field of view. That means the whole vehicle can be covered with just four sensors.

Benefits of simulation and emulation

There is no clarity yet as to what the mix of sensors will be on levels three, four and five autonomous vehicle and, to work that out, real world testing is not feasible on its own, according to Valentina Donzella, associate professor for the Warwick Manufacturing Group (WMG) at the University of Warwick.

"We need to make future vehicle technologies and services dependable, desirable and viable," she said. "We need to learn from a continuum of simulation, testing, trials and early deployment."

She said testing was needed in modelling and simulation technologies as well as in controlled and public environments. This can involve having a driver in the loop and simulating the driver.

At the WMG's RF shielded test environment, the researchers can generate GPS signals, V2X signals, 3G and 4G cellular and so on. "Whatever we want," said Donzella. "We can simulate the movement of vehicles; we are working on improving this."

The group is working with a comprehensive mix of road environments in Coventry and Birmingham in the UK, and working with different companies to build the test bed.

Valentina Donzella: "Sensor emulators are very important tools."

The goal, she said, was to eliminate road fatalities and injuries as most accidents are caused by human error, about 94% in the USA in 2015.

However, one of the problems she said was that whenever there was a crash involving an autonomous vehicle it made the news, despite the average being far less than for human drivers.

What is clear is that real world testing will not be enough. Estimates suggest the a hundred million kilometres of testing would be needed and that is not feasible in real world testing alone.

"But the corner cases are sporadic, infrequent and difficult to recreate," she said.

Sensor simulation would be needed, she said, so that researchers could predict sensor responses and thus the responses of the systems relying on them, such as autonomous vehicles.

Key, she said, would be enhancing the sotif (safety of the intended function) approach by developing techniques for hazard identification and analysis. One of the projects is to set up a simulation framework for gathering evidence for sotif and safety verification and validation.

With lidar, they are looking at how noises affect intensity, time of flight, point coordinates and the angle of emission.

Sensor emulation involves having a box that can replace to some extent sensors in real world environments.

"Sensor emulators are very important tools for carrying out autonomous vehicle testing," she said. "Finding sensor limitations is key to the final performance of adas and future autonomous vehicles, so it is important to simulate the sensors and understand them."

In his keynote, Brendan Hermalyn, director of autonomous hardware systems for Cruise, said the number of lidar, radar and cameras would change with time.

"Simulation tools can work this out and it will vary," he said. "But it is hard without real-world testing. There is a lot of value in simulation and that is getting better, but you still need to prove yourself when the rubber hits the road."

Brendan Hermalyn: "Need to prove yourself."

Safe systems must cope with failure

A safe system is not one that doesn't fail but one that fails in a safe way, explained Andrew Richards, CEO and co-founder of Codeplay Software.

"Systems can fail," he said. "It is about how we manage that failure in a safe way."

He said that both incorrect results and late results could be classed as failures. It is not enough to show the system has produced a correct result but that it has done it in time to react properly to the situation.

"We don't have to be perfect, we just have to be safer than existing systems," he said. "We are trying to move the state of the art forward and not make things more dangerous."

When it comes to functional safety, there are two types of failure – systematic failures and random failure. Systematic failures result from a failure in design or manufacturing, often as a result of a failure to follow best practices. These can be reduced through rigorous and continual process improvement. An example would be an algorithm that failed to recognise a hazard in an image.

Andrew Richards: "You can get away with having a fault as long as you can detect it."

Random failures result from random defects inherent to a process or usage condition. The rate of these failures cannot generally be reduced so the focus must be on detecting and handling them.

Helping with this is sotif, for safety of the intended function, a standard under development. This looks at how the system is meant to behave and how it reacts if there is a hazard. It is intended to address sensor limitations such as bad reflections or snow, decision algorithms caused by the environment such as highway construction, and misuse by the driver.

"You can get away with having a fault as long as you can detect it," said Richards. "That is why you need fault injection when you are testing things. You need to check that your test cases cover everything. You need to apply code guidelines such as Misra."

The sensor fusion unit has to have much tougher safety requirements than the sensor at the front end, he said.

Open standards essential

Open standards for safety critical systems are essential to reduce confusion and increase usability, said Stephane Strahm, senior product marketing manager for Kalray.

They can also reduce costs and accelerate time to market by encouraging interoperability, said Strahm, who was also representing the Khronos Group.

"An open standard helps promote interoperability," he said. "A good standard will help with implementation. A bad standard stifles innovation by forcing everyone to implement a lowest common denominator."

Stephane Strahm

He also said a truly open standard was not controlled by a single company but by the industry as a whole.

"The whole industry should be able to participate without royalty payments," he said.

He was pushing the Khronos Safety Critical Advisory Forum, which he said was free to join and could help companies in selecting an rtos, work within ISO 26262 and comply with Misra.

How lidar can advance adas

Intelligent lidar could take adas beyond the tipping point for its evolution into fully automated vehicle technology, according to Aravind Ratnam, vice president at AEye.

"The biggest problem with adas is cost," he said. "But lidar is not just there for high performance. Lidar can solve problems that other technologies can't."

He said much of the talk about lidar was about 200m range, 0.1˚ resolution, 20Hz update rate and so on.

"But you don't need these all the time," he said. "And much of the angst about lidar has been caused by cost."

What AEye is offering is a sensor fusion between a camera and lidar.

"It is an intelligent scan that can react depending on the type of scene," he said.

The platform fuses a 2D camera with 3D lidar hardware. Integrating pixels and voxels at the point of data acquisition can deliver salient sensor data and sensor redundancy.

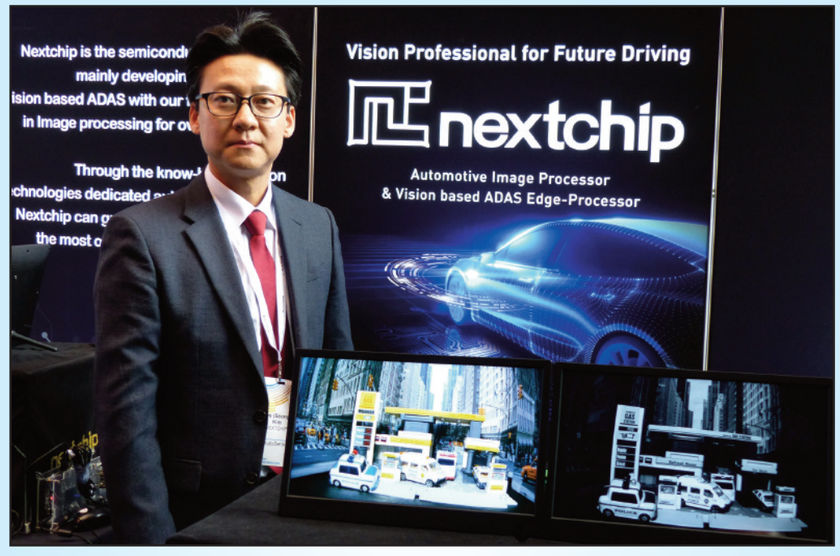
The solid-state 1550nm lidar produces a software-definable and dynamically changeable scan pattern without hardware changes. Artificial intelligence enables new feedback loops with real-time edge processing and target interrogation.

"Our focus now is finishing this product and getting it ready for production in the next three to six months," said Ratnam.

Aeye, he said, with its tier-one partners could produce a system at below $1000 at volume and believes it will be ready for automotive series production by 2023.

Aravind Ratnam

Nextchip promotes adas processors



Korean company Nextchip was promoting the latest version of its Apache series of adas processors, the Apache 4, which should go into mass production by the end of the year. Samples are available now.

This is a computer vision processor based on an Arm Cortex core with an image signal processor and a Ceva XM4 DSP. The chip is Asil B compliant.

"This is for object and pedestrian detection systems," said Seong Yul Kim (pictured), Nextchip team leader. "It can also be used for lane detection. We do the processors behind the sensors to make the images better."

Already being designed in and due to start sampling soon is the Apache 5. This is a deep-learning adas processor with an embedded AI accelerator. It supports Autosar. Still in the idea stage is the Apache 6 sensor fusion chip for upper level adas applications.

"We are at the show to know the trends in the industry," said Seong Yul. "We don't want to lose the direction of our product line. Also, collaboration is possible because we do work with other companies. There are potential customers here."

Camera can detect of what material objects are made

French company Outsight revealed a 3D semantic camera that combines software from Dibotics with 3D sensor technology. This can be used for object classification as it can detect of what material an object is made.

The technology can simultaneously perceive and comprehend the environment from hundreds of metres, including the key chemical composition of objects such as skin, cotton, ice, snow, plastic, metal and wood.

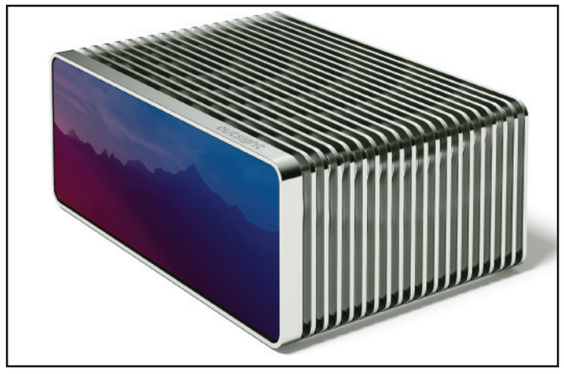
This can provide information regarding road conditions and can, for example, identify black ice and other hazardous road conditions.

The goal is to bring full situation awareness and increased levels of safety and reliability for levels one to three adas, and accelerate the emergence of fully automated levels four to five self-driving cars.

"The mainstream approach is you need separate sensors for localisation, perception, semantics and behaviour," said co-founder Raul Bravo. "We think you can do all that in one device."

Bravo was CEO of former company Dibotics. He joined forces with Cedric Hutchings, co-founder of Withings and former VP of Nokia Technologies, and Dibotics' other co-founder Oliver Garcia and Scott Buchter, co-founder of Lasersec, to assemble teams in San Francisco, Paris and Helsinki.

They have developed a low powered, long range and eye-safe broadband laser that allows for material composition to be identified through active hyper-spectral analysis.



Outsight's 3D semantic camera

Raul Bravo: "This is just the beginning."

Combined with its 3D slam (simultaneous localisation and mapping) on chip capability, the technology can show the world in real time. The camera can provide actionable information and object classification through the on-board SoC, which does not rely on machine learning, resulting in lower power consumption and bandwidth.

This approach is said to eliminate the need for massive data sets for training and the guesswork is eliminated through actually measuring the objects. Being able to determine the material of an object adds a level of confidence to determine what the camera is actually seeing.

The system can also quickly identify pedestrians and bicyclists through its material identification capabilities.

"Our 3D semantic camera is not only able to tackle current driving safety problems, but bring driving safety to new levels," said Bravo. "With being able to unveil the full reality of the world by providing information that was previously invisible, we at Outsight are convinced that a whole new world of applications will be unleashed. This is just the beginning."

Searching for the ideal image sensor

The ideal image sensor has to work from dark to bright sunlight, ideally in one exposure and with a minimum of noise, said Geoff Ballew, On Semiconductor's senior director of marketing, in his keynote speech.

"We have a system approach," he said. "We make devices, devices go into systems, and systems solve problems. We also engage deeply with the ecosystem."

However, he said each application had different priorities, with some needing higher resolution and others not.

"This means you need a broad array of products," he said. "Other characteristics when it goes into a system are also important such as safety and security. To serve these markets requires a very diverse set of products. And we need them to be power, space and cost efficient."

Geoff Ballew

Wade Appelman: "Cmos has to be winner for long-range, low-cost lidar."

He said one of the main machine-vision challenges was detecting vulnerable road users, such as pedestrians and cyclists.

"Machine vision is about edges and contrast," he said. "The basic tasks are detection, orientation, recognition and identification. Detection is about seeing an object. You don't know what it is, but let's not hit it. The more you move up from that through orientation, recognition and identification, the more resolution you need."

OnSemi, he said, had built a tool that let users put in all their specifications and it helped them choose the right sensor.

His colleague, OnSemi VP Wade Appelman, said a suite of sensors was required for automotive including cameras, radar, ultrasonic and lidar. Appelman moved to OnSemi when his previous company SensL was acquired in May 2018. This is still an independent division based in Ireland focussing on lidar and depth sensors.

"We don't make lidar systems but the components that make up lidar systems," he said.

Lidar involved six major hardware functions, he said. These were transmit using near infrared (NIR), receive for return photon detection, beam steering for scene illumination, optics for transmit and receive focussing, readout to generate the point cloud, and power management.

There is much disagreement in the industry about what wavelength to use for the transmit side between the more expensive InGaAs option at 1000 to 1600nm and cmos at 830 to 940nm.

"Cmos," he said, "has to be the winner for long-range, low-cost lidar."

On detectors, Appelman said OnSemi used the same technology used to detect cancer. This is a silicon photomultiplier, a parallel array of microcells summed together to provide a single output.

Single photon avalanche diode (spad) arrays, he said, gave better angle resolution, better ambient light rejection and the flexibility for low-cost system design.

Early bird captures better images

When should sensor fusion take place? It can be late, after all the sensors have gathered the information, or early as the images are being captured.

Wilfried Philips, a senior professor at Ghent University, is a fan of the early bird. He said that late sensors had the advantage of allowing different radar and lidar specialists to produce black-box sensors independently, but said the result of the fusion was limited by the capabilities of individual sensors.

Wilfried Philips: "Radar and video sensors complement each other nicely."

"The evidence in each sensor may be too weak to see a road user," he said.

Early fusion, on the other hand, involves combining the images from each sensor at the start.

"This is more complex, but creates a richer image," said Philips.

For example, he said pedestrians and cyclists often produce weak or confusing signals. What is not detected cannot be fused.

For example, he said that cameras were good at direction but not at distance calculations, whereas radar was better at distance calculation but more vague on direction.

"Fusing these gives a better picture with more certainty," he said. "This can also help eliminate clutter."

This technology also allowed the researchers to detect a road user and track them in time.

"We use particle filters to see where the road user may be and then compare this with the evidence from the fused image," he said. "If you look at Doppler images, these are very different for pedestrians, cyclists and static objects. The images are weak, so it is hard to do it, but it can be done."

With deep learning, it is possible to train a neural network to compute where road users are, but he warned that even this could make mistakes.

He is thus an advocate of what he calls cooperative fusion of radar and video.

"You have a feedback loop," he said. "This lets you build better occupancy maps with less chance of missing someone and fewer false positives."

So even though early fusion creates richer data and yields better results that late fusion, it is complex due to high data rate processing. Cooperative fusion is the compromise with systems coupled loosely by low data rate connections and with mostly independent processing.

"Radar and video sensors complement each other nicely," he said.

Architecture for deep neural nets

Ceva announced NeuPro-S, its second-generation AI processor architecture for deep neural network inferencing at the edge. The firm also introduced the CDNN-Invite API, a deep neural network compiler technology that supports heterogeneous co-processing of NeuPro-S cores with custom neural network engines, in a unified neural network optimising run-time firmware.

NeuPro-S, with CDNN-Invite API is for any vision-based device with the need for edge AI processing, including autonomous cars.

Designed to process neural networks for segmentation, detection and classification of objects within videos and images in edge devices, NeuPro-S includes support for multi-level memory to reduce transfers with external sdram, multiple weight compression options, and heterogeneous scalability that enables various combinations of Ceva-XM6 vision DSPs, NeuPro-S cores and custom AI engines in one unified architecture. This enables NeuPro-S to achieve, on average, 50% higher performance, 40% lower memory bandwidth and 30% lower power consumption than Ceva's first-generation AI processor.

The CDNN-Invite API allows the seamless incorporation of user-designed neural network engines into Ceva's deep neural network (CDNN) framework.

NeuPro-S is available today and has been licensed to lead customers for automotive and consumer camera use.

Lidar detects up to 250m

Blickfeld, a provider of solid-state lidar technology, introduced in the Cube range a mems-based lidar sensor for extended detection of objects at a distance of up to 250m.

In combination with the well-established Blickfeld Cube, the Munich company now offers a full lidar suite for autonomous vehicles.

"It is not about how you can get the best lidar, but how can you get to a mass-market product," said Timor Knudsen, Blickfeld's head of embedded software.

The sensor was designed as a robust 3D solid-state lidar for the mass market. It has a range of 150m with ten per cent reflection; a range of up to 250m is achievable with higher reflection. In addition, the range exhibits n resolution of 0.18˚.

The core of this technology is a proprietary silicon mems mirror embedded in a coaxial structure that is based on commercial standard components.

Knudsen said existing mems mirrors were not suitable for lidar applications as their field of view (FoV) was too small, frequency of operation too high, area of mirror too small, excessive non-linearity at large FoV, poor optical resolution due to Lissajous based trajectories, electrostatic actuation, sensitive to particles, not rugged and too weak to allow for vibration noise cancellation.

"Existing technology does not scale in size and cost," he said. "We have an optimised design to support a large FoV."

He said the firm's technology had an optimised resonance frequency for coaxial automotive lidar, a design that avoids strong non-linearities, rugged piezoelectric actuation of the mirror and active noise suppression.

With its resolution and range, the Cube addresses the need for moving objects to be detected with high accuracy. By generating a dense 3D point cloud and then evaluating it in real time using Blickfeld's software stack, the company says it is helping enable autonomous driving. The technology is said to ensure precise environmental detection even in darkness, fog or strong sunlight.

Timor Knudsen: "We optimise design."

Sensors play to strengths

Ben Rathaus: "We need more than one type of sensor."

Cameras and radar have different strengths and the industry should exploit both," believes Ben Rathaus, head of artificial intelligence at Arbe.

"We also want redundancy for a truly autonomous system," he said.

And he said that algorithms for autonomous driving needed to be able to recover from their own errors and must use priors to build a better autonomous driving model.

"We need more than one type of sensor to build a better autonomous driving model," he said.

The Doppler effect was a neat feature of radar, he said, that gave robustness.

"You don't get that with lidar or cameras," he said. "Doppler can provide orientation and help with classification. You always see the relative velocity between you and the object you are tracking."

For self localisation, GPS is seen as the logical candidate but it can be unreliable or not available.

Radar, on the other hand, can distinguish between stationary and non-stationary detection and can achieve in-lane localisation.

"You should still use GPS, but use radar to be independent of this," he said. "You can superimpose radar information onto Google Maps, and you can do that in real time."

Matching simulation to performance

Siemens believes the best way to design a vehicle is to create digital twins of the vehicle and the world around it. This can be done using the company's Simcenter Prescan simulation platform.

Rogier van Aken

"This can be used to simulate and verify development in automotive," said Rogier van Aken, senior project engineer for Siemens PLM Software. "We use simulation to compute real-world effects on actual sensors. Our philosophy is to develop physics-based sensors."

Physical effects can be faithfully reproduced. These include physical quantities, conservation of energy, dynamic range, bit depth, optical effects such as distortions, and filtering.

The raw signal is computed, whether it is a lidar full waveform signal, radar channel response or raw camera images. This can all be verified against real sensors and validated for specific use cases.

As an example, van Aken showed the results using a Sekonix SF3325 camera used in the NVidia Drive AGX and PX2 platforms. The goal was to express as a percentage how well the simulation result matched with actual measurement results.

The percentage results were distortion 98.4%, shading 88.8%, resolution 83.6%, optical electric conversion function (which tells how pixels relate to light intensity) 92.7%, and colour reproduction 89.8%.

"Simcenter Prescan can qualify how well the simulation results match the actual camera performance," he said.

Tesla raises the bar

Tesla has set the bar for the future of vehicles, according to Phil Magney, founder of VSI Labs.

In a panel discussion, he said that the future would be software-defined vehicles.

"OEMs are way behind in anything related to that," he said. "They are in danger of becoming merely coach builders or going out of business. I think Tesla is very solid."

Phil Magney

Rudy Burger

Benjamin May

Rudy Burger, managing partner at Woodside Capital Partners, agreed, saying: "Tesla has turned itself into a vertically integrated company. Tesla has led in software updates over the air."

Benjamin May, CEO of AMX13, said this was because most OEMs carried a legacy and that legacy was a burden.

Part of the problem, said Burger, was the relationship that OEMs had with their dealers.

"Updates over the air is classed as a service," he said. "They are tied in contracts with dealers that all services have to be done by dealers."

Burger said he believed over the next five to ten years Tesla would split into two companies – one would be a technology company and the other a transportation-as-a-service company.

Mapping is essential

Ratnajit Mukherjee

Bouke Douma

Detailed mapping data will be essential for autonomous driving, said Bouke Douma, director of product marketing for TomTom Automotive.

"Autonomous driving is a reality," he said. "We are already seeing the first systems. The benefits are so big, companies will continue to invest."

He said TomTom's main focus was for highway driving because that is where the company was seeing the most interest for OEMs. Already, it has more then 400,000km of mapping data.

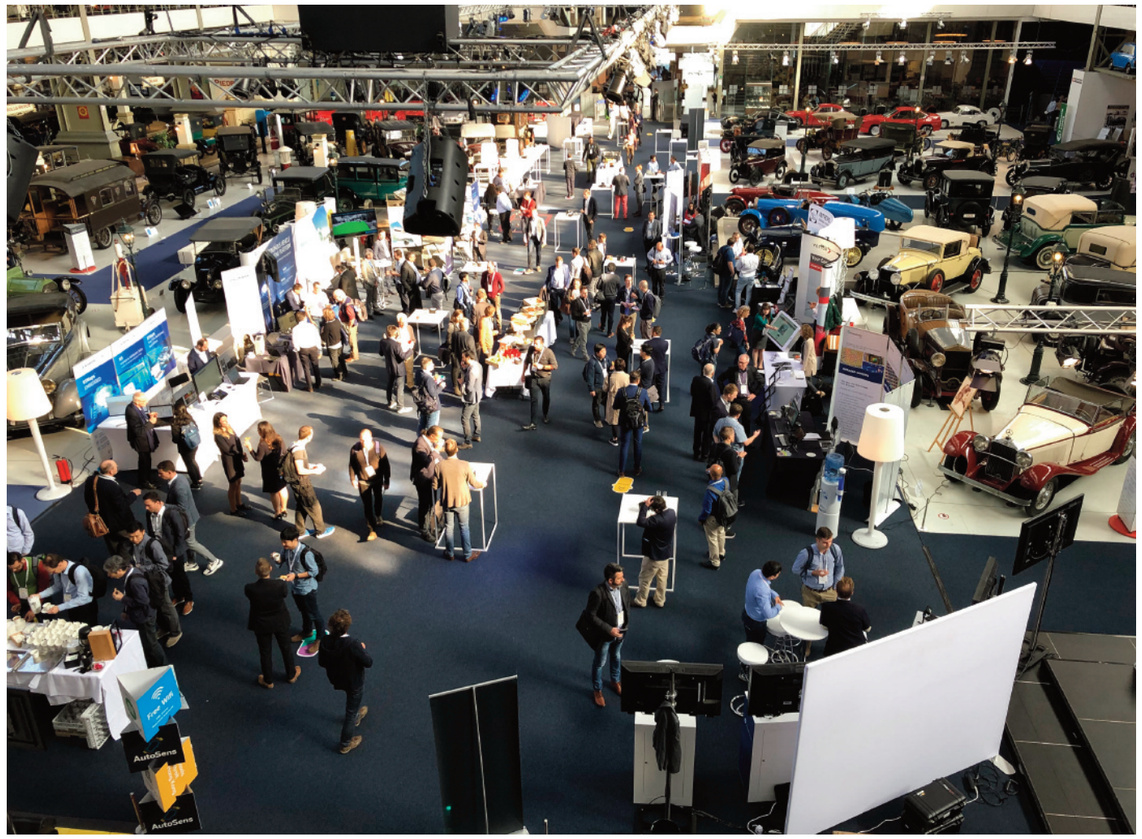
"There are big perception challenges for autonomous vehicles," he said. "Sensors have advanced but still struggle in certain situations."

In complicated junctions, it can often be difficult to work out which signals apply to which vehicles.

Here, he said, maps could help, and that they could also help autonomous vehicles understand the environment.

Ratnajit Mukherjee, a deep learning scientist at Navinfo, said the maps needed to be combined with automated feature extraction from video feeds coming from multiple vehicles.

"These data can be used for automated map updates," he said. "Object detection is more than just classifying what they are but localising where they are."



Safety depends on security

Steve Rogerson reports from the Aesin conference earlier this month at the UK's National Motorcycle Museum

If autonomous cars are to become a reality, they have to be safe. This may sound obvious, but the problem is deciding what is meant by safe, and not just safer than current vehicles but a lot safer if they are to be accepted by the public.

As has already been seen, accidents with autonomous vehicles are being jumped on by the media, and that will continue until the industry proves that the level of safety is much better than with manual vehicles.

Some may say that proof is already happening as adas is showing that even a little bit of driver assistance can help reduce accidents and save lives.

On the face of it, the statistics look good. Some elements of adas have been around now for a decade and from 2011 to 2017 there was a 27% drop in road fatalities and a 9.3% drop in injuries, according to Jonathan Moore, director of advanced systems at Exida. But adas, he said, could not take the credit.

"Most of that reduction," he said, "was caused by stronger metal and more soft spots in vehicles. That means adas has not really achieved an important penetration. There will be a smaller reduction in fatalities than we would expect from automated driving."

And there lies a problem. Today on the roads, humans are in control and there will be accidents no matter how much help is given.

"We have to deal with the fact that humans can't be relied on," he said. "They make mistakes and take risks. When we look at risk versus benefit for automated driving, it has to be better than humans."

Jonathan Moore: "You don't need the 26262 cookbook method."

Moore was also critical about the way the ISO 26262 functional safety standard operated as he said it overlooked the importance of architecture.

"If you have system-level protection in place, you have safety," he said. "You don't need the 26262 cookbook method. Following this blindly means you lose the system level view. If you go down a blind Asil route, you will over-engineer your parts. The 26262 standard is not suitable for future cars, and even today's cars. We crave simplicity, and functional safety is not simple in any form."

Yet Stuart Jobbins from Softintsys suggested that over designing was one way to achieve safety, especially when it came to level-three autonomy where a human had to be ready to take over. He took the example of designing a steering actuator.

"Level three says a driver has to be able to take control, but that is not always realistic so you might as well design to levels four and five," he said. "If you do that as your starting point, you don't care whether there is a steering wheel there or not."

Roger Rivett from Misra said the end goal was not to meet all the requirements but to have a safe product.

Misra has just published guidelines on how to meet the safety arguments requirement in ISO 26262 (see page 2). Rivett said following this could be used as a legal defence against litigation but stressed it was "also a valuable addition to product design and evaluation".

He added: "Safety culture is a very difficult thing to measure. The safety argument needs to be constantly reviewed and updated in the light of experience."

Security

One thing most in the industry these days agree on is that safety and security go hand in hand. You cannot have one without the other.

"Safety means having the system behave according to requirements and protecting humans from machines," said Stephen Janouch, senior business development manager at Green Hills Software. "But safety depends on security. Even if the system is built in a safe way, if it gets hacked that can compromise that. There is no safety without

Roger Rivett: "Safety culture is a very difficult thing to measure."

Stuart Jobbins: "You might as well design to levels four and five."

security."

He said rather than securing the system from the outside, what was needed was to isolate critical components from non-critical ones.

"You have to assume that non-critical components will be compromised," he said. "Security in depth is an absolute requirement. Security is not an add-on feature but has to be built in from the beginning."

Andrew Banks from LDRA agreed. He said: "You can't bolt on safety or security; you have to design it in."

He said the industry still had not learned the lessons of having secure zones in vehicles, something other sectors did all the time. And he said that keeping vehicles secure had to be on-going as the threats change.

"There are layers and layers of vulnerability," he said. "It might have been safe yesterday, but is it safe today and will it be safe tomorrow?"

Stephen Janouch: "Security in depth is an absolute requirement."

Testing

One of the biggest challenges in autonomous vehicles will not be building them but proving that they have been built correctly and can handle the real world situations they will face.

And the better they are made the more complex they will become and the more difficult to validate.

"System complexity becomes engineering complexity," said Tim Edwards, an engineer at Horiba Mira. "That cascades into a series of testing challenges. As we move to automated vehicles, we will have test cases that are almost infinite. This creates a long road to certification. You need processes that are flexible enough to cope with that."

He said it was necessary to build the confidence that there was a plan to achieve this. This would be needed to convince investors to spend money and to campaign for changes in legislation.

"You need a verification and validation roadmap," he said. "The end goal is you need a certification regime for autonomous vehicles. This needs to be whole-life certification. You need system-engineering processes to achieve that certification. And you need a virtual and physical testing capability."

Mike Dempsey, managing director of Claytex, added: "Autonomous vehicles are coming. The big question is how are we going to prove these things are safe."

He pointed out there were reports suggesting between five and eleven billion miles of real physical testing would be needed.

"Those figures are just not practical," he said, "so it is going to have to be a mix of simulation and real-world testing. They can also be tested on proving grounds where you have a lot of control but not total control, such as with the weather and so on. In field testing, you have no control over the environment."

He said what was important was to have a continuum through the different test methods from pure

Andrew Banks: "You can't bolt on safety or security."

Tim Edwards: "The end goal is a certification regime for autonomous vehicles."

simulation through proving grounds to real-world testing.

"The simulation needs to model the real world," he said. "You need to model how the vehicle will interact with the physical world, and to do that you need physics to see how it will react with different road surfaces. You also need to model all the sensors, whether radar, lidar, ultrasound or whatever. And you have to model the effect of other factors such as rainfall. And then you need to scale the whole thing to include traffic, pedestrian, cyclists and so on."

He said Formula One was leading the way with the way it had produced highly accurate models of all the circuits because of the restrictions on real-world testing.

"And simulation is already being used for adas development," he said, "but more work needs to be done to support autonomous vehicles. Simulation will be an essential part of the development and testing of autonomous vehicles."

Philip Clarke from DSpace said the industry should not be looking at millions of miles of testing but dealing with it terms of scenarios.

"A scenario is a collection of elements that constitute a test," he said. "It is a description of a driving situation, such as say overtaking on a motorway."

For this, you need a model of a road network with traffic around and behind. It has to consider what happens if the car hits the brakes and how that affects other vehicles. It needs representations of 2D and 3D sensors and an object list simulation.

"A lot of simulations depend on the algorithms that are sitting on the ECUs," he said. "Some OEMs will just supply the actual box and you have to put that into the simulation. Some OEMs give you a lot more, such as the source code, but often you can't get full access to the ECU."

With a radar, for example, if there is no access to what is happening inside, all the tester can do is put it in a vehicle and drive it.

"But if you can get to where the signals go out and in, you can simulate the radar," he said.

Philip Clarke: "Often you can't get full access to the ECU."

Conclusion

Despite the hype, there is still much to do before autonomous vehicles are considered safe and secure enough for everyday use. But as the Aesin conference showed, the problems are known and are being worked on. And when that happens, answers will usually be found.

Mike Dempsey: "It is going to have to be a mix of simulation and real-world testing."

SOFTWARE

AUTONOMOUS LEAP

Bob Leigh discusses a game changing autonomous vehicle software architecture

Highly autonomous vehicles require a software technology and architectural approach that is entirely new to the industry. Their software needs to operate in diverse real-time environments, interoperate with other systems within the vehicle and meet stringent safety and security requirements.

In highly autonomous levels four and five vehicles, an immense amount of data is passed between applications that then must be able to sense and react to the surrounding environment in real time. This must be done safely and securely.

However, today's designs for autonomous vehicles are not yet good enough to satisfy simultaneously all these requirements. Investments are needed in technology to meet autonomous vehicles' functional requirements, while also maintaining the high standard of non-functional requirements for which the industry is known. Out of all technology embedded into an autonomous vehicle, it is software that is providing this game-changing leap ahead.

Software has become the chief competitive advantage in autonomous vehicles due to key factors in the market: advanced technology, innovative start-ups and new business models. All the latest innovations – ridesharing, autonomous vehicles, EVs and connected cars – are based primarily on advanced software.

To design these systems for the future, auto manufacturers realise they must separate software procurement from hardware, and think about the vehicle's software as a global effort that spans across brands, models and years. This is more challenging than it sounds given how custom most vehicle software is today.

Frameworks

Aerospace and defence (A&D) applications come to mind when considering a mission-critical system with similar requirements to an autonomous vehicle. Systems such as naval ships and unmanned aircrafts also require high performance, safety and redundancy for flight and ground systems with additional demands to reduce size, weight and power.

To satisfy these requirements, A&D programmes formalised standards-based software frameworks, such as Future Airborne Capabilities Environment (Face). The added benefit of this approach to A&D systems is increased software reuse through modularity and portability, as well as interoperability between disparate systems and suppliers.

Some may think the automotive industry already has suitable software frameworks in place. For example, Autosar Classic. However, in practice, Autosar Classic is focused on limited-capability microcontrollers, and doesn't accommodate the dynamic and modular services required by emerging applications.

Every project using Autosar today requires custom development. Code that is developed for one car platform cannot be easily leveraged by another, causing additional manufacturing time and cost. As a result, reusability should be a key metric to identify a good automotive framework.

Furthermore, good frameworks should provide interoperability between components, de-couple individual applications, and provide a viable path from development to production. They should also be agnostic to the underlying hardware on which they run.

Autosar and ROS2

A few emerging frameworks are specifically targeted at autonomous vehicles, including the new Autosar Adaptive platform. This framework is a service-oriented architecture that builds on the idea of Autosar Classic, but enabling more dynamic capabilities so applications (services) can come and go without breaking the whole system. It also leverages more widely adopted and cross-industry standards, such as running on Posix-based operating systems.

The Robotic Operating System (ROS) open-source software is popular with research and academia. It's really more a robotics framework than a traditional operating system, and it has been used by many of the Darpa Grand Challenge competitors, a competition for unmanned ground vehicles.

The latest generation, ROS2, has evolved ROS to make it more scalable, reliable and performant. There are even future aspirations to provide safety-certifiable instantiations of this open-source project.

The big secret behind the Autosar and ROS2 frameworks, and many of the platforms built internally by tier-ones and manufacturers, is that they are based on the Data Distribution Service (DDS) standard. The DDS standard is managed by the Object Management Group (OMG) and is proven in many complex, real-time environments including unmanned aircraft, surgical robotics, distributed energy resources and air traffic control.

ROS2 and Autosar both adopted DDS as the underlying communication framework to meet the complex use cases of

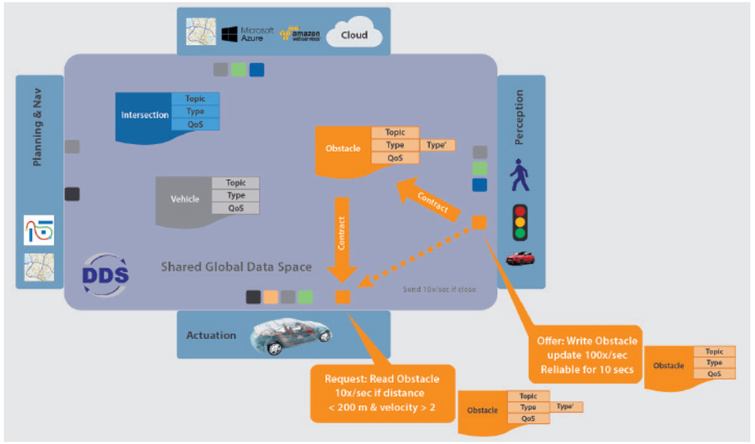


Fig. 1: The traffic monitor will send only obstacles that are close to the requester and moving at a rate it can handle

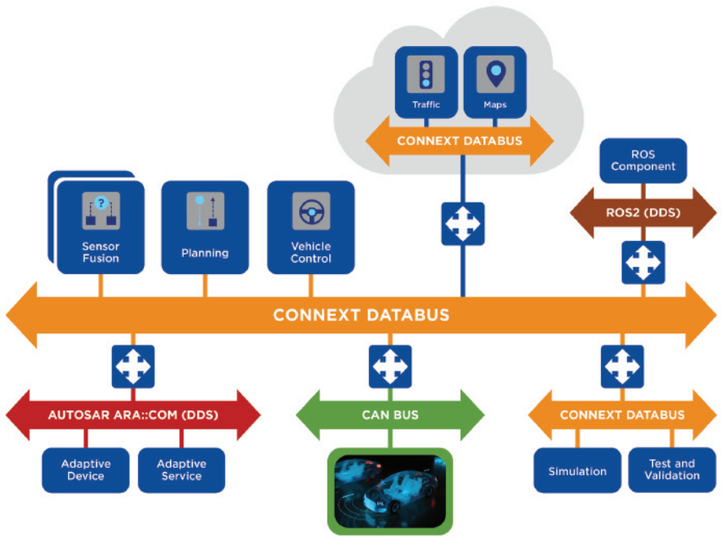


Fig. 2: Autonomous vehicle system architecture example: DDS integrates all components and frameworks; teams can work independently with the assurance that the infrastructure will directly support the data interaction needed for system-wide operation

highly and fully autonomous vehicles, especially where real-time quality of service (QoS), security and performance are critical.

Native framework DDS

DDS provides connectivity capabilities for industrial applications that require real-time performance, highly-meshed interaction between applications and their development teams, and safety-critical reliability. Built on a technology called a databus, DDS offers all the benefits of a data-sharing IT enterprise service bus, including communication and network abstraction, but was purpose-designed for embedded and distributed industrial systems.

The databus, see Fig. 1, links any language, device or transport. It automatically discovers information sources, understands data types and communicates them to interested participants. The databus scales across millions of data paths, enforces sub-millisecond timing, ensures reliability, supports redundancy and selectively filters information. Each path can be unicast, multicast, open data or fully secure.

DDS is used in at least 40 different commercial autonomous vehicle development programmes today that are based on ROS2 or Autosar, or that use DDS as their native framework.

Additionally, with an autonomous vehicle, if a system can't meet the real-time performance requirements, then nothing else matters. For example, unreliable communication renders interoperability meaningless because the connected system does not receive the data that its algorithms need. Developers need to ensure the vehicle can sense, think and act fast enough to react to the environment.

This is challenging because these systems must accommodate large data samples, such as from high definition cameras and lidar, with increasing bandwidth requirements. Typically, there is an inherent trade-off between optimising for low latency and increasing bandwidth. But the QoS parameters of DDS allow designers to tune latency and bandwidth use for each specific use case and type of data, see Fig. 2.

Reusing software applications across diverse platforms is no easy task considering the extensive types of technology used in different classes of vehicles. A luxury SUV has vastly different features and sensor configurations than an economy coupe, requiring customised deployment. A software framework enables manufacturers to reuse applications easily across these diverse environments, and configure the technology appropriately for each application.

A DDS databus supports this dynamic environment by offering the following:

- A modular architecture that removes each software application's dependency on how it communicates with other applications or services.
- Improved portability of applications by abstracting away the underlying compute platform and physical communication mechanisms.
- Configurable QoS to customise each application's specific connectivity requirements without any additional software development.

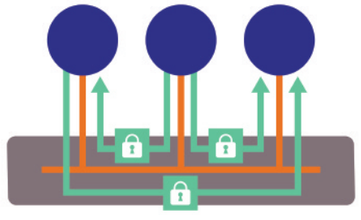


Fig. 3: DDS enables dataflow security, which secures the data itself, protecting the data while enabling high performance and scalability

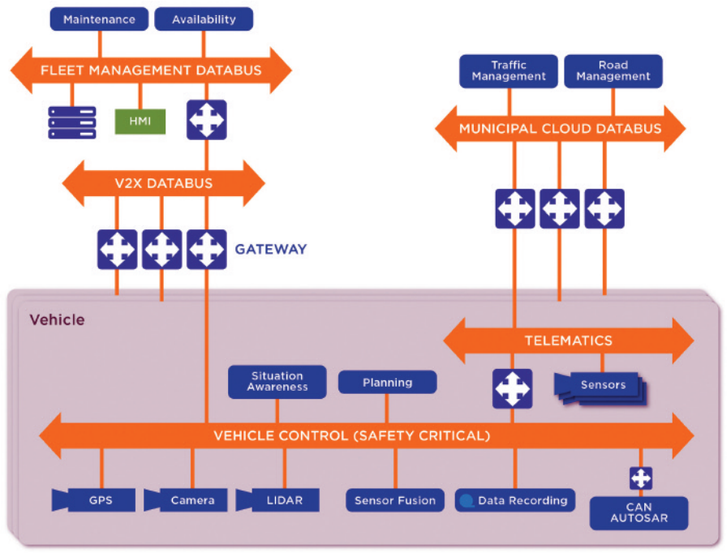


Fig. 4: Example of an autonomous vehicles layered architecture, in which all components and frameworks are integrated

Security

Properly securing operations becomes critical as autonomous systems improve and expand into more and more aspects of society. This means protecting the DDS databus from untrusted parties and malicious insider threats. Bad actors should neither acquire data in transit nor produce data affecting the behaviour of other components.

A secured DDS databus offers all these assurances, while retaining its data-centric approach and all the aforementioned features:

- Granular configuration of authentication, access control and data encryption.
- Protection is per data type, allowing flexible and efficient coexistence of data streams with different degrees of security requirements within an untrusted network.
- Portability, modularity and QoS are not compromised when applying security measures.
- Industry standard algorithms for authentication, key exchange and encryption

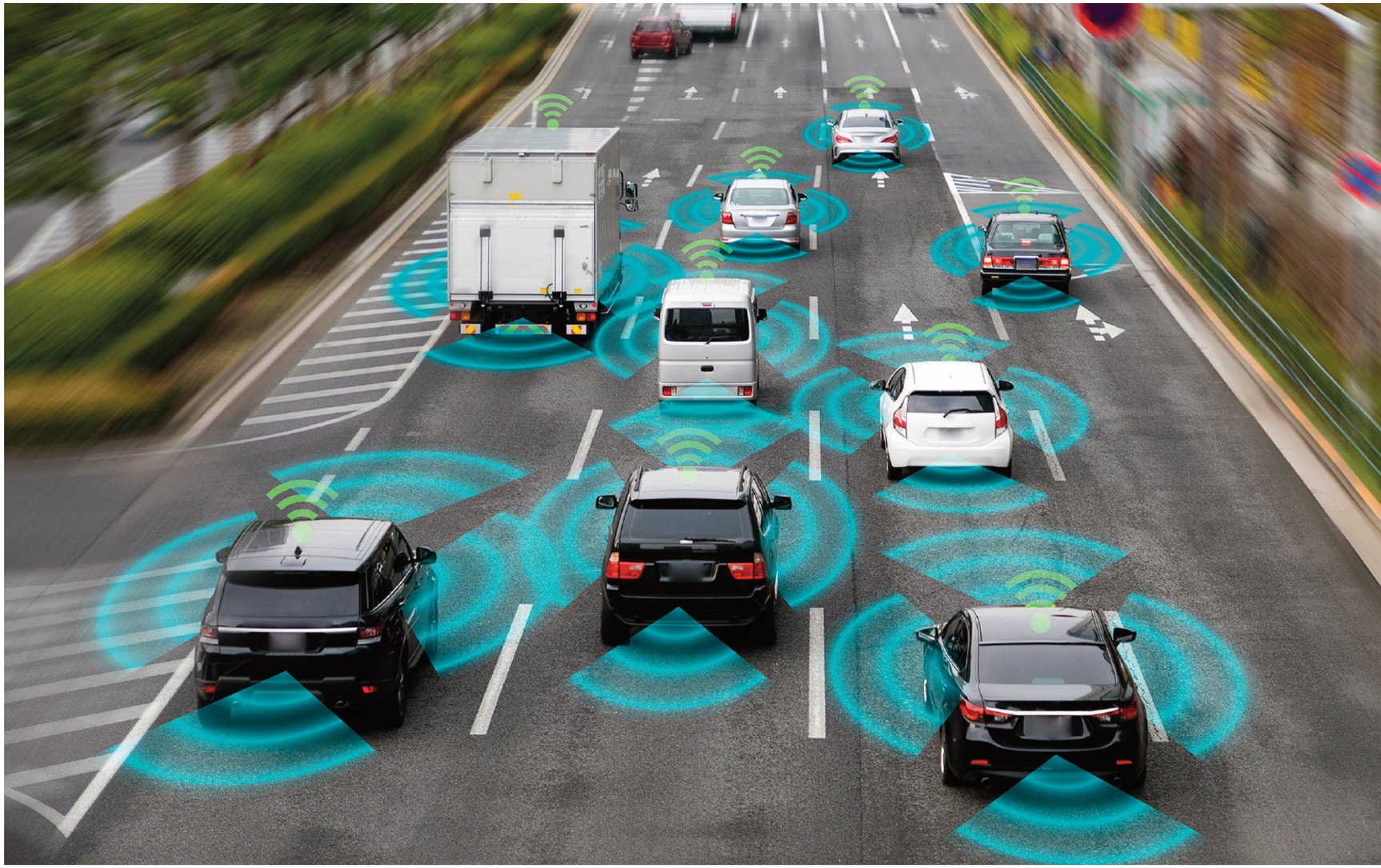
Future of autonomy

The future of autonomy is built on software that is increasingly being built on DDS, which has already been deployed in thousands of mission and safety-critical applications. Not only can DDS help the use cases of today, but it is well-suited, and well-tested, to solve the autonomous and connected transportation problems of the future.

Bob Leigh is senior director of automotive at RTI

COMMUNICATIONS

In the race to open the market for connected and autonomous vehicles, Andy White looks at the competing technologies



Who's talking with whom?

In August this year, Continental, Europe's largest auto technology supplier, announced it would stop investing in parts for petrol and diesel engines as it positions itself for rapid growth in cleaner transportation amid declining global production of cars and lorries.

In July, Ford and Volkswagen announced a significant expansion of their global collaboration on electric vehicles and self-driving technology, as they look to manage the storms battering the global auto industry.

VW will invest $2.6bn in Argo AI, the Ford-backed driverless technology start-up, and will begin testing self-driving cars in Europe, while Ford will build a mass-produced electric vehicle in Europe using VW's in-house development and manufacturing system for battery cars, promising savings for both companies in duplicated investment costs.

Further, Toyota and Suzuki announced in August that they would deepen their existing alliance and take stakes in each other's businesses to bear the costs of developing autonomous vehicle technology.

Connected vehicles

It is no surprise that as vehicles use smarter technology, they need to adopt industry-accepted communication protocols to ensure interoperability, to communicate with one another and their external environment.

One of the most widely adopted protocols is the Can, which is now the ISO 11898-2 standard. It dates back to 1986 and can attain 1Mbit/s but, using the latest specification ISO-11898-2 2915, which uses flexible data rate operation (Can-FD), it can reach 12Mbit/s.

However, with the increased prevalence of on-vehicle safety systems such as adas providing functions including adaptive cruise control, lane departure warning systems, radar and lidar sensors, and so on, such speeds are woefully inadequate. Furthermore, Can is limited to a wired system.

With more advanced safety systems, and with autonomous vehicles on the horizon, there is a need for vehicles to communicate wirelessly not only with each other, but also with their wider environment. These communication systems are generally labelled as vehicle to vehicle (V2V) or vehicle to anything (V2X), with the anything including the wider environment such as infrastructure and pedestrians.

Of course, these systems have major implications for public safety and are governed by tight regulatory and network constraints. Furthermore, for those businesses that are quick to protect core IP in this area, this may represent a real opportunity to disrupt the entire automotive industry.

DSRC

Over the years, two competing communication protocols have been developed. The first is Dedicated Short Range Communication (DSRC).

This is an amendment to the IEEE 802.11 standard.

In short it is wifi for cars, but it has been adapted to be specifically suited to the automotive environment so has to have very low latency and be able to cope with extremely short windows in which it can exchange and transmit data.

The US Department of Transportation has been a big supporter of this system, having invested over $700m in its development, and a section of spectrum in the 5.9GHz band was allocated back in 1999. NXP has been actively pursuing DSRC technology, as have VW and Toyota having both trialled the technology.

Toyota announced in April 2018 that it would begin installation of DSRC technology in 2021, and

General Motors began installing the technology in a small number of vehicles.

DSRC does, however, have shortcomings; its short range of 150 to 300m may not be large enough for safety-critical applications when considering vehicles travelling at speed. Collisions between messages from two devices may also occur when they are transmitted at the same time.

This coupled with a lack of sufficient coverage may have an impact on vehicle safety, despite the technology having been demonstrated to be highly effective.

Furthermore, a lack of commitment from the automotive industry, plus Donald Trump's administration failing to push ahead with a mandate for the technology to be installed in all new vehicles, means DSRC hasn't yet experienced a wide uptake and is perhaps falling out of favour with the industry, with Toyota announcing in April 2019 that it was going to abandon its plans to use DSRC.

LTE-V2X

As an alternative to DSRC, many car makers are looking to 5G cellular, known as LTE-V2X, which is included in the latest 5G specification. In short, it makes use of the existing planned 5G infrastructure to enable high speed interactions at greater ranges than DSRC.

Qualcomm is very active in this area, with a V2X product based around its 9150 chipset developed in 2017. Working with the Chinese National Development & Reform Commission to achieve a target V2X network coverage rate of 90% in 2020, Qualcomm is also working with mobile network operators such as China Mobile.

One of the benefits of LTE-V2X is that it allows direct communication between enabled devices, meaning a signal doesn't get held up travelling through the network. Ultimately, it may allow vehicles to see around corners.

LTE-V2X seems to be experiencing a warmer reception in the industry. Ford announced in January 2019 that it was going to deploy cellular V2X technology in all new US vehicles sold from 2022. Audi, BMW, Ford and Daimler, along with Ericsson, Huawei and Nokia, have also all been trialling the technology.

Collaboration and interoperability are extremely important

As well as not requiring such extensive and expensive infrastructure upgrades, another selling point for LTE-V2X is that many car makers would likely want to add in some cellular network capacity in their vehicles anyway, and using LTE-V2X may allow both to be done with only one chipset.

The fact that there are two main competing protocols has led many in the industry to adopt a wait-and-see approach. However, with the ongoing rollout of 5G infrastructure, and the commitments made by car makers to use LTE-V2X technology, there is a chance the winner will soon emerge from this battle over connected vehicles and perhaps these vehicles will be travelling on roads in the very near future.

IP strategy

Many businesses will have invested heavily in research and development (R&D) and protecting their IP. For example, through patents, which is a way of helping preserve their R&D investment and achieve their long-term strategic goals.

The protection of core strategic IP relating to communications protocols is nothing new – indeed it has been around for decades, and covers everything from GSM to 5G.

When it comes to telecommunications protocols, collaboration and interoperability are extremely important – a Nokia handset must communicate with

Vehicles need to adopt industry-accepted communication protocols

Ericsson equipment, for example. This generally results in competing businesses signing up to standards setting organisations (SSOs), such as the Etsi or the 3GPP.

Once businesses are signed up to these SSOs, they must set particular agreed technical standards to ensure interoperability. If a business has patents that cover the technology in a standard – what is known in the field as a standards essential patent – then the business, as a condition of its membership of the SSO, agrees to license the technology covered by that patent on fair, reasonable and non-discriminatory (frand) terms.

The consequences of businesses not protecting IP may be severe. In the telecoms field, many non-practising entities or trolls have acquired large patent portfolios they are aggressively asserting.

Many cars already encompass telecommunication technology – such as involving wifi, 3G or 4G technology – that is the subject of various different patents.

The trolls are very experienced and may exploit inexperienced automotive suppliers and OEMs, often pressuring them to accept the terms of an unfair licence agreement rather than face litigation. These licence agreements may fall foul of the frand terms that those businesses are required to meet, or may not even cover what is being asserted.

While automotive companies have not typically been targeted by troll patent holders to date, things seem likely to change. A report by Managing IP in 2018 indicated that 95% of respondents considered that IP would play an important role in the development of the automotive sector over the next five years, with 86% indicating that they expect to see more litigation over IP rights.

In times of disruption such as these, there may be fantastic opportunities for businesses that are quick to protect key strategic IP to obtain a controlling position in the market. Whether this comes from a forward-looking automotive company protecting important strategic IP relating to LTE-V2X, or from a well-established telecoms company, only time will tell.

One thing is certain – patenting activity in this area is on the up and is likely to affect everyone in the automotive industry in the race to get connected and autonomous vehicles on the streets.

Andy White is European patent attorney at Mathys & Squire

ELECTRIC VEHICLES

Steering the EV market

Simone Bruckner explains where the electric vehicle market is heading and how it will meet the drive for efficiency

With electric vehicle capabilities switching from an environmentally kinder preference to a mandatory requirement, the industry will have to electrify more than just commercial vehicles. EVs represent exciting opportunities.

With the potential to reduce emissions in the largest-emitting sector, international market trends suggest electric cars and vans will reach price equivalency with internal combustion engine (ICE) vehicles by the mid-2020s and that EV sales will overtake petrol and diesel engines by the late 2030s.

Despite this burgeoning expected growth, there are still some important questions that need answering surrounding just how manufacturers can guarantee efficiency levels that can outperform those of traditional vehicles.

Going public

Urban electric buses are surpassing the growth of every other EV segment and constitute the fastest-growing part of the EV market.

In China, the once quaint city of Shenzhen has become a megalopolis. Over 40 years, Shenzhen's population has accelerated from 30,000 citizens to over twelve million. In line with this remarkably rapid transformation, the city began introducing electric buses in 2009 to combat rising air pollution. Today, it has become the first city to electrify all its public buses.

In fact, a report by Bloomberg estimates that China adds around 9500 buses – the size of London's entire fleet – to its services every five weeks. Elsewhere, Paris has renewed its public bus fleet with 100 per cent electric buses, making it a world leader in sustainable public transport. Over the next decade, most of Europe's bus fleets are predicted to reap the benefits of electrified transport.

And benefits there are. The cost of maintenance for electric buses is around 25 per cent lower than that of a diesel bus, as the electric motor doesn't need the same level of servicing that a diesel one requires. Electric engine losses are also significantly lower than a diesel engine's, lowering the cost per kilometre of electric bus travel.

However, the e-bus phenomenon presents cities with some major challenges: namely technological uncertainty, large up-front investment and the need for new capabilities. It is therefore important that the long-term efficiency of these vehicles outshines their large initial expenditure and that the technology is in place to transform potential into reality.

Not only do cities need to revamp their infrastructure, as charging stations could require a full redesign of bus depots, but software must also be considered to manage vehicle operations effectively. This may include building IT systems that can monitor and handle a potentially complex web of timetables and charging schedules. Real-time energy system monitoring is also

Urban electric buses are surpassing growth of every EV segment

required to prevent malfunctions and delays.

Bear the load

There is also concern over how other heavier vehicles will be electrified. In late 2017, Tesla announced that its Semi heavy electric truck would be ready for production by 2020. Enticing the industry with pledges of a 800km driving range and solar-powered Megacharger stations, the company certainly has a lot to deliver if it is to act on its promises.

Many people are speculating about the exact specifications of the Tesla Semi. One of the most important items in question seems to be its weight. If the electric vehicle is to require several electric motors to power it, this weight would be roughly comparable to that of a diesel engine. With the addition of the lorry's battery weight, the components inside EVs must be refined so they can bear the load of this extra mass without it impacting efficiency.

Despite slick marketing campaigns and captivating master plans, there is still a long way to go before there is a complete overhaul of heavy vehicles. In 2018, 97 per cent of lorries and 100 per cent of camper vans sold in Europe were diesel powered. To help make ambitions of electric heavy vehicles become a reality, the components going into them must be assessed and perfected, and the focus shouldn't solely be on batteries.

Regeneration game

According to Toyota, the average car is made up of 30,000 parts, right down to each individual screw. These parts must battle adverse weather conditions, withstand repeated bouts of acceleration and braking, and proactively contribute to maintaining vehicle efficiency.

Instead of internal combustion engines, electric vehicles use a braking chopper to convert the energy generated by high-speed braking, typically when on the motorway. Urban drive cycles have a considerable amount of acceleration and decelerating periods due to traffic control in place around towns and cities. While braking, a car's motor continues to spin even though the vehicle is trying to slow down, creating excess energy. Integrating a braking resistor allows this otherwise wasted energy to be dissipated as heat and recovered to warm the vehicle's cabin in cold weather or to regenerate the kinetic energy to improve efficiency.

The concept is widely implemented on electric trains, where wasted energy is dissipated back into the power line and consumed by other trains on the track. On the road, regenerative brakes can not only significantly improve energy efficiency, but can also contribute to maintaining the overall upkeep of the vehicle. Regenerative braking means mechanical friction brakes are only used in emergency situations, such as sudden stops, so there is far less need for maintenance. In addition, accessory components, including resistors, don't require any maintenance, unlike the high cost of replacing brake pads and discs.

To increase a braking resistor's dissipation capability, it's important the component is prevented from overheating.

Water and air

The effect of temperature on a product's performance is an important design consideration. Overheating can reduce the efficiency and longevity of components, and regulating this is critical.

The challenge of managing temperature is critical when ensuring the efficiency of electric vehicles, and standard electrical items may not always fulfil this requirement. Electric brake resistors are well known in the domain of power electronics, railway or elevator technology to dissipate heat and slow down a mechanical system to avoid overheating.

Most brake resistors are typically encased in a frame to create a safe distance between surrounding components. These frames feature a choice of either cooling fans or liquid coolants.

Air cooling has traditionally been the most common cooling method, as its fan technology is robust and able to withstand a significant amount of wear and tear without malfunctioning. If, for example, a single fin broke on the fan, it would still function safely.

This method of dissipating heat does, however, come with its limitations. Air fans create an additional source of noise, which interferes with the quiet running that is typically one of an EV's benefits. Using a fan also means its enclosures are generally bulkier and take up more space, which limits the range of vehicles that can use it. Air-cooling fans are further limited by their reliance on ambient temperatures to cool down heating components, which impacts the consistency of their efficiency.

On the other hand, water-cooled resistors can be easily integrated into existing cooling systems and are able to deliver cooling to areas where fans often fall short. Pipes containing a liquid coolant circulate around an enclosure and out of the device to help keep components cool using the principal of heat exchange.

Excess heat is thermally conducted by the water in the pipes, which is transferred out of the device and regenerated for other purposes.

As the water can be stored in pipes at temperatures below the application's ambient level, cooling can happen faster and with greater reliability.

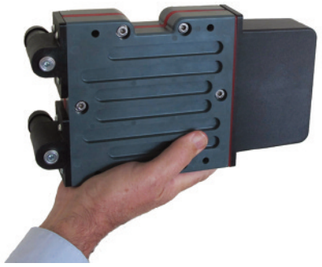
The efficiency of air-cooled fans also depends on the size of the application. Manufacturers may need to integrate multiple fans, instead of just one, if they are being used to cool components in large electric vehicles such as lorries and buses. As water has a high heat conductivity, a water-cooled resistor only requires a single pump. This significantly lowers energy consumption and overall cost, while increasing the amount of space left inside the vehicle.

New norm

With the electric vehicle market continuing to flourish, EVs are no longer a new concept. While there is still a way to go before the entire transport system is electrified, manufacturers need to work to make sure that vehicles meet efficiency targets.

If the planet is to truly feel the impact of the move away from petrol and diesel, all vehicles on the road need to undergo an upgrade. For this to happen, vehicle technology needs to keep pace. It isn't all about batteries. Other components, such as braking resistors, must also be perfected to increase the drive for greener roads.

EV sales are set to overtake petrol and diesel engines by the late 2030s



Water-cooled resistors can be integrated into existing cooling systems

Simone Bruckner is managing director of Cressall Resistors

Crystals withstand harsh conditions

Automotive-compliant timekeeping crystals from Diodes can withstand harsh operating conditions to ensure accuracy and reliability in tyre-pressure monitoring systems (TPMS), infotainment, telematics and adas.

Capable of sustained operation at centrifugal forces up to 1500g, the XRQ crystals pass the SAE J2657 specification for TPMS. The crystals resist shocks up to 8000g. They also surpass JIS-C0044 drop tests by surviving falls of up to 1.2m.

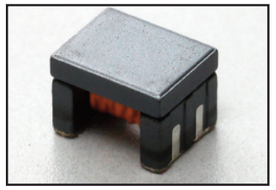
They meet the requirements of ultrasonic welding processes for hermetically sealed objects, such as a TPMS.

The series is suitable for automotive applications, both under-the-bonnet and in passenger compartments. They are AEC-Q200 qualified and available in grades one (-40 to +125˚C), two (-40 to +105˚C) and three (-40 to +85˚C) temperature ranges.

The devices are PPAP capable and are manufactured in IATF16949 certified facilities.

Three standard sizes are available. XR32Q variants in the 3.2 by 2.5mm outline are available in frequencies from 12 to 66MHz. The 2.5 by 2.0mm XR25Q devices range from 16 to 66MHz. And the 2.0 by 1.6mm XR20Q go from 24 to 66MHz.

The ceramic surface-mount packages are seam-sealed for hermeticity and mechanical integrity.



Can-FD choke coil

A wire-wound common mode choke coil from Murata supports class-three differential to common mode rejection to fulfil the IEC62228-3 requirement for Can-FD automotive networks.

The DLW32SH101XF2 has a common-mode inductance of 100μH and is rated up to 115mA and 50V DC.

The surface mounted device is constructed in a 1210 package, measuring 3.2 by 2.5mm.

Ethernet switches have multi-gigabit routing

Two high-port count, low latency Automotive Ethernet switches from Marvell have multi-gigabit routing capabilities.

One is a high-port count aggregation switch, offering all ports at gigabit capacity enabling clustering of safety critical sensor data in an adas and data transfer over high-speed PCIe host uplink.

The other is a differentiated switch with integrated 100baseT1 phys and routing and security features that can be used in large gateway applications to connect multiple domain controllers.

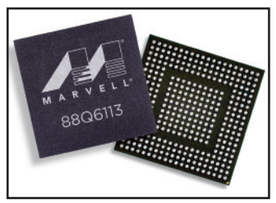
The 88Q5072 and 88Q6113 switches are single-chip, monolithic die products based on the Arm Cortex-M7. They can implement protocols and security software on switch, offloading the external host processor.

They equip time sensitive networks in vehicles with added features to enable low policing and filtering (IEEE 802.1Qci) and frame presumption (IEEE 802.1Qbu).

The integrated L3 hardware accelerator allows multi-gigabit routing throughput up to 10Gbit/s without internal processor intervention.

While facilitating large data transfers in vehicle networks, the devices have efficient sleep-wake capabilities supporting the TC10 standard lowering the overall power consumption.

They have been built to address the increasing risk cyber crime represents to the automotive industry. They have a robust level of security features including deep packet inspection engine and trusted boot functionality at the foundational hardware layer.



Driver IC supports large and small LCD panels

An LED driver IC from Rohm is optimised for LCD backlighting in instrument cluster, centre information displays and car navigation.

Unlike conventional drivers with four channels that support LCDs up to 20cm, the BD81A76-EFV-M IC provides six channels of output with 120mA per channel that can support LCD panels of up to 25 to 30cm.

Original buck-boost control ensures compatibility with small and large LCDs using a single driver. This makes it possible to develop a common design of LCD control board suitable for conventional panels along with the latest large-size displays.

Analogue design technology and proprietary technologies have been integrated to achieve flicker-free operation and contribute to a common control board design.

The buck-boost control provides application flexibility in LCD applications.

Although conventional LED drivers can only drive 36 to 60 LEDs (6-10 LEDs/channel), this IC expands the range from six to 60 LEDs (1-10 LEDs/channel). This ensures the support of not only larger displays but also small and medium size panels using a single driver, contributing to a common design of control board.

Incorporating a constant current driver with low heat generation enables a six channels LED current output of 120mA per channel.

PWM dimming technology provides a dimming ratio of 10,000:1, improving visibility and design flexibility for centre information displays and instrument clusters.

Leveraging analogue design expertise and process technologies allowed the reduction of standby current consumption to 10μA.

In addition to AEC-Q100 qualification, the device integrates a spread spectrum function as a countermeasure against EMI that allows it to clear Cispr 25 noise requirements for vehicle applications.

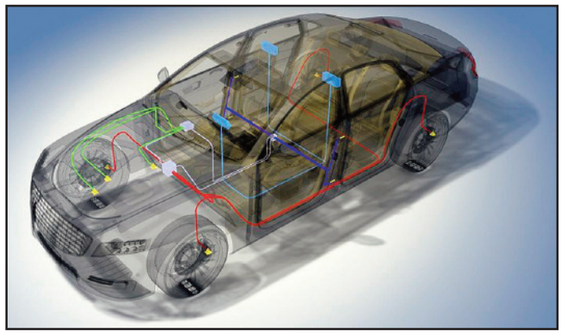
Compliance testing for Automotive Ethernet

Rohde & Schwarz has introduced 10baseT1S compliance testing for Automotive Ethernet and other bus systems for its RTO and RTP oscilloscopes, which will provide automated testing conforming to the current version of IEEE 802.3cg 10baseT1S interfaces.

As for other Ethernet standards, the K89 compliance test software includes pictorial instructions to guide users through the measurements step by step.

Both the oscilloscopes and the firm's ZND network analyser are automatically configured. The test results are documented in a PDF test report. The compliance test offering also includes a test fixture, simplifying connecting the 10baseT1S interface to the test setup.

With this addition, the firm will be able to supply a complete portfolio for testing all available Automotive Ethernet standards (10baseT1S, 100baseT1 and 1000baseT1) and for other automotive buses such as Lin, Can, Can-FD, Flexray and CXPI.



Exfat file system protects data

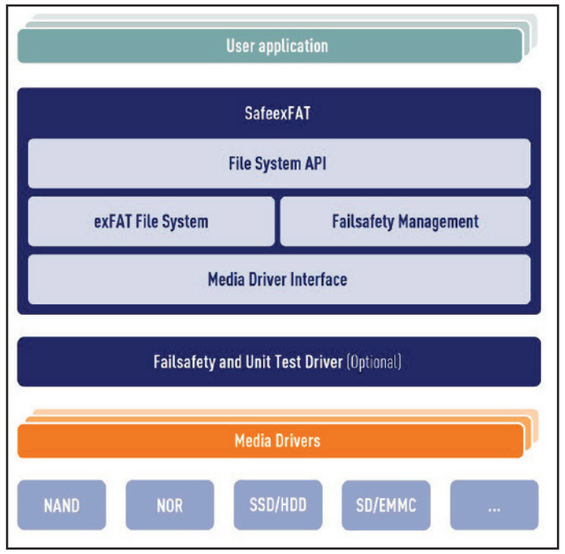
A failsafe, rtos-independent exfat file system implementation from HCC Embedded provides integration for device manufacturers who want storage reliability for deeply embedded applications.

This targets manufacturers of devices where loss of data could be detrimental, such as in automotive, industrial and medical applications.

HCC is a Microsoft exfat partner, with rights to license HCC and Microsoft exfat IP.

The Safe Exfat is designed and tested to be failsafe, ensuring no loss of data or, worse, complete file system. Because it was designed with integration and target verification in mind, the user can prove that the product behaves correctly when integrated with a product using the included test suite.

To validate failsafety on the target system, a test driver lets users verify the correctness of the implementation by injecting errors at the media driver level.



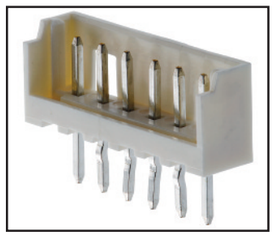
It enables integration with almost any target platform, so device manufacturers using a range of operating systems can use the same code on all their designs.

The code is Misra 2012 compliant.

Wire-to-board connector

A wire-to-board connector from Molex suits automotive uses that need a high-temperature design.

The Micro-Latch 2.00mm connector has two to 15 single-row plug-in circuits, with vertical and horizontal configurations; through-hole terminals; a 2.00mm-pitch low-profile connector; RoHS compliance; and high-temperature capabilities.



Controller includes four-lane Mipi-CS12 input

A full HD 1080p LCD video controller from Renesas includes a four-lane or dual two-lane Mipi-CSI2 input.

The RAA278842 supports up to 1Gbit/s per lane to interface with automotive cameras, application processors and graphics processors. It also supports a 150MHz single-channel Open LDI interface, and various video interfaces and LCD panel sizes with resolutions up to 1920 x 1080.

It suits central infotainment displays and head units, instrument clusters, HUDs, and mirror replacement displays.

The device has 10bit per colour processing built into the image enhancement engine to provide near-zero latency video. Its video diagnostics detect if the incoming video is frozen or corrupted and can provide a direct path for the rear camera video to be displayed on the LCD.

This improves rear camera display reliability, virtually eliminating software related problems causing the rear camera video to be displayed incorrectly or not at all.

The device is AEC-Q100 grade-two qualified for -40 to +105˚C and comes in a 14 by14mm, 128-lead LQFP package.

Shunt resistors reduce component count

Automotive-grade power metal plate shunt resistors from Vishay have a 20W power rating in a 3939-size package with Kelvin terminals.

With their high power density, the Vishay Dale hybrid-mount WFPA-3939 and WFPB-3939 can save space, decrease component count and increase measurement accuracy.

The construction incorporates a thermal management design using a copper heat spreader.

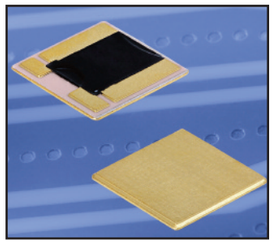
The AEC-Q200 qualified devices let designers use a single high-power resistor in place of multiple low-power devices in parallel, reducing measurement errors and board space needs while allowing the design of smaller and lighter products.

A proprietary processing technique produces resistance values from 2 to 8mΩ with tolerances down to ±1.0%.

The devices suit all types of current sensing and pulse applications in automotive electronic power steering systems, brushless DC motor controls and battery management for electric and hybrid vehicles.

The resistors have a solid metal manganese-copper and nickel-chromium alloy resistive element with TCR of ±20ppm/˚C, inductance values less than 10nH, thermal EMF below 2μV/˚C, and operating range of -65 to +170˚C.

The devices are RoHS-compliant, halogen-free and Vishay Green.



AEC-Q100 diodes target audio amps

The 200V Qspeed LQ-10N200CQ and LQ20N-200CQ diodes from Power Integrations are available with AEC-Q101 automotive qualification.

Qspeed silicon diodes use merged-pin technology to offer a balance of soft switching and low reverse recovery charge (Qrr). This results in low EMI and reduced output noise, which is important for in-vehicle audio systems.

The diodes have a typical reverse recovery charge of 32.4nC at a TJ of +125˚C, and a diode softness ratio of 0.39. This reduces high-frequency EMI inherent in the Schottky rectifiers often used in class-D power amplifier output stages.

Dual 10 and 20A common-cathode diodes are housed in the standard, rugged DPak TO-252 package.

The diodes are produced in IATF 16949-certified facilities.

Module integrates dead reckoning and RTK

An automotive-grade dual-band high-precision GNSS module from Quectel Wireless integrates dead reckoning and real-time kinematic (RTK) technologies.

The LG69T module, announced at the Apsara Conference in Hangzhou, can facilitate open sky positioning performance with an accuracy of up to 10cm. It can support precision positioning capabilities for smart vehicles and autonomous driving scenarios.

The module is based on STM's STA8100GA, an automotive-grade dual-frequency positioning chip with 80 tracking channels and four rapid-acquisition channels that are compatible with GPS, Beidou, Galileo, Navic-IRNSS and QZSS.

It is an AEC-Q100 qualified dual-band (L1+L5) GNSS module that integrates multi-band RTK technology.

The dead reckoning capabilities feature an integrated inertial measurement unit that provides continuous high-precision positioning.

The module supports corrections input for standard Radio Technical Commission for Maritime Services (RTCM) and centimetre-level navigation by using RTCM data from third-local base stations.

FPGAs accelerate video bridging

An FPGA family for Mipi D-Phy based embedded vision systems is available from Lattice Semiconductor for automotive, industrial, computing and consumer applications.

CrossLink Plus devices have integrated flash memory, hardened Mipi D-Phy and high-speed IOs for instant-on panel display performance, and flexible on-device programming. Additionally, Lattice provides ready-to-use IPs and reference designs to accelerate sensor and display bridging, aggregation, and splitting functionality.

Developers want to enhance the user experience by adding multiple image sensors and/or displays to embedded vision systems, while also meeting system cost and power budgets. This addresses this need with 3.5 by 3.5mm, less than 300μW power devices optimised for embedded vision applications.

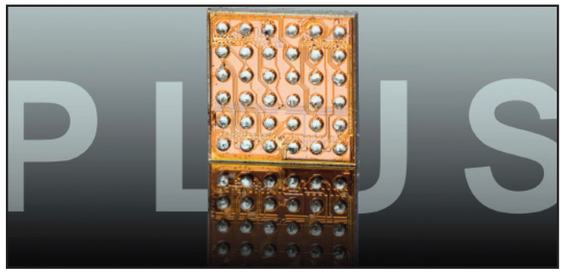
There is support for interfaces such as Open LDI and RGB, and on-chip non-volatile flash memory. The on-chip flash supports instant-on to reduce visual artefacts that detract from the user experience. They allow flexible device reprogramming in the field.

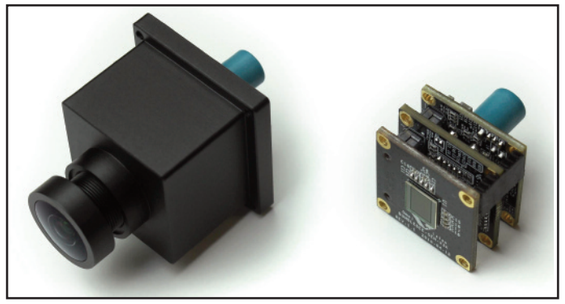
On-device reprogrammable flash memory enables instant-on is less than 10ms. The hardened, pre-verified Mipi D-Phy interface suppors speeds up to 6Gbit/s per port.

There is support for high-speed IOs such as LVDS, SLVS and sub-LVDS.

The IP library includes Mipi CSI-2, Mipi DSI, Open LDI transmitters and receivers. These IPs are compatible with other Lattice FPGAs for design portability.

There is compatibility with the Lattice Diamond design software tool flow, from synthesis and design capture through implementation, verification and programming





SoC imaging handles different conditions

A 1.3MP SoC from Omnivision Technologies provides automotive designers with imaging performance across a range of different lighting conditions.

In a single, 0.635cm optical format package, the OX01F10 integrates a 3.0μm image sensor and an image signal processor (ISP) for automotive rear view camera and surround view system applications.

The firm's dual conversion gain technology is employed in this SoC to achieve a dynamic range of 120dB with two captures, as opposed to three required by some devices, which reduces motion artefacts while lowering power consumption and boosting low-light performance.

Its integrated ISP enables image quality with features such as lens chromatic aberration correction, noise reduction and local tone mapping, and optimisations for the on-chip image sensor's PureCel Plus technology.

PureCel Plus technology has low-light sensitivity, providing an SNR1 of 0.19 lux.

This enables the ability to eliminate unnatural halos from LEDs and provide better contrast on bright days.

The device has less than 300mW typical power consumption. It does not require a metal heat sink, allowing for the use of plastic camera module bodies to reduce costs.

By integrating the image sensor and ISP into a single chip, designers can save on cost and space by eliminating the second PCB in typical two-chip implementations.

This SoC provides 1.3MP resolution and a 1340 by 1020 array size at 30fps, which offers ample resolution for calibration. It also enables output flexibility with both two-lane Mipi and 10bit DVP interfaces.

Rugged terminals receive facelift

Rugged vehicle-mounted terminals from Advantech have RF switches, 802.11ac standard wlan, LTE connectivity and smart sensors.

The DLT-V72 Facelift series has four models – V7210, V7212, V7212 P+ and V7210 K/KD.

V72 terminals launched in 2015; the Facelift terminals have adopted a more stylish and compact design and can be fitted with screen blanking to enhance driving safety.

The V7212 P+ has a 30.5cm TFT display with projected capacitive (P-cap) touch control.

TheV7210 KD also has a P-cap touchscreen but with screen defroster for operation in cold-storage environments.

All models have a red line through the front panel and are 5M3 certified for shock and vibration tolerance, IP66-rated for water and dust resistance – except the V7210 K/KD, which is IP65 rated – and built with an IK08-certified touchscreen for durability.

Powered by an Intel Atom E3845 quad-core processor, the terminals support Windows, Android and Linux. They are certified for third-party software, including Soti mobile device management and Navis N4 terminal operating system.

The terminals have been upgraded to support wlan IEEE 802.111 ac/a/b/g/n, WWAN (LTE, UMTS, HSPA+, GSM, GPRS and Edge), and Bluetooth 4.2. The wlan driver combined with a SparkLan wlan card improves roaming performance for seamless wifi roaming.

They also support LTE-based applications and outdoor operations.

The display screen has a thin bezel so the terminal does not block the drivers' view.

For applications that require keyboard input, the V7210 KD has a 25.4cm widescreen display with 55-key and number pad for data entry.

All terminals have firmware that enables the touchscreen to support nearly every type of gloved operation.

Operating temperature is -30 to +50˚C.

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