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Autonomous technology developer Embark's recently-launched prototype tractor fronts SAE Level 4 automated-driving capability and leverages "active learning" in its data-gathering to constantly improve the application of machine learning. (Embark)

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Editorial

Fool Self-Driving II

Certain to be the year's most significant development in the automated-driving milieu was the August announcement from the National Highway Traffic Safety Admin. (NHTSA) that it opened an investigation into Tesla's Autopilot driver-assistance system after a disturbing pattern of accidents over the past several years. To now, the agency's inaction on these generally widely reported incidents has mystified all manner of entities related to automated-driving development.

On the facing page, our advanced-mobility columnist Sam Abuelsamid offers a succinct technical hypothesis of a sensor-software mashup likely at the root of the Tesla accidents. The incidents under NHTSA investigation — 11 since 2018 involving stationary first-responder vehicles somehow intruding in the Teslas' intended path of travel — would seem to represent the classic software "edge case" that even laypeople can comprehend, no?

I posed that question to Michael DeKort, an outspoken critic of current industry thinking regarding development of automated-driving systems and one of the most widely educated and tuned-in people I know regarding everything automated-vehicle (AV), from sensor design to simulation best practices (a story from our September 2020 issue details DeKort's ideas about AV simulation testing). As often happens when we talk, his answer offered stunning clarity.

"I don't think it is an edge case at all. Edge cases should be statistically rare events for a given ODD (operational design domain). Stationary objects are not rare. I would argue they are basic scenarios. I think people confuse crashes or unwanted scenarios or outcomes with 'edge cases.' The outcome — or whether a scenario or result is desired — is irrelevant. It should be purely based on statistical chance of occurrence."

He added that there almost surely would be more crashes in the Tesla situation and other AV public-road trials, but an attentive human is disengaging and "saving" the system. Regarding the 11 Tesla events under NHTSA investigation, "It's actually far more," DeKort asserted. "The vast majority are hidden by [system] disengagements."

Mr. DeKort, who just joined SAE International's task force considering new revisions to the J3018 Standard (Safety-Relevant Guidance for On-Road Testing of SAE Level 3, 4, and 5 Prototype Automated Driving System (ADS)-Operated Vehicles), may not be the last word on Tesla's software, but in my experience his observations and analyses have proved accurate and prescient. If NHTSA's experts are worth their salt, it's probable the agency might reach conclusions similar to his.

The implications for AV development may be far-reaching, as nearly all developers name safety as the chief aspirational aspect of high-level vehicle automation. At the automaker level, many less "projective" than Tesla about current system capabilities nonetheless have been reticent to directly correlate driver-assistance systems with enhanced safety — largely because that aspect, for now, is nigh on impossible to prove. So, driver-assistance systems thus far are billed mostly for their potential to reduce driving "fatigue" or stress.

Whatever the result of NHTSA's investigation of Tesla, one fundamental tension between AV development and AV marketing is likely to remain: Has the customer been caused to expect too much – or do current-technology driver-assistance systems deliver too little?

Bill Visnic, Editorial Director

EDITORIAL

Bill Visnic
Editorial Director
Bill.Visnic@sae.org

Lindsay Brooke
Editor-in-Chief
Lindsay.Brooke@sae.org

Paul Seredynski
Senior Editor
Paul.Seredynski@sae.org

Ryan Gehm
Associate Editor
Ryan.Gehm@sae.org

Jennifer Shuttleworth
Associate Editor
Jennifer.Shuttleworth@sae.org

Lisa Arrigo
Custom Electronic Products Editor
Lisa.Arrigo@sae.org

Contributors

Kami Buchholz
Detroit Editor

John Kendall
Europe Editor

Terry Costlow
Electronic Technologies Editor

Bradley Berman
U.S. West Coast Editor

Sebastian Blanco, Don Sherman, Paul Weissler

DESIGN

Lois Erlacher
Creative Director

Ray Carlson
Associate Art Director

SALES & MARKETING

Joe Pramberger
Publisher
joe@techbriefs.com

Kaitlyn Sommer
Marketing Director
ksommer@techbriefs.com

Martha Tress
Recruitment Sales Manager
+1.724.772.7155
Martha.Tress@sae.org

REGIONAL SALES

North America

New England/Eastern Canada:
ME, VT, NH, MA, RI, QC
Ed Marecki
+1.401.351.0274
emarecki@techbriefs.com

CT:
Stan Greenfield
+1.203.938.2418
greenco@optonline.net

Mid-Atlantic/Southeast/TX:
DC, VA, WV, TN, NC, SC, GA, FL, AL, MS, LA, AR, OK, TX
Ray Tompkins
+1.281.313.1004
rtompkins@techbriefs.com

NY, NJ, OH:
Ryan Beckman
+1.973.409.4687
rbeckman@techbriefs.com

PA/DE:
Desiree Stygar
+1.908.300.2539
dstygar@techbriefs.com

Midwest/Great Lakes:
IN, MI, WI, IA, IL, MN
Chris Kennedy
+1.847.498.4520, x3008
ckennedy@techbriefs.com

Midwest/Central Canada:
KS, KY, MO, NE, ND, SD, ON, MB
Bob Casey
+1.847.223.5225
bobc@techbriefs.com

Southern CA, AZ, NM, Rocky Mountain States:
Tim Powers
+1.424.247.9207
tpowers@techbriefs.com

Northern CA, WA, OR, Western Canada:
Twyla Sulesky
+1.408.779.0005
tsulesky@techbriefs.com

International

Europe:
Sven Anacker
Britta Steinberg
+49.202.27169.11
sa@intermediapartners.de
steinberg@intermediapartners.de

China:
Alan Ao
+86.21.6140.8920
alan.ao@sae.org

Japan:
Shigenori Nagatomo
+81.3.3661.6138
Nagatomo-pbi@gol.com

South Korea:
Eun-Tae Kim
+82-2-564-3971/2
ksae1@ksae.org

Integrated Media Consultants

Christian DeLalla
+1.973.841.6035
christiand@techbriefs.com

Patrick Harvey
+1.973.409.4686
pharvey@techbriefs.com

Todd Holtz
+1.973.545.2566
tholtz@techbriefs.com

Rick Rosenberg
+1.973.545.2565
rrosenberg@techbriefs.com

Scott Williams
+1.973.545.2464
swilliams@techbriefs.com

SUBSCRIPTIONS

+1.866.354.1125
AVE@OMEDA.COM

REPRINTS

Jill Kaletha
+1.574.347.4211
jkaletha@mossbergco.com

What will result from NHTSA's Tesla Autopilot investigation?

Sam Abuelsamid
Principal Analyst, eMobility
Guidehouse Insights
sam.abuelsamid@guidehouse.com

More than five years after Joshua Brown's death, life signs are emerging at the National Highway Traffic Safety Administration (NHTSA). Brown was decapitated when his Tesla Model S drove itself under a tractor-trailer while he wasn't paying attention. In the intervening years, there have been dozens of crashes where Tesla's Autopilot advanced driver-assistance system (ADAS) setup was active. Until recently, NHTSA has done nothing to reign in how Tesla and other automakers deploy such systems. Just weeks after the agency issued an order for all companies developing or deploying partially or highly automated driving systems to report all crashes, it has opened (as of this writing in mid-August) a formal investigation into Teslas slamming into parked emergency vehicles.

Sadly, the meme of Tesla's plowing into the back of fire trucks and police cars on the side of the road has become something of a running joke in the last few years. The new NHTSA investigation is specifically focused on at least 11 such incidents. Chances are similar that incidents have occurred with other OEMs' vehicles as well, but at this point we simply don't have the data to know. I recently asked General Motors' Duncan Aldred, the global VP of GMC and Buick, if there have been any crashes with vehicles where the automaker's hands-free Super Cruise system was active. He sidestepped the question, providing no response.

> **Ideally, NHTSA will bar automakers from publicly beta testing their safety-critical software in the hands of consumers.**

While the new inquiry by NHTSA's Office of Defect Investigations is specifically targeting Tesla, most automakers now are offering ADAS with similar functionality to Autopilot. It's possible that whatever result comes from this investigation may impact the entire industry and how it deploys ADAS. It may even result in new rulemaking by the agency.

Like most such systems, Autopilot has used a combination of long-range/low-resolution forward radar and one or more cameras (although Tesla recently stopped using radar in North America). The radar tracks the distance and closing speed to the car ahead to maintain a safe gap for adaptive cruise control (ACC). However, the narrow beam and limited resolution make it difficult to distinguish between objects.

As a result, at speeds above about 40 mph (64 km/h), any signal returns from objects that appear to be stationary are typically ignored. In most cases, when using ACC for its intended use on highways, stationary objects usually are road signs and overpasses. Responding to all of these returns would yield repeated phantom braking, another common complaint from Tesla drivers.

The inconsistent performance of Tesla's camera-based machine vision, combined with its limited ability to gauge distance and position of objects, has led to numerous crashes when emergency vehicles are stopped but partially intruding into the roadway. It's likely that systems deployed by other automakers are also susceptible — but there is a key difference.

Tesla drivers seem instilled with a much higher and unwarranted degree of confidence in the performance of Autopilot. They seem more inclined to use it hands-free and eyes-off. Without an IR-camera-based driver monitor and capacitive sensors in the steering wheel to minimize abuse, it's difficult to curtail inattentive driving.

Perhaps the NHTSA investigation will lead to rulemaking that mandates robust driver monitoring for all automakers. That also would have more impact on reducing distracted or drowsy driving than any laws banning use of handheld devices. Ideally, NHTSA will also bar Tesla and other automakers from publicly beta testing their safety-critical software in the hands of consumers. It's a longshot, but at least NHTSA now is doing something. ■

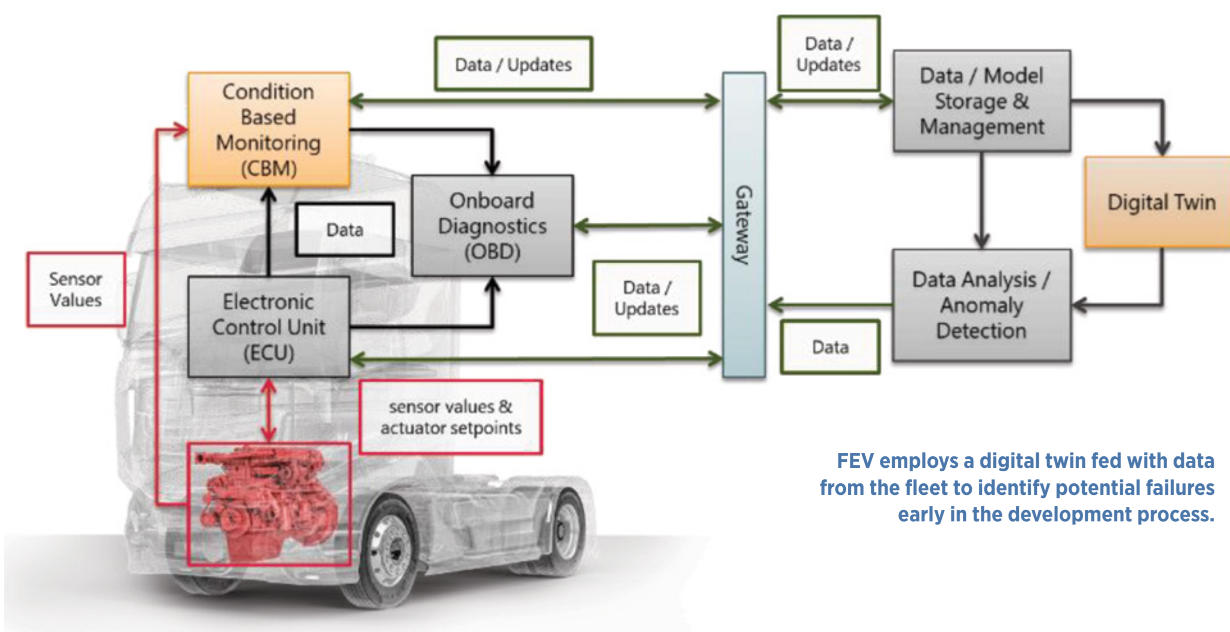
Data Drives Driverless Truck Launch

by Ryan Gehm

Smart diagnostics and advanced validation help support the reliability metrics required to gain confidence that autonomous trucks are ready for the road.

Transforming raw data into high-quality structured data is a critical path to properly fueling machine-learning (ML) models and deploying artificial-intelligence (AI) applications across autonomous fleets. Companies are working to overcome data challenges to ensure their ML algorithms can produce the AI required to achieve widespread SAE Level 4 and 5 automated-driving operations.

"When our trucks drive on the road, they're collecting terabytes upon terabytes of data, and we need to get that up into the cloud and into the hands of our engineers, ultimately," said Brandon Moak, co-founder and CTO of autonomous technology developer Embark, whose recently-launched prototype SAE Level 4 tractor is shown on this issue's cover. The startup uses "active learning" techniques



FEV employs a digital twin fed with data from the fleet to identify potential failures early in the development process.

FEV

Embark uses "active learning" techniques to identify the most relevant detections and provide the most useful insights into critical edge cases.

Embark

to identify the most relevant detections and provide the most useful insights into critical edge cases.

"You can think of active learning as a way for us to understand the ways in which our machine-learning models are failing," Moak explained. "We can actually sample our data using this technology to build high-quality datasets that are lower in volume but higher in quality to get more performance out of our systems."

The level of preprocessing required to make sure the raw data is useful for machine learning is a key challenge, said Tom Tasky, director of Intelligent Mobility at FEV North America. The supplier has a patented preprocessing and analytics solution that handles up to 40 TB of data per vehicle per day in an L3 Pilot project taking place in Europe. The amount of time and effort involved in this part of the process can be underestimated, he said.

"Once you start developing and looking at the data, you see it might be poor quality and how much additional software effort is required," Tasky said. "To really understand the sensors, the quality output, any limitations in certain environmental conditions, things like that really need to be factored in to make sure you have time to account for it, prior to running some expensive tests."

Field data analytics are extremely valuable for the development and production of optimized components, as well as to identify design weaknesses, status analysis and predictive maintenance. "Especially if you look at ADAS features, these are new components being developed and you don't necessarily have the same reliability data in different applications being introduced," Tasky explained. "Discovering that information is extremely valuable to [determine] trends and the life cycle of these new components."

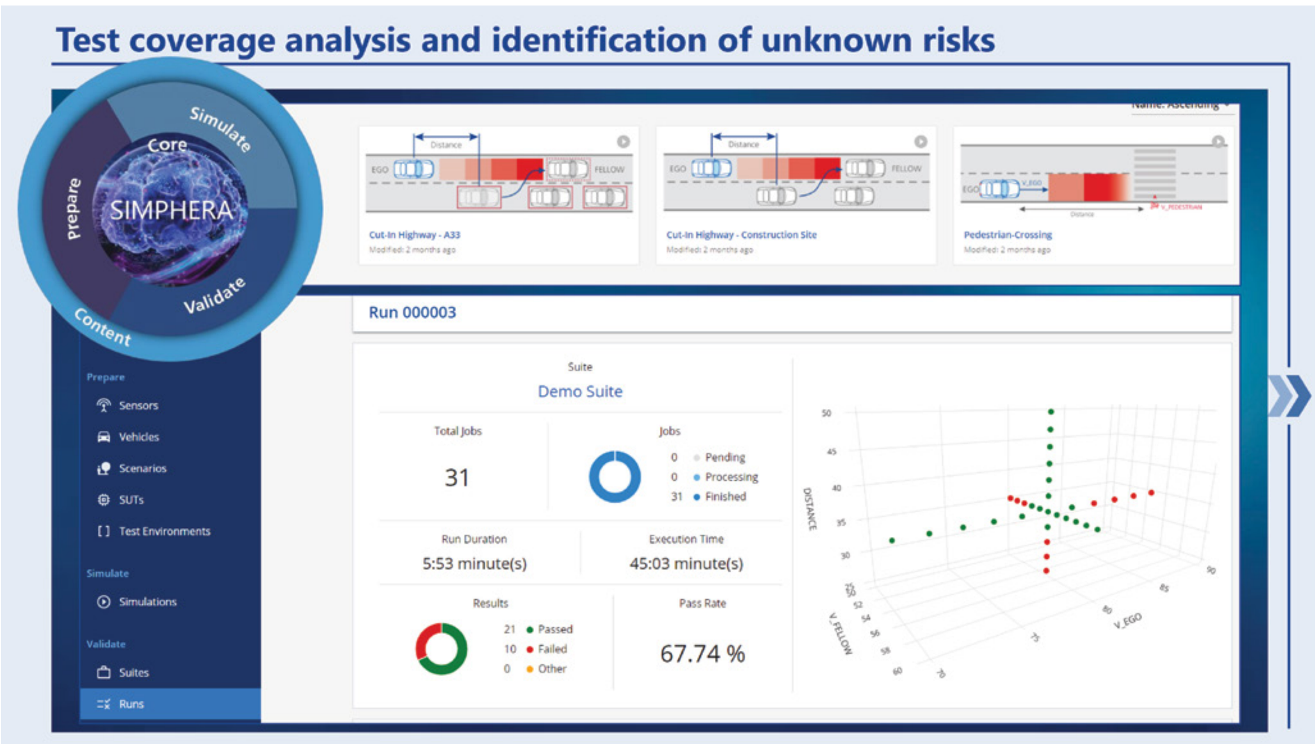
The digital twin also is a useful tool in identifying potential failures and determining root causing issues. A complicated example, according to Tasky, is when there is onboard monitoring with offboard failure analysis and a digital twin.

"You enable this through the use of a gateway that has the connectivity aspects to communicate to the digital twin in the cloud," he said. "There's a lot involved with setting up this infrastructure, which we help our customers with today. But the value of this is identifying failures well in advance during development or even field data in fleets."

Smart diagnostics

As automated-vehicle (AV) developers began combining more advanced sensors such as lidars, infrared cameras and L4-specific sensors for redundancy and higher integrity, diagnostic capabilities lagged initially, according to Ananda Pandy, technical specialist for ADAS and autonomy at ZF.

"Once you start developing and looking at the data, you see it might be poor quality and how much additional software effort is required."



dSPACE

SIMPHERA can simulate and validate millions of test cases in the cloud, offering scenario-based evaluation of AV-system safety according to SOTIF.

"The focus was on improving the computing ability and hardware development for the 'virtual driver' and how to scale that development," Pandy explained. "The diagnostic capabilities of the vehicle actuation systems were still at the same level as how it was developed for the core ADAS functions and were dependent on the safety driver in the vehicle during these development phases."

As AV development enters the "shakeout" phase, where the integrated vehicle platform accumulates significantly more mileage and infrastructure setup begins, the focus shifts more to creating the reliability metrics necessary to build confidence prior to rollout.

"Diagnostics play a major role in supporting these reliabilities, and it's not just the number of miles driven without interventions or the number of trips being completed," Pandy said. "It's imperative to have the predictive diagnostics and not have any latent failures in the system in order to make the call for the driverless launch."

Smart diagnostic features should include a "self test" at the beginning of the journey to check for any pre-existing faults, Pandy said. A passing test can be a condition required to enter autonomous configuration. Self-test can be done either by simulating inputs internally within the fail-operational steering system, for example, or can be executed by the virtual driver before requesting autonomous configuration.

After a successful self-test, "dynamic diagnostics" can help continuously check for validity of the inputs required to detect for normal steering effort. Feedback can be provided to the virtual driver and vehicle trajectory planning can be enabled to handle any latent faults. "For example, by going to a safer speed before entering a tighter curve or ramp. This can help ensure safe maneuvering of the vehicle," he said.

Another important feature is a "fail operational window" that can be different for different actuation systems. "A general best practice could be to report the validated time that is available for the virtual driver to bring the vehicle to a safe stop when fail operation is initiated by a particular actuation system," Pandy noted. "This information can be used by other actuation systems, or it could be used for compliance purposes to ensure that the vehicle was indeed brought to a safe state within the fail-operational window that was provided."

Over-the-air troubleshooting during the early stages of development and integration work also is key. "A master diagnostic message that consolidates the status of a fail-operational system, including the fault codes, fail-operational time window, and performance measures, can help other subsystems to plan for safe actions as well as roadside inspections," Pandy said. "This can be similar to the existing diagnostic message, but it is tailored for AVs such that it can be easily integrated with the V2V or V2I [vehicle-to-vehicle or vehicle-to-infrastructure] communications."

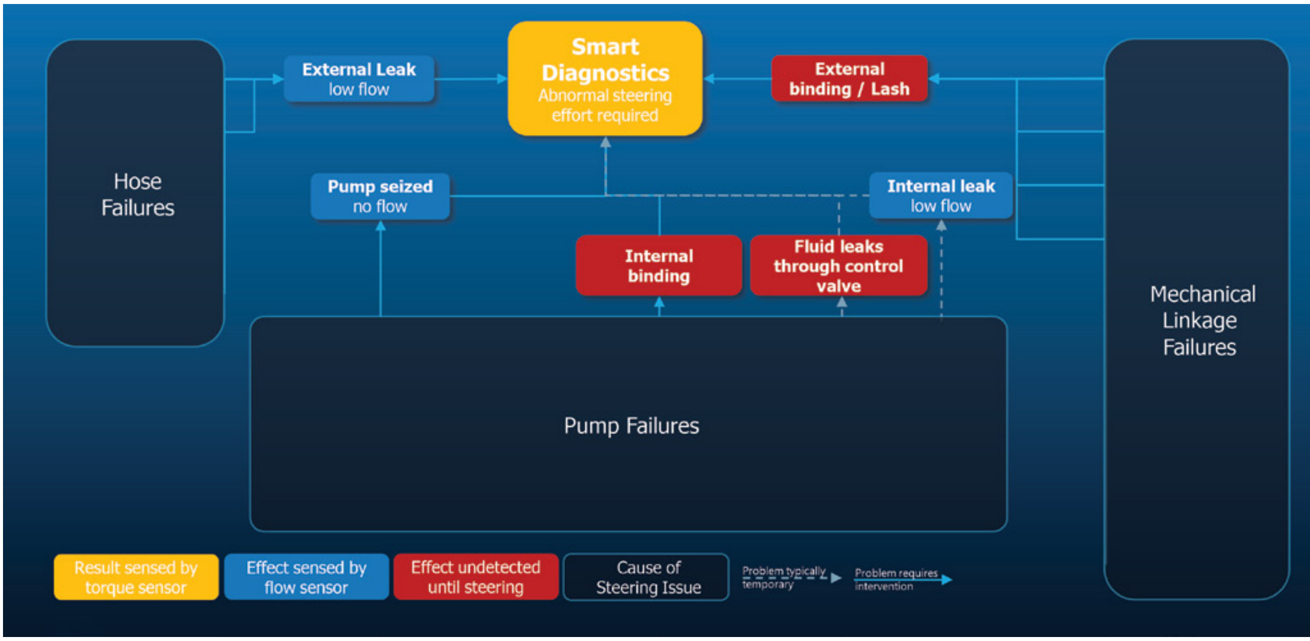
Release testing and homologation

A sequence of testing – from model-in-the-loop (MIL), software-in-the-loop (SIL), component, domain and vehicle hardware-in-the-loop (HIL) and finally real-vehicle testing – is necessary to achieve the software quality and robustness required for ADAS and AV systems.

"It's about running a lot of tests and finding the critical edge cases that you need to validate the software that needs to be deployed," said Jace Allen, director of ADAS/AD Engineering and Business Development for dSPACE, Inc. "Integral to all of this is really trying to get a truck to certification or homologation."

dSPACE participates with different organizations including ISO and collaborates with companies such as TÜV to offer broad expertise from system requirements to release testing and homologation. The company also expanded its partnership with BTC Embedded Systems to offer a new web-based solution, SIMPHERA, that uses simulation to validate and homologate autonomous-driving systems.

Available for use in general customer projects starting second half of 2021, the SIMPHERA simulation and validation environment integrates the BTC ScenarioPlatform that creates scenarios and generates and evaluates



ZF

A conventional steering system is transformed for higher levels of autonomy. It's critical to understand how much of the existing diagnostics from ADAS can be reused, said ZF's Ananda Pandy.

tests based on coverage. The high level of abstraction makes it possible to express thousands of test cases with just one abstract scenario, the companies claim.

BTC's automated test generation functionality uses advanced technology such as model checking, AI and intelligent weakness detection, which allows test cases to be generated based on statistical methods and meaningful coverage metrics. Compared to random or "brute force" test-generation approaches, this strategy "considerably" reduces the amount of test data and delivers clear metrics, says BTC, even with regard to future homologation criteria.

"It's the same methodology we've talked about for SIL and HIL — test asset reuse," Allen explained. "I can define my sensors, my vehicles, my scenario, the interface to my SUTs [systems under test] and then run whatever simulations I want so that I can find those edge cases, so that I can evaluate my AV-system safety according to SOTIF [Safety of the Intended Functionality] and so forth." ■

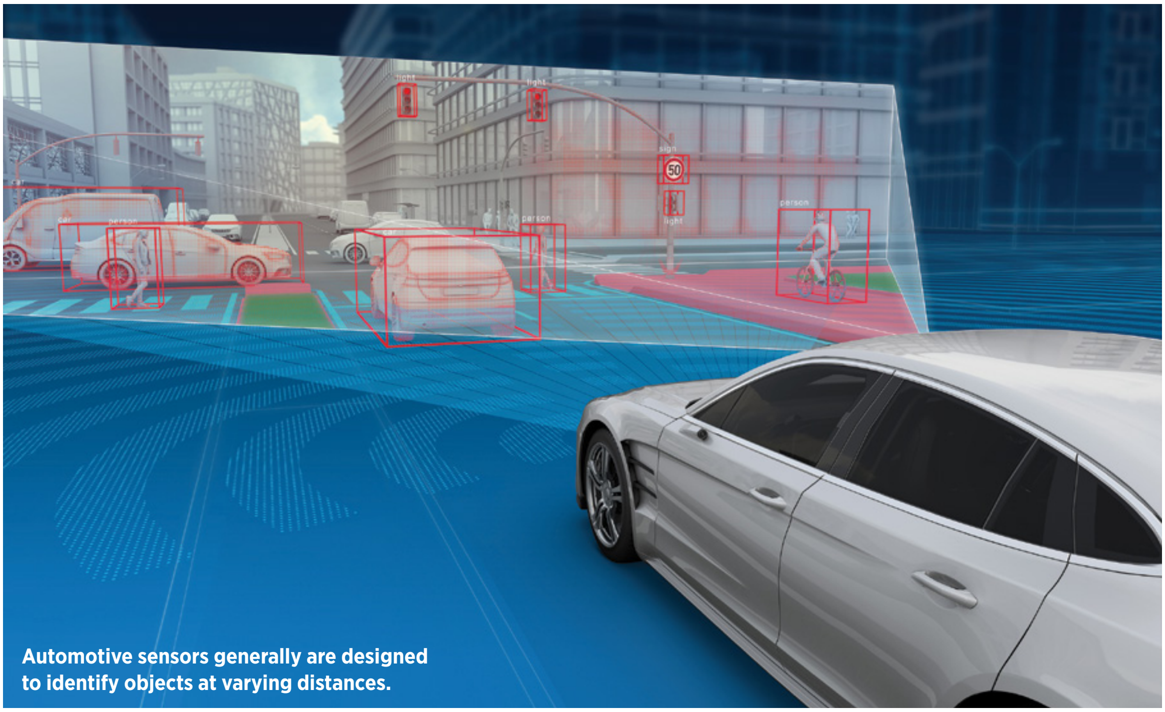
Peering into the **Distance**

by Terry Costlow

New sensors of all types look out longer distances – and provide higher resolutions – for engineers pushing ADAS capabilities and higher-level vehicle automation.

Sensors are the frontline technology for advanced driver-assistance systems (ADAS) and future vehicles with high-level (SAE Levels 4-5) automation. Designers at all levels are working to find the optimal and number of sensors and their ideal performance levels, capturing data that's farther away while increasing field of view and resolution.

Tier 1s and OEMs have long leveraged different sensors – radar, cameras and lidar – to provide redundancy and gain insight into what's around the vehicle.

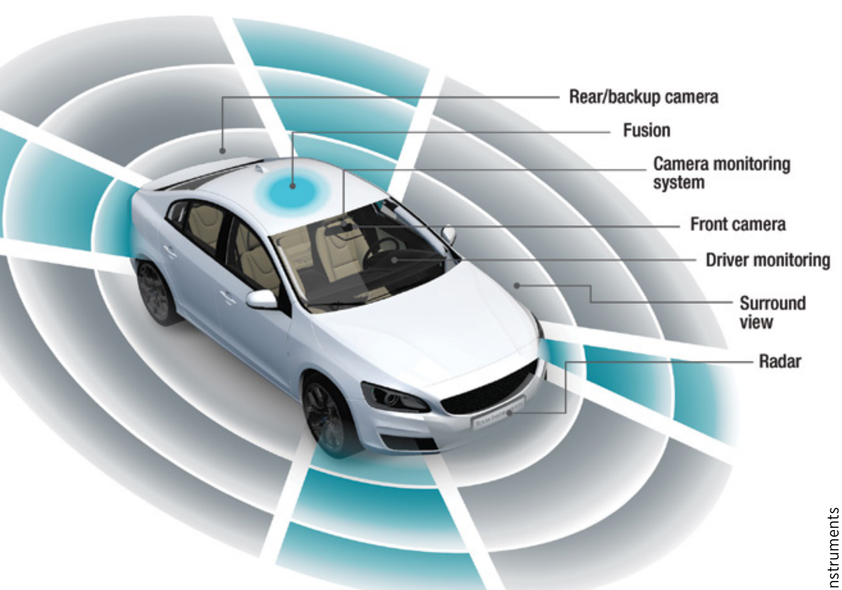


Automotive sensors generally are designed to identify objects at varying distances.

ZF


Sensor developers are working to stretch sensing systems' distance capabilities.

Continental



Radar can help cameras monitor front, sides and rear.

Texas Instruments

The first high-level automated vehicles for public use will be heavily laden with sensors as engineers and developers strive to prove that driverless vehicles can navigate safely. Automated taxis and shuttles are being loaded with input devices.

"When we look at Level 4-5 robotaxis, ultimately they'll be at 30 or more," said Andy Whydell, VP of systems product planning for ZF. "Some of the challenging situations are slow movement when you're maneuvering the vehicle."

The latest generation of ADAS, mostly considered to be at the high end of the SAE's Level 2 classification, generally use several radars and cameras. Both the number of sensors and the technologies being leveraged will grow as automakers move to higher automation. Even suppliers of cameras and radar generally agree that most vehicles will move from one sensor modality to multiple versions of varied sensor types.

"For [the so-called] Level 2-plus ADAS, we are

Processing capability TOPs-out

Sensors are the vehicle's eyes and ears, but their inputs must be analyzed, processed and acted upon. A hefty amount of computing power is needed to fuse complex data from several sensors and determine how those inputs should be used.

Many, but not all, sensor modules possess little intelligence, feeding information to zonal processing modules that do a bit of processing before the data goes to a centralized controller. These powerful central controllers fuse data from cameras, radar and lidar, then decide how to assist the driver – or automatically brake, steer or accelerate. Meanwhile, Tier 1 suppliers are taking advantage of rapid increases in processing power.

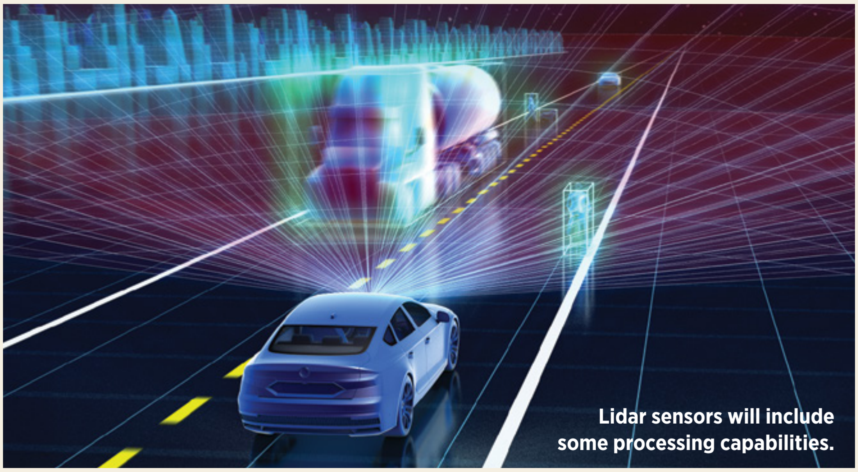
"We've gone from 30 TOPS (trillion operations per second) to 1,000 TOPS in four to five years," said Andy Whydell, VP of systems product planning for ZF. "The industry is ramping up processing to handle all the inputs, but that needs to be balanced with power consumption."

The performance gains in processors can be combined with sensors that also are leveraging semiconductor production advances. Design teams are using multiple sensor types to blend the strengths of different technologies, then they're exploiting powerful controllers to run multiple analysis tools. It's a potent combination.

"By putting cameras and radar together to check each other, it's amazing what the processors can do with the extra information, especially if you have enough processing power to run different algorithms in parallel," said Martin Duncan, ADAS division general manager at STMicroelectronics.

Stripping intelligence from sensors generates significant benefits. Sensor counts are rising, with plans for 30 or so on a highly automated vehicle. Eliminating power demand and shrinking size are important factors for hiding sensors.

"Removing some processing power means sensors are smaller and power consumption is less," Whydell said. "Smaller packages make it easier to integrate sensors into lighting structures or the A- and B-pillars."



Velodyne

Lidar sensors will include some processing capabilities.

However, some sensor modules will include an integrated microprocessor. This "distributed processing" model reduces bandwidth requirements while also reducing the workload of the vehicle's central controller. Some lidar packages include processors to analyze light that bounces back to the sensor, sending the main controller more pertinent data.

ZF

Processing power has leapt 30 fold in the past five years.

"We look to subsume more functions, doing some first-level computing," said Anand Gopalan, Velodyne's CEO. "The camera guys talk about using GPUs (graphics processing units), lidar does more at the 'edge,' so systems can get away with using low-cost FPGAs (field programmable gate arrays) or low-cost CPUs."

Artificial intelligence will play a role when processors analyze sensor inputs; AI takes a fair amount of computing power, but its benefits far outweigh the processing demand. Determining what's being seen by an array of sensors can be a confusing task for machines that only know what's been written into software.

"AI can help cameras deal with something they're not trained to recognize," Whydell said. "A European OEM [during on-road testing] came across a kangaroo that was sometimes on the ground, sometimes in the air, so the system couldn't tell whether it was a bird or not."

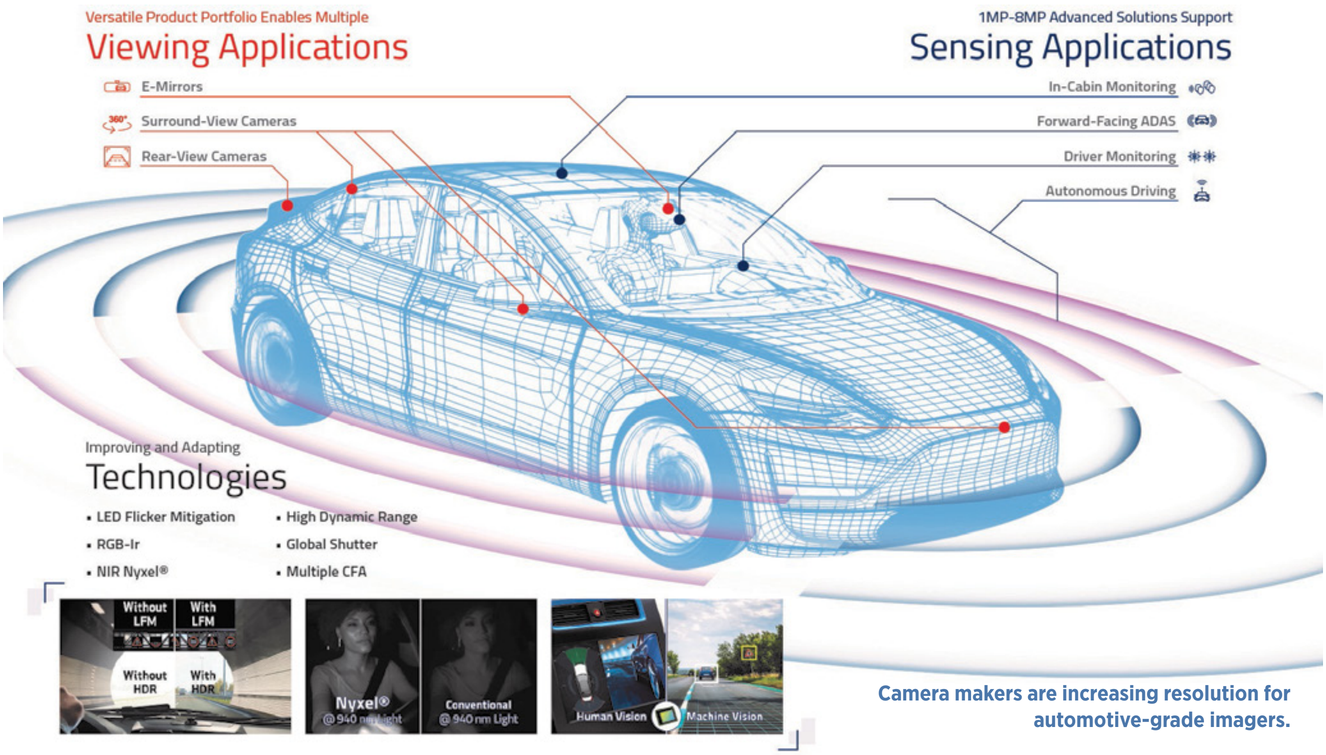
Ryan Gehm

seeing five radar sensors being required to achieve the ADAS functions – two in the rear corner, two in the front corner and one in the front," said Prajakta Desai, marketing manager for Texas Instruments mmWave automotive radar. "For Level 3, additional sensors on the side would be needed for 360-degree coverage. For Level 4 and beyond, we believe that all the sensing modalities (vision, radar and lidar) might be required to achieve fully autonomous driving."

Sensors galore

Most front-facing sensing systems rely on a combination of sensor types. Though it's possible to provide full autonomy with a single technology, combining cameras, radar and lidar provides some redundancy while also adding complimentary sensing capabilities.

"None of the available sensor technologies – be it camera, lidar, radar or ultrasonic – will be able to realize automated driving functionalities on their own," *There's a lot of growth for long-range, 4D high-resolution imaging radar, high performance radars with more signal channels than you find in most mass-market passenger cars today.*



Camera makers are increasing resolution for automotive-grade imagers.

Omnivision

asserted Arnaud Lagandré, VP of the ADAS Business Unit, Continental North America. "Furthermore, we need to understand redundancy as sensors use different physical principles. Adding more forward-looking cameras will not help when you are driving directly towards the sunset, they will all be equally blinded. Considering the top three sensor technologies currently in use (camera, radar, and lidar), you would always need to have at least two different physical principles operational to ensure safe sensing of the environment in any complex driving scenarios."

Sensor suppliers are continuing to expand their capabilities, extending distances and improving resolution. Automakers utilize CMOS imagers like those in phones, but most automotive-grade cameras remain in the 1-2 megapixel range. However, higher-resolution automotive cameras are beginning to ship.

"The most widely discussed challenge within CMOS imaging sensors is to make the sensor with smaller pixel and higher performance targets, such as higher resolution, and to make sure they operate smoothly in extreme temperatures," said Andy Hanvey, director of automotive marketing, OmniVision Technologies Inc. "As the level increases, the resolution increases to 8 megapixels in order to see farther distances."

Changing channels

Radar developers are adding more channels to boost resolution and increase sensing distance. When channel counts double, the number of virtual channels soars significantly, giving systems greater ability to determine distance and identify objects.

"Radars have gone from a 2x2 channel format to 4x4, so there's four times higher resolution," said Martin Duncan, ADAS division general manager at STMicroelectronics. "The four transmitter and four receivers communicate independently and can communicate at different times, creating massive numbers of virtual channels."

These higher-resolution sensors are critical for advanced ADAS and high-level automated vehicles, experts note. At highway speeds, they offer more time to determine what's ahead, while at city speeds, the same radar devices can provide wider fields of view.

"There's a lot of growth for long-range, 4D high-resolution imaging radar, high-performance radars with more signal channels than you find in most mass-market passenger cars today," Whydell said. "Our long-range radars have a distance of up to 350 meters. At high speeds, the beam is narrow; at slower speeds, energy shifts to a "flood," more with a wider field of view."

Tiny is terrific

Engineers want the benefits that come from using multiple sensors, but design stylists don't want sensors to mar their sleek exterior lines. Those competing concerns put pressure on sensor designers, making package size even more critical than it's been in the past. That concern ripples out to wiring harnesses that connect sensors to controllers.

Radar size has reduced dramatically over the past several years, driven in part by declining prices and a shift to higher frequencies. A few years ago, 24-GHz modules that cost well over $100 were fairly common. But 77-GHz devices that cost in the realm of $50 now are mainstream. That helps increase distance performance while trimming both size and cost.

"Moving to 77 GHz gives you smaller packages so more can be squeezed in – people are also adding the antenna in the basic package," Duncan said. "The circuit boards used for radar are expensive, so making them small reduces the price significantly."

When packaging engineers devise ways to trim size and lower cost, engineers often clamor for more components. Small packages are easier for stylists to hide. Tiny packages also can be housed in areas like headlights and by rearview mirrors, where they're less likely to get dirty or be covered by snow.

"We see a trend to integrate sensors in small spaces on vehicles, such as door handles or headlights, for better coverage," Desai said. "Antenna-on-package technology enables extremely small form factor that removes small space constraints and enables sensor integration into new places enabling newer applications and functions inside and outside the vehicles."

Commercial vehicle sensor challenges

Commercial vehicles share many of the same challenges as passenger vehicles, but they also have additional requirements. Reliability and longevity demands increase and operating conditions in agriculture and construction are vastly different.

Autonomous vehicles have operated in mining and some other closed environments for some time. In other off-highway fields, automated systems aid operators – but don't replace them. In agriculture and construction, sensing ranges often are relatively short.

"We expect most of our challenges to come in close range and involve signal-blocking structures like trees, silos and storage sheds," said Nancy Post, director, Intelligent Solutions Group at John Deere.

Volvo

Certified sensors with longer sensing distances will hasten AV development for on- and off-road environments.

Deere

Sensors combine with satellite positioning inputs for the specific guidance requirements of most agricultural vehicles.

"As a result, our next-generation receivers will have technology that mitigates most, if not all, of the scintillation and interference issues that are common today."

Driving-related sensors on these vehicles often will be relegated to secondary status, because companies like Caterpillar and Deere have their own satellite-positioning technologies. "Our primary sensor is the satellite navigation system, which typically doesn't have the same issues with inclement weather," Post said. "During short periods where it may be affected, we can fuse the positioning information for the additional sensors like inertial navigation systems, camera and imaging radar to bridge these gaps."

On highways, reliability over the long haul is an essential factor. Commercial vehicles have demanding environmental prerequisites that are challenging suppliers' capabilities. Getting sensors that can "see" far enough away to safeguard vehicles that haul heavy cargo payloads is not easy.

"Sensors' range is quite important for some applications, and we are always looking for sensors that are certified for safety purposes," said Luca Delgrossi, head of technology, Volvo Autonomous Solutions. "Today, there are a few certified sensors and the distance they can cover is still relatively short. Lidar's reliability is one of the factors that determines how fast we can drive under safe conditions. Different sensors can handle adverse weather conditions in different ways. It is important to understand specific sensors limitations and avoid running operations when the system cannot operate safely."

Ryan Gehm

Wiring is another critical issue that arises in the proliferation of sensors that generate large data streams. CAN doesn't have the necessary bandwidth, while Ethernet requires bulkier and more costly cables. That's prompted many engineering teams to deploy a standard used in many phone cameras: the MIPI-A-PHY standard, developed by the MIPI Alliance, is gaining acceptance as a sensor link.

"Most sensor transmissions are largely mono-directional, so you don't need to go to Ethernet," Duncan said. "A new protocol, MIPI-A-PHY, can be quite efficient. It uses cheap cables, they're about a third the cost of Ethernet cables." ■

Ford Drives into **SAE Level 2**

by Lindsay Brooke

Driver monitoring was an essential component to engineering the new "hands-free" BlueCruise/Active Glide enhanced ADAS system.

U.S. Patent #10752253, granted to four Ford Motor Co. engineers in August 2020, covers the "driver awareness detection system" that is a key safety component in the company's first "hands-free" driver-assistance system. Branded both as 'BlueCruise' in Ford vehicles and 'Active Glide' in Lincolns, the SAE Level 2 ADAS is the next step in Ford's Co-Pilot360 technology suite that debuted in 2020 on Mustang Mach-E and the 2021 F-150. It was recently announced for the 2022 Lincoln Navigator

Ford's aim with BlueCruise is to reduce driver stress and fatigue without compromising safety.

Ford

Ford has always known that driver-in-the-loop – driver engagement – is a critical component of these features being successful.

BlueCruise: Driver engagement is critical

Ford engineer Dianne Liyana is a technical specialist on the BlueCruise development team. She spoke with SAE Media during a BlueCruise demo drive about what she calls the "key component" of ADAS features.

What is Ford doing to clear up some of the ambiguities related to driver-assistance technology that's causing confusion for the end customer? This started when a certain automaker made misleading statements about the capabilities of their driver-assistance system. That, unfortunately set the tone for this space. Going forward, Ford has always known that driver-in-the-loop — driver engagement — is a critical component of these features being successful. In addition to our committing to driver monitoring, we have user-interface studies regarding the customer's ability to understand what we're communicating to the driver. That's a key component for us for these systems, regardless of the SAE level.

A growing number of engineers and planners see SAE Level 3 as a non-starter. That's because of the inability to properly control that handoff [from ADAS system to driver], or how quickly that handoff might need to happen. Outward facing, I don't refer to the [SAE] levels because I don't expect the average consumer to know what the level means. I refer to the feature and the expectation it has with the consumer. Our job is to communicate our expectation for that feature. The expectation for BlueCruise, our Level 2, is that you will be able to experience hands-free driving and reduced stress — but we require your 100% attentiveness with it. BlueCruise has some error-proofing engineered into it to prevent flat-out abuse: You cannot move to the back seat when this system is engaged!

To effectively communicate what Level 2 technologies provide, the industry could put it very simply: We *expect* you to *always* watch the road.

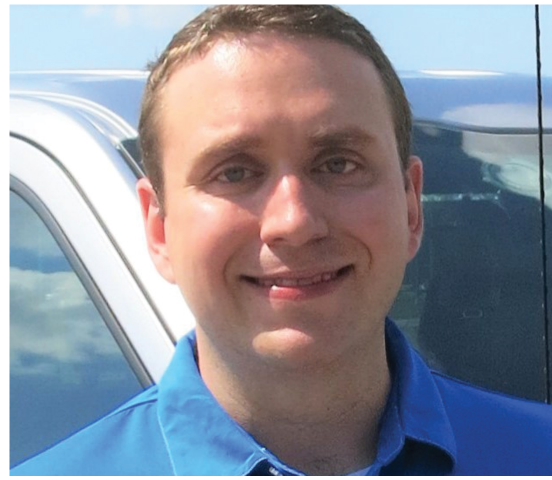
Lindsay Brooke

Lindsay Brooke

Dianne Liyana.

and is expected to eventually be a cross-portfolio offering. (See https://www.sae.org/news/2021/04/ford-bluecruise-hands-free-driver-assistance.)

"Ford is taking a 'building blocks' approach to driver assistance technology," explained Justin Teems, one of the patent holders and manager of the company's Active Driver Assist Features team. At a BlueCruise demonstration drive for media in early August attended by SAE Media, Teems and other experts stressed that the driver-monitoring "block" is essential — and non-debatable among engineers and planners — for hands-free driving features.



Lindsay Brooke

"Part of our testing is making sure that if anything happens within a hands-free zone, the driver has time to put their hands back on the wheel," said Ford engineer Shane Larkin.

"Certainly, the technology is developing rapidly; it's leaps-and-bounds beyond where it was two years ago," added Shane Larkin, an engineering supervisor in Teems' group. "But Ford is proceeding conservatively to ensure that the driver is always paying attention to the road ahead. Our aim with BlueCruise is to reduce driver stress and fatigue without compromising safety."

Larkin rode 'shotgun' during our demo drive in a hybrid-propulsion F-150 on busy metro Detroit freeways, guiding the author through BlueCruise's simple functions. As we accelerated down the freeway onramp into 80-mph (129-km/h), truck-intense traffic, I moved the pickup into the center lane. Following Larkin's prompt, I tried to engage the hands-free function. This requires actuating the adaptive cruise control (ACC) then pressing an icon on the steering wheel. Also required: driving in a "Hands-Free Blue Zone," part of some 130,000 miles (209,000 km) of U.S. (37 states to date) and Canadian (five provinces) divided highways that Ford has GPS-mapped and digitized for BlueCruise driving.

In my first attempted deployment, however, the driver-recognition system (with driver-facing infrared camera mounted on the steering column) would not cooperate. I was wearing a COVID mask and removed it. Still no reaction. I then removed my sunglasses (which have caused driver-recognition hiccups for me in GM vehicles equipped with its hands-free Super Cruise system) — bingo! The F-150's instrument-cluster screen turned blue and showed the "hands-free" icon. We were BlueCruisin' in the middle lane of M39. And I was very conscious of keeping my eyes on the road ahead. Larkin noted that the development team chose audible warnings, rather than physical alerts (no seat buzzers) to correct driver inattention.

"The system 'finds' your eyes by surveying all of your facial features," Larkin explained. "With the mask and glasses on, it only has the top of your head, your chin and ears to go by. That makes it challenging to find where your eyes are. It's not just what it sees, but the analysis of it." The facial-recognition software is a joint development with the system supplier, which is responsible for the low-level image processing. "What to do with that information is all on the Ford side," he said.

To ensure that the BlueCruise-equipped vehicle obeys posted speed limits, the system can automatically adjust the road-speed setting. Or, to keep pace with traffic, it enables the driver to select a velocity range of up to 20-mph above or below the posted speed. Another handy feature: If BlueCruise was engaged the last time the ACC was active, BlueCruise automatically engages with the next ACC activation.

The level of stress reduction afforded by BlueCruise depends on the driver's own acclimation to hands-free driving. According to Larkin, new ADAS features typically require about 45 minutes for drivers to 'trust' the vehicle in most highway scenarios. Even as I came to trust the F-150's L2 operation during our demo drive, my heart rate still raced while running a gauntlet of 45-foot-long semitrucks doing their usual 75-mph snake-weave.

I cautiously kept my hands in close proximity to the steering wheel. "We let the driver decide where to place their hands," Larkin said. "Part of our testing is making sure that if anything happens within a hands-free zone, the driver has time to put their hands back on the wheel if they need to react, if we're prompting them that they need to resume control." When it was time to move into the right lane to exit to another highway, I had to resume manual "hands-on" control of the vehicle. Lane-change assist still is in development; "it'll be just a tap-the-turn-indicator" function," Larkin promised. ■

A Chore **No More**?

The Detroit Smart Parking Lab opens to develop and test emerging parking technology in real-world settings.

by Bill Visnic

The state of Michigan, Ford, Bosch and real-estate company Bedrock announced last week their collaboration for the Detroit Smart Parking Lab (DSPL), claimed to be the first real-world test site for advanced parking technology. The DSPL will open in September 2021 in a Bedrock-owned parking garage in Detroit that also hosted a valet-parking demonstration project (https://www.sae.org/news/2020/08/ford-bosch-automated-parking-in-detroit) initiated by Ford and Bosch in August, 2020.

The DSPL project, announced by Michigan Governor Gretchen Whitmer, is intended to facilitate smart-infrastructure and mobility companies and startups in development of "parking-related mobility, logistics and electric vehicle charging technologies," according to the DSPL. Michigan will encourage work with the DSPL, said Whitmer, through Michigan Mobility Funding Program grants administered by its Michigan Economic Development Corp. and Office of Future Mobility and Electrification. One of the early awardees of a grant is vehicle-rental agency Enterprise, which intends to use the DSPL to test automated valet parking and electric vehicle (EV) charging to improve vehicle quick-turnaround strategies.

Operated by proving-grounds expert

Day-to-day operations of the DSPL will be handled by the American Center for Mobility (ACM) in Ypsilanti, Michigan. "ACM has broad experience operating a 500-acre smart mobility test center where we've seen the power of testing emerging mobility technologies in intentionally challenging environments," said Reuben Sarkar, president and CEO of ACM. "The Detroit Smart Parking Lab provides a new platform for ACM to introduce our operational excellence and client-base to, enabling further development of new mobility innovations."

The Detroit Smart Parking Lab will facilitate testing and development of advanced parking technologies.

DSPL

Bosch and Ford already have automated-parking experience at the site with their prior demonstration project. Paul Thomas, executive VP of Mobility Solutions, Americas for Bosch, stressed the efficiency and advantages of teamwork for developing automated-vehicle technology. "Collaboration is essential for the future of mobility," he noted. "With the Detroit Smart Parking Lab, we have a cross section of collaborators – from government leaders to mobility and tech companies – that that will empower us to bring innovation to market through collaboration."

The DSPL's open innovation platform will enable a variety of independent and collaborative development and testing paths. The DSPL said those interested in testing at the site should visit acmwillowrun.org. Information on innovation grants available to support projects utilizing DSPL can be found by visiting michiganbusiness.org/mobility-funding/.

As with the earlier Ford-Bosch valet parking project, the DSPL hopes work at the site will lead to automated functionality and driver-assist technology to ease the difficulty of parking in congested or unfamiliar areas. Craig Stephens, director, Controls & Automated Systems, Ford Research and Advanced Engineering, said, "Parallel parking or finding spots in busy, tight structures are some of the most stressful driving situations, which is why Ford invested heavily in innovations such as our parallel-parking assistance technology. The Detroit Smart Parking Lab will help us collaborate with other innovators on even better solutions to make parking easier." ■

Share and **Share Alike**

by Bill Visnic

The concepts of rideshare and urban mobility continue to evolve as new projects test what's possible.

Transportation-sector entities and cities and towns around the globe are continuing to define the role of ridesharing – while vehicle automation (the endgame for many rideshare concepts) is advancing in increasingly aspiring efforts. Several new rideshare pilot programs initiated or announced in summer 2021 differ in their details, but all aimed at acquiring a better understanding of what users want and what fast-moving technology is capable of achieving.

This past summer, the city of Pittsburgh, Pennsylvania, started an ambitious effort designed not only to expand rideshare and ride-hailing options, but to make those services available on a more equitable basis. The city runs the initiative, Move PGH, through its Department of Mobility and Infrastructure (DOMI), and partnered with a variety of entities for what it said is "a first-of-its-kind Mobility as a Service (MaaS) system. Move PGH integrates transit and shared mobility in both physical and digital 'mobility hubs,' making multimodal travel in the city easy and convenient."

Pittsburgh announced that Move PGH is "the first integrated MaaS project in the U.S. to connect traditional and emerging low-cost, shared transportation options into a single, easy-to-use system." Via a smartphone app, users are able to schedule and pay for rides on a city bus, a share-service bicycle, a scooter from Move PGH partner Spin, a Scoobi moped, a car from program partner Zipcar or a carpool shared ride facilitated by Waze Carpool. Users also can engage this variety of mobility options at one of the 50 Move PGH mobility hubs throughout the city.

Pittsburgh Mayor Bill Peduto summarized Move PGH's intent by saying, "Transportation mobility is key to economic mobility and a major determinant in household health, education and welfare. In Pittsburgh, too many residents are one missed bus or one flat tire away from losing their job or missing a critical appointment." Move PGH is being piloted in the city's Manchester neighborhood. To help overcome mobility insecurity, a co-joined program called Universal Basic Mobility leverages Move PGH's services. The program provides up to 100 residents with monthly transit subscriptions and access to the Move PGH's "last-mile" transportation and shared-mobility services.

"Universal Basic Mobility, using the services of Move PGH, will demonstrate that when people have a readily available transportation back-up plan, they

David Kelly/Spin

MOVE PGH in Pittsburgh meshes last-mile and other transportation options in what it calls the first-of-its-kind Mobility as a Service (MasS) system. This is one of 50 mobility hubs central to the program.

Electric-scooter maker Spin is a primary partner in the Move PGH program.

Spin

Ford

Ford, Argo AI and Lyft team to offer automated Ford Escapes to Lyft riders in certain sections of Miami by the end of 2021.

are able to access more opportunities and climb the economic ladder," said Peduto. The partnership claims roughly 40,000 people currently use Move PGH's Transit app. Katie Monroe, from the partnership team that administers the app, told the *Pittsburgh Post-Gazette*, "Of our users in Pittsburgh, 79 percent do not have access to a car. More than one-third earn less than $20,000 a year and more than 50 percent identify as nonwhite, so these are important things to keep in mind as we are working on Universal Basic Mobility and Move PGH in general. The city of Pittsburgh is really on the leading edge of cities taking charge of their mobility future."

Miami and Korea test advanced programs

In another shared-mobility partnership said to be a first of its kind and starting late in 2021, Ford, Argo AI and Lyft will "work together to commercialize autonomous ride hailing at scale." Argo AI and Ford will deploy Ford automated cars (with safety drivers) on the Lyft network as part of a network access agreement between Ford and Lyft. The companies pledged that the public will be able to hail the automated cars in Miami, Florida, by the end of 2021, and in Austin, Texas starting in 2022.

Lyft users in the program-defined service areas will be able to opt for a Ford automated vehicle when hailing a ride. "This initial deployment phase will lay the groundwork for scaling operations, as the parties are now working to finalize agreements aiming to deploy at least 1,000 autonomous vehicles on the Lyft network, across multiple markets over the next five years," said Ford in a release.

"This collaboration marks the first time all the pieces of the autonomous vehicle puzzle have come together this way," Lyft co-founder and CEO Logan Green added. "Each company brings the scale, knowledge and capability in their area of expertise that is necessary to make autonomous ride-hailing a business reality."

In August 2021, Hyundai began a pilot program in South Korea with an automated ride-share van that riders can summon along a 6.1-km (3.8-mile), 20-stop route in Sejong Smart City. Hyundai said the van is equipped with SAE Level 4 automation developed by its in-house Autonomous Driving Center.

The vehicle "also obtained a temporary operation permit of 'autonomous driving Level 3' from the South Korean Ministry of Land, Infrastructure and Transport," the company said in a release.

Hyundai said the program operates in collaboration with Shucle, a demand mobility service launched by AIRS Company, a specialized AI research lab under Hyundai Motor Group.

Shucle delivers shared mobility options to passengers intending to use similar routes by using algorithms to determine the optimal route. When the roboshuttle van is requested, the vehicle employs AI to calculate the most efficient route to pick up that passenger.

Hyundai said it also intends to operate the roboshuttle service at its Hyundai Motor and Kia Namyang Research and Development Center campus in the second half of 2021. ■

Hyundai

Hyundai's roboshuttle service in South Korea uses artificial intelligence to optimize service along a 3.8-mile route in South Korea.

Ethernet Backbones will Support Many Branches

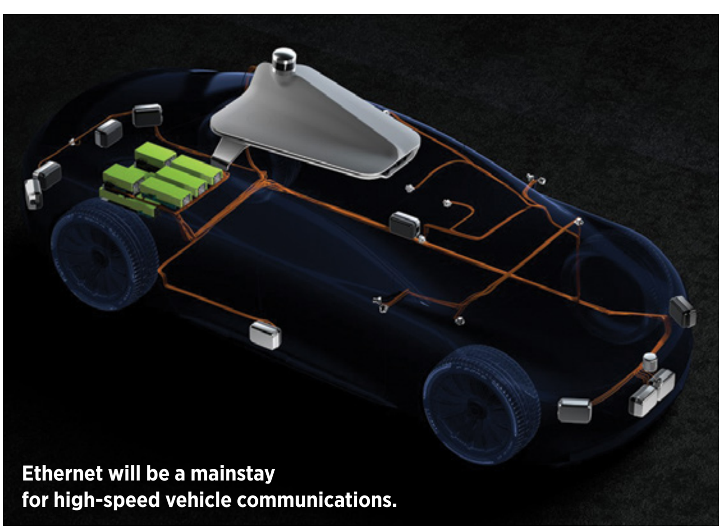
Ethernet is going mainstream, but CAN and other networks still will be needed as software and electronics do more.

by Terry Costlow

Ethernet is displacing CAN (controller area networks) as the primary architecture for automotive networks, but a host of other communications protocols are helping reduce cost and complexity. Multiple consumer networks are being used to carry input from sensors and other devices to Ethernet backbones that transfer huge volumes of data to centralized controllers.

The ubiquitous network used in homes and businesses brings speed and low cost along with integration in both microchips and design tools. That's making it the mainstay in emerging vehicle architectures.

"We expect Ethernet to be the 'bus of the future' and provide the primary interconnect for modern vehicles," said Danny Shapiro, senior director of automotive at NVIDIA. "This will replace most previous buses and help OEMs realize a software-defined vehicle that is scalable and updatable, with the potential to greatly reduce the cost and weight associated with legacy cabling harnesses."



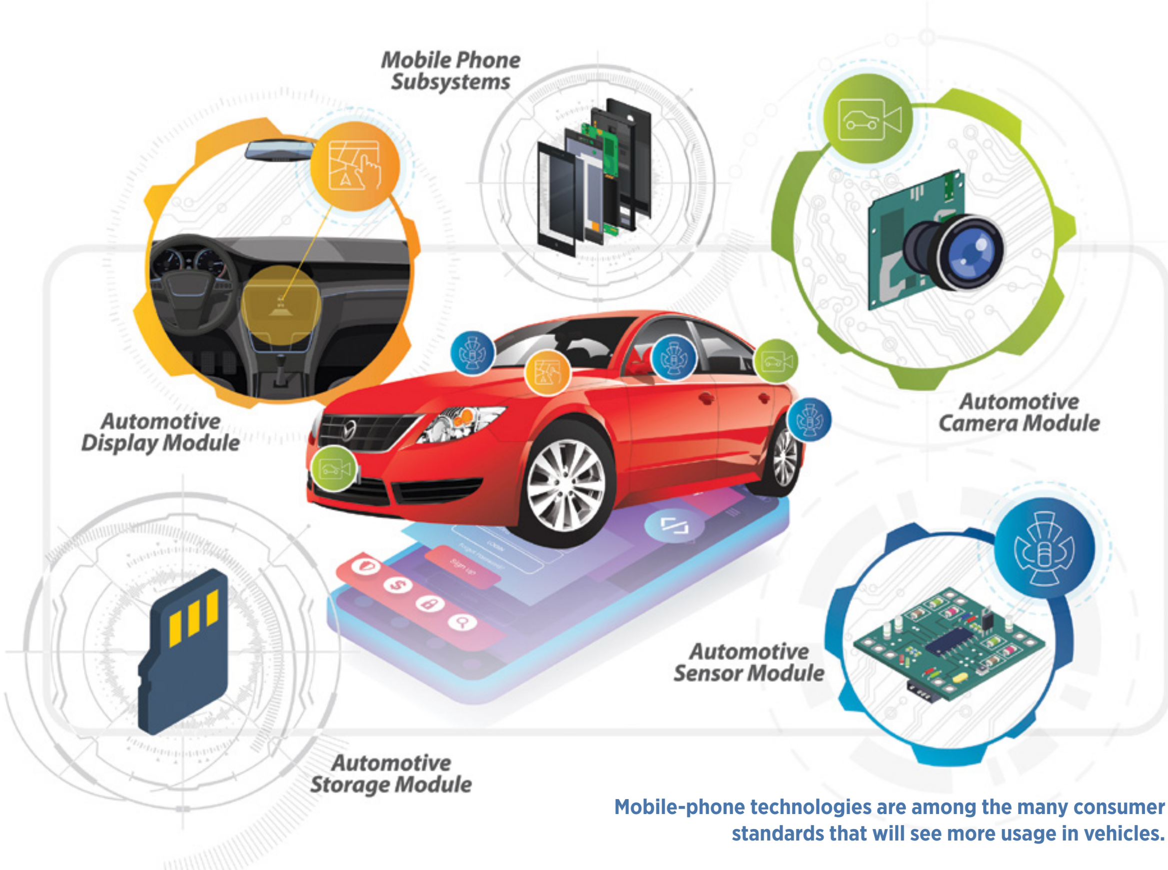
Ethernet will be a mainstay for high-speed vehicle communications.

NVIDIA

However, Ethernet won't totally displace communication technologies that have been used for years. CAN and LIN will continue as links for many devices and modules, while a range of technologies, many coming from consumer products, are being used to handle data from the many sensors and actuators found in modern vehicles. For example, the cell-phone industry's MIPI standard is seeing usage as a link for cameras and radar. Still other standards meet other requirements in bandwidth and speed. Many protocols will be used to address needs ranging from high-volume cameras, radar and lidar to low-speed nodes such as window and seat motors.

"Beside classic CAN, other buses like LIN and Ethernet, other short/long distance communication links have emerged in the last decades such as the MIPI standards," said Davide Santo, ST Automotive Group's microcontrollers business unit director. "The recent Automotive Serdes Alliance complements and enriches the pre-existing proprietary solutions. All of these specific solutions address the increasing needs for reliable, safe, secure data highways for demanding heavy-payload applications, especially in the space of semi/autonomous driving."

While Ethernet's broad knowledge base is a key driving force, so too is the auto industry's experience with CAN. It's increasingly being seen as a low-speed solution, but an updated version of CAN is expected to see use in some areas where large packet sizes are common. That will make it useful across a fairly broad spectrum.



Mobile-phone technologies are among the many consumer standards that will see more usage in vehicles.

"CAN has a long legacy and has proven itself for over two decades inside of vehicles," said Daniel Hopf, system architect at Continental. "For lower-speed applications, CAN will remain the technology of choice mostly due to its cost advantage. Furthermore, CAN is very well known at OEMs and suppliers and is a 'safe bet' when designing new systems. With the upcoming 10BASE-T1S automotive Ethernet specification for 10 Mbit/s operation over a shared medium, competition with the upcoming CAN-XL standard will grow, since they will end up in a similar speed- and maybe even cost-range."

Long-term scalability and openness are major requirements for the many networking architectures being deployed today and into the future. Autonomy requires extensive communications that must meet tight real-time requirements. The addition of electrified powertrains is another factor that requires a holistic approach to intersystem communications.

The Ethernet standard includes a well-planned pathway towards higher speeds while also maintaining compatibility make it a safe choice for long-term planning. The IEEE, which manages the technology, has added an automotive committee that will manage any changes needed to meet automakers' requirements.

"The automotive Ethernet standards now are also created within the same group, IEEE 802.3, with the OPEN Alliance creating all sets of supplementary specifications for successful operation under automotive conditions.," Hopf said

Understanding wiring for this range of networking schemes isn't the only challenge facing communication specialists. Many engineers also will have to add wireless networking to their skillset. Over-the-air updating is expected to soar as software and security become more important elements in connected vehicles; Wi-Fi is another home/business technology that is expected to dominate, again due in part to its integration in semiconductors and design tools.

"Wi-Fi connectivity is often utilized to enable over-the-air updates and is especially important as we move into the next generation of software-defined vehicles where data will be flowing to and from the vehicle to ultimately increase safety and enable refreshing of HD maps," Shapiro said. "It will also enable new entertainment options in an autonomous vehicle, such as streaming movies, shows, games and music so that occupants can enjoy the hands-free ride, although most of these services will be enabled by 5G cellular technology." ■

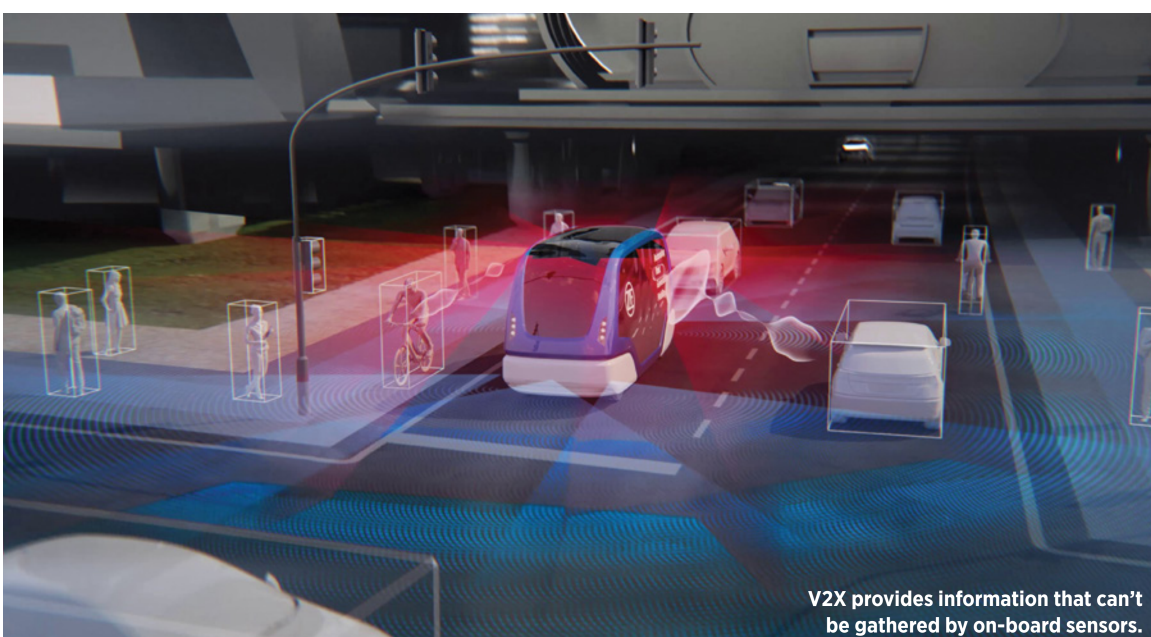
V2X Signals are Looking Up

by Terry Costlow

Security concerns and the move to autonomy should spark acceptance, but engineers must overcome challenges in sensor fusion, reliability and security.

Vehicle-to-vehicle/infrastructure (V2X) hasn't lived up to expectations, but many feel it will soon become an important factor for improving safety and autonomous driving systems. To make it successful, engineers will need to create strategies that fuse V2X data with input from the vehicle's sensors while also paying close attention to security and signal reliability.

V2X has been in development for decades, but it hasn't gained traction in part because connectivity wasn't widespread. As modem usage becomes more common, it's expected to grow, driven by increasing focus on safety and autonomy. Safety planners like V2X because it can "see" around corners and obstructions, augmenting sensors like cameras, radar and lidar that



V2X provides information that can't be gathered by on-board sensors.

ZF


Continental

Extensive communications are expected to improve safety and enable autonomy.

are limited to line of sight (LOS) data collection.

"V2X provides more information than LOS sensors, such as steering wheel angle and self-reported vehicle speed of the other vehicles," said Robert Gee, senior manager portfolio development, connected vehicle solutions & V2X at Continental. "But this is not to say that V2X does more than LOS sensors in every situation. It is important to recognize that V2X can help to confirm, enhance, and extend the data from the LOS sensors, providing both additional information and corroboration of LOS sensor information to enable the vehicle to make the best decision."

That can help improve safety margins by identifying vehicles that are not detected by on-vehicle sensors. The benefits go beyond spotting vehicles in blind spots. Information can include warnings for nearby emergency vehicles as well as speed data for unseen vehicles.

"V2X could extend the range of the vehicle environment," said Michael Burkhart, system engineering connected car manager at ZF. "For example, with on-board sensors, it's not easy to identify an emergency vehicle. Additionally, V2X provides position, speed and lane information. Information gathered by the on-vehicle sensors, for example traffic jam/accident after the curve, could be forwarded to other vehicles."

The commercial rollout of V2X will likely be slow. Many OEMs and infrastructure planners are reluctant to spend money on V2X until there are some vehicles that can communicate. This chicken-or-egg issue has been a long-term stumbling block for deployment.

The reluctance to move ahead with V2X on mainstream production vehicles is also driven by questions over communication protocols. Cellular V2X (C-V2X) has been gaining momentum in the U.S. and China. The seasoned WiFi-like standard, dedicated short range communications (DSRC), is showing signs of strength in Europe. While different regions may settle on different standards, the issue brings some uncertainty and doubt for product planners.

Caveat emptor

While V2X is considered a powerful tool in the efforts to improve safety and advance autonomy, even proponents note that it's like all sensors: They have strengths and weaknesses that work best when multiple inputs are fused together to create a single image. Wireless links are generally considered to be limited to augmenting on-vehicle systems, unlike some on-vehicle sensors that can temporarily guide vehicles single handedly.

The vehicle is never alone: A secure server system is the vehicle's overwatch.

V2X connections can operate in snow and other harsh conditions that blind most sensors, but they may fail in other situations. Though wireless protocols have improved dramatically, they are still prone to dropouts. Even a brief disconnection could cause serious problems for vehicles dependent on those connections.

"While some experts claim V2X is essential in the large-scale deployment of AVs, in reality, a self-driving car cannot be reliant on anything external through connectivity, either to other vehicles, infrastructure, or the cloud," said Danny Shapiro, senior director of automotive, NVIDIA. "Driving decisions must happen at lightning-fast speed, requiring all sensor processing, perception and planning to happen in-vehicle."

Who are you?

Security is another huge issue. Signals sent by cars and roadside stations must be reliable, or they're worthless. That means signal generators must be vetted and controlled, while communication channels must be immune to hackers.

In the vehicle, hardware must protect the encryption keys. Software must use a layered, defense-in-depth approach. A vehicle's network gateways and vehicle buses must be protected, with security techniques that separate and protect critical driving and safety functions from non-critical functions like infotainment.

Over the air updates will be critical so vehicle systems can be updated as new threats emerge. Staying

Standards provide foundation for security

Gaining the benefits of V2X requires a heavy focus on security, since quick life-and-death decisions will be made based in part on data from vehicles and roadside infrastructure. Internationally, industry stakeholders are working together to ensure data integrity, creating standards and developing ways to share data as new security challenges arise.

V2X promises to enhance vehicle safety systems by providing input that on-board sensors can't detect. Given the importance of making sure that data is not hacked or otherwise corrupted is a major challenge, one that's compounded by the long life of vehicles. Creating system strategies that provide acceptable security risks at levels that society can support requires broad long-term strategies.

"Maintaining security over 15-20 years is an extremely difficult task and might require hardware changes after several years," said Achim Fahrner, head of Automotive Security, Autonomous Mobility Systems at ZF. "Also, the security activities – security process, implementation of security measures, lifetime security support, and so on – can cause significant efforts and costs. In the end, all road users will be protected by cybersecurity, but it potentially results in significantly higher product costs."

Several standards have been created to help system designers achieve adequate cybersecurity levels. Highlighting the international focus on vehicle security, SAE and the International Standards Organization have developed ISO/SAE FDIS 21434. Additionally, the United Nations Economic Commission for Europe created UN R155, which is based on ISO/SAE FDIS 21434. It makes cybersecurity a pre-requisite for final approvals. Japan and China have started similar security standard developments.

Standards create a base for companies to build on, as well as processes that can be followed to ensure the integrity of solutions.

Autotalks

Chipsets will need to have built-in security to augment defense-in-depth software strategies.

Though the goal is to eliminate vulnerabilities, quick responses to breaches are an important element in all automakers' protective schemes.

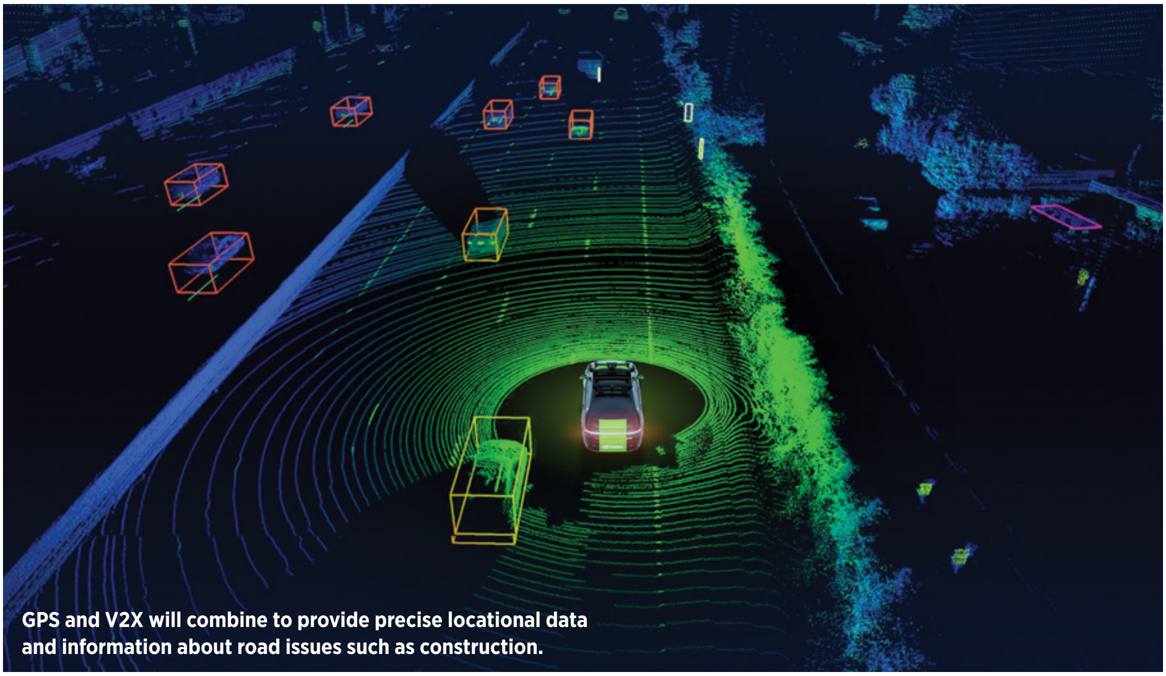
"A robust security monitoring system and the fast ability to respond to security incidents in the field is critical," said Danny Shapiro, senior director of automotive at NVIDIA. "Zero-day issues and the value of targets in the automotive industry dictate the ability to rapidly respond, within hours or days, to security incidents that occur in the field. Having a robust product security incident response team program is a must going forward."

Those response teams will work to create patches that will generally be downloaded to vehicles over the air. Their efforts will be supported by groups like the AutoISAC, a U.S. organization that gathers security-related information and shares it with members. AutoISAC members, which number nearly 50, can also work together to address security breaches as they arise.

These efforts dovetail the strategies built into V2X schemes. The teams that developed C-V2X and DSRC started with an emphasis on security. For example, they require that devices have a valid certificate issued by a certificate authority. Otherwise, its transmissions will be simply ignored.

"V2X security was developed by industry experts and scrutinized by national security authorities," said Onn Haran, Autotalks CTO. "Every vehicle must use a certified V2X solution by an accredited lab. The security strength is far beyond the security needed for the next decades. Having said that, security can be upgraded over lifetime, if needed. Some chipsets, like Autotalks' V2X chipset manufactured by ST, are crypto-agile, and can support longer security keys. Over-the-air updates can be used to fix vulnerabilities, if detected during vehicle lifetime."

Terry Costlow



GPS and V2X will combine to provide precise locational data and information about road issues such as construction.

Nvidia

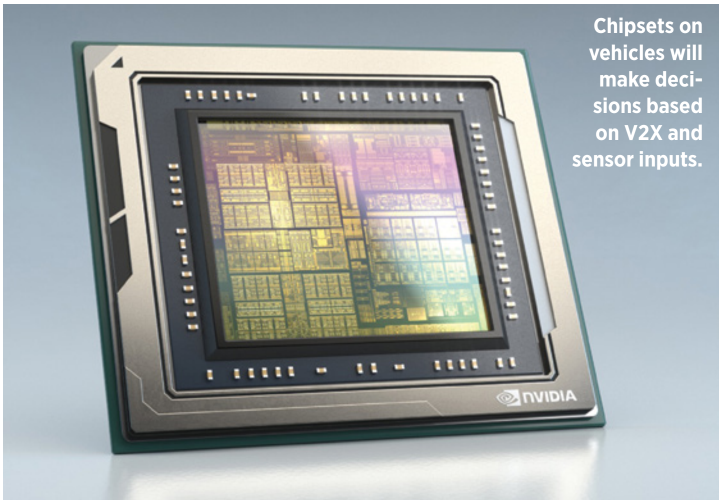
current will be a complex issue, since vehicle lifetimes are long. Hack attacks on vehicles will be compounded by attacks on corporate servers that communicate with cars.

"The vehicle is never alone: A secure server system is the vehicle's overwatch," Gee said. "While an attack on one vehicle might be able to expose that one vehicle's protected data, a successful attack on a server system could expose the data for many vehicles. Because such back-end systems are monitored 24/7 and have constant patches and upgrades, the vehicle's overwatch can filter and block new attacks from compromised third party servers."

Future needs

As autonomy comes into play, communications will grow in importance. Satellite navigation data is likely to be used to help advanced vehicles navigate better, conserving fuel or battery life by adjusting speed before entering curves or hilly areas. GPS data will further supplement V2X links by providing very precise positioning data. Combining V2X and GPS data can provide important information, such as telling the vehicle it will need to adjust lanes in construction zones.

"Unlike GPS navigation for human-driven vehicles, which operate within a few meters of accuracy to provide turn-by-turn directions, maps for AVs have greater requirements to ensure safety," Shapiro said. "They must operate with centimeter-level precision for accurate localization, the ability of an AV to locate itself in space. Proper localization also requires maps that are constantly updated and reflect current road conditions, such as a work zone or a lane closure."



Chipsets on vehicles will make decisions based on V2X and sensor inputs.

Nvidia

Communication can also help system designers continue to make ongoing improvements. Data collected from vehicles helps engineers and programmers enhance systems and software. "Data collection, data quality and data management are of vital importance," said Arnaud Lagandré, ADAS business unit VP, Continental North America. "Therefore, we collect daily more than 100 terabytes with our global fleets that entail hundreds of vehicles." ■

New Tools & Technologies

Brain-wave sensor

Hyundai Mobis (Seoul, South Korea) introduces M.Brain, a new healthcare technology-based brainwave-measurement sensor the company is prepping for applying for the first time in the automotive industry. Brainwave measurement, said the company, is known to be one of the most advanced and challenging biosignals with which to work. M.Brain measures the driver's condition on a real-time basis by detecting the brainwaves around the ears through earpiece sensors; software analyzes and creates data derived from the brainwaves. M.Brain also can integrate with a smartphone app. The accident-prevention technology can provide alerts for different sensory alerts such as LEDs around the driver's seat, seat vibration or headrest-speaker auditory alerts. Hyundai Mobis plans to initially apply various bio-healthcare technologies to public transportation; M. Brain will be first tested in Gyeonggi-do's public buses.

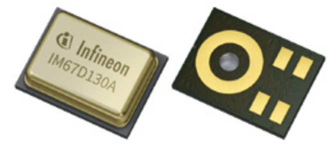
For more information, visit http://info.hotims.com/79451-450

New 77GHz radar in series production

With the introduction of 77GHz radar sensors, Hella (Northville, MI) is expanding its leading position in radar technology. For functions such as autonomous parking or automated lane changes, 77GHz technology offers a significantly larger signal bandwidth and improved environmental resolution compared to 24GHz, Hella said. The centerpiece of the 77GHz radar sensors is the radar system chip, which is based on RF-CMOS technology. Thanks to the special architecture, digital components as well as systems for self-diagnosis can be integrated on the chip, in addition to the components for transmitting and receiving. The company said it also is developing the second generation of 77GHz radar, slated for series production for a German premium manufacturer in 2024. Second-generation 77GHz radar will have the latest antenna and chip technologies to increase range, extend field-of-view (FOV) and further improve measuring capability at close range.

For more information, visit http://info.hotims.com/79451-451

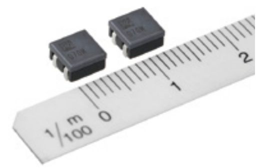
MEMS microphone for automotive



Infineon Technologies (Munich, Germany) launches the XENSIV™ IM67D130A, a new high performance, low-noise MEMS microphone for automotive applications. The XENSIV™ IM67D130A is the first microphone in the market to be qualified for automotive applications, which Infineon said will help simplify the design-in efforts for the industry and reduce the risk of qualification fails. The microphone has an increased operating temperature range from -40°C to +105°C to enable various use cases in harsh automotive environments. The high acoustic overload point (AOP) of 130 dB SPL allows the microphone to capture distortion-free audio signals in loud environments. The microphone is also suited for exterior applications such as siren or road-condition detection. The high signal-to-noise ratio (SNR) of 67 dB combined with an exceptionally low distortion level leads to optimum speech quality and superior speech intelligence for applications based on speech recognition.

For more information, visit http://info.hotims.com/79451-452

High-current, low-inductance power inductors



TDK Corporation (Tokyo, Japan) developed new HPL505032F1 power inductors for use in automotive circuits. The inductors enable SAE Level 5 Advanced Driver-Assistance System (ADAS) applications for cameras by offering high-current and low-inductance for power circuits in central processing units (CPUs) and graphic processing units (GPUs). The new power inductors achieve high power efficiency by adopting a low-resistance frame for the highly permeable and low-loss ferrite made of high BS material and low-RDC that is fully developed in-house. Rated current is 1.5 times higher than TDK's existing product (HPL505028), accommodating currents as high as 40 A to 50 A. While the proprietary structural design generates magnetic flux-canceling effects contributing to noise control, the frame that integrates internal and external electrodes reduces the risk of an open circuit and short circuit, ensuring high reliability. Mass production of the new inductors began in July 2021.

For more information, visit http://info.hotims.com/79451-453

WEBINARS

BEST SIGNAL AND INTERCONNECT TECHNOLOGIES FOR ADAS/EV INFOTAINMENT SYSTEMS

Thursday, September 9, 2021 at 11:00 am U.S. EDT

This 60-minute Webinar provides an overview of electronic and electrical trends underway in vehicle safety and control systems including ADAS and vehicle electrification — trends that are driving changes in vehicles ranging from passenger cars to on- and off-highway vehicles.

An expert in interconnect technologies offers insight and best practices on how both component and systems designers are turning to proven, as well as emerging, connector technologies to provide more robust, easier to assemble components capable of supporting higher density requirements in mission-critical vehicle electronic modules.

Speaker:

Matt McWhinney
Business Development Manager, Molex

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Hosted by: SAE INTERNATIONAL

For additional details and to register visit: www.sae.org/webcasts

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NEW FRONTIERS IN DYNAMIC GESTURE SENSING FOR AUTOMOTIVE APPLICATIONS

Available On Demand

Automakers predict driver safety will improve when gesture and proximity sensing replace knobs and touchscreens for infotainment, phone, side mirror, climate, trunk, sunroof, and reading lamp controls. However, most gesture-sensing systems in today's market are based on traditional time-of-flight (ToF) cameras that also bring high cost, complexity, and space issues, which many system designers wish to avoid.

This 15-minute Webinar covers streamlined, cost-effective automotive gesture-sensing solutions featuring infrared-based optical sensors with integrated photodiode array and lens. It also includes a dynamic gesture-sensing demo and explains how to swiftly implement the right solution into your next design.

Speaker:

Szu-Kang Hsien
Director, Business Management, Automotive Business Unit, Maxim Integrated

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For additional details and to register visit: www.sae.org/webcasts