**Automated Driving**

Everybody is heading in the direction of automated driving, declared Hans-Peter Hübner, executive vice president of engineering for chassis control systems at Robert Bosch GmbH, in his presentation at the 2014 Advances in Automotive Electronics Congress. Because 90% of today’s fatal accidents are caused by human error, safety is the major motivation for taking the driver out of the loop.

Along with being a hardware and software supplier and systems integrator, Bosch plans to also be a provider of dynamic map data via the cloud. Because the data will come from multiple sources, Dr. Hübner wants the industry to develop standards for delivering that data to the cloud where it will be consolidated.

What else will happen, and when? Dr. Hübner expects to see automated remote park-assist systems on the road in 2015. Automated driving supervised by the driver will find production in 2018. Free driving on motor ways with less driver supervision will come in 2020. Fully automated driving on all roads in all situations won’t hit the road until after 2025.

There is much to recommend automated and connected driving, according to one of Dr. Hübner’s slides:

- 80% improvement in traffic throughput.
- Synchronized traffic flow will lead to a 23% to 39% improvement in highway fuel economy.
- More productive use of time in transit.
- Increased mobility for older or disabled people.
- Potentially a 90% reduction in the 1.2 million road fatalities that occur each year.

**Mobileye**

After his Ludwigsburg presentation, I talked briefly with Amnon Shashua.

**Turn to Ludwigsburg, page 2**

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**Audi’s Ricky Hudi on What’s Next**

When it comes to automotive electronics, Audi gets to claim a lot of firsts. Audi will be first to deploy a 48-volt starter-alternator, in a 2015 production vehicle. The system will incorporate a supercapacitor.

In 2015 Audi will be the first to launch the Mobileye EyeQ3 image processor in series production.

Closing in on the development speed gap between consumer and automotive electronics, Audi will soon be able to replace the infotainment system’s MMX (multimedia processor) with a later version at the dealer, post-sale. Audi leads the world in the adoption and advancement of LED headlights, and it introduced the world’s first user-programmable instrument cluster with real-time 3D graphics. Not a world’s-first, but Audi will bring automatic braking for pedestrians into series production in 2015.

**Advice for Suppliers**

Following his presentation at the Advances in Automotive Electronics Conference in Ludwigsburg earlier this month, I asked Ricky Hudi, Audi’s chief executive engineer for electrical and electronics, where he would like to see greater supplier investment and focus. “In ADAS and infotainment especially there is a lot of interaction between domains. We are doing more cross-functional thinking, which has us crossing over our organizational structures. But suppliers are still organized in the classic domains: powertrain, chassis, comfort/body, infotainment and so on. If they want to be involved in the next big thing they need to be able to combine experts from different domains into cross-functional development teams.”

As an example, Mr. Hudi cited Audi’s zFAS central driver assistance system for

**Turn to Ricky Hudi, page 2**

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**BMW’s Elmar Frickenstein on What’s Next**

Elmar Frickenstein is BMW’s executive vice president of electrical/electronics and driver experience environment. He is responsible for all E/E systems, including software, from development to the dealer. When it comes to automotive electronics, BMW also claims many world’s firsts. First in the market, BMW’s laser headlamps provide up to 600 meters of clear, white light. BMW was first to introduce a head-unit based on Genivi, an open-source infotainment software platform based on the Linux operating system. In 2013, BMW was the first to make LTE Wi-Fi hotspots available for all its cars. The snap-in hotspot module can also be used outside the vehicle.

BMW is also a leader in offering innovative services that support urban mobility both with and without automobiles. The BMW-owned venture capital firm BMW i Ventures supports many such services. (BMW i stands for both its electric vehicles and mobility services.)

Currently available in the greater San Francisco area, ParkNow is a web-based service that directs users to a reserved parking place and accepts payment for the parking fee. DriveNow is the car sharing service that makes available the BMW i, Mini and BMW luxury vehicles from Sixt car rental.

**Suppliers**

BMW’s recently introduced i3 electric vehicle has approximately 100 miles of range. “Battery suppliers will be making investments in more efficient batteries; we have to expand the range of our vehicles,” said Mr. Frickenstein. Thus far, BMW has been working on batteries with Samsung. Mr. Frickenstein would also like to see more investments in charging station infrastructure.

“The next biggest thing where suppliers can invest is connected driver assistance and autonomous driving. That means we need investment in highly accurate map

**Turn to Elmar Frickenstein, page 8**
piloted driving, which relies on computing power and software akin to that found in infotainment systems, but must conform to safety, reliability and security requirements like those applied to chassis and powertrain systems. zFAS, which decouples hardware from software and allows for additional functions, will soon go into series production.

Mr. Hudi would also like suppliers to get better at tackling large software development projects. For example, high-end infotainment system development requires hundreds of software engineers to manage the level of complexity involved. “Staffing the teams, making the systems safe, responding to all the functional specifications, the coding, testing and integration—this is something where the suppliers have to improve,” advised Mr. Hudi.

More than three years ago Audi established strategic partnerships with Texas Instruments, Nvidia, Qualcomm, NXP, STMicroelectronics, Infineon and Analog Devices, all of which are now part of the Audi Progressive Semiconductor Program. “Innovation begins at the semiconductor level,” said Mr. Hudi. “They are very, very important.”

Cooperative Developments

According to Mr. Hudi, the German carmakers—Daimler, Volkswagen, Audi, Porsche and BMW—will continue to cooperate as 48-volt systems are introduced. “All the specification work is done, but there are things we can learn together in the introduction phase,” he said. Audi needs 48 volts to power functions such as electronic stability control, an electric turbocharger and to maintain the air-conditioning levels in start-stop vehicles.

Another joint effort still underway by the German Five involves furthering car-to-x communications. “We did a joint concept and test in Frankfurt over a four-year period,” said Mr. Hudi. “Next we will identify the car-to-x applications we will do together and which will be OEM specific. For example, we don’t want to differentiate in the way we warn drivers about slippery roads, fog or accidents. We’ll work jointly on those to improve driver safety for all.”

Ethernet

“I am absolutely convinced that cross-networking of the big domain computers in the car will be done with gigabit Ethernet,” declared Mr. Hudi. Because Audi already uses the 150 megabit Ethernet channel on its MOST 150 network, Mr. Hudi sees no reason to join the OPEN (One Pair Ether-Net) Alliance Special Interest Group supported by BMW and numerous other carmakers who are establishing the 100 megabits-per-second BroadR-Reach physical layer Ethernet specification for cars. Mr. Hudi quipped, “Why should we go back to 100 megabits when we have MOST 150?”

According to Henry Muyshondt, senior manager for Microchip Technology and technical liaison for the MOST Cooperation, “In a MOST network, you assign bandwidth for various types of data transfers, such as the Ethernet channel, synchronous data, asynchronous data, etc. It is possible to assign all the available bandwidth to the MOST Ethernet Packet (MEP) channel, and use the full 150 Mbit/s for Ethernet packets.”

Yes to Android, No to Genivi

“Linux and Android are interesting, but Genivi is not for us because we have our e.solutions framework,” said Mr. Hudi. e.solutions is the Elektrobit and Audi joint venture that created the software platform underpinning Audi’s infotainment system. e.solutions partners include Nvidia, QNX, Nuance, Google and Gracenote.

Unveiled at CES 2014, the Audi Smart Display is a 10.2-inch HD display tablet for use by passengers. It is based on Android and integrates with the vehicle’s infotainment system. Slated for introduction in 2015, possibly on the TT, the display is crash resistant and can handle temperatures up to 80 degrees C.

Ludwigsburg...

co-founder and chairman of Mobileye Vision Technologies, who told me that Mobileye’s much anticipated IPO will almost certainly take place next month. Last summer, Mobileye brought in a handful of new investors raising $400 million, which valued the company then at $1.5 billion.

Based on a single-camera approach, Mobileye’s image processing algorithms and system-on-chip processors own a dominant share of the world’s forward-looking camera applications. Mobileye’s proprietary technology will underpin the vast majority of automatic emergency braking (AEB) for vehicles or pedestrian applications. AEB is coming to market on standard fitment vehicles in Europe as a result of the government NCAP (New Car Assessment Program) rating system. AEB became part of Euro NCAP assessments in 2014. NHTSA is still evaluating whether or not to revise U.S. NCAP ratings to include AEB.

In his presentation, Dr. Shashua described the motion analysis technology Mobileye is perfecting. By fusing motion analysis with pattern recognition, Mobileye will be able to limit the false positives which cause the vehicle to initiate unnecessary emergency braking. According to Dr. Shashua, carmakers have had to implement five recalls to fix false positive problems with radar-based systems.

Along with its intellectual property, a big competitive advantage for Mobileye is the experience it has gained from years of testing its camera technology in each new vehicle in which it is employed. According to Dr. Shashua, Mobileye has collected seven million kilometers of data, equivalent to 100 thousand hours of driving.
GM Global E/E Engineering Update

One of GM’s responses to its ignition switch crisis was made in April when the company restructured Global Vehicle Engineering. GM assigned two managers to run that massive organization, which until April was managed individually by John Calabrese, who will retire in August.

Ken Morris was named vice president of Global Product Integrity, responsible for vehicle, powertrain and electrical systems engineering, vehicle performance, supplier quality and managing the Global Vehicle Safety organization.

Ken Kelzer was named vice president, Global Vehicle Components and Subsystems. He handles engineering operations, components development and advanced vehicle development. Mr. Morris and Mr. Kelzer are mechanical engineers.

Those changes led to the assignment of two electrical engineering managers, both with global responsibility. Matt Schroeder is global functional leader for electrical systems engineering, reporting to Ken Morris. Gary Bandurski is global functional leader for electrical components and subsystems, reporting to Ken Kelzer.

Given the changes in E/E leadership, I was especially interested in listening to Burkhard Milke’s talk earlier this month at the Advances in Automotive Electronics Conference in Ludwigsburg, Germany. Dr. Milke is director of electrical components and subsystems for GM Europe Engineering.

While Dr. Milke’s presentation didn’t address how the bifurcation of GM’s Global Vehicle Engineering organization will be reflected outside of North America—GM is currently sorting that out—he did advocate strongly for adhering to a single E/E architecture globally.

Opel hasn’t always been so keen to adopt GM’s global E/E architecture. Some years ago, the Opel Meriva development was based on legacy architecture, which was regional, not GM’s global architecture. “That was a mistake we will not repeat,” said Dr. Milke. As a result, Meriva’s bill of materials didn’t benefit from GM’s global scale; developers couldn’t reuse features that had already been developed. Further, because the vehicle was unique, Opel engineers were unable to get help from GM’s global engineering footprint as they faced development and launch issues.

In email correspondence following the Ludwigsburg meeting, Dr. Milke wrote that he wants to deal with suppliers who are capable of managing complex programs that cross multiple domains. And further, “a constant increase of E/E functionality in former mechanical domains must be reflected in the company’s skill set and growth plans.”

In a matrix organization, GM operates five tech centers around the world, which cooperate with each other to create more value than if they operated alone. The tech centers fill the pipeline with new and enhanced features. Since product development processes are the same in each region, programs can be transferred from region to region, depending on workloads.

One of the downsides of a vast global organization is that change comes slowly and, especially these days at GM, carefully. In the past, GM engineers had indicated that the transition from Global A architecture to the next one, Global B, would begin in earnest in 2015. Among its new features, Global B will embrace Autosar 4.x. However, due partly to the recent organizational restructuring, implementation of Global B will be delayed. “We won’t see any products based on Global B for quite some time,” said Jennie Ecclestone, engineering and safety communications manager at GM. “I don’t know the exact timing, but it’s so far out that it is not really predictable right now.”

One of the benefits of its global engineering operation cited by GM management is its ability to work around the clock. A project could conceivably be passed east to west from one tech center to the next throughout the 24-hour day. But engineers in Warren are not so happy about that as their days are often very long to accommodate telephone conferences with the other tech centers. According to one former GM engineer, associates who he used to work with tell him they are stretched pretty thin, putting in very long days. According to this engineer, GM is likely to see some turnover as the booming North American automotive market creates unusual demand from suppliers and other carmakers for experienced E/E engineers, especially software engineers, who are in very short supply.

### GM E/E Global Organization

<table>
<thead>
<tr>
<th>Tech Center</th>
<th>E/E Development Footprint</th>
<th>Program Execution Footprint</th>
<th>Key E/E Managers*</th>
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<td>D-segment, trucks/SUVs, luxury</td>
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</table>

*Matt Schroeder, Executive Director, Global Functional Leader, Electrical Systems Engineering (software and coding for infotainment systems, IP, and the electrical architecture of vehicles)
Gary Bandurski, Executive Director, Global Functional Leader, Electrical Components & Subsystems (electrical components for in-vehicle systems: HVAC, active/passive safety, chassis and controls)
Burkhard Milke, Director, Electrical Components and Subsystems, GME Engineering
Paul Gibson, Managing Director, Electrical Components and Subsystems, GMIIO Engineering
Alexandre Guimares, Director, Electrical, Software and Infotainment, GMSA Engineering
Mrs. Usha HV, Engineering Group Manager (manages both Electrical Components & Subsystems and Electrical Systems and Infotainment Engineering)

Source: GM
The Company Profile…

**ETAS GmbH**

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**Headquarters:** Stuttgart, Germany  
**2013 Sales:** €145.8 million  
**2013 Operating Margin:** Approximately 15%  
**2013 R&D:** 39% of sales  
**Employees:** 805, as of January 1, 2014  
**2013 Sales per Employee:** €181,118 euros  
**Ownership:** Bosch owns 100% of ETAS.  
**Products:** Software, hardware, engineering tools and services for the development of embedded software

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**Background**

Founded by Robert Bosch GmbH in 1994 in Stuttgart, Germany, ETAS has become a global leader in automotive embedded software development tools, especially for powertrain ECUs. Siemens VDO acquired 10% ownership of ETAS in 2000, in exchange for Siemens’ line of calibration and measurement tools, and other technology. ETAS became a 100% Bosch-owned subsidiary following Continental’s acquisition of Siemens VDO in 2007.

ETAS operates as a separate entity from Bosch’s Automotive Technology business sector in order to serve both Bosch and Bosch competitors such as Continental, Delphi, Denso and Visteon (formerly JCI’s automotive electronics business) with assurances that no trade secrets will be compromised. “We’ve been doing business with these customers for 20 years. They trust that we can handle their projects while maintaining strict confidentiality from Bosch,” said Friedhelm Pickhard, president of ETAS and chairman of the advisory board. Mr. Pickhard is responsible for product management, product engineering and Real-Time Application (RTA) consulting. He was assigned to ETAS from Bosch four years ago, when he was managing Robert Bosch Engineering and Business Solutions in Bangalore, which at the time had 6,500 engineers.

Bosch subsidiaries ETAS and SoftTec are both in the business of providing embedded software and services to carmakers and tier-one suppliers. SoftTec focuses on vehicle connectivity and infotainment, whereas ETAS solutions are more deeply embedded into the vehicle’s control systems.

ETAS has been profitable every year for the last five, including 2009, a year when sales slumped markedly due to the global recession, although operating margin was only slightly above zero that year. According to the company, from 2010 through 2013 operating margins have been “double digit” and recently have been roughly 15%. ETAS annually spends a large percentage—between 30% and 40%—of sales on R&D. In 2013 the figure was 39%.

**Regional Market Development**

Since 2009, ETAS’ sales have been growing annually at the rate of 14.6%. Much of that growth is a result of increasing engineering and sales staff in some of ETAS’ 23 facilities in 13 different countries, and making sure they are well chosen and well trained. Especially in Japan, China and Korea, ETAS has been locating customer-facing staff closer to the carmakers’ engineering centers where the cars are developed.

“To adopt our tools, customers often have to change their processes. Not only have we brought in more people to help our customers do this, but we have done a lot of training to be sure that they have solid technical knowledge,” said Mr. Pickhard. “Everywhere we try to hire local people, but if we bring in people from Germany or elsewhere, we want them to know the local language and the culture.”

At present, ETAS employs approximately 30 development engineers in Japan, approximately 15 in Korea and some 30 in China. During 2013, ETAS increased its workforce in Germany to 500 employees. In Japan, China, South Korea and the Americas, employment increased between 12% and 20% in that period.

Revenue in Asia and the Americas grew “in the two-digit range,” in 2013, according to the company. ETAS opened a third facility in Japan and one in Thailand that year.
Industry Trends Drive Future ETAS Sales; More Embedded Software and Tool Development Engineers Needed

Finding more well-qualified engineers is one of the ongoing challenges that the industry worldwide faces. For example, ETAS’ RTA Solutions business could grow more quickly if more “quality” embedded software engineers could be found, meaning candidates with at least six years of experience. As the development of autonomous driving systems ramps up, ETAS is also looking for engineers who can support the growing demand for validation tools, which are needed as vehicle functions grow in complexity. With more connected vehicles hitting the road, more security solutions for embedded systems will be needed.

The migration to more model-based development is another trend that favors ETAS’ product line. “These are all areas where we can grow,” said Mr. Pickhard.

Major Products

ETAS provides services and software, but primarily tools. ETAS tools cover the complete V design cycle from model-based design tools to validation and calibration. The ASCET product family supports model-based development of application software and automatic code generation from those models.

ASCET has been on the market since 1997, used particularly in the development of software for brake, steering and engine management systems. According to ETAS, ASCET-developed software can be found in more than 300 million ECUs.

◆ INCA (Integrated Calibration and Acquisition), a product of ETAS’ MCD (Measurement, Calibration and Diagnostics) business, is by far the company’s largest selling product. “The measurement and calibration of powertrain is definitely our biggest business,” Mr. Pickhard noted. According to the company, there are currently more than 25,000 installations of INCA tools globally used in development and series production projects.

INCA tools are used for ECU development and test, and for validation and calibration of electronic control systems in the vehicle, on the test bench or on a PC. Included in the tools are the following functions:

◆ Pre-calibration of function models on the PC
◆ ECU flash programming
◆ Measurement data analysis
◆ Calibration data management
◆ Automated optimization of ECU parameters

Optimizing ECU parameters for a new vehicle or engine is critical to the vehicle’s performance, fuel efficiency, emissions controls, safety features and reliability. Tens of thousands of calibration parameters need to be determined for all the variants of the engine, for different vehicle models and for different markets. INCA supports all standard ECU description formats, measurement, calibration and diagnostic protocols, and offers connectivity to vehicle bus systems such as LIN and FlexRay.

In addition to the INCA base product, ETAS has developed several add-on packages that increase INCA’s functionality and allow for integration with tools from other vendors such as Mathworks. These interfaces allow customers to integrate INCA functions with their existing tool chain or third-party tools.

◆ The EHOOKS bypass-hook insertion tool is showing solid growth since it was first introduced in 2010. “EHOOKS shows our expertise in embedded software engineering,” said Mr. Pickhard. The tool allows a function developer to easily insert a software bypass hook in existing ECU software, so that modifications can be made after the ECU ships, for example by the OEM. Since changes can be made without access to the ECU source code or build environment, development time and costs are saved.

“Imagine an OEM gets software from a tier one, but he wants to use it as a base for function extension,” Mr. Pickhard explained. “He can use EHOOKS to hack into the software, make a bypass automatically and add a function in the ECU without knowing its architecture. This supports our customers tremendously.”

◆ Operating Systems and Software

“While we are well known as a tools provider, a lot of companies don’t know that we also provide software,” Mr. Pickhard observed. ETAS provides OSEK-com mundane.
ETAS GmbH

**Distinctions Claimed by ETAS**
- More than one billion ECUs in vehicles on the road run on operating systems from ETAS.
- ETAS' ASCET code generator is more efficient and requires less hardware resources than the code generator from Mathworks.
- ETAS provides more operating systems to GM and Ford than any other supplier, via tier-one ECU suppliers Bosch, Continental and Delphi.

plant operating systems for powertrain ECUs to the major powertrain suppliers including Bosch, Continental and Delphi.

According to ETAS, its RTA operating systems and Autosar run-time environment already power more than one billion ECUs worldwide.

ETAS' RTA product family includes RTA-RTE, a mature, production-quality, Autosar runtime environment (RTE) generator that conforms to Autosar release 3.0. Basic software modules from other vendors can be integrated with ETAS’ operating system and RTE. Bosch uses ETAS' OS and RTE as the basis for its Autosar ECU architecture in series production.

In February 2014, ETAS expanded its RTA Basic Software and Tools portfolio to provide complete coverage of the Autosar 4.x standard for basic software modules.

- **ASCMO** is an ETAS tool that allows developers to create mathematical models of complex systems, automotive powertrains for example, using a small number of measurements. According to ETAS, “This tool uses new database methods which make it possible to represent characteristic engine behaviors such as consumption, engine-out emissions and exhaust gas temperature as a function of the operating conditions (speed, load, engine temperature) and the settings of calibration parameters (for example, ignition, fuel injection, camshaft position, etc.) on the basis of a few measurements in a largely automated manner in the form of a mathematical model.”

At the 5th International Symposium for Development Methodology in Wiesbaden, Germany, Volkswagen reported that by using ASCMO, it was able to reduce fuel consumption by 2% to 4%.

The promise of model-based design replacing map-based software and look-up tables has been a subject of discussion in the industry for more than 20 years. ETAS is well positioned to benefit if more automotive tier ones and OEMs implement model-based control software. Mr. Pickhard estimated that more than 70% of engine ECUs are still designed the old way, using look-up tables and maps. "It is always about what computational resources are available in a real-time application," he said. “Most of the controllers struggle for sufficient resources, because functionality is increasing exponentially. As a control engineer I would say it should be done, but I believe we will be living a long time with tables. A huge amount of parameters are still look-up table based.”

**Hottest New Products/Applications**

LABCAR XiL is one of ETAS’ most promising future products. "X" refers to software in the loop, model in the loop or hardware in the loop. Normally hardware in the loop tools are used at the end of the development cycle, but LABCAR XiL can be applied across the complete V cycle, according to the company. Like the LabCAR HiL (hardware in the loop) test system, LABCAR XiL will work with models generated by different tools from different tool vendors. The XiL product is due to be released in mid-2015. Pilot versions of the platform are currently being tested by three ETAS customers: two European OEMs (one German, one non-German) and an American tier one.

ETAS sees a growing demand for high quality embedded software. "We are hearing from our customers that they care not only about the lowest price, but also about quality, because most of our applications are safety applications. We offer high quality software at a reasonable price. And we have proven with our operating system that we are able to make highly reliable embedded software for low-resource ECUs," Mr. Pickhard asserted.

As more functions migrate to the powertrain ECU, more computing resources are required, and the tier-one suppliers are switching to multicore microprocessors.
ETAS GmbH

- Vehicle-vehicle and vehicle-to-infrastructure data exchanges must be trustworthy and secure.
- In the future, autonomous driving features such as communications between vehicles and electronic traffic and speed-limit signs need to be secure to prevent unintended braking or acceleration.

ETAS covers the complete V cycle, from requirements analysis through test. ETAS tools have proven to be very robust and reliable. “You can put our measurement tools in boiling water and they’ll still work,” he quipped. The third factor Mr. Pickhard stressed was ETAS’ global footprint. “We can support our customers in Detroit, or Germany, or South Korea, China, India—wherever they are.”

With its Bosch parentage, ETAS has strong relationships with the major European tier ones, especially in the powertrain domain. A company goal is to expand that powertrain dominance globally and at the same time grow business in the other vehicle domains and widen its customer base globally.

**Major Acquisitions**

ETAS has a small department that monitors the market for acquisition opportunities. It has set a target of 5% future growth through acquisitions. Possible candidates might be companies with local expertise, for example in the Japanese or Chinese markets, or companies with unique technology that is more easily acquired than developed in house.

In 2003 ETAS acquired LiveDevices, a developer of OSEK operating systems, and Vetronix, which developed remote diagnostics software. Vetronix operated as an ETAS subsidiary until 2012, when it became part of Bosch’s Automotive Aftermarket Division.

**Alliances**

- **Autosar** is probably ETAS’ most important alliance. The standards created by the Autosar partnership form the basis of ETAS’ embedded software development tools, its principal product. Most of the world’s carmakers are basing their systems on Autosar architecture. “The Autosar standard enables us to design tools that go deeper into the ECU development process,” said Mr. Pickhard.
- **COMASSO e.V.**, founded by Robert Bosch GmbH and ETAS in May 2013, is an open source community of 22 companies that support a common implementation of the Autosar software standard version 4.0. After paying a modest membership fee, companies can use the contributed Autosar software free of charge.
- Bosch provided the community with the first set of Autosar basic software modules as well as acceptance test software, which can be changed and extended by community members. In addition, Bosch provided the basic software development tool.
- **BUSMASTER**, initiated jointly by ETAS and Robert Bosch Engineering and Business Solutions, Bangalore, India, BUSMASTER is an open source tool to simulate, analyze and test CAN, LIN and other buses used in automotive and automation applications. Thus far, the project is supported by seven additional companies.
- **ETAS** is a member of the OPEN Alliance (One-Pair Ether-Net), promoting and supporting the adoption of Ethernet-based networks as the standard in automotive networking applications. "Ethernet, along with Broadcom’s BroadR-Reach physical layer, is important to us because we assume that eventually most cars will have Ethernet connections,” said Mr. Pickhard. “We want our tools to be compatible with the car’s backbone, which in the future will be Ethernet.” BMW and Broadcom have been strong supporters of the OPEN Alliance.

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**Partners**

Because ETAS’ main mission is the provision of software design tools and services that increase the efficiency and quality of embedded software, it picks partners that can complement that mission. For example, ETAS invests in virtualization and knows how to develop tools for the embedded software engineer, but looks to partners who are competent in the domains of simulation, for example the simulation of hydraulic systems, chassis or engines. “What differentiates us is our tools are very open for integration of components from different partners,” noted Mr. Pickhard.

**IAV Automotive Engineering** – Partner for guided application with INCA-Flow

**Kvaser AB** – advanced CAN solutions

**Mechanical Simulation** – Partner for CarSim, TruckSim and BikeSim based on open product interfaces in ASCET, INTEGRIO and LABCAR

**Model Engineering Solutions GmbH** – Partner for the examination of modeling guidelines on the basis of ASCET’s open product interfaces with the aid of Model Examiner

**Omni GmbH** – Partner for the integration of ASCET models in requirements engineering by means of VeriConf

**SIMPACK** – Partner for SIMPACK-VDYM V5.0 based on the open interfaces of LABCAR

**Softing** – Partner for DTS7 (Diagnostic Tool-Set) based on the open product interfaces of INCA ODX-LINK

**TESIS DYNAware** – Partner for vehicle simulation software in LABCAR

**Visu-ITI** – Partner for ASAP-2 tool kit based on the ASAM MCD 2MC standard exchange format, which is supported by INCA
AT&T on Most Promising 4G Automotive Use Cases

Not counting smartphones and tablets, AT&T says it is responsible for more machine-to-machine connections than any other carrier. AT&T connects nearly 17 million non-traditional devices such as consumer electronics products, e-readers and wearable devices, to the Internet of Things.

Cars aren’t yet one of those “things.” AT&T’s automotive revenue is insignificant today, but according to Joe Mosele, vice president of business development for Emerging Devices, “By 2015 or 2016 cars will account for a majority of AT&T’s Emerging Devices business.”

Launched in April, the Audi A3 sedan was the first car in the U.S. to offer embedded 4G LTE, over the AT&T network. Starting with the 2015 Malibu this month, GM will launch OnStar with 4G LTE connections from AT&T. Both carmakers plan to roll out 4G further as new models are introduced.

“We look at automobiles as the ultimate mobile device,” said Mr. Mosele. “We are going to introduce the experience you are used to having on your smartphone or tablet into the vehicle, obviously in a safe way. We expect the connected vehicle market to grow similarly to what you saw when mobile data on smartphones and tablets took off. The ability to have 4G in the car will be the catalyst. By 2020 we expect that 50% of new cars will come equipped with embedded 4G connectivity.” According to PC Magazine, AT&T has the fastest 4G LTE network in the U.S.

The most promising use case for 4G connectivity, according to Mr. Mosele, is the mobile hotspot. “Today more than 70% of tablets have wireless connectivity. You are going to be able to take your Wi-Fi connected tablets, gaming devices and e-readers and use them in the car.” The Audi A3 is capable of supporting up to eight devices used by passengers.

The next most promising use case for 4G is to deliver over-the-air firmware updates and new applications to the telematics control unit and the infotainment system. Not only will wireless software delivery be less expensive for carmakers, it will also save customers the hassle of having to bring their vehicles in for service. AT&T has partnered with Red Bend Software, the leader in mobile software management. “Updating is a huge opportunity for the car owner, the OEM and AT&T,” said Mr. Mosele.

Some years from now, AT&T expects its 4G network will be used in vehicle-to-vehicle and vehicle-to-infrastructure applications.

AT&T intends to be more than a wireless carrier for automotive customers. “We are prepared to work with different ecosystem partners to put together an entire deal,” said Mr. Mosele. “We can provide the entire telematics solution or parts of it.” In addition to Red Bend, AT&T can also partner with Qualcomm, Accenture, JasPar, Ericsson and VoiceBox. Today AT&T provides 2G and 3G connectivity in BMW, Volvo, Tesla, Nissan and Ford’s electric vehicles.

Elmar Frickenstein...

BMW Technology Leadership

BMW has been investing in the development of inductive charging for electric and plugin hybrid vehicles. At the same time it is working with other carmakers to create a worldwide standard. “We would like to have the inductive charging standard complete by 2016 and hope to introduce inductive charging in a production vehicle by 2017,” said Mr. Frickenstein.

BMW’s next-generation 7 series, reportedly due in 2015 or 2016, will take the next step in driver assistance. Among its new features, the car will be capable of parking itself, without a driver. “This and the inductive charging development are two big approaches where we can bring automotive electronics a little bit ahead of the rest of the world,” said Mr. Frickenstein.

Genivi

BMW will continue its advocacy for Genivi, the open-source software development alliance it started in 2009. Ultimately all BMW, Mini and Rolls Royce vehicles will benefit from the ability to reuse proven infotainment software. BMW’s first Genivi implementation came to market in 2013, and is being rolled out across all product lines.

“Our next implementation will have 60% of its code already available. That’s six million to seven million lines of code, and that code is available to the rest of the world,” said Mr. Frickenstein.

Updateable Software, Not Hardware

Mr. Frickenstein said that BMW worked with Nvidia four years ago to come up with infotainment hardware packaging that could receive hardware updates.

“We created a [prototype] piggy-back board for our head units. Our customers want to be able to keep their infotainment system current. We checked in the smartphone and tablet industries but could not find a solution for hardware updates that worked. So we are concentrating instead on updating software. This year we are going to be the first carmaker to update the head unit’s embedded navigation map over-the-air. This year we will also launch our BMW i3 and i8 app store, where you will be able to download apps to the head unit.”

Ethernet

Mr. Frickenstein, whose organization has been pioneering automotive Ethernet, is very pleased with the level of industry support he is getting for the 100 Mbit/s standard over twisted pair, known as the OABR (Open Alliance BroadR-Reach) specification. In parallel, the industry is working on a gigabit Ethernet standard. The first version of that standard is expected within the year. Possible implementations in BMW vehicles are planned for the 2018 timeframe.

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