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2016/2017

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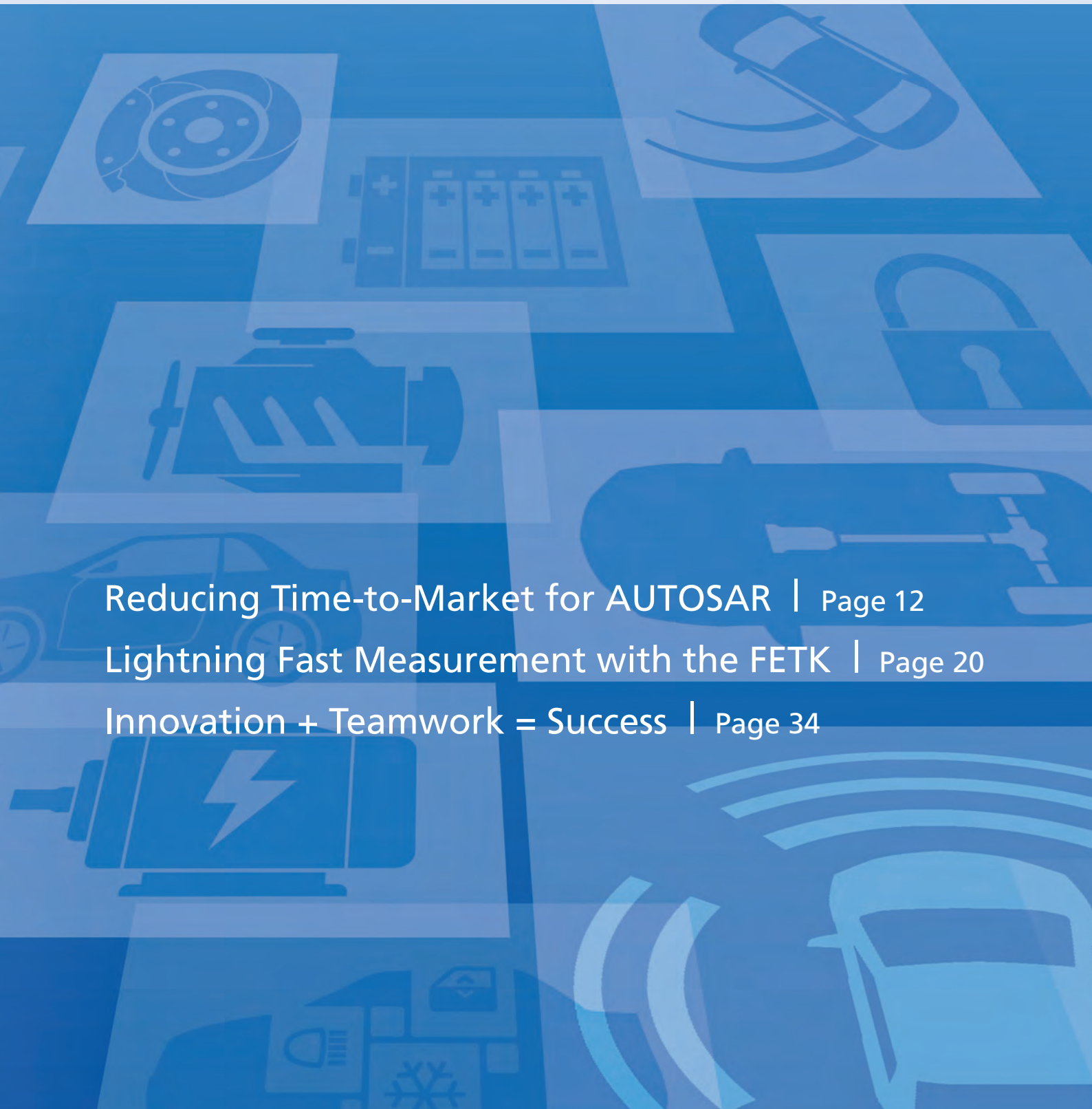

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Christopher White
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Dear readers,

In this new issue of RealTimes, you will once again find ETAS solutions that are ideally tailored to the requirements of the automotive industry and related sectors. Articles about proven, refined, or new ETAS solutions describe the many potential applications of our portfolio. Customer success stories show the practical advantages of the ETAS products. We also give insight into our global expansion through new locations and strategic partnerships.

The topics in this latest issue illustrate the challenges in embedded systems development that impact our industry and that we have set out to master: More energy-efficient drive systems, autonomous driving, and vehicle connectivity. As a systems provider, ETAS is actively shaping these pertinent topics – together with you, our customers and partners. ETAS' solutions and security solutions by our subsidiary ESCRYPT ensure that your company is equipped with the best tools to handle whatever comes your way, enabling you to turn your ideas into successful products and quickly bring them to market.

We hope this latest issue of RealTimes delivers some interesting insights and ideas that will inspire you.

Friedhelm Pickhard Bernd Hergert Christopher White

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Security in ECU Production

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ESCRYPT is a 100-percent subsidiary of ETAS GmbH and offers security solutions for embedded systems.

Production Key Server for secure key management

Cryptography protects connected embedded systems against attacks and unauthorized access. However, ensuring availability and secure injection of keys is a challenge – particularly in global production chains. To secure ECU production to the greatest extent possible, ESCRYPT offers its new Production Key Server (PKS). This easy-to-implement, scalable solution complements ESCRYPT's Key Management Solution (KMS) and guarantees reliable protection of sensitive cryptographic data over the entire system lifecycle.

Embedded systems are taking on more and more functions. The large number of ECUs in vehicles is a prime example, with their software coordinating more and more powertrain, safety, and convenience functions. Previously, IT systems in vehicles were isolated and independent. Now it is time to provide connectivity with the outside digital world in order to take advantage of the security and service potential of Car-to-X communication, or of Firmware-over-the-Air updates (FOTA).

Opening up to the outside world harbors not only opportunities, but also new security risks. Negligent or willful tampering with embedded systems in vehicles will become possible if we fail to protect them reliably. Permission for digital data exchange must be made dependent on an appropriate authentication with cryptographic keys and certificates. However, providing and implementing these keys and certificates in production, as well as managing them over the entire life of the protected products, is challenging – especially in business areas that rely on globally distributed production and supply chains and on a diverse array of supplier structures, such as the automotive industry.

Decentralized or centralized key provisioning?

To date, there have been parallel approaches that either decentralize the provisioning of cryptographic data (keys, certificates, etc.) or manage it from a central location. Neither solution is perfect. The advantage of isolated, decentralized solutions for each production site is that they can be implemented easily and are independent from higher-level IT systems. Additionally, key availability is high and does not depend on the quality of the local internet connection. However, the security and maintenance overhead of decentralized solutions is high. In addition, it is difficult for device manufacturers to maintain an overview of the keys generated and assigned, especially when some of the keys are generated in the manufacturers' own plants and some by suppliers. Conversely, centralized solutions offer advantages in terms of key management and security issues. However, if the internet connection fails or transfer rates are suboptimal, there is a risk of longer latency times when injecting the keys, potentially resulting in delays or even production downtimes.

The solution: decentralized servers and centralized backend

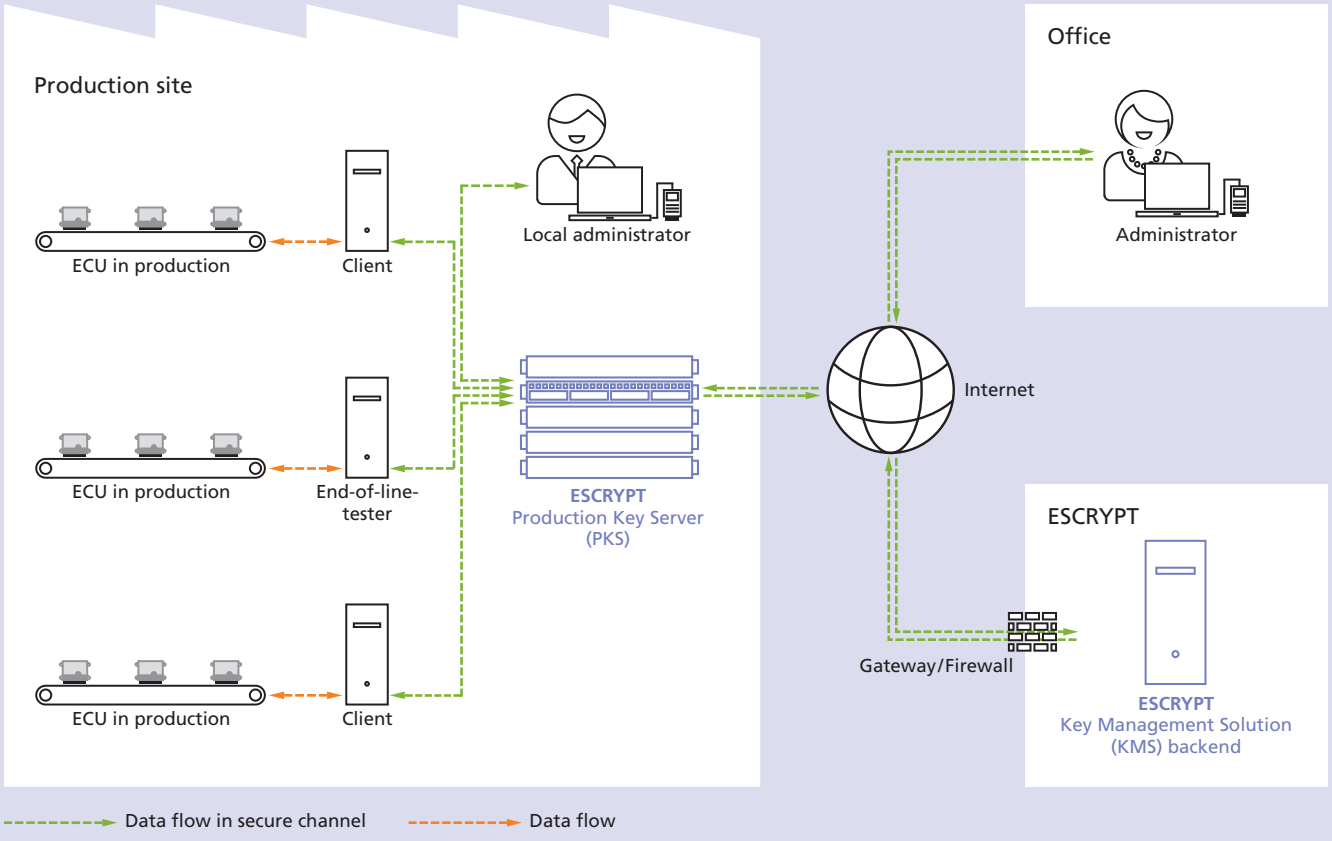
ESCRYPT is following a third path, which combines a centralized backend – the Key Management Solution (KMS) – with decentralized key injection on Production Key Servers (PKS) in the plants. This guarantees not only maximum availability and low latency times, but also optimum protection of cryptographic data, as every PKS is protected against unauthorized access by a powerful Hardware Security Module (HSM) that is suitable for industrial use, and appropriate security software. Furthermore, since the PKSs are only occasionally in contact with the backend – to synchronize the data and perform updates – this approach offers the greatest possible independence from the internet connection. The frequency of this exchange is adjustable.

The PKS is a standardized module for server racks and has its own power connection, Gigabit Ethernet interfaces, an HSM, and pre-installed ESCRYPT software. After a one-time configuration, it is ready for operation. Maintenance and administration can be done online through the KMS backend. If desired, PKSs can automatically report – for instance by e-mail – critical events such as expiring certificates, key access authorizations, full log databases, or a shortage of cryptographic data in local buffers.

While the servers are distributed across production sites around the world, management and monitoring of key assignment, as well as maintenance and configuration of the PKSs, is handled in the centralized KMS backend. If cryptographic data from another source is to be used in production, this data can be manually imported into the KMS backend. Another option is to use the backend of a third party that can connect through authentication directly to the KMS to exchange the relevant cryptographic material. Since the PKS and the KMS backend synchronize at specified intervals, thus creating sufficient buffers of cryptographic data, ECU manufacturers are largely independent from internet connection stability when accessing the KMS.

The flexible architecture ensures that manufacturers can either maintain control over key management themselves or have ESCRYPT implement the key management. In both cases, the connection between the KMS and the distributed servers forms a powerful basis on which the PKS hardware can execute complex cryptographic operations quickly and reliably. PKSs can also be operated in clusters. Importantly, they offer maximum protection – also against

Production Key Server (PKS)
Keys/Certificate injection



intellectual property theft – in production environments where providing an adequate level of security is an issue. With confidential data (such as security keys for authorized associates) stored on the HSM, and their retrieval tied to previously determined routines and authentication on the KMS, data will remain inaccessible even if the entire PKS hardware is stolen. Furthermore, the HSM serves as a safe for cryptographic data installed on the systems; it secures this data through additional encryption and a security check when booting up. On top of all this, firewalls, encryption, tamper-proof software, and HSM-based security operations protect each individual step when data is exchanged between servers, the backend, and all other recipients involved in the process.

Holistic security solutions are needed

These security precautions and the sophisticated architecture ensure that typical automotive use cases – such as secure booting of microcontrollers, locking of diagnostic interfaces, and injection of Secure Hardware Extension (SHE) keys or Transport Layer Security (TLS) certificates – remain secure even in the increasingly connected car of the future. This also applies to securing future Car-to-X communication and final testing of ECUs that require testers to authenticate themselves. The security achieved in this way can be maintained over the entire life of the vehicle – using ESCRYPT's holistic approach for embedded security. While PKSs ensure secure management and injection of cryptographic data in ECU production, embedded systems need to be protected over the entire vehicle lifecycle to prevent willful or negligent tampering. ESCRYPT has the appropriate security solutions and the required expertise for all stages of the vehicle's lifecycle, including reliable deletion of keys and certificates after vehicles are scrapped.

The flexible solution architecture for securing distributed production sites for ECUs guarantees maximum availability, low latency times, and optimum protection of the cryptographic data used.

New RTA Basic Software

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Solid basis for next-generation software

With its RTA Basic Software (RTA-BSW), ETAS introduces a new software product for developing AUTOSAR-based electronic control units. ETAS RTA-BSW facilitates the configuration, integration, and testing of modern embedded software applications.

Currently, RTA-BSW is a solution that can be fully applied in control units with the highest safety requirements. The basic software's quality and reliability rest on complying with the strictest software development processes in the market. Development based on the ISO standard 26262, which is consistent with ASIL D, enables the usage for applications that are both sophisticated and relevant to safety.

Ready-for-use solution for control unit development thanks to comprehensive AUTOSAR 4.x support

RTA-BSW offers a broad range of AUTOSAR basic software modules and, in combination with the operating system ETAS RTA-OS as well as the Runtime Environment ETAS RTA-RTE products, a holistic platform software for developing control unit applications. AUTOSAR 4.x is a key technology for managing ever-expanding and more complex electronics; RTA-BSW aims to reduce the complexity and offer to the user a complete environment supporting AUTOSAR 4. In addition, the new ETAS product facilitates automatic configuration and code generation, by which the effort for establishing an AUTOSAR application is reduced. ETAS' comprehensive support for the AUTOSAR basic software include training, engineering, and consulting as well as standard extensions:

- RTA-BSW Customer Release Package – a service for configuration, integration, and testing of RTA-BSW for customer-specific hardware platforms
- Functional Safety Qualification Package – helps users of RTA-BSW to ensure ISO 26262 conformity (safety manuals, proof for the development process, consulting)

Groundwork for developing safety-relevant systems

RTA-BSW combines the highest standards in vehicle safety with first-class performance. This arises from a range of basic software optimizations preserving system integrity.
However, in our experience, project-specific functional safety requirements have to be addressed and a standard, AUTOSAR-based solution does not always satisfy these needs. To cover this gap, ETAS offers the functional safety qualification package, with the goal of making a gap analysis, providing a revised set of project-specific safety manuals, and defining a remediation plan for achieving full compliance.

Safety- and non-safety-relevant software under one umbrella

All RTA-BSW modules are application-independent safety elements that have been developed according to ISO 26262/ASIL D. The concept of freedom from interference enables users to implement architectures containing both safety- and non-safety-relevant software modules in the same control unit. RTA-OS fully implements all scalability classes defined in AUTOSAR (1 to 4), providing all the required features for isolating safety-relevant software from any other component.
Furthermore, RTA-BSW supports the early validation of a complete stack in a virtual platform such as ETAS ISOLAR-EVE.

Quick start with the ETAS Starter Kit

The ETAS Starter Kit provides an out-of-the-box example of a completely configured RTA-BSW stack that can be ready to run within only a couple of minutes. Users can generate control unit code that runs on either a virtual control unit platform or a development board. In addition to training, the ETAS Starter Kit contains the complete set of ETAS tools such as ISOLAR-A, ISOLAR-EVE, RTA-RTE, RTA-OS, RTA-BSW, example applications, and an MCAL (microcontroller abstraction layer) relevant to the specific variant of the starter kit.

Automotive Open System Architecture (AUTOSAR)

AUTOSAR is a worldwide development partnership between car manufacturers and suppliers as well as electronics, semiconductor, and software manufacturers. The partnership's aim is to team up and develop innovative electronics systems that improve performance, safety, and eco-friendliness.

Virtual ECUs

ETAS ISOLAR-EVE in application

Developing new, electronically controlled vehicle functions involves a number of discrete stages: design, prototyping, implementation, verification, integration, and validation. However, these can all be seamlessly connected by using virtual ECUs. Virtual ECUs can be duplicated any number of times, which makes it easier for work processes to be performed in parallel and for tasks to be better assigned. Both these factors can do a lot to speed up software development and improve software quality. At the same time, using virtual ECUs brings down development costs because they make it possible to recognize errors or flaws at the design and implementation stages and resolve them early on.

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As a result of this, there is much less of a need for elaborate breadboard assemblies, challenging Hardware-in-the-Loop test systems, test benches that cost a lot to purchase and operate, or expensive test vehicles. Software- and Hardware-in-the-Loop tests will increasingly complement each other in the future, with fluid boundaries. In this process, tools such as ISOLAR-EVE are key factors in bridging the gap between these methods of testing.

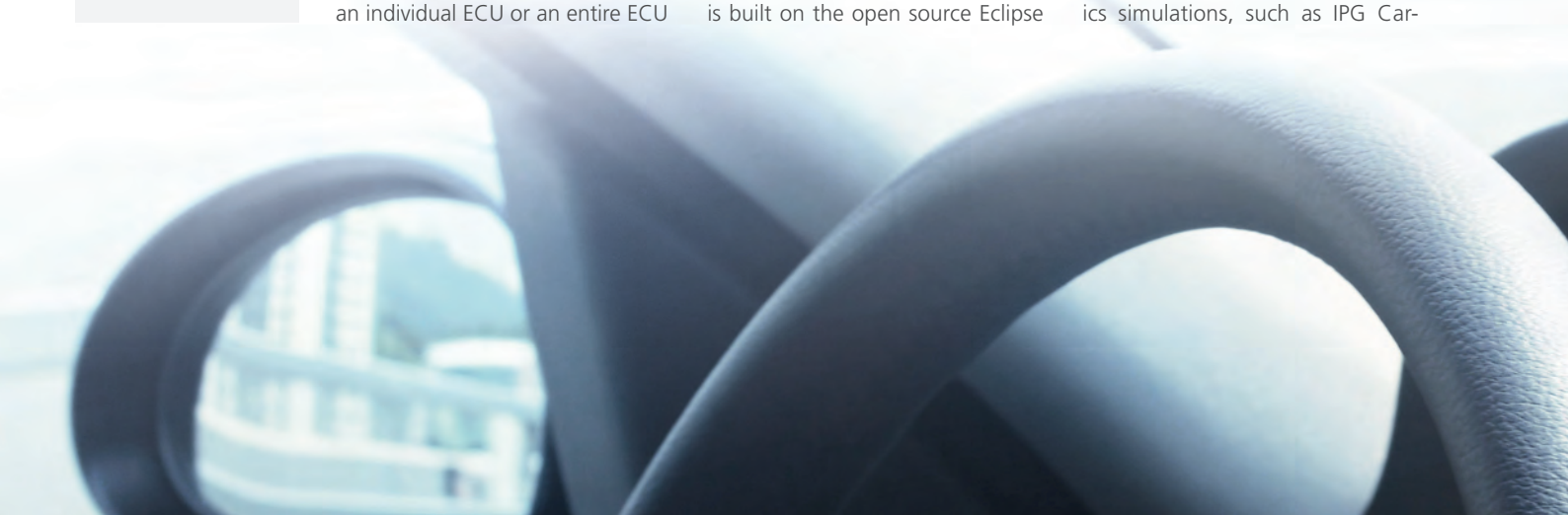
ISOLAR-EVE: open, and based on the Eclipse platform

With ISOLAR-EVE (ETAS Virtual ECU), ETAS provides an open platform that makes it possible to virtualize an individual ECU or an entire ECU network on a PC. In doing this, the solution supports both AUTOSAR and proprietary software. Functional models, application software components, and basic software modules from various sources can be integrated quickly and easily – and they can then be tested and calibrated with the virtual ECUs generated. It is no problem to configure and parameterize these virtual ECUs flexibly on a Windows PC, and so to customize them for the current application.

ISOLAR-EVE is interoperable with development, testing, measuring, and calibration tools offered by ETAS and other vendors. This is due to the fact that on the one hand it is built on the open source Eclipse platform and on the other hand it offers open, flexible, and configurable interfaces that comply with automotive standards.

Applications

Because of the virtualization platform's openness, it is easy to integrate it with special editors, version control systems, or specific tools for the purposes of test automation. The same is true for software testing environments as well as for measurement and calibration tools. In addition, ISOLAR-EVE supports the generation of virtual ECUs with functional mockup interfaces (FMIs) for co-simulation of systems in various vehicle domains; it also supports integration into vehicle dynamics simulations, such as IPG Car-



Maker. Over and above that, virtual ECUs can be packaged together as S-functions for integration into Simulink® simulations. Virtual ECUs can be calibrated in the same way as real ECUs by connecting them to measurement and calibration tools such as ETAS INCA – and calibrating them in a closed-loop simulation, for example. The calibration data obtained can then be used again in subsequent process steps.

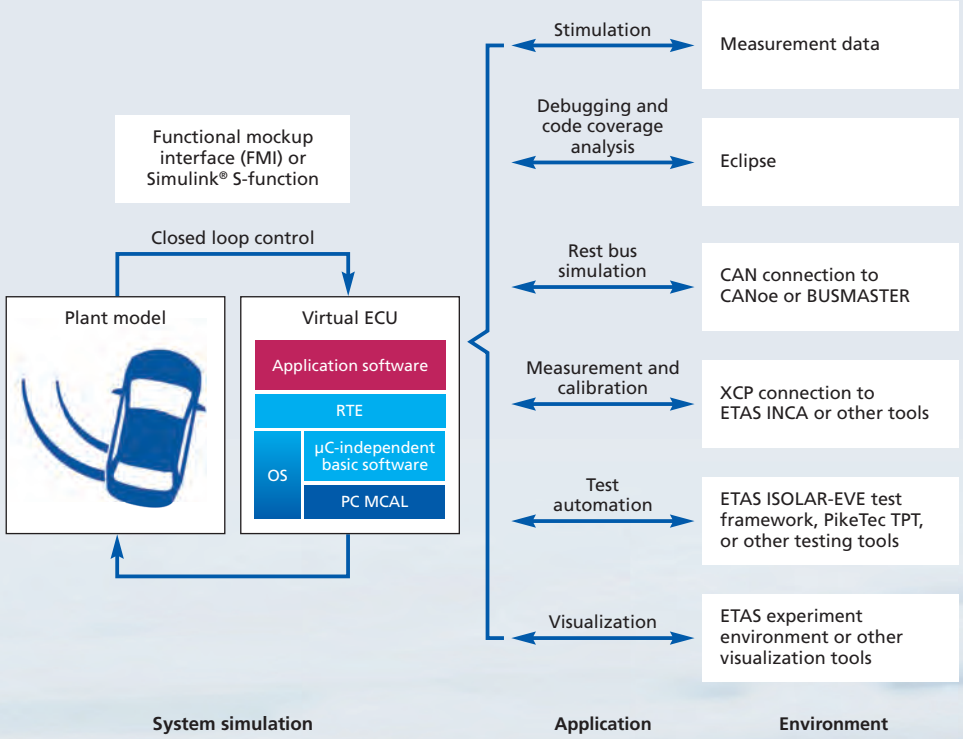
Since both the application software and the basic software of ETAS Virtual ECUs – including RTE and OS – correspond as closely as possible to the software of real ECUs, then the right test designs permit many integration and release tests to be performed using them. Using ISOLAR-EVE, developers can verify and validate the implementation as well as the behavior of application software components and basic software modules provided by a number of vendors. The spectrum here ranges from component tests, including AUTOSAR conformity testing, to integration testing and downstream functional validation. In this process, the virtualization platform makes it possible to generate test interfaces at all levels of the software architecture – be it on the level of the application software, the basic software, the runtime environment (RTE), or the microcontroller abstraction layer (MCAL).

Simulation versus measurement

Measurement data from experiments on vehicles or at a test bench serves as an important basis for simulations and virtualizations. On the one hand, this data can act as a source of reference for calibrating functions in the virtual environment. On the other hand, it can be used both to stimulate simulations and to generate data-based models – which often make system behavior easier to describe and more precise to predict than do physical calculations.

In the future, test drives will mainly be used to create the database for computer simulations and to back up validations that have been performed in these simulations. In spite of the growing complexity of powertrains and assistance systems – and equally the ever-growing numbers of sensors and ECUs – it will thus be possible to further shorten the testing stages and to significantly reduce again the number of prototypes and test vehicles.

ISOLAR-EVE V3.1 runs on Windows 10 and supports automotive Ethernet. Furthermore, it features a variety of other improvements. Find out more on page 29.



The openness of ISOLAR-EVE enables flexible integration into available tool environments.

Reducing Time-to-Market

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Optimizing rapid prototyping for AUTOSAR software components

Rapid prototyping in automotive software development is a complex matter. The tried and tested tools provided by ETAS pave the way to develop a truly customized solution for each customer's specific use case. With the ETAS solution, PSA Peugeot Citroën was able to speed up the engine control development to master EURO 6.2.

In prototyping, models from ETAS ASCET and MATLAB®/Simulink®, or C code are traditionally integrated into the prototyping target. However, with the introduction of EURO 6.2, the approach for designing future diesel and gasoline engines as well as hybrid drivetrains has changed, at least for PSA. Now, under its newly established software development cycle, a functional validation in the form of rapid prototyping of AUTOSAR software components (SWCs) is essential. By integrating the AUTOSAR C code generated by the function model, the internal (arithmetical) functions of the AUTOSAR SWCs are validated.

Customization enhances available rapid prototyping solution

In PSA's case, the typical configuration for a rapid prototyping system with ETAS software and hardware products needed some additional features, such as:

- Free mapping of the runnables managed by the AUTOSAR Runtime Environment (RTE) to any task in the bypass raster
- A way to measure and calibrate the components' internal variables
- Handling of client/server calls

The AUTOSAR and rapid prototyping experts of ETAS and PSA teamed up to develop these customized extensions. Together, they designed the conversion tool AR2SIX, which makes the AUTOSAR SWCs compatible with ETAS INTECRIO.

It takes original arxml, C, H, and A2L input files and converts them into Scoop-IX – a format that can be understood by INTECRIO. How the new extension complements the typical configuration of a rapid prototyping system with ETAS software and hardware products is shown in figure 1.

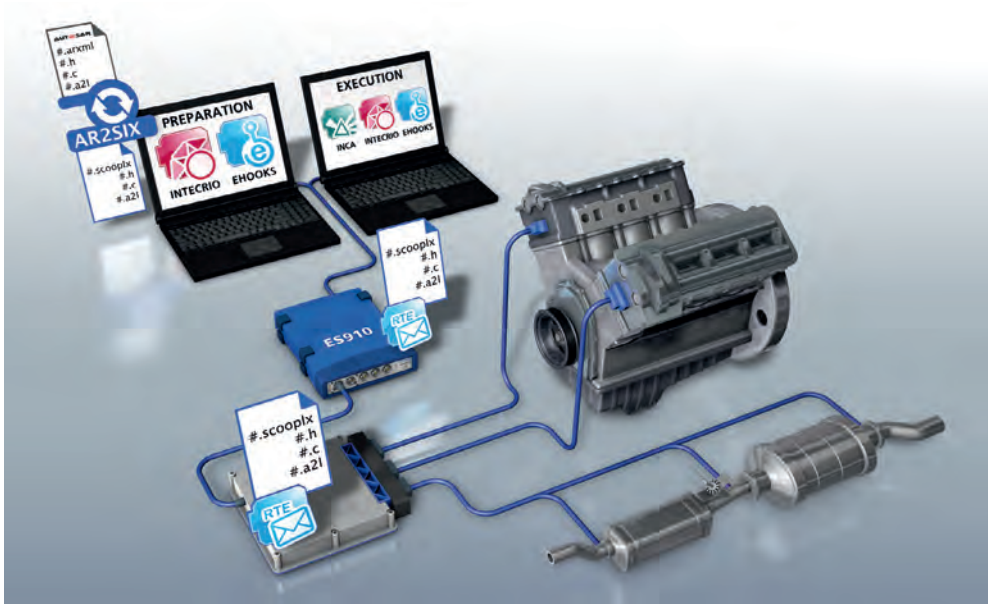
The conversion takes place in four major steps. First, the AUTOSAR SWCs under test contain calls to the RTE and other AUTOSAR SWCs that are not available on the INTECRIO rapid prototyping platform. These AUTOSAR SWCs are stubbed by generating C code adapters. Second, the internal SWC variables not included in the component's A2L file such as Inter-Runnable Variables (IRV) need to be visible during rapid prototyping. In order to find and visualize these internal variables, AR2SIX parses the arxml files and adds them to the SCOOP-IX interface. Third, the SCOOP-IX file defining the sources, variables, data types, etc. of a C code to be integrated is automatically generated based on its arxml definition, its A2L file, and its C code. The INTECRIO rapid prototyping platform uses the SCOOP-IX format described in xml for integrating C Code. Finally, the previously described steps can be carried out for each SWC in a composition. The effort needed to create a workspace is minimized by the automatic creation of an INTECRIO workspace with interconnecting modules.

New tool proves its worth every day

Through the AR2SIX conversion tool, the PSA coding teams can now prototype, simulate, and debug most of PSA's AUTOSAR modules in addition to their unitary validation before integrating them into the engine or hybrid supervision software. The process proposed by ETAS comes with a double advantage for PSA: it's compatible both with real-time targets such as the ES910 prototyping and interface module and with the offline simulation offered by INTECRIO Virtual Prototyping.

PSA has been working with its own customized solution for two years now and reaps its benefits on a daily basis. Their SWCs are functionally tested on the vehicle designed for their needs, using the installed prototyping hardware. Additional validations – often regression tests – are made via offline simulation on the basis of real recording data using INTECRIO-RLINK. SWC compositions covering several functional areas such as pollution and combustion functions, ADAS or hybrid functions are validated in vehicles and simulations. But most of all, PSA uses AR2SIX for a particular use case: several software and functional bugs have been detected and fixed even before they could propagate into different software projects.

Figure 1: The new conversion tool AR2SIX (see laptop on the left) enhances the typical rapid prototyping system with bypass.



"The AR2SIX project with ETAS demonstrated the high agility of ETAS Engineering that made it possible to develop a tool serving EURO 6.2 developments of an automotive group such as PSA Peugeot Citroën in less than six months."

El Mahdi Abghour, PSA Peugeot Citroën

Figure 2: The PSA project team members were Mohammed Dahhani, Julien Allard, and El Mahdi Abghour (left to right).

Cleverly Connected

Testing ECUs in a networked system

Software that is ever more connected is controlling vehicle functions that are ever more complex. To validate this software, developers need to have the option to connect Hardware-in-the-Loop (HiL) simulations of individual domains to form a network – and ideally to be able to switch back and forth between testing individual components and testing the connected system. ETAS has now developed a solution for flexible real-time networking of component HiLs, and it also offers an impressive open architecture.

AUTHORS

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In connected vehicles, electronic control units (ECUs) act as neural nodes. Because safety, powertrain, and convenience functions are increasingly interacting with each other, the distributed ECU intelligence needs to be interconnected. This, in turn, requires that the software for the relevant ECUs function smoothly and be capable of interoperating.

Hardware-in-the-Loop (HiL) simulation has proven very effective for validating ECU software. Now it is important to test software functions in connected ECUs. This requires synchronous connectivity of the component HiLs used to validate individual software modules and functions, as well as guaranteed real-time data traffic.

ETAS Multi-Real-Time PC for network HiL

ETAS developed Multi-Real-Time PC (Multi-RTPC) as a solution for the ETAS LABCAR HiL system. It connects component HiL systems via Ethernet and incorporates new versions of both the ETAS LABCAR-OPERATOR HiL configuration and experiment environment and the ETAS LABCAR-RTPC simulation target.

The RTPC software turns normal PCs into high-performance real-time simulation targets that calculate models with cycle times of under 0.5 ms and satisfy even rigorous real-time requirements in simulating highly dynamic physical control processes. Developers can now integrate any number of RTPCs into a

LABCAR network HiL – in other words, they can scale it according to the complexity of the ECU network. This enables them to simulate connected, physically accurate complete-vehicle models with hybrid powertrain and many driver assistance systems in a network.

The LABCAR-RTPCs are linked via three separate networks (see figure). These networks are responsible for the following:

- Communication with the LABCAR-OPERATOR software on a host PC
- Time synchronization of the integrated simulation targets
- Exchange of data between the targets

The three channels – the component HiL connection, the multi-core PC technology based on the Intel Core i7 processor, and the standard interfaces and network protocols – ensure top performance. Every target can communicate with all other targets at transfer rates exceeding 80 MB/s. The domains are synchronized using the Precision Time Protocol (PTP) defined in IEEE 1588.

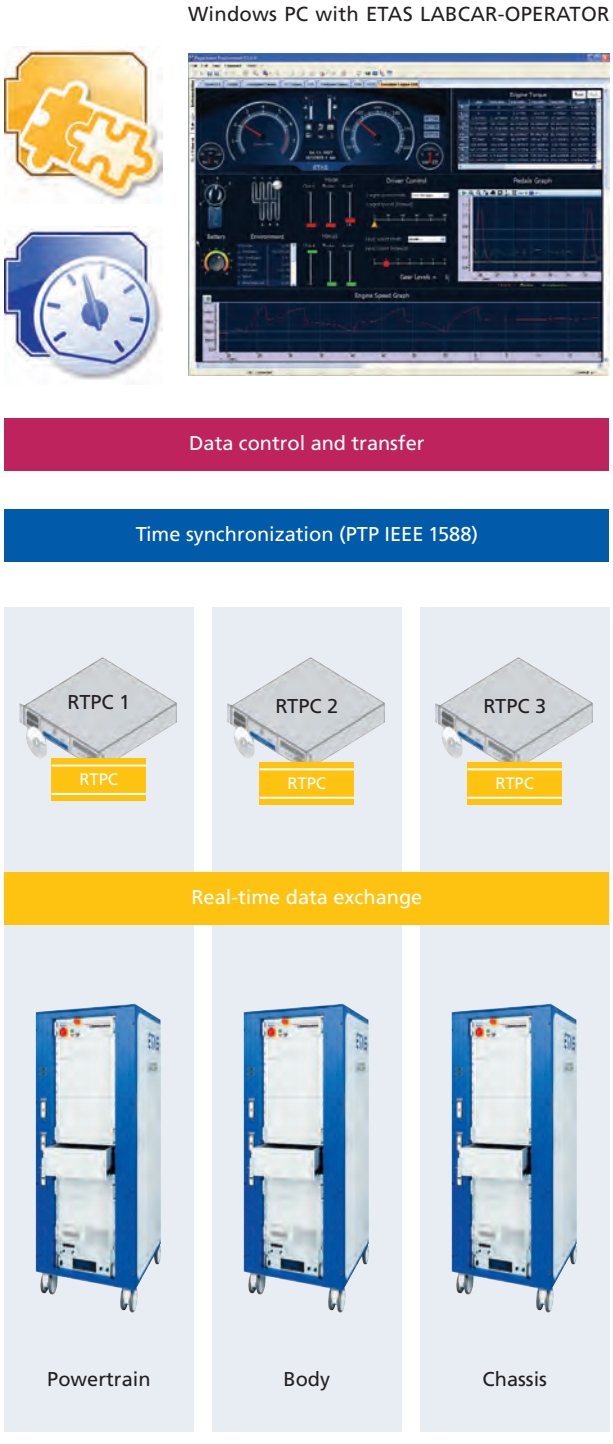
Modular design

The scalability of the network HiLs allows developers to test and validate ECU software individually at first, and then in a network. If connectivity and complexity continue their forward march, further component HiLs can easily be integrated. Thanks to standardized, tried-and-tested technology, it is easy to upgrade existing development environments to include Multi-RTPC. To keep costs down, ETAS paid special attention to the hardware, using Ethernet switches instead of expensive shared memory cards. The RTPCs incorporate PTP-capable network cards, which ensure synchronization of the simulation targets with deviations of <1 µs while costing barely more than conventional network adapters. Thanks to the progress that has been made in standardization, there is a broad array of manufacturers to choose from.

The component HiLs are connected to the network HiL via standard network communication, but they can also be operated separately, allowing developers from different areas to work in parallel. The LABCAR-OPERATOR software is useful for project configuration. Before creating the network HiLs, users set up one project for each of the individual component HiLs. When all interfaces and points of contact have been clearly established, the component HiLs can be merged using the new LABCAR-OPERATOR *Project Merger*, and then they can all be executed at the same time. Since the domain-specific HiLs are connected only by a network switch, users can continue to address the individual component HiLs without modifying the network wiring – so they can switch between the broad overview and the detailed view.

Outlook

Comprehensive environmental sensors and the trend toward partially automated driving are resulting in a rapid rise in system complexity and data traffic. That is why ETAS switched to a 64-bit Linux system for the latest version (V6.2.0) of the LABCAR-RTPC HiL simulation target – and why it continues to drive the performance and usability of its HiL solutions forward. After all, keeping the complexity manageable in the long term will only be possible with tools that provide optimum support for development processes.



Simplified structure of a complete-vehicle HiL system. Specialized PTP-capable network cards are required only for the PTP IEEE 1588 network. The other networks can function with standard network switches and cards.

Growing Partnerships

ETAS at universities all over the world

Sustainable research vehicle controlled by FlexECU

As part of their education, students from various courses of study at Germany's University of Esslingen build a research range extender vehicle to underline the theory they learned in their courses with practical experience. They build the powertrain by combining a combustion engine with an electric motor. To control the interaction of the two, they use the ETAS Flex-ECU as the main engine control unit. The software is realized with ETAS ASCET and ETAS EHOOKS, giving students hands-on training on these products. The following step is to calibrate the FlexECU with ETAS INCA. The project involves the students over the long term and gives them an opportunity to combine their ideas with innovative technologies.

Klaus Fronius, ETAS GmbH, Germany

Application software development for flex-fuel engines

The technical research and development group of the University of São Paulo, Brazil, in cooperation with ETAS, has developed application software for managing a multi-port fuel injection (MPFI) engine using ETAS ASCET, EHOOKS, INCA, FlexECU, and ES592. Although the software is now fully capable of the basic management of the engine, the group is taking it one step further, aiming to develop new functions and control algorithms for flex-fuel engines, with ETAS providing software, training, and consulting. In addition to developing innovations, the collaboration prepares students for the automotive field by giving them the opportunity to engage in hands-on projects using ETAS tools.

Pedro Rossetti, ETAS Brazil

ETAS shared its know-how during the Formula Student conference at Moscow Automobile and Road Construction State Technical University (MADI).

Activities within the Russian student community

Since 2015, ETAS and Bosch Russia have been working together to make the ETAS brand, tools, and solutions well-known to young talents within the Russian student community. During the Formula Student conference at Moscow Automobile and Road Construction State Technical University (MADI), ETAS presented its soft- and hardware to the students and provided them with software licences as well as measurement equipment. The short-term objective for 2016 is to include ETAS tools in the official training process at pilot universities, starting with ETAS INCA and followed by ETAS ASCET and ETAS ASCMO. In the long term, ETAS aims to be present at a great number of Russian technical universities.

Evgeny Evdonin, ETAS GmbH, Germany

Learning how to make cleaner cars

In the U.S., ETAS sponsors the prestigious EcoCAR 3 competition (www.ecocar3.org), a four-year engineering program with 16 competing college teams. General Motors donated a Chevrolet Camaro to each of the teams, who were then tasked with designing a powertrain configuration that reduces energy consumption and greenhouse gas and tailpipe emissions. In addition to funding, ETAS provided several of the teams with ETAS ES900 prototyping and interface modules, and is involved in training the students. EcoCAR 3 recently completed its Year Two Finals, and ETAS is looking forward to continuing its involvement in Years Three and Four.

Claudia Hartwell, ETAS Inc., USA

ETAS supports college teams in designing powertrain configurations for their EcoCAR 3 competition.

Automotive seminar at Tianjin University

In July 2016, ETAS held an automotive seminar at Tianjin University in China to deepen students' understanding of automotive software engineering, AUTOSAR, and the verification of operating systems. The seminar lasts two days and takes place every quarter. Additionally, ETAS and Tianjin University have also collaborated to create a lab where ETAS ASCET is used to develop ECUs for a common-rail diesel engine and to enhance students' software development skills.

Amanda Wang, ETAS Automotive Technology (Shanghai) Co., Ltd., China

Joint lecture series on safety and security

In April 2016, an expert from the Information Security Group at Germany's Ruhr University Bochum (RUB) and ESCRYPT hosted a one-week lecture series entitled *Security* in York, Great Britain. The lectures covered topics such as the fundamentals of IT security and cryptography, security standards, network security, and embedded security. The following month, two expert lecturers from the Department of Computer Science in York gave a one-week lecture series entitled *Safety* at RUB in Bochum. Students attending the lectures learn at an early stage about the important role that reliable and secure software components play in an age of increasingly connected and autonomous vehicles. The lecture series will be continued in the coming years.

Mareike Samsz, ESCRYPT GmbH, Gemany

Supporting French students in obtaining technician degree

The national technician degree in internal combustion engines (BTS MCI), which is well-known in the automotive field, is offered at eight schools across France, including Sadi Carnot and La Jolliverie. This two-year degree involves in-depth learning about the combustion engine. ETAS solutions are the most relevant ones for the practical portion of the degree, which covers measurement and calibration. For this reason, ETAS hardware and software, such as ETAS INCA and various measurement modules, are provided to these universities. During the two-year program, the 200 students who pursue the BTS MCI use ETAS products primarily on test benches for measurement and calibration purposes, thus learning how to work with ETAS tools, which are widely used in the automotive field. Students also gain the knowledge and skills they need to succeed in the job market or in the workplace.

Guillaume Hauchecorne and José de Almeida, ETAS S.A.S., France

Top Speed on Every Track

Calibrating motorsport and production vehicles with ETAS INCA

At WENDLAND MOTORENTECHNIK GmbH in Rangendingen, Germany, ETAS INCA is ever present, whether the team is preparing cars for the next race or optimizing production vehicle powertrains for low emissions. Looking back at more than three decades of motor racing experience – with many wins and records as well as a considerable number of production-vehicle projects – Dieter Wendland, the company's head, is entirely satisfied.

AUTHOR

Dieter Wendland, together with his brother Karl-Heinz, has been managing the business affairs of the engine technology company **WENDLAND MOTORENTECHNIK GmbH** in Rangendingen, Germany, since 1985.

Every racetrack has its own characteristics, and every race has different environmental and weather conditions. The conditions change even during the course of a weekend's racing, because there is so much rubber on the track towards the end that the tires noticeably lose traction. In any case, cold snaps or the onset of rain change everything.

For us at WENDLAND MOTORENTECHNIK, it's this uncertainty that makes motor racing so appealing. We have been optimizing racing car engines, transmissions, and chassis for over 30 years. On our test benches we simulate racetracks, we adapt powertrains, chassis, and transmissions to any upcoming race, and we coax thehighest levels of performance out of gasoline and diesel engines. We mainly work with Porsche engines, but just in 2014 we also put a VW Polo TDI on a racing chassis in Hockenheim and converted it from 130 bhp to 200 bhp. It still holds the diesel class track record today. Our other three vehicles were also best in class that weekend.

Such victories – which include our win in 2007, when we entered the ADAC Rallye Masters for the first and currently only time, as well as our triumphs in many Porsche Carrera Cup and Porsche Supercup races and even the 24 Hours Nürburgring event – are the icing on the cake. Just getting ready for a race is pure joy. We are caught up in dismantling and gauging engine components as we revise them, in reading and analyzing vehicle data at our test benches and the racetrack, in deciding on which tires to use and the suspension geometry, and in developing the race strategy. Then, on the night before the race, we realize just how many things are different than expected. That's when we work until deep into the night, tweaking the

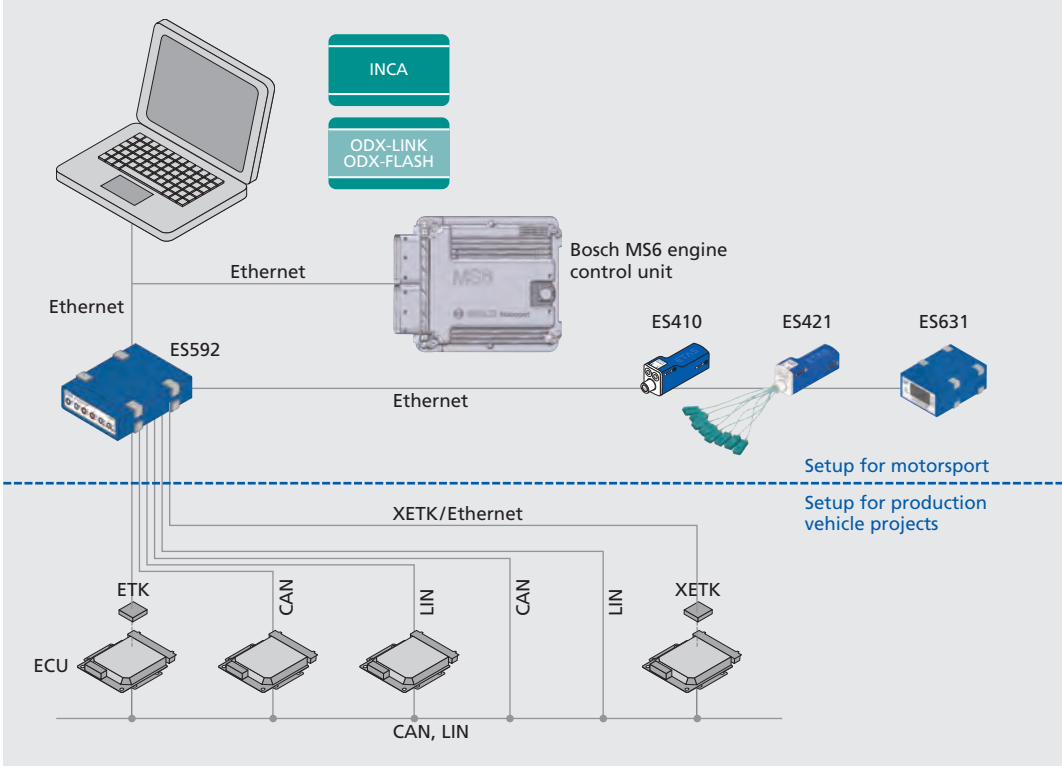
A Wendland Porsche 911 having its power measured on the dynamometer test bench.

engine management system and fine-tuning the gear pairs or the chassis design. I wouldn't want to change places with anyone. We have fulfilled our dream and turned our hobby into our job.

On this journey, ETAS has been at our side almost from the beginning. I can still remember the INCA V1.0 measurement, calibration, and diagnostics software, that came in a dedicated motorsport version. Today, we're using INCA V7.2. That means we've worked with seven generations of this tool – in the context both of motor racing and also of our production vehicle projects, where our role is to provide services for powertrain development and calibration. Before a race, we use INCA to go over the mappings of all the powertrain parameters: ignition timings, fuel injection strategies, turbocharger boost pressures, and many more things. On the basis of this, we aim to adjust the calibration of the engine and transmission control units in order to optimize the responsiveness and acceleration respectively for the racetrack in question.

Our calibration experience in the motor racing context teaches us a lot of things that can be applied in the production vehicle context, and vice versa – particularly as regards the relationship between fuel consumption and performance. Efficiency is essential. Moreover, emissions limits are an important matter on public roads in the same way as there are regulations that have to be obeyed on racetracks. In both cases, INCA helps us to gather and evaluate powertrain data and to calibrate engines in a way that conforms to the regulations. It is *the* calibration tool on the market – and with good reason. On the one hand, the INCA product family's open interfaces and its compliance with the most important industry standards make it easy for us to integrate it into the hardware and software environment that we have developed. On the other hand, it simplifies our work because the graphical measurement displays and oscilloscopes, the ease of use, and also the calibration and data management tools are all well thought out. When we're caught up in the stressful stages of a project or when we're preparing for a race, this defined structure is very helpful. And last but not least, our measuring equipment comes from ETAS, too – in other words, Lambda Module and devices for measuring temperature, voltage, and pressure. This equipment gives us a fast and flexible setup, and we can rely on the accuracy of the measurements as well as on their time-synchronous acquisition and transmission.

We've been working with INCA successfully for over 20 years. Yet even now I am still discovering new possibilities of this calibration software. Measuring equipment has advanced enormously in recent years, and consequently we can work faster and with greater precision today. For us, the functions afforded by the INCA product family are a key to our success – both on the racetrack and in production vehicle projects. We need state-of-the-art measuring equipment and well thought-out tools if we are to master the increasing complexity of tuning and calibrating production powertrains. That is all the more true during the stress of preparing for a race. We've been counting on ETAS tools for two decades, and so it was the perfect match when ETAS came on board as one of our sponsors two years ago. Together we're hitting top speed on every track.



Dieter Wendland relies on INCA V7.2 to calibrate and adjust his engine control units. In this process, he uses INCA software to transfer data through an ES592 Universal Interface Module to a PC. The data is collected by an ES410 A/D Module and an ES421 Thermo Module. The ES631 Lambda Module measures the oxygen content in the exhaust gas and records the ambient atmospheric pressure.

ETAS FETK-T and -S

New interfaces for high-performance ECUs

The FETK is a new interface for high-performance ECUs that connects the ECU and the host application through XCP via Gigabit Ethernet. FETK hardware is available in two versions, T and S, for trace and serial debug interfaces.

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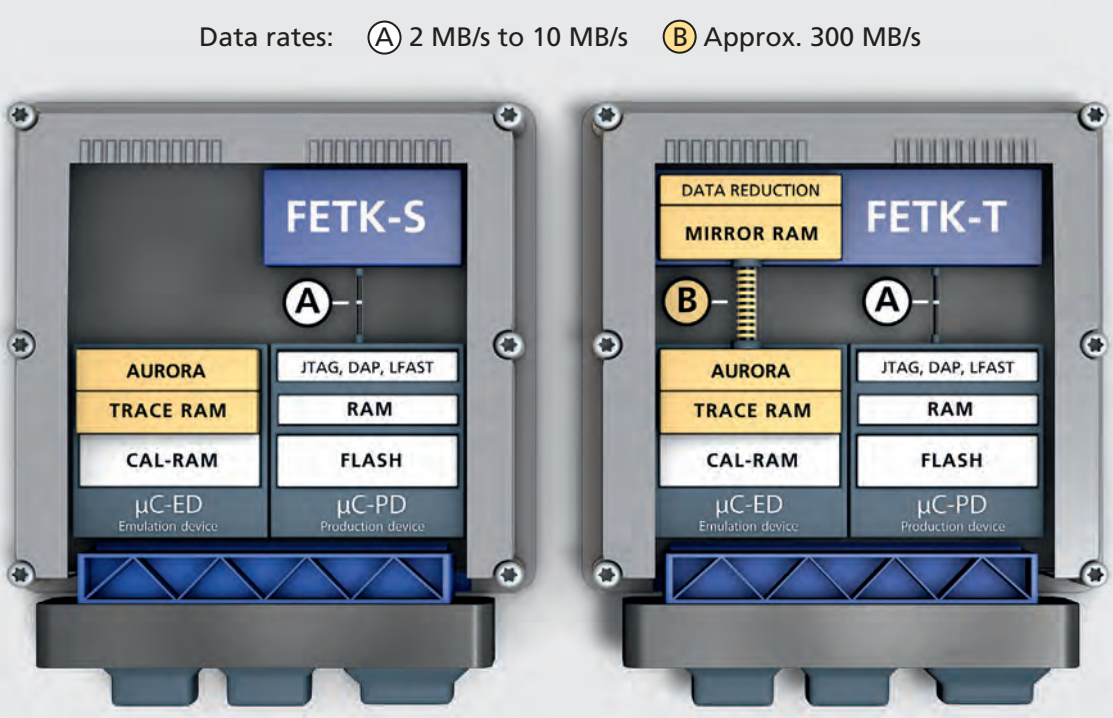
Christoph Müller is Senior Product Manager FETK at **ETAS GmbH**.

For measurement purposes, users can achieve maximum data throughput with FETK-T. Measurement values can be recorded from the ECU at a raw data rate of up to 300 MB/s via the trace/Aurora interface. This has almost no impact on the runtime behavior of the microcontroller (µC) in the ECU, because trace data is generated independently of the ECU program through automatic copying of the values of the relevant measurement signals, which the µC cores write to RAM cells. In FETK-T, the trace data (consisting of time stamp, memory addresses, values, and trigger events) is written to a mirror RAM. In the mirror RAM, the trace data is selected from the various measurement rasters with respect to trigger time, thus reducing the data volume.

Connection through XCP and to ETAS INCA

Using the same cable type, both FETK versions are connected to an



FETKs are available in two versions: FETK-S (left) and FETK-T (right). Both variants use a microcontroller-specific production device (µC-PD) debug interface such as JTAG (Joint Test Action Group), DAP, or LFAST as access to the ECU. The FETK-T version additionally supports the particularly powerful µC emulation device (µC-ED) trace interfaces together with the high-performance transmission of trace data from the ECU via the serial Aurora interface.

ES891 or ES892 interface module, through which they communicate over the efficient, latency-optimized FETK protocol. Via the ES89x module, applications can access the FETK ECU interface using the XCP protocol, which allows easy integration with customized solutions or third-party tools.

Transmission of the measured data payload currently reaches speeds of 20 MB/s over the entire route from the FETK to the INCA V7.2 application on the host computer. Thanks to the µC trace mechanism's high raw data rate, the FETK-T is capable of recording signals from control processes with repetition frequencies of up to 200 kHz with great time precision. For prototyping and configuration purposes, both FETK-S and FETK-T use the microcontroller's debug interface. Through its µC connection via debug interface, FETK-S delivers a measurement performance that is well suited for many calibration tasks.

High data transmission rate and low latency

Their compact, 46 x 25 mm footprint makes the new FETKs ideal for installation in production ECU housings, allowing companies to reduce the costs of calibration projects. They assist research and application engineers as well as function developers in their work. Users can simultaneously record large volumes of measurement data from ECUs while running and adapting characteristic values in the ECU. Furthermore, real-time-capable systems can be connected, such as the ES910 prototyping and interface module. A new prototyping module to join the ES800 family, and that uses the ES800 system's PCI Express interface, is in the planning stage. It will allow users to achieve very short measurement and calibration cycles on the test bench and calculate new functions synchronously with the control unit in short time frames with very low latency and without raster offset in the external bypass. In addition, via the FETK access, users can program ECU flash memories and connect software debuggers in parallel to a development tool.

Summary

With the ES800 hardware product family and FETK ECU interface, users can record measurement data from ECUs and the system environment synchronously at high rates. This solution allows the implementation of modular systems that meet the high requirements for validating electronic systems in the next generations of vehicles. The FETK/ES800 solution makes it possible to significantly increase both the efficiency and quality of the calibration and validation of electronic systems in the vehicle and on the test bench.

Feature	FETK-S	FETK-T
Microcontroller (µC) support	▪ Infineon AURIX µC ▪ NXP MPC57xx and STMicroelectronics EMU57xx families	▪ Infineon AURIX µC
Data rate between µC and host application	▪ 2 MB/s (typically)	▪ 20 MB/s (currently with INCA V7.2)
Return time of a 128-byte signal between FETK and prototyping module (latency)	▪ Via Ethernet (ES910 module): 220 µs ▪ Via PCI Express: under 100 µs	
Smallest measurement grid	▪ 50 µs	▪ 5 µs
Flash programming time	▪ 8 MB/s	

Features of the two ECU interfaces FETK-S and FETK-T.

ETAS INCA V7.2

A new basis for top performance

Available since the second quarter of 2016, the ETAS FETK-T interface for high-performance ECUs allows recording of ECU signals at rates of up to 20 MB/s. On the software side, ETAS offers flexible INCA tools for recording measurement data and for calibrating and diagnosing ECUs. In combination with the FETK-T as well as the ES891 or ES892 interface modules, the new INCA V7.2 release enables data processing at high clock speeds. This makes it possible to perform actions such as simultaneous capturing and recording of more than 56,000 different variables from the ECU during measurement trips. Coinciding with the release of INCA V7.2, the latest firmware update of the ES89x modules means they now support the integration of CAN, CAN FD, LIN, and FlexRay vehicle buses.

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Excellent software performance

To enable more convenient preparation of the extremely comprehensive measurements, the loading times needed for opening the INCA experimentation environment and variables selection dialog window have been significantly reduced. In addition, the variables selection dialog window has been upgraded so that numerous signals can be quickly and easily selected and assigned to measurement rasters. For instance, it is now possible with one click to select all measurement parameters of a function or group within the corresponding views (see figure 1).

Real-time connection between ECU and test bench

Together with the ES910 prototyping and interface module, the INCA-MCE (Measurement and Calibration Embedded) add-on is capable of establishing a real-time connection between the test bench and the ECU. In addition, INCA V7.2 now supports the measurement grids of ECUs with signal lengths totaling more than 1024 bytes. Configuration of the embedded INCA system on the ES910 module has also been simplified. All measurement and adjustment parameters of an INCA experiment can now be automatically added to this configuration.

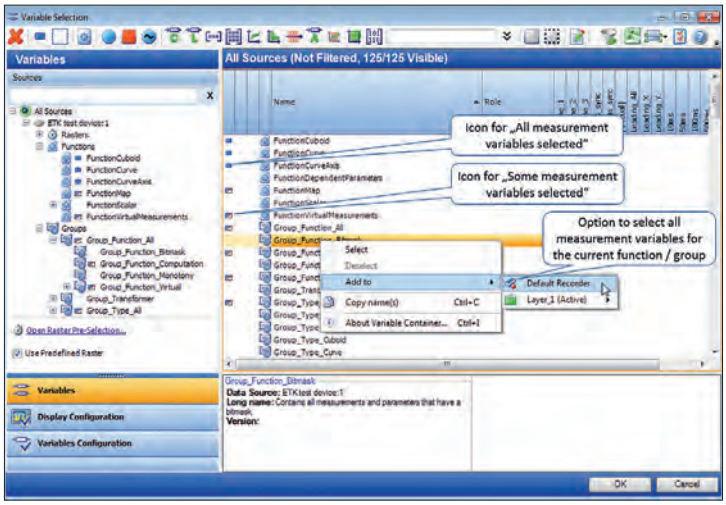

Figure 1: In the variables selection dialog, users can select all measurement variables of one or multiple functions/groups for measurement at the same time. INCA adds the measurement variables to the default raster.

Simulink® integration included

Starting with INCA V7.2, licenses are also available for INCA-LIN and INCA-FLEXRAY; as with other INCA add-ons, these licenses can be tied to computers or individual users, or they can float. The functionality of the INCA-SIP add-on is now included as a part of the INCA-EIP (Experimental Target Integration Package) add-on. This allows parameter values from MATLAB®/Simulink® models to be recorded and modified during running simulations within

Figure 2: Acquisition of data from the ECU through the FETK interface. FETKs are offered in two versions, FETK-S (left) and FETK-T (right). Both variants use a microcontroller-specific production device (µC-PD) debug interface such as JTAG (Joint Test Action Group), DAP, or LFAST as control access. Additionally, T-type FETKs support the particularly powerful µC emulation device (µC-ED) trace interfaces, along with the high-performance transmission of trace data from the ECU over the serial Aurora interface.

INCA. It is available to all INCA-EIP users at no additional cost.

Installation

INCA V7.2 can be installed either by itself, or alongside an existing version 7.1 software installation on the computer. For the first time, the installation routine is based on Microsoft Installer (MSI) technology, which greatly simplifies the rollout of centrally coordinated, automated INCA installations. This process uses the familiar service pack installation interface. The range of software tools required can be installed and configured by the user in a single step using the MSI routine, which allows installation not just of the INCA base product but also of several add-ons as well as ETAS' MDA Measurement Data Analysis. Furthermore, the routine ensures compatibility between the various add-on versions and the base installation.

As a part of INCA's continuous development, quarterly service packs have been made available as of version 7.1. The currently available version 7.2 encompasses all features from the INCA V7.1 service pack, as well as several new features. In addition to the Microsoft Windows Vista, 7, 8, and 8.1 operating systems, INCA V7.2 also supports Windows 10.

A complete description of all INCA family software products, as well as all new features available with INCA V7.2, can be found at www.etas.com/INCA and in the release notes of the installation DVD.

INCA-FLOW at Ford

AUTHORS

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Efficiency gains in diesel aftertreatment systems calibration

For all types of diesel vehicles, US Environmental Protection Agency (EPA) regulations require strategies that induce drivers of vehicles with selective catalytic reduction (SCR) exhaust aftertreatment systems to keep diesel exhaust fluid (DEF) on board and ensure that aftertreatment systems remain functional. In practice, the inducement takes the form of a performance penalty applied by the electronic control unit to the engine in certain circumstances.

These circumstances include a low level of diesel exhaust fluid, incorrect fluid in the DEF tank, or the occurrence of SCR faults. To prevent activation of an SCR inducement, a number of alerts, such as warning lights in the instrument cluster, are provided to draw the driver's attention to low DEF levels or the wrong fluid, for example. Numerous SCR inducement tests have to be performed to ensure the functionality of SCR systems.

Automation of SCR inducement tests

ETAS INCA-FLOW is used to automate the SCR inducement audit tests. Once the INCA-FLOW script (see figure 1) has been started, the test inserts the relevant vehicle functions into the warning chain. It then runs through all the messages in that chain, enters the SCR inducement chain, and exits it at the end of the test.

Here is how INCA-FLOW guides the calibrator in the car: first, INCA-FLOW asks the calibrator to start the engine. Once the script detects that the engine has started, it asks the calibrator if the cluster is displaying a warning message saying that vehicle speed will be limited to 50 mph. It then requests that the calibrator turns the engine off, waits for an ECU reset, and turns the engine on again. INCA-FLOW automatically detects the ECU reset and asks the calibrator if speed is again limited to 50 mph. It then detects a series of warning messages such as *engine idled soon, put on the parking brake,* or *engine idled, see manual* and guides the calibrator through all of them (see figure 2). At the end of the test, INCA-FLOW automatically undoes all the changes the user has made by copying the reference page to the working page in the ECU memory and ensuring that all cluster warnings are reset.

INCA-FLOW automates the complete SCR inducement test series. It makes sure that every test is executed with the correct presets and automatically generates the complete documentation required in parallel. Test results are stored automatically in an Excel template provided by the user, with each change in the warning and inducement state recorded there as well. The certification process itself is documented in INCA-FLOW and can be easily extended if required. The resulting report can be presented to agencies or other stakeholders who need to verify the compliance of the tests.

Benefits of INCA-FLOW

The growing number of vehicle variants, extensive diagnostic requirements, decrease in test vehicles, and increasingly ambitious quality goals require the standardization of measurement and calibration procedures in diesel systems. Calibration and validation efforts can be largely reduced by employing automation, numerical optimization, and simulation methods. INCA-FLOW provides solutions that make in-vehicle calibration and validation more efficient. The software facilitates simple graphical specification of measurement and calibration procedures to address the demand for automation, guidance, and documentation of calibration and validation processes. And despite all the benefits it offers, the tool does not require any special programming skills.

INCA-FLOW aims to reduce manual calibration errors, and its results are easily reproducible for each control

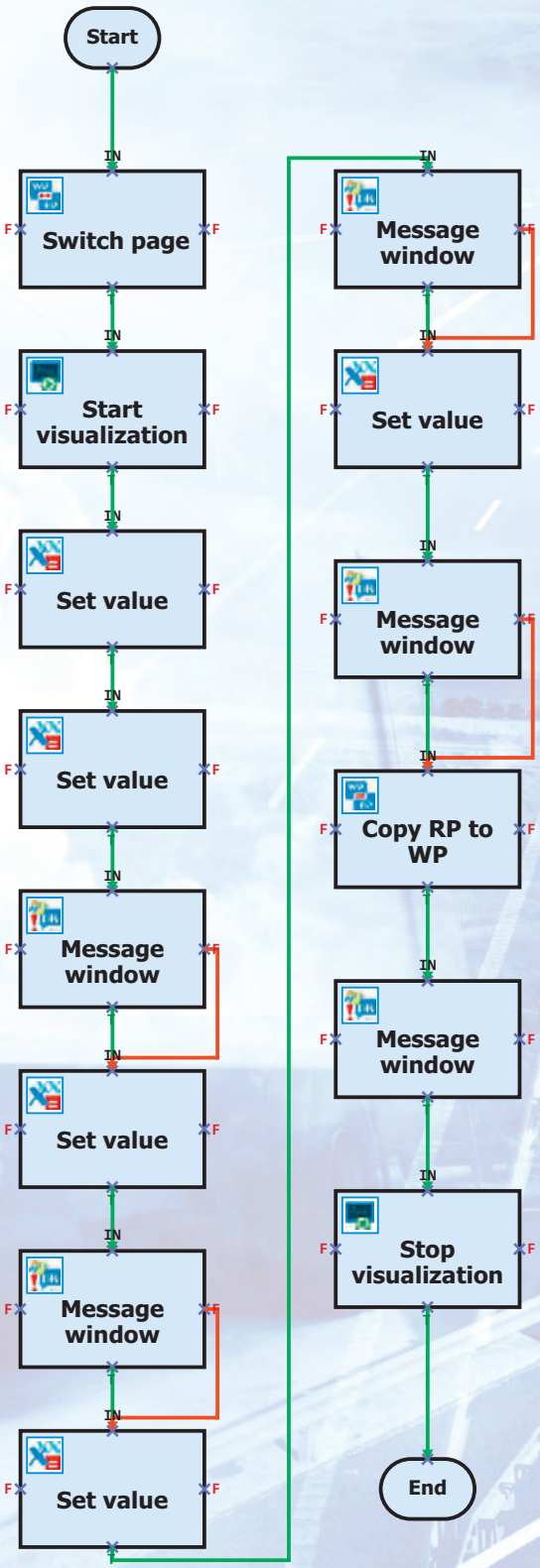


Figure 1: INCA-FLOW SCR inducement test flow chart.

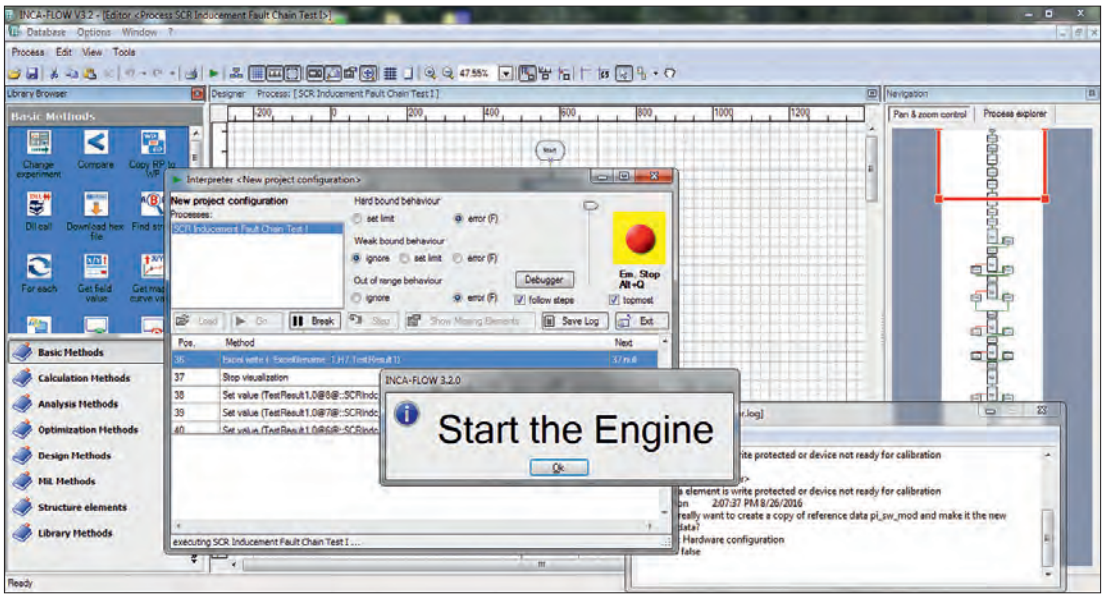


Figure 2: Guided testing of SCR inducements in the vehicle with INCA-FLOW.

function and variant. User-defined variables such as counters, Boolean values, and timers employed in the INCA-FLOW calibration procedure are viewable in the INCA experiment through the XCP gateway (see figure 3). Through this mechanism, user-defined values in INCA-FLOW are stored in the same MDF file as ECU data acquired with INCA. The XCP gateway enables the user to analyze the MDF data easily should any problems occur.

Conclusion

Engineers can plan the calibration tasks at their desk in the office, in order to make the most of their time in the test vehicle. Other important benefits include the improved up-skilling phase for new calibrators and the fact that best practice in calibration can be established throughout the company. In addition to SCR inducement testing, INCA-FLOW is used for other auto-calibration and validation tests at the Ford Motor Company such as emission control, onboard diagnostics (OBD), and drivability.

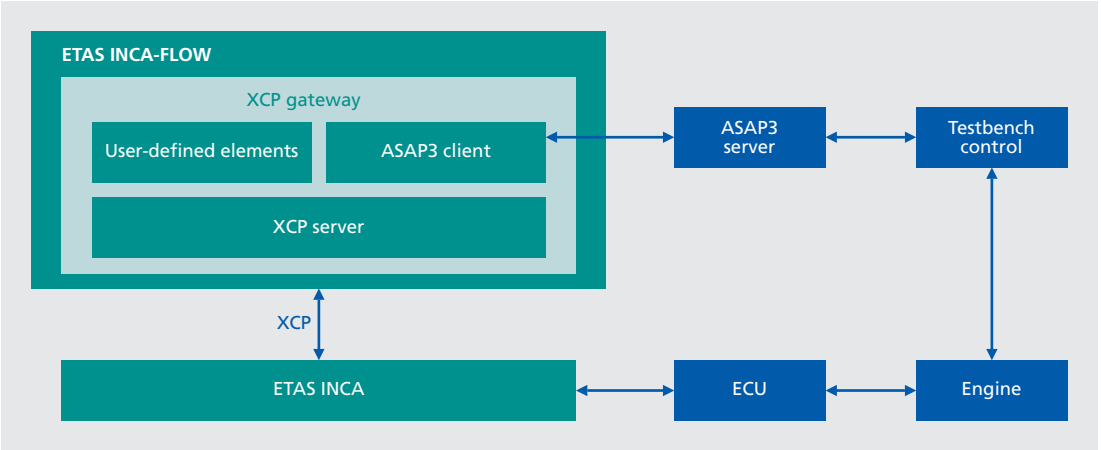


Figure 3: The XCP gateway integrated into INCA-FLOW allows INCA to access values of variables that have been defined by the user in INCA-FLOW as a function of time. When INCA-FLOW is connected to the test-bench control via ASAP3 or CAN, the values of testbench parameters such as load or speed can also be accessed by INCA through the XCP gateway. INCA integrates all required data into one measurement file.

New ETAS Location in Canada

ETAS joins Waterloo Region's center of technology innovation

In June 2016, ETAS celebrated the opening of a new office in Waterloo Region, Canada. Working closely with ETAS' subsidiary and embedded security specialist ESCRYPT, ETAS Embedded Systems Canada Inc. will provide integrated safety and security solutions for embedded systems.

AUTHORS

Claudia Hartwell is Senior Marketing Specialist Communications at **ETAS Inc.** in Ann Arbor, Michigan, USA.

David MacFarlane is General Manager at **ETAS Embedded Systems Canada Inc.** in Kitchener, Ontario, Canada.

Friedhelm Pickhard, President of the Board of Management of ETAS GmbH, was in attendance and delivered the opening speech: "This new facility will allow us to further improve our development and consulting capabilities and strengthen our position as a provider of innovative solutions for embedded systems. It will be a valuable addition to our network of locations offering end-to-end safety and security solutions."

Waterloo Region is an incubator for innovation

With its new office in Waterloo Region – more specific, in the city of Kitchener, Ontario – ETAS joins an ecosystem of innovative technology companies and research institutes and is strategically placed to collaborate with world-class education facilities, including the University of Waterloo. Thomas Wollinger, Managing Director at ESCRYPT GmbH, is excited about the Canadian office: "We have taken an important step in continuing the internationalization of our business. Waterloo is an incubator for innovation – especially with regard to automotive security solutions. ESCRYPT's focus for the new location will be to develop comprehensive cyber defense solutions for cars."

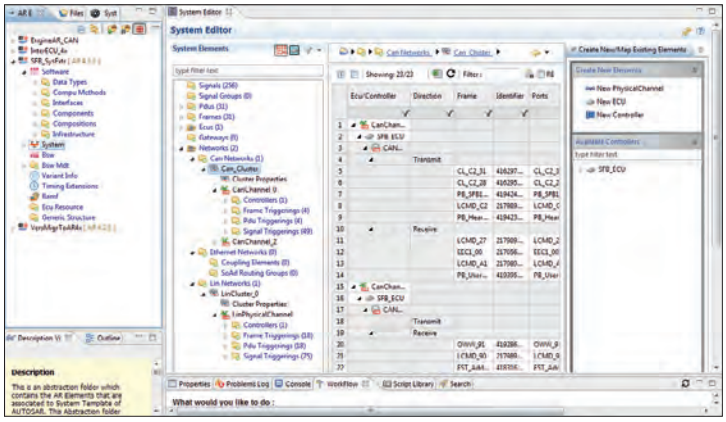
Cooperation with local research facilities

David MacFarlane, the new General Manager of ETAS Embedded Systems Canada Inc., is not only an expert in cyber security, he is also a graduate of the University of Waterloo. It should come as no surprise that ETAS will expand its research activities in cooperation with local universities. "I'm continually impressed with the results of cooperation with local research facilities like the University of Waterloo," MacFarlane says. "Our local universities have talented students and produce high-quality graduates, so I'm excited to develop partnerships and offer rewarding placements in the area of embedded security."

Opening ceremony of the new ETAS location (from left to right): Tony LaMantia, CEO of the Waterloo Region Economic Development Corporation; Thomas Wollinger, Managing Director of ESCRYPT GmbH; David MacFarlane, General Manager of ETAS Embedded Systems Canada Inc.; Friedhelm Pickhard, President of the ETAS Board of Management; Berry Vrbanovic, Mayor, City of Kitchener.

ISOLAR-A News

The integrated AUTOSAR architecture and basic software configuration tool ETAS ISOLAR-A **supports AUTOSAR developers** through sophisticated editors, the importing of DBC, LDF, FIBEX, and ODX formats, and assistance with iterative customer workflows. ISOLAR-A is the tool of choice for configuring AUTOSAR systems and software, for generating system, ECU, and diagnostics extracts, and for carrying out RTE configurations up to and including the latest AUTOSAR Release 4.2.2. For configuration of the ECU basic software, users have a powerful and expandable tool at their disposal with the Basic Software Configuration Tool (BCT) add-on. In addition, BCT supports code generation for the basic software (using ETAS RTA-BSW for instance). Both ISOLAR-A and BCT are based on Eclipse and Artop, which facilitates integration into customer-specific development environments. The integration of other ETAS and third-party tools is also possible.

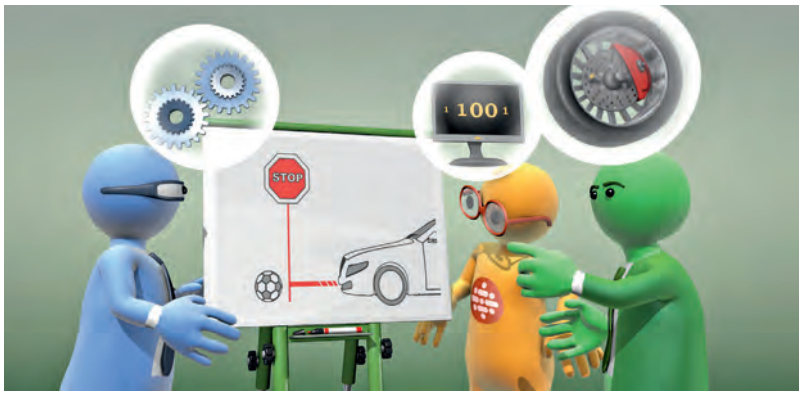


The system editor helps users configure networks, messages, protocol data units (PDUs), signals, and more.

New RTA Products

ETAS RTA-BSW (Basic Software) is the **next-generation software platform for AUTOSAR basic software** that supports ECUs. Easy to configure, integrate, and test, it supports the deployment of applications on real ECU hardware as well as on virtual targets. RTA-BSW components have been developed as safety elements out of context (SEooC) in accordance with ASIL D-compliant ISO 26262 processes and can be used in even the most demanding safety-critical applications. It supports AUTOSAR 4.x and consists of several stacks that provide support for a wide range of features, including the operating system, runtime environment, memory, communication via CAN and LIN, and diagnostic and calibration protocols such as XCP. ETAS provides an RTA Starter Kit, which comprises a complete AUTOSAR environment, including ISOLAR-A editor, basic software components, operating system (RTA-OS), and runtime environment (RTA-RTE).

New Safety and Security Video

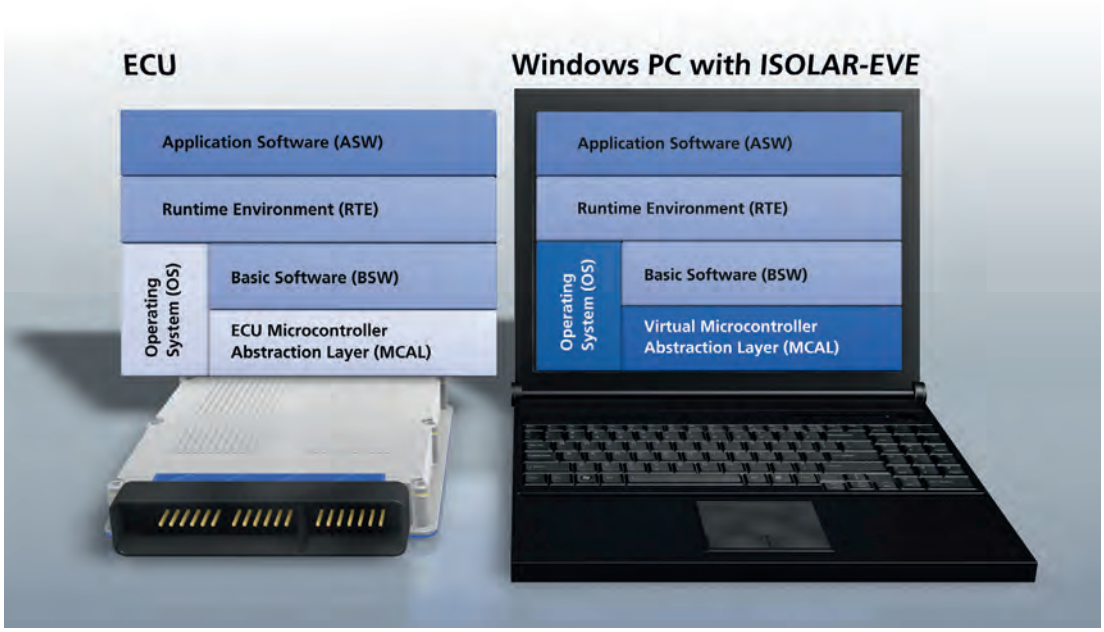


Scene from the video *Safety and Security with ETAS and ESCRYPT.*

In cars, safety and security are paramount: they ensure **safe driving without compromises**. This also holds true for the software embedded in a vehicle's many electronic control units. The software has to work reliably in all situations, which is easier said than done. Our entertaining new video *Safety and Security with ETAS and ESCRYPT* spells out the development steps needed for the relevant software. All aspects of safety and security are guaranteed even when malfunctions occur thanks to the solutions by ETAS and ESCRYPT. You can find the video here: www.etas.com/safetyvideo. Enjoy!

Innovations in ISOLAR-EVE

Version 3.1 of ETAS ISOLAR-EVE, the latest version of the ETAS tool for developing and testing with the aid of virtual ECUs, **can also be installed on Windows 10 systems**. Because it now exclusively supports 64-bit Windows and LINUX operating systems, it can make optimum use of PC resources. ISOLAR-EVE V3.1 supports AUTOSAR R4.2 and was expanded to incorporate a microcontroller abstraction layer (MCAL) for **automotive Ethernet.** In addition, it offers a range of enhanced details, including through the use of new versions of RTA-OS (AUTOSAR operating system) and RTA-RTE (AUTOSAR runtime environment). ISOLAR-EVE V3.1 permits the use of runtime environments and AUTOSAR basic software supplied by ETAS as well as third-party providers.



ISOLAR-EVE realistically simulates an ECU on a Windows PC.

New LABCAR Boards

The new boards for the ETAS ES53xx product family are used flexibly in many typical **HiL test applications for automotive ECUs**, such as in powertrains or hybrid electronic vehicles. They provide functions for the generation and measurement of the following:

- Analog and discrete I/O signals
- Digital and PWM I/O signals (e.g. ES5321, ES5340, ES5350)
- Arbitrary signal forms (ASG)
- Multi-pulse signals
- Resistor cascades
- Current signals (e.g. ES5321, ES5335, ES5385)

In addition, some of the boards, for instance the ES5392, allow the simulation of battery nodes such as terminal 15 or terminal 30 and of electrical injector loads (controlled valve operation, CVO, and valve closing control, VCC). Other boards, e.g. ES5321 and ES5338, support the automotive protocols SENT and PSI5. Thanks to the use of PCIe technology, the ES53xx boards are also open to boards from third-party providers and their functionalities.

"Product of the Year" Award by *Elektronik* Magazine

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Ralf Rick is Application Project Manager at **ETAS GmbH**.

ETAS EHANDBOOK achieves third place in the *Automotive* category

Readers of the trade magazines *Elektronik* and *Elektronik automotive* voted ETAS' EHANDBOOK interactive documentation tool third place in their "Product of the Year 2016" awards. In second place was Bosch's solid-state cell for lithium-ion batteries, and first place was taken by Audi's Matrix laser headlights.

With EHANDBOOK, ETAS provides a new solution for the documentation of electronic control unit (ECU) software. This solution enables information to be located more quickly and to be better understood. EHANDBOOK's documentation helps users focus on their key tasks when calibrating ECUs and developing functions. With its interactive and flexible graphical displays, EHANDBOOK's documentation is of enormous benefit to engineers who need to have a precise understanding of ECU logic for their work in areas such as calibration or function development.

ECU documentation for calibration and function development

Unlike extensive PDF documentation, EHANDBOOK makes it possible for functional interactions, such as the interdependencies of functions and signals, to be seamlessly displayed in an interactive model. On top of that, searches for particular information (e.g. measurement and calibration variables) are specific and fast, even when the documentation has large amounts of content.

In the ETAS solution, ECU documentation is generated from various pieces of source data by a tool (EHANDBOOK Container Build) that can be flexibly adapted to the development environment. In this process,

Figure 1: On behalf of ETAS, Ralf Rick and Dr. Patrick Frey (first and second from the right) accepted the EHANDBOOK award in the *Automotive* category.

specification models generated in ETAS ASCET or MATLAB®/Simulink® are translated into interactive graphical models optimized for the purposes of the documentation. Functions that were manually coded in C can also be represented in the form of graphical interactive models. In addition, the documentation content is supplemented by data from different sources. Measurements, such as ECU variables and parameters, that are contained in texts, images, and interactive models are automatically identified and indexed. Links are created between these objects to allow for function overviews to be generated.

Software developers and calibration engineers can use the EHANDBOOK-NAVIGATOR tool to explore and analyze the prepared content, which is made available in the form of EHANDBOOK Containers (see figure 2).

EHANDBOOK-NAVIGATOR can be used to merge several EHANDBOOK Containers in a flexible fashion. This means users can incorporate individual software documentation from several automotive and ECU manufacturers seamlessly into complete documentation of the entire software that is embedded in an electronically controlled system.

Connection to ETAS INCA

In practical applications, the efficiency of this new documentation solution is increased even further due to the seamless interface of EHANDBOOK-NAVIGATOR with the INCA measurement and calibration tool. The interface enables the automatic generation of INCA experiments with measurement and calibration labels directly from EHANDBOOK-NAVIGATOR. In reverse, measured values from the INCA experiment can be displayed live in EHANDBOOK-NAVIGATOR.

Know-how protection included

EHANDBOOK is geared towards producing a comprehensive and clearly organized display of the functional interactions in an ECU. Key to this are special interactive graphical models that are generated by means of various innovative technologies, such as graphically displaying C code logic in the form of block diagrams. As a result, EHANDBOOK is particularly suitable for the documentation of software being developed by manufacturers and suppliers in joint projects. However, this kind of collaboration means that there has to be protection for companies' intellectual property rights over their software. This protection is guaranteed by the interactive models, which are not suitable for generating code and cannot be modified by software development tools.

Distribution

ETAS is continuing to develop EHANDBOOK in close collaboration with its customers. Bosch provides EHANDBOOK documentation of engine control software upon request. Aside from that, several automotive and ECU manufacturers are already using this award-winning solution to make documentation of their content.

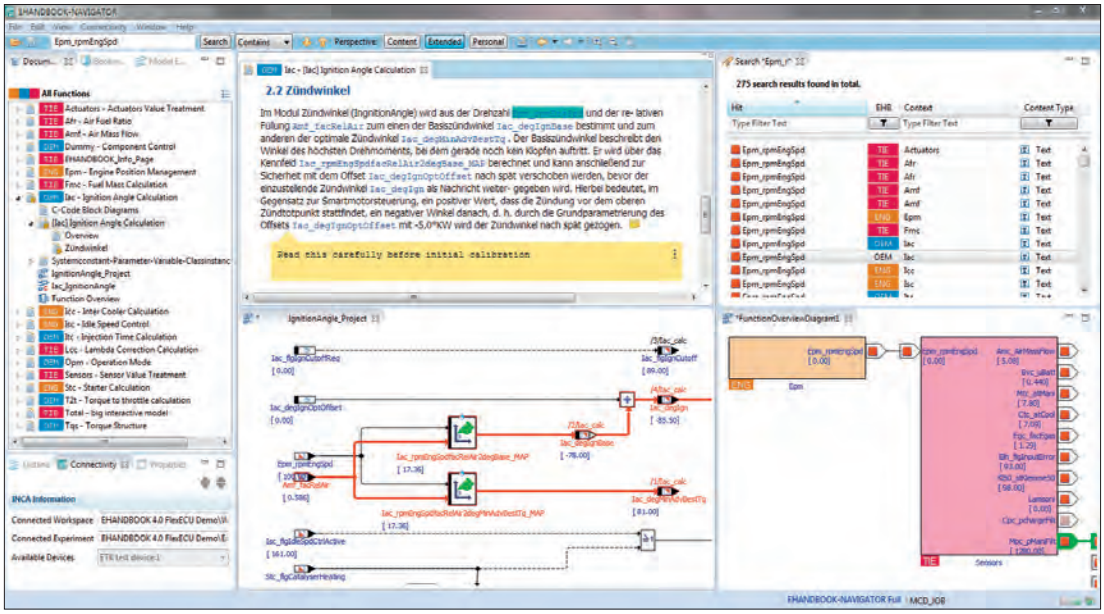


Figure 2: User interface of the EHANDBOOK-NAVIGATOR tool.

ETAS MDA V8

Next-generation Measure Data Analyzer

With the newly developed MDA V8 tool for the analysis of measurement data, users can efficiently evaluate measurements with a large volume of data. Measurement data files with a hundred thousand signals recorded in any given number of time rasters can be opened quickly and processed swiftly. To do this, the new MDA offers a clearly structured user interface and a sophisticated virtual oscilloscope with innovative operating concepts that were developed jointly with pilot users. For example, short periods in long measurement series can be easily zoomed out with an intuitive time slider and conveniently shifted along the measurement series.

AUTHORS

Dr. Matthias Gekeler is Product Manager MDA at **ETAS GmbH**.

Dr. Ulrich Lauff is Senior Expert Marketing Communication at **ETAS GmbH**.

User-centric

The completely redesigned user interface of the new MDA is a real eye-catcher. As with the current versions of the Microsoft Office tools, entries in the MDA menu are clearly arranged in a ribbon. The MDA V8 user interface is available in German, English, French, Japanese, and Chinese.

By default, on the left and right edges of the screen there are Explorer views for the management of configurations, measurement data files, and signals. The measurement data is evaluated in the central area of the screen with the aid of various instruments. For a better overview, the evaluation range can be divided into as many levels as desired. The levels, instruments, and signals can be stored together as an evaluation configuration that is linked to the measurement data files used. Once saved, an evaluation configuration can be simply reused by replacing the allocated measurement data file. As many evaluation configurations as desired can be open within an MDA session.

Tailored to applications

Both the Explorer views and the evaluation range or its individual levels can be flexibly rearranged by means of docking and floating mechanisms and thus distributed between several computer screens. The MDA currently offers two instruments: a virtual oscilloscope and a tabular view that displays time-related signals. The oscilloscope's measurement display can be subdivided into several strips in which signals can be shown separately from one another. If several oscilloscopes are used, the measurement displays can be simultaneously scrolled along the time axis and the same periods simultaneously zoomed out. Meanwhile, the tabular displays provide a detailed view of the individual measurements. When comparing signals that were sampled at different frequencies, users have the option of choosing whether to display only actually measured values or to fill in measurement gaps with interpolated data.

For fast navigation between the different instruments at one level, the tool shows thumbnails and previews of them in the task bar. The *Configuration Manager* shows the active evaluation configuration with its levels, instruments, and signals displayed in an Explorer-style interactive tree structure. Evaluation configurations can be modified simply through customary drag & drop operations. This enables users to place measurement signals from the *Configuration Manager* or the *Signal Explorer*, for example, or display instruments from the *Tool Box* onto working levels.

Based on the signals measured, users can enter formulas to calculate derived signals in just a few steps. To this end, there is an intuitive formula editor with which to freely define calculation rules that can be combined with any given functions.

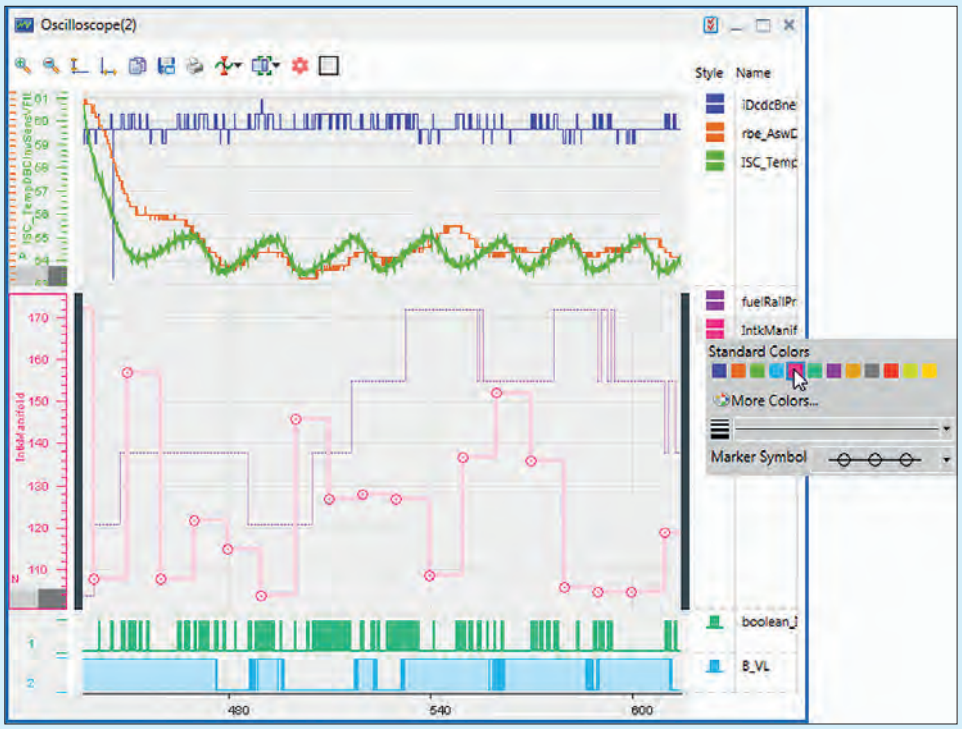
MDF-compatible

MDA V8 reads and writes all the versions of the MDF (Measurement Data Format) file format. In particular, it supports the indication and compression of measurement data

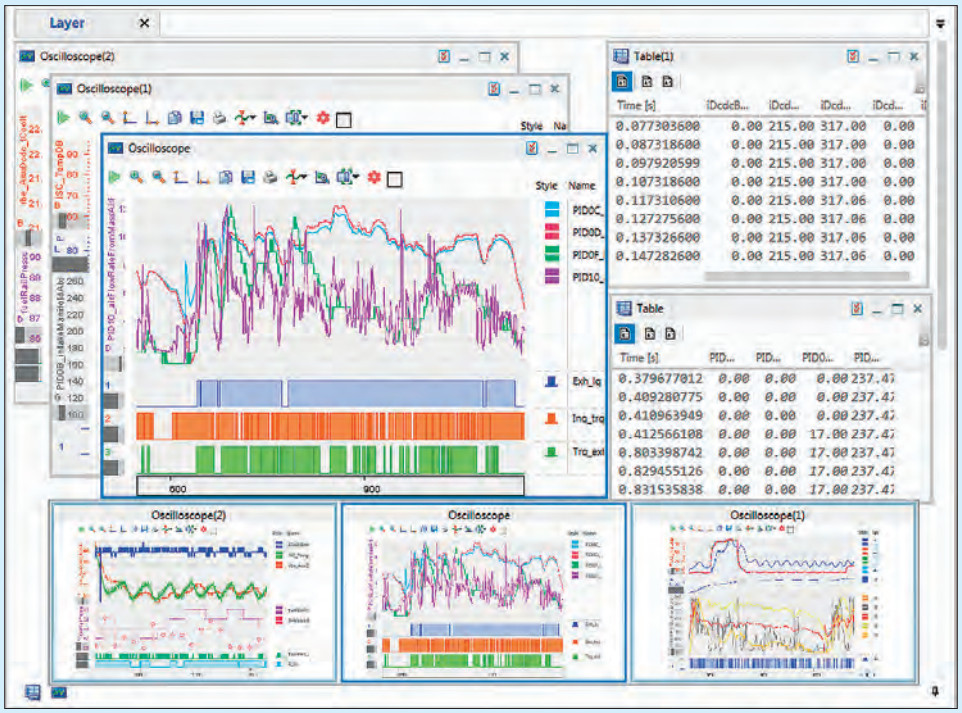
in line with ASAM specification MDF V4. Selected signals and time intervals can be easily extracted from the original measurement data and saved as a new MDF file. In addition, users can convert files between different versions of the MDF format. Configuration data files that were generated with MDA versions 7.2 and older can be imported and reused with MDA V8.

Version 8.1 of the new MDA was launched in September 2016. Installation is available free of charge for ETAS INCA users under www.etas.com in the Download Center.

ETAS increases the scope of functions of the MDA V8 on a quarterly basis, taking account of user requirements through software updates in the form of service packs. This tool can be used to analyze the large volumes of data that can arise in measurements with the new ETAS FETK ECU interface, the ES89x ECU and Bus Interfaces Modules, ETAS INCA V7.2 or the new ES820 Drive Recorder Module.



Virtual oscilloscope with display areas for analog and binary signals. The time axis can be shifted and scaled using the time slider (at the bottom of the image).



Preview of the instruments of a work level in the task bar.

"We're always redefining the limits of what is possible"

Endurance racing demands first-rate performances from drivers and their cars

The racing cars of Manthey-Racing GmbH regularly occupy the top spots in endurance racing events, and ETAS has been a sponsor of the company since 2011. In an interview with RealTimes, its directors Nicolas and Martin Raeder explain their winning formula: careful planning, teamwork, experience, and constant technological innovation.

IN THIS INTERVIEW

Brothers **Nicolas** and **Martin Raeder** are the directors of **Manthey-Racing GmbH** in Meuspath, Germany.

RealTimes: For many years now, Manthey-Racing has notched up success after success in motor racing, particularly in endurance racing. What is it about this sport that appeals to you?

Martin Raeder: Endurance racing demands first-rate performances from drivers and their cars. Success is only possible when the whole team pushes its limits, and when we tune the many components in our cars perfectly. The slightest deviation determines whether we win or lose.

Nicolas Raeder: 24-hour races are increasingly turning into sprints. From the green flag to the checkered flag, our drivers have a battle on their hands if they want to compete in a field of top-class race cars.

"For us, it's obvious: If you go over the limit, you lose; if you don't push the limit, you lose too."

Martin Raeder, Director of Manthey-Racing GmbH

The number of top teams is higher than ever, and in terms of engineering they are practically all on the same level. This means you have to work hard even for the smallest competitive advantage.

RealTimes: How was your recent win in *Green Hell*?

Nicolas Raeder: The 24-hour race on the North Loop of the Nürburgring is a highlight. Its *Green Hell* is a really tight track with restricted visibility. Races are hard to plan because the unexpected always happens there. This year, the weather forced us to suspend the race after just 50 minutes. For motorsports technology, which is always being pushed to the limit, an interruption like that can be problematic. Opti-

Manthey-Racing's Cayman GT4 Clubsport MR won in the SPX class of this year's 24-hour race at Nürburgring.

mal tuning and top-quality components are everything. The same is true of the electronics – an ever more important part of the car. Everything was just right for us this time, and our Cayman GT4 Clubsport MR won in the SPX class of the *2016 ADAC Zurich 24-hour race*.

RealTimes: What challenges go along with "optimal tuning"?

Martin Raeder: The biggest challenge in motor racing lies in the growing complexity of our vehicles. We build new technology into our race cars as soon as it becomes available. This means many tools are obsolete after a year. We just have to accept that. Given the rapid pace of innovation in motor racing, if you don't go forwards, you go backwards. Integrating new technology has its risks, though, because it makes vehicles more complex. Interactions occur between individual components, and you need to be able to control them. To know every detail without losing sight of the overall picture is a challenge, but for us that's the whole point. We're always redefining the limits of what is possible, and our partners help us in that – including ETAS.

RealTimes: Can you describe the cooperation?

Martin Raeder: We've been working with ETAS measurement technology since 2004, and ETAS has been one of our sponsors since 2011 – but it goes beyond ordinary sponsorship. ETAS is a competent partner, who we wouldn't want to do without. ETAS modules have been proven in numerous 24-hour tests, and there has never been a malfunction. They are compact, quick to install, and easy to connect. Using ETAS tools, we've been able to diagnose – and eliminate – many a problem early on. Our colleagues from ETAS support us out on the racetrack. We work very well together – and we both benefit from the experience of the other.

RealTimes: Thank you for the interesting conversation. We wish you many more successes on the racetrack!

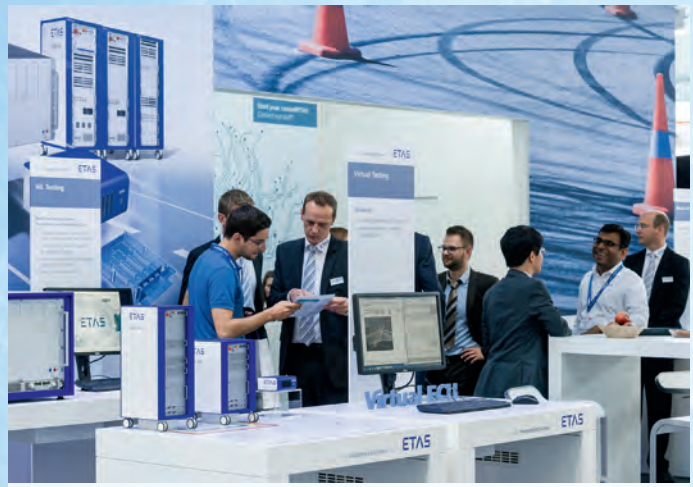
Nicolas (left) and Martin Raeder at this year's 24-hour race at Nürburgring.

ETAS tools on and off the racetrack

As they get ready for a race, Manthey-Racing relies on the **ES720** Drive Recorder in combination with the **ES415** and **ES421** Measurement Modules. The team uses the **ES595** Interface Module to monitor vehicle data during a race. Simulations make use of the **ES581** interface, which allows recorded data to be played back on a PC. Manthey-Racing's testing bench features full connectivity to enable the rapid, safe, and flexible installation of ETAS products. With time in short supply in the run-up to a race, it is helpful to have modern tools that allow a host of measurements to be conducted simultaneously.

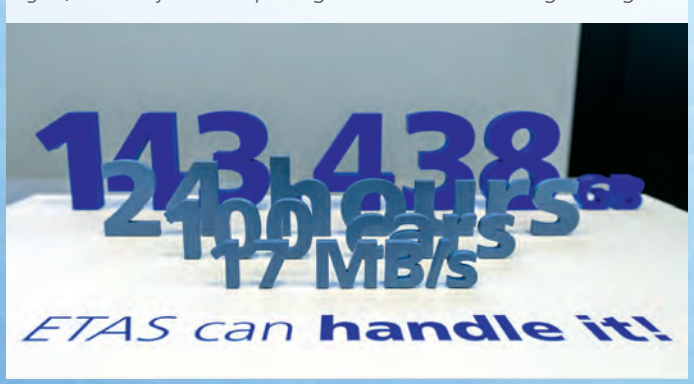
One Year in ETAS Pictures

ETAS and ESCRYPT showcased their portfolio at **embedded world** in Nuremberg, Germany. *Focus topics: Safety and security, efficient testing, Eclipse-based software development.*



ETAS presented solutions at the **Automotive Testing Expo** in Stuttgart, Germany. *Focus topics: Efficient testing, managing calibration complexity.*

ETAS welcomed customers to its **ETAS Connections** event in Stuttgart, Germany. *Focus topic: Big data in automotive engineering.*



ETAS UK took part in the **Cenex Low Carbon Vehicle Event** in Millbrook, United Kingdom. *Focus topic: Efficiently testing and calibrating engine control units.*

ETAS France hosted the **Advanced Calibration** customer event in Paris, France. *Focus topic: Innovative ETAS calibration solutions.*

ETAS India participated in the **Automotive Testing Expo** in Chennai, India. *Focus topics: Efficient testing, managing calibration complexity.*

The ETAS support team assisted calibrators during their **test drives in Granada**, Spain.

ETAS Korea presented solutions at **FISITA** in Busan, Korea. *Focus topics: Smart calibration, safety and security.*

Bird of prey demonstration at the ETAS anniversary summer party.

Fifteen Years of Know-how in Embedded Systems

ETAS Limited celebrates its 15th anniversary in the United Kingdom

Starting with only a small sales office, ETAS Ltd. has grown steadily over the years. Today, in addition to sales, our sites in Derby and York provide premium services and support in order to put our customers in the lead – a very good reason for us to celebrate!

AUTHOR
Debra Cullen is a key member of the Sales and Support team of **ETAS Ltd.** in Derby, United Kingdom.

In early July, associates from both ETAS locations in the UK came together and enjoyed an anniversary summer party. This was a chance for colleagues and their families to mingle and celebrate with a barbecue and a host of entertainment activities such as shooting, archery, and cross-bow as well as a bird of prey demonstration. All in all, it was a great opportunity to bring the two locations together and to reflect on how ETAS has flourished from a small sales office to the important sales and development center it is nowadays. Let us take you on a retrospective journey through the history of ETAS Ltd.

The grand opening of ETAS Ltd. took place in December 2001, when ETAS GmbH established a sales and support office in the UK. Originally based in Burton-upon-Trent, the sales office is now in Derby, and has been providing sales, support, and customer service across the full range of ETAS products. In addition, customer training is regularly held both at the Derby facility as well as on-site at our customer locations throughout the UK.

In 2003, ETAS acquired the York-based company LiveDevices, a leading provider of embedded software solutions. Today, the York location is ETAS' *Center of Embedded Excellence* for embedded software systems and AUTOSAR tools and embedded software components are developed here. More than one billion copies of the York-developed embedded operating system have been deployed on the roads globally.

Furthermore, York is the base for ETAS' *Embedded Software and Safety Consulting* business area. As a global consulting organization, it has been set up to provide training, consulting, and software development support to all our customers worldwide, independent of ETAS' tool portfolio.

The staff of ETAS Ltd. appreciates the trust that has been placed in us over the past 15 years and looks forward to the next years of providing expertise, support, and service for the added benefit of our customers.

ETAS Locations Worldwide

Germany
Stuttgart
(Headquarters)

Brazil
São Bernardo do Campo

Canada
Kitchener, Ontario

France
Saint-Ouen

India
Bangalore
Chennai
Gurgaon
Pune

Italy
Turin

Japan
Utsunomiya
Yokohama

Korea
Seongnam-Si

P.R. China
Beijing
Changchun
Chongqing
Guangzhou
Shanghai
Wuhan

Sweden
Gothenburg

United Kingdom
Derby
York

USA
Ann Arbor, Michigan

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Our **RealTimes online** newsletter is a complement to the print edition of RealTimes magazine. It lets us provide you with regular updates on current topics from across the ETAS world:

- Use cases and success stories with ETAS products
- Technical articles
- Company information
- Information on training and events
- Interviews
- FAQs

The registration form and previous issues of **RealTimes online** are available at:

www.etas.com/RTo

RealTimes online

NEWS

Exact. Virtual. Keeping pace with the future.

Dear Sir or Madam,

among other topics, this issue features articles about the ETAS ES636 **Precision Lambda Meter** and **Virtual injection needles-in-the-loop** as well as a new category: frequently asked questions (**FAQs**). In addition, we provide you with the latest **publications** in technical magazines and **upcoming trainings and events**. We hope you enjoy reading this newsletter and that it inspires you with some new ideas. We look forward to your feedback!

Best regards,
Your ETAS team

Exact. Universal. Connected. ETAS ES636

An upgraded feature of the ETAS ES636 Precision Lambda Meter mathematically determines the relative humidity from existing measurement data. This greatly simplifies the complete collection of physical parameters in combustion processes.

read more

Virtual injection needles-in-the-loop

Modern injection systems ensure that combustion is clean and low in emissions. In doing so, they are helped by increasingly precise development tools. A new Hardware-in-the-Loop solution from ETAS now precisely simulates the behavior of individual injectors.

read more

© Robert Bosch GmbH

Keeping pace with the future

With excellent preparation and support, the ETAS-sponsored Formula Student teams tested their vehicles under real conditions on the Bosch proving ground in Boxberg. Many of the teams managed to finish in top positions at the Formula Student Germany competition in Hockenheim. Plans are in the works for a new competition in autonomous driving.

read more

"On-the-road" support

For the fourth summer in a row, ETAS provided support to customers testing their ECUs in the Sierra Nevada Mountains.

read more

Trainings

INCA Calibration in Stuttgart (German)