InNovation

Customer Magazine of MicroNova

MicroNova
Software and Systems

02-2018

BMS Expertise for China

Insights into MicroNova's China strategy and the development of the BMS market

Testing Platform for Mobile Vehicle Apps

MicroNova bundles telco and automotive competence for new testing solutions

Protection against Cyber Attacks

New ManageEngine solutions for higher network security

„Innovation as a Priority“

Dear Reader,

I would like to start this editorial with a confession: I drive a diesel. This might still be taken sarcastically for now, but in the current discussion in Germany the impression sometimes arises that an apology will soon actually be necessary from those who use this drive technology.

A more nuanced approach would be desirable. Despite all the current and future importance of electromobility, there are also arguments in favor of a modern and clean diesel engine. This starts with electrical power generation, extends to the life-cycle consideration of an electric car, through to the challenges of the charging infrastructure. And even a look at the pollutant balance is better for the diesel engine than perhaps sometimes assumed by people outside the industry. Personally, I would rather sit next to a diesel engine than some laser printers... That's why I would like everyone involved to discuss the subject more objectively and less ideologically.

Looking at these facts, my impression is that diesel is currently a good technology that actually allows us to make the transition to something better. That's why we should avoid in Germany driving the automotive industry against the wall at all costs. At the same time, it is up to the industry to prove its innovative strength – and it will not be able to avoid alternative forms of propulsion. Are hydrogen and fuel cells or even synfuels already out of the race...? It remains exciting. For MicroNova, I can say that we already offer suitable test systems in the field of automotive electronics for all these energy sources. This is reflected in some of the articles in this issue of InNOVAtion, such as in the article on battery management systems.

At the same time – and I'm coming back to innovative strength here – a significant amount of focus will be on the IT side of cars in future. Hardware has reached an extremely high level of maturity, so that services are the business models of the future. Probably all these services will depend on the networking of vehicles. Here, too, we would like to present you with some exciting contributions, in particular on 5G and the simulation of the air interface. The integrative work of our two divisions Telco Solutions and Testing Solutions is equally important to our founder Josef W. Karl (see Interview with Josef W. Karl) and to us as company management. We see a lot of potential for you as our customers.

Furthermore, we do not want to forget that actual IT operations provide the technological foundation for any application. Our IT Management team knows a thing or two about this... as do the satisfied users of ManageEngine solutions. We have therefore also included contributions on this subject.

But if we want to talk about the actual foundation, it can only be the people who work with us and with you every day. We will always attach the highest importance to this fact, which is why our in-house topics are, as always, an integral part of this issue of InNOVAtion – topics with a touch of the human factor. At that I would particularly like to draw your attention to our "Special" on the Business Park Vierkirchen. A great team has achieved an incredible result here. For this I would like to thank all those involved; I would like to highlight three of them in particular, namely "our" Josef W. Karl with his wife Dorothee and their son Maximilian: We all appreciate your great and always sustainable commitment for a good future of MicroNova! Not only, but also with the construction of the new building. THANK YOU!

I wish you, as always, happy reading.

Ihr Orazio Ragonesi

Testing Solutions

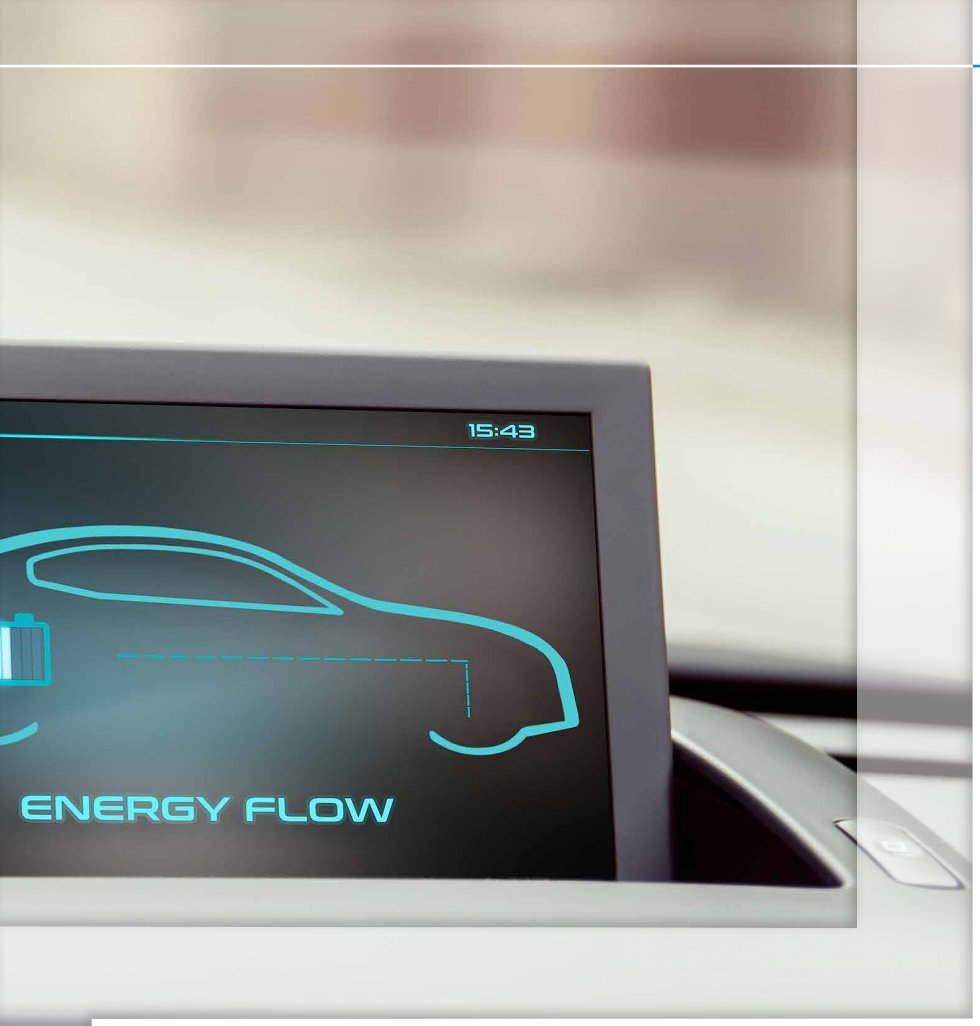
Telco Solutions

IT Management

BMS Expertise for China

Electric mobility is booming in Europe, but the greatest growth potential is currently in the Chinese market. The software and systems house MicroNova specializes, among other things, in the testing of electric motors and battery management systems. Martin Bayer, Head of Testing Solutions, and Franz Dengler, Senior Technical Expert HiL Simulation, present MicroNova's China strategy and explain the challenges and opportunities in the BMS market.

TEXT: Editorial staff PICTURES: © Daniel Krason, Magi Bagi / Shutterstock.com; © Sentavio / Fotolia.com



InNOVAtion: The growth rate of new registrations for electric cars is impressive. In China, 142,445 electric cars were purchased in the first quarter of this year alone.

Martin Bayer: The country has been the fastest-growing automobile market for several years now. With its impressive sales figures China is currently the key market, especially in the field of electric mobility. As a testing specialist, however, we are not exclusively interested in the expected sales of electric vehicles themselves, given that most of our business is generated through product development. And this is where the greatest potential lies in China in the coming years, especially since the electric sector is regulated by the state.

With the Chinese government's electrical quota coming into force in 2019 and further raising in 2020, manufacturers will have to further increase their e-sales. For VW, the largest German manufacturer in China with some 3 million cars sold, these standards will have a direct effect on both company strategy as well as the pace of development. Enormous amounts of capital investment in electric mobility have been announced. In the coming years, the VW concern plans on manufacturing up to 50 different models with alternative drives, a number far higher than originally planned. The product range of electrically powered vehicles offered by other manufacturers is likely to develop in a similar manner.

The battery constitutes the core of each electric car. It can account for up to a third of a vehicle's value. In order to keep this component healthy and running as efficiently as possible for as long as possible, a properly functioning battery management system (BMS) is absolutely indispensable. The testing of this system is therefore equally important to the development process. And this is where MicroNova comes into play.

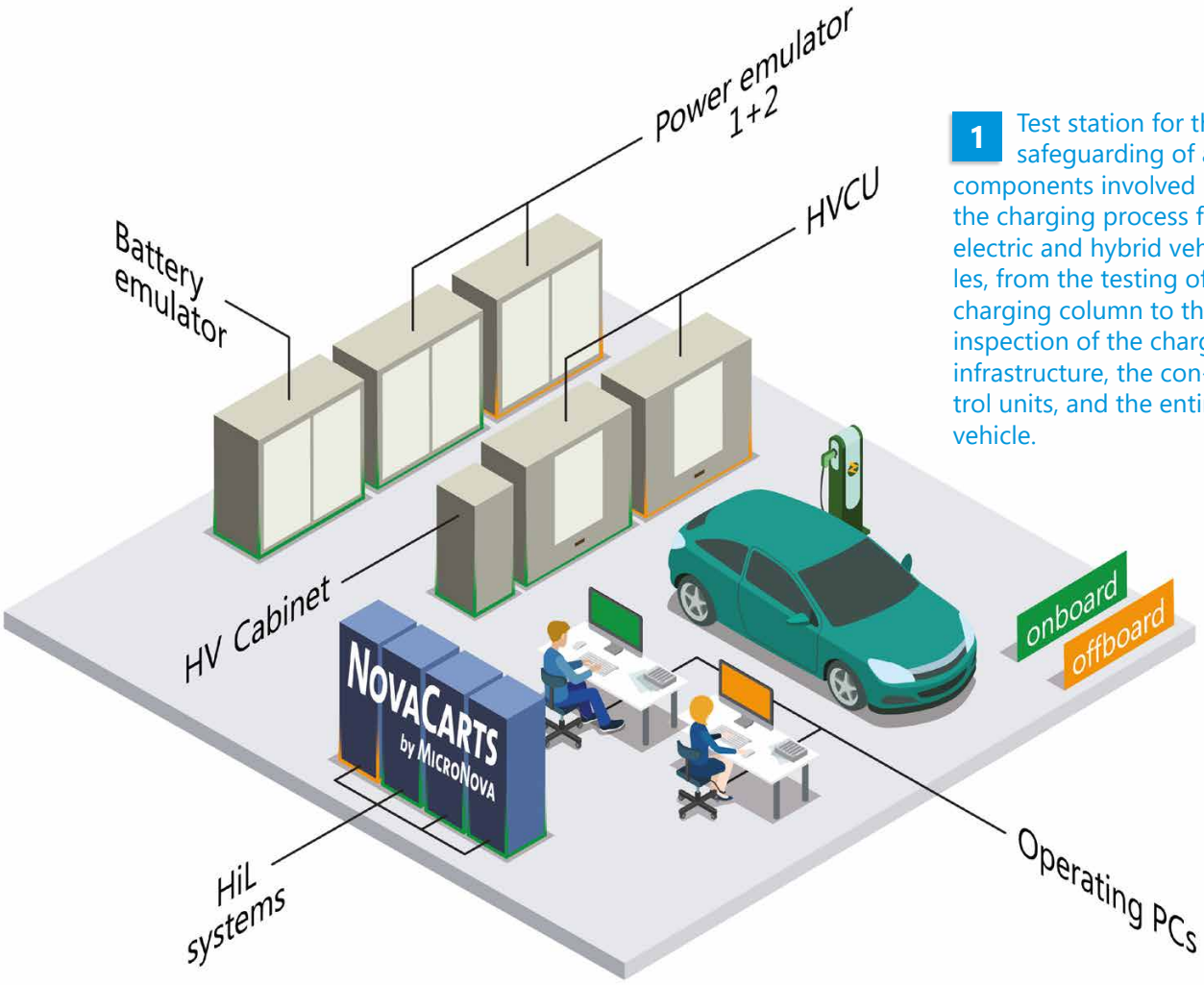
InNOVAtion: The Chinese market is not exactly easy for Europeans. Does MicroNova have any experience there?

Martin Bayer: Whoever wants to be successful in the Chinese market needs, first and foremost, a good product and a certain local presence along with an international network. MicroNova has been active in this market for ten years now, so far mainly with test systems for motors and drive. In addition, through our long and close cooperation with German manufacturers over the years, we have won partners in China with whom we have already carried out projects involving BMS for VW subsidiaries. We have convinced our customers with our more than 12 years of expertise in building battery simulators.

We are also expanding our expertise in China in terms of personnel: Our first Chinese employee is already on board and the establishment of our own site there is also on the agenda.

InNOVAtion: The market outlook is good. But what are the current technical challenges for battery management systems?

Franz Dengler: Further improving the detection of the battery's state of charge (SOC) and the state of health (SOH) is the current challenge for providers of battery management systems. Current systems tend to give a rather conservative estimate of the charge and aging of a battery; that is, one that is a little worse than the actual status. But in order to make the most efficient use of lithium-ion battery systems, a more precise determination of the state of charge is needed. This allows to minimize the safety reserves and maximize the range at no extra cost.



1 Test station for the safeguarding of all components involved in the charging process for electric and hybrid vehicles, from the testing of the charging column to the inspection of the charging infrastructure, the control units, and the entire vehicle.

In addition to a precise calculation of the SOC, an exact determination of the health of the battery cells is necessary in order to accurately calculate the range, determine maintenance intervals, and guarantee lifelong optimized battery operation. The algorithms developed for this purpose must be verified for possible influence parameters – such as temperature, number of charge cycles, cell history, and age – in the development phase. This has been possible only to a limited extent with real batteries: A test run over many thousands of charge cycles at various temperatures to set cell conditions is neither practicable nor reproducible, or it would take years to do.

Our comprehensive portfolio in the BMS area is perfect for such challenges. The NovaCarts products cover all of the functions of a classic BMS test, from the non-electrified testing of electric control units (ECU) for electric and hybrid vehicles to the electrified testing of the entire network. Parameters can be adjusted for individual tests. We can customize our products according to customer requirements just as we can integrate performance components into, for example, laboratory vehicles in which complete electrical systems and electrical components are installed.

InNOVAtion: How can tests be improved in order to determine the condition of a battery as precisely as possible?

Franz Dengler: What is important in this regard is steady further development in which MicroNova cooperates with its partners to future-proof and comprehensively support the testing of BMS. It is for this purpose that we have worked successfully for many years with the Fraunhofer Institute for Energy Economics and Energy System Technology. We can currently simulate the behavior of batteries very well using our hardware in combination with electrochemical models from the IEE. With the further development of battery management systems comes new and additional requirements.

Previous modeling approaches do not yet cover the entire spectrum of cell operation. Future test programs must be able to run dynamic aging simulations based on a physical-electrochemical battery model. At the same time, the real-time behavior of real batteries under various influence factors must be reliably represented. The simulation of a cell, for example, that has already undergone several thousand charging and discharging cycles, that is 75 percent charged, and that has a current temperature of 5 degrees Celsius, must be done with increased accuracy in the future.

Furthermore, it will be necessary for the operator to be able to more precisely set the various parameters, such as SOH, SOC or temperature, within seconds via test automation. Manufacturers and suppliers will then be able to run the tests of BMS and the associated algorithms significantly faster while ensuring cost optimization. This will facilitate the development of even better ECU algorithms.

Additional significant advantages of an expanded simulation and emulation approach include the reproducibility of the tests as well as the ability to factor in thermal and electrical interactions. In this way, significant improvements in the determination of SOC and SOH – when compared to current techniques – can be made in future control units of electric vehicles. This means that statements about critical parameters – such as remaining available range or even battery failure – can be made much more precise for test system users and subsequently vehicle users in the future.

2 Martin Bayer (right), Head of Testing Solutions, and Franz Dengler, Senior Technical Expert HiL Simulation at MicroNova

InNOVAtion: What sales volumes do you expect for new BMS test systems? Does the market outlook justify such high – at times subsidized – investments in these kinds of research projects?

Martin Bayer: Analysts are predicting that the market for BMS, within the automobile industry alone, will grow 43 percent per year between 2016 and 2021. But it is not just the automobile industry; developments in the energy sector, i.e., solar or wind power, are also reinforcing this trend. We have also been successfully involved in these industries for a long time. That is why we believe that an investment in BMS technology makes sense. This is the only way to ensure quality and reliability and thereby gain acceptance among customers. This makes these solutions critical to the success of the traffic and energy transition.

3 NovaCarts HiL System for the testing of battery management Systems

Automated Testing Worldwide

Now available in a license model: The Test Cloud Controller and the Test Case Generator from MicroNova. The new solutions significantly increase the efficiency of the testing process and make it easier to handle the increasing number of tests for new functions in areas such as autonomous driving and car-to-X (C2X) communication.

TEXT: Rainer Moosburger, Tobias Weimer

Automobile manufacturers, suppliers, and service providers in the testing domain are all currently facing the same challenge: to cope with the sheer mass of test cases necessary to secure all the driver assistance systems, sensors, charging, and communication technologies of the coming generations of automobiles. MicroNova has used its decades of experience in test automation to optimize the test process with two new solutions. This means that: hardware-in-the-loop (HiL) resources must be used optimally, and automation solutions relieve the strain on employees.

The Test Cloud Controller (TCC) decouples the creation and execution of test cases, and automates the global distribution of test orders to free HiL resources. This lessens the workload for test engineers, improves the utilization of existing HiL systems, and thus enables a 24/7 testing operation. The implementation of test cases in EXAM is now accelerated by the Test Case Generator (TCG): With its help, "TestCases" can be generated automatically from specifications – quickly and with consistent quality. This increases the efficiency of test case creation many times over. The following overview shows exactly what the two products can do and how test departments benefit from their use:

Test Cloud Controller

In the same way as product-related innovations in the development area, the corresponding infrastructure of test departments is also changing: Up to now, teams have usually worked together on a project – usually at the same location – but today, electronic control units (ECU) and control components are often validated on specialized test benches distributed all over the world. Consequently, it is sensible to separate the creation and execution of test cases: engineers create their test order but no longer have to worry about test times and free HiL resources – TCC takes care of that. It no longer matters where and on which system the test is carried out.

The Test Cloud Controller consists of two parts: The server component is installed on a corresponding application server, while the client component integrates seamlessly into the test automation solution as a plug-in, enhances it with the necessary interfaces, and enables access to the TCC system. The procedure is very similar to starting a "normal" test run. The TCC practically functions as an upgrade that can be easily integrated into the existing server infrastructure. This means no cost-intensive and time-consuming new developments are necessary.

Central distribution of the test jobs via cloud

The responsible auditor first hands over his test orders to the Test Cloud Controller. The TCC then distributes them independently to x-in-the-loop (XiL) resources with free capacities according to predefined rules. The system uses integrated load balancing to simultaneously distribute processes with a long runtime – such as those required for autonomous driving – among several simulation instances. If a run is successfully completed, the client plug-in automatically provides a link to the corresponding report. Once the test has been completed, the HiL simulator is available again in the TCC.

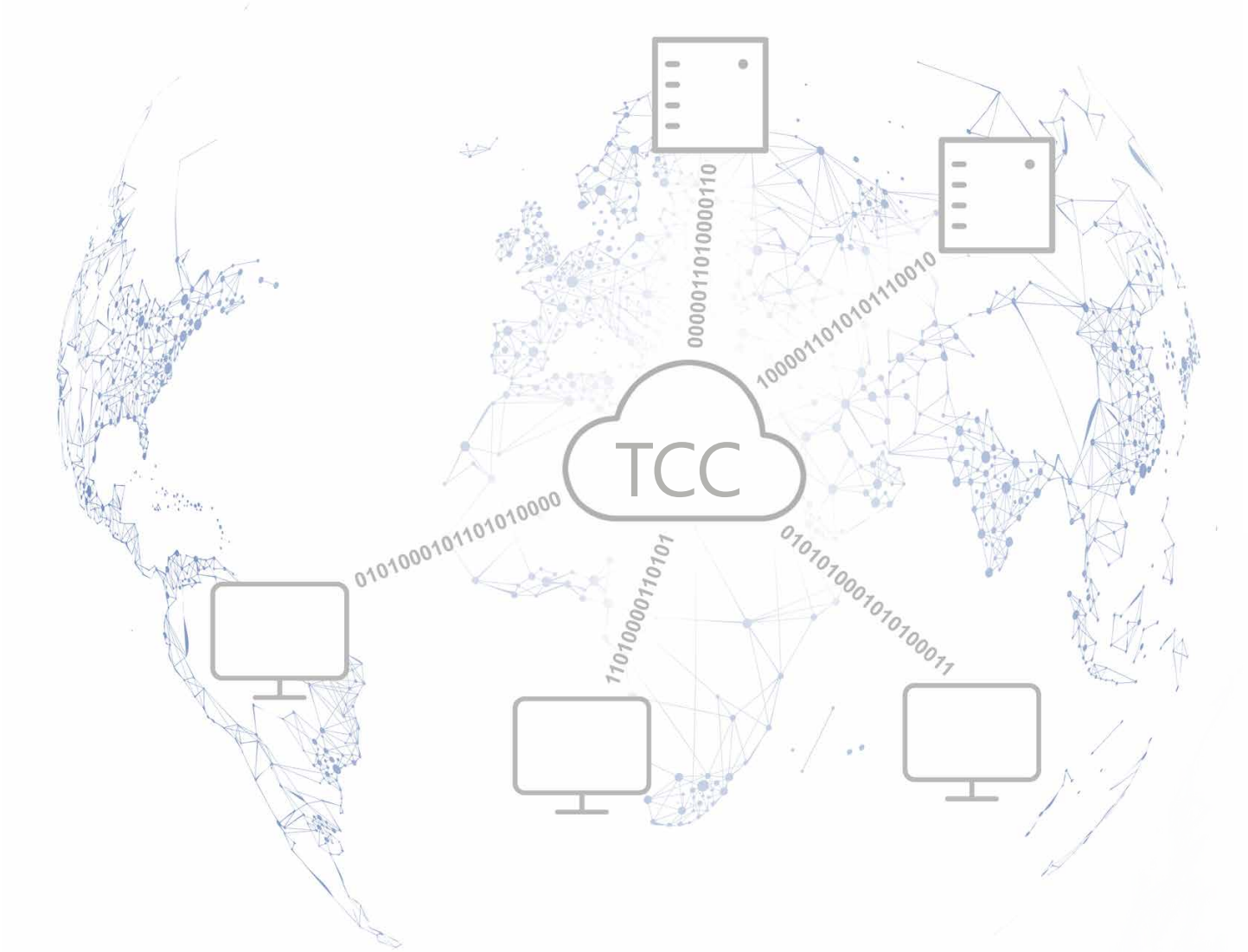
The central and automated placing of orders increases the availability and utilization of the testing systems – including across subsidiaries or even national borders. In addition, existing HiL landscapes can also be used for external partners and suppliers, e.g. for integration tests.

This is an important step towards 24/7 testing in view of the ever increasing demand because it is not possible to scale the existing HiL systems infinitely, nor is it possible to increase the number of test engineers indefinitely. The solution represents an optimal utilization of existing test resources.

License model and maintenance

With that in mind, the TCC can optimize testing in any company that operates HiL test benches automatically. It is the first such solution for EXAM on the market.

The Test Cloud Controller is available now under a floating license: the prices for licenses depend on the



number of HiL systems that are to process test cases via the TCC – the number of test cases is irrelevant. As soon as a system has finished the test orders assigned to it by the TCC, the HiL manager logs it back out and the respective license is released for another HiL simulator. Licenses can be purchased directly from MicroNova and can be used for an unlimited period.

Test Case Generator

The optimal use of HiL resources is always preceded by the creation of test cases. Up to now, engineers have usually implemented test cases for ECUs and associated software manually via the respective automation solution, such as EXAM, which has been in use throughout the VW Group since 2006. Test specifications are used as the basis for this. These are generally not standardized, which makes it costlier to maintain the "TestCases": subsequent changes must be made manually at several points – a time-consuming and error-prone procedure.

Creating test cases automatically

MicroNova's Test Case Generator, with which "TestCases" in EXAM can be created completely automatically from the test specifications, provides a remedy. The developers focused on creating a central tool that could meet the challenges mentioned above – more complexity, more tests – as well as the needs of the specialist departments.

To enable fully automated generation of cases from existing specifications, MicroNova's developers opted for the following approach: the test specifications were understood as a sequence of commands. Mapping commands to EXAM operations then automatically generates the test cases. This saves the additional effort of manually implementing the test cases. The TCG is basically a functional extension to EXAM, from which numerous users benefit.

The consistent structure of the test cases designed in this way contributes significantly to quality assurance: Using the TCG for all test runs allows their results to be checked uniformly and the progressions to be reliably tracked – a clear advantage over the

previous procedure. For manually created test cases, different handwriting is more the rule than the exception because each tester implements the specifications slightly differently. Previously, this has made every review more difficult.

Compared to manual generation, test cases can be created far more quickly with the TCG. The high efficiency of the solution impresses leading automobile manufacturers, given the ever-increasing number of tests: "A test designer can manage many times more test cases with the TCG than with purely manual implementation, which means more results are available more quickly. This frees up more time for the designers to focus on particularly complex cases," explains the responsible test manager at our pilot customer. "The TCG could also be fully integrated into EXAM. No additional and cost-intensive interfaces were required."

The uniform and clearly structured procedure when using the Test Case Generator reduces the effort needed to maintain test cases and significantly improves their traceability. Benefits from which companies from all industries can benefit in ECU and software testing. Thanks to this new tool, all parties save considerable time, work, and costs. There is currently no comparable product available for EXAM among the competition.

License model and maintenance

The Test Case Generator is now available under both node-locked and floating licenses. Both are valid for an unlimited period.

With the node-locked license, the TCG EXAM plug-in can be used on a previously defined computer. In the floating model, the company acquires the required number of licenses, which can then be used by the test engineers. The license is released again when EXAM is closed. The test automation solution itself is of course available to manually create test cases as usual.

This applies to both products: In the first year, maintenance is included in the license fee. Thereafter, maintenance contracts can be concluded on an annual basis, covering bug fixes and version updates in addition to support. Moreover, additional chargeable services such as on-site installation or customization, as well as consulting and training, are offered as required.

With the Test Cloud Controller and the Test Case Generator MicroNova supports automobile manufacturers, suppliers and service providers to handle the growing number of tests for new vehicle functions efficiently, resource-saving and with high test quality.

Further Information

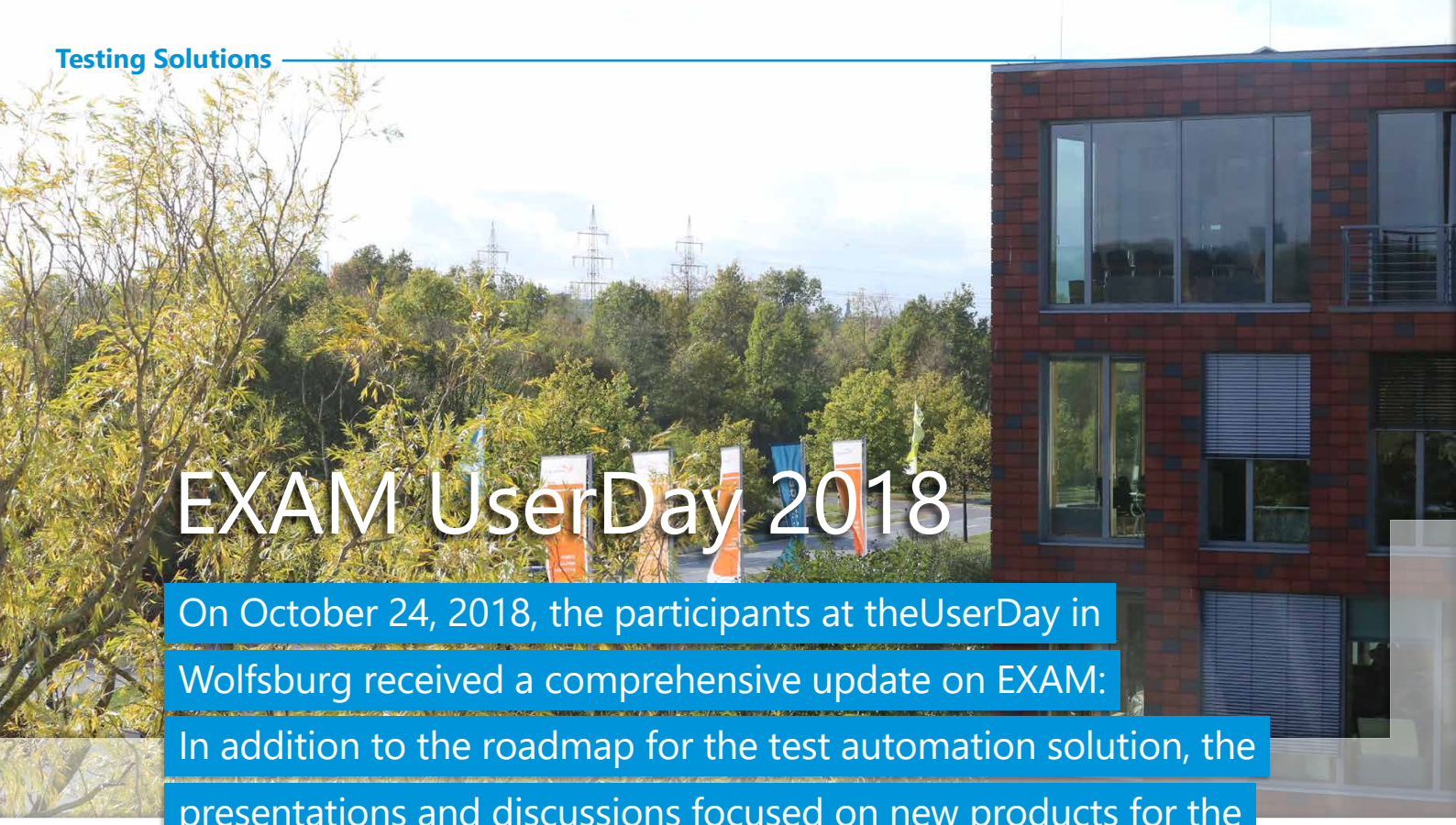
Detailed articles on the Test Cloud Controller and the Test Case Generator have already been published in previous issues of our customer magazine (in German):

Test Cloud Controller
Automatic allocation of test resources
bit.ly/2PlJHfw

Test Case Generator
Swift and efficient: Generating test cases automatically
bit.ly/2E6kOmS

Further information is available for download:
www.micronova.de/en/testing/info

For further information, please contact:
Michael Seeger
sales-testing@micronova.de
+49 8139 9300-0



EXAM UserDay 2018

On October 24, 2018, the participants at theUserDay in Wolfsburg received a comprehensive update on EXAM: In addition to the roadmap for the test automation solution, the presentations and discussions focused on new products for the efficient use of EXAM, as well as interesting use cases.

TEXT: Rainer Moosburger PICTURES: © MicroNova

MicroNova CEO Orazio Ragonesi welcomed the more than 60 users of the test automation solution EXAM, and was delighted with the highest number of participants of the event series in Wolfsburg to date. In the presentations, experts from Volkswagen Group and Audi talked about innovations in EXAM and explained the future roadmap. Users from kumkeo and TraceTronic revealed use cases from practical work with the test automation solution, and the EXAM experts from MicroNova presented new products. In addition, there was of course plenty of opportunity for professional exchange and networking among users and with MicroNova.

Versioning and roadmap

At the start of the afternoon, Frank Manz, EXAM specialist at AUDI, ex-plained the most important ad-van-tages of versioning in the application introduced in EXAM Release 4.6 and in particular addressed the central role of model configuration as well as the new model structure. The experienced EXAM specialist also used the opportunity to announce his departure from Audi and thus also his departure from the EXAM program. His appeal to those present: exchange best practices with versioning to be as efficient as possible.

Sebastian Frixel-Seifert, who heads the EXAM program at Audi AG, then provided information about the future roadmap up to 2020. The most important statement: distribution will continue. This means that the EXAM Group Steering Committee will continue to support the free use of EXAM by distribution partners. In addition, the Steering Committee confirmed that versioning is planned with the release of EXAM 4.8 (Q4/2019) as an additional paid feature. Furthermore, additional approvals for interfaces, such as the ASAM XIL-API, or for diagnostic tools have been issued in the libraries.

Optimization of the development process through Continuous Integration

The next two presentations focused on different approaches to integrating EXAM into the continuous development workflow – the keyword being Continuous Integration (CI). Rainer Moosburger, Project Manager at MicroNova, first introduced the new MicroNova products EXAM Jenkins Plugin and EXAM REST-API Plugin: The EXAM Jenkins Plugin connects the Jenkins CI system and EXAM via a REST interface. The result is the automation of test execution with EXAM. Tests are automated at various software development stages and carried out continuously. This process is summarized by the term Continuous Testing. Automated test execution also improves the utilization of test resources. Results

can also be quickly fed back into the development process, and test efforts and sources of error in the test process can be reduced in the long term.

Philipp Looft then explained how the engineering firm kumkeo uses Continuous Integration with EXAM in the field of test management for wind turbines. After a brief introduction to the design and development of a wind turbine, he showed how a solution for Continuous Integration was implemented using tools such as Confluence and Jira in conjunction with EXAM.

As part of his presentation "INCA or ControlDesk or CANape? – YES!" Matthias Berthold (TraceTronic) presented an Audi library for connecting the three tools mentioned in the title for measuring and calibrating ECUs. The three tools have been implemented in the EXAM interface CalibrationSystem (responsible for access to ECU addresses) with different implementation classes – each very complex in itself. These three different connections have been combined in a new architecture and implementation: the ApplicationSystem library. This simplifies both the interchangeability of test cases and the addition of new tools. The new library will be available in the distribution version of EXAM from version 4.8.

Efficient testing: Test Cloud Controller and Test Case Generator

MicroNova has developed two new test automation solutions to meet the ever-increasing demand for testing in vehicle development due to the constantly growing variety of functions. At EXAM UserDay 2018, David Leuck and Tobias Weimer demonstrated the basis on which the Test Cloud Controller (TCC) and the Test Case Generator (TCG) were developed and how their use can save a lot of time and work for all those involved in the testing process.

Further information on the functionality of the TCC and TCG, as well as on the licensing model, can be found in this issue of InNOVAtion on 008 ff.

At the end of the presentations, Robert Herre from TraceTronic GmbH presented Intelligent Test-Environment Monitoring (ITM), a method for monitoring and stabilizing test environments. The aim is to reduce the time between failures or errors in technical components as much as possible. This period is significantly shorter for software tools than for hardware. During the nightly run of automated HiL tests, this means that if an error occurs during a "TestCase", the entire test run is blocked and no results are obtained. If the test environment is monitored in parallel during execution using ITM in EXAM, a soft reset is performed automatically before the next test case if a problem occurs. Ideally, only the results of one "TestCase" from the nightly run are lost – the rest is retained.

Conclusion

Thanks to the exciting projects and the lively exchange among users and developers, EXAM UserDay 2018 was once again a resounding success. Even during the presentations themselves there were numerous interested questions, some of which were answered and discussed directly by the participants. The MicroNova EXAM team was delighted with the lively participation and positive atmosphere, as well as the record number of participants and the consistently very positive feedback. As always, UserDay follows UserDay – planning for the next meeting of users in Ingolstadt in autumn 2019 is already underway.

Telco meets Automotive – Thanks to 5G

MicroNova has been successfully active in both the automotive and telco industries for several decades. This expertise is now benefiting an integrated project – a platform for the automated testing of mobile services.

TEXT: Ingo Bauer, Markus Wiedholz

5G wireless technology is seen as a key technology for the digital revolution in a wide range of industries and areas of life. New business models will emerge and existing ones will experience significant enhancements and added value. This also applies to the automotive and telecommunications industries.

In this digitalized world, reliability and quality must be proven to go together. In the context of agile or fluid developments, the importance of powerful test mechanisms is even greater than before. This is why EANTC AG (see box page 019) and MicroNova are working together on a platform for the automated testing of mobile services.

5G: From hype to market

As part of their surveys, market research and analyst companies regularly identify technology trends that are set to cause a sensation in the coming years. These trends are often represented in graphical diagrams – curves, matrices, and so on – and describe the phases of a technology in terms of its public attention or market penetration. According to various recent studies of this kind, 5G will be one of the most important trends in the coming years.

5G will therefore follow the familiar path from trend to ubiquitous solution with associated services. The technological triggers have happened, and so we are likely to be in a phase of high expectations and uncertain business models, somewhere between innovators and early adopters, comparable to the boom on the then new market at the time of the dot-com bubble. This also suggests that not all business models will survive. Nevertheless, the introduction of 5G over the next few years will bring a variety of new services and applications to market maturity and hence enable business success for their providers.

The financial potential of the technology alone will ensure this: According to estimates by one study, by 2035 ICT companies will be able to generate around twelve trillion US dollars in revenue from 5G technologies for ICT manufacturers. The potential spreads across basically all sectors.

Network Slicing

Some technologies within the 5G subject field are of particular importance. These include developments in radio interfaces such as beamforming, massive MIMO and mmWave. The realization of self-organizing networks (SON) through the use of artificial intelligence will significantly accelerate network slicing and thus the development of new services.

At present, mainly static network slices, such as those known from NB IoT, are still in use. Soon, flexible concepts that can be made available as and when in the network will prevail here: network slicing is the resulting key technology from 5G network architecture development with software-defined networking (SDN). The service classes determined in the 5G standard (eMBB, uRLLC, mMTC; see box for more details) can be paired to form functional, application-specific services and can be provided in the form of network slices in a dedicated way within the network (see also interview with Prof. Wiegand, page 022 ff).

Service classes

5G offers several service categories, each covering different mobile communications needs. Enhanced mobile broadband (eMBB) is one such service category that provides extremely high data rates of up to ten gigabits per second and therefore supports services with high bandwidth requirements. Ultra reliable low latency communications (uRLLC) focuses on services with low latency times of about one millisecond – important for the shortest response times with practically no service downtime; relevant applications include automatic driving assistants in motor vehicles or remote plant maintenance. Massive machine-type communications (mMTC) comprises services that require a high connection density of up to one million per square kilometer, for example for the design of smart cities, smart homes, and so on.

The key to diversified 5G services

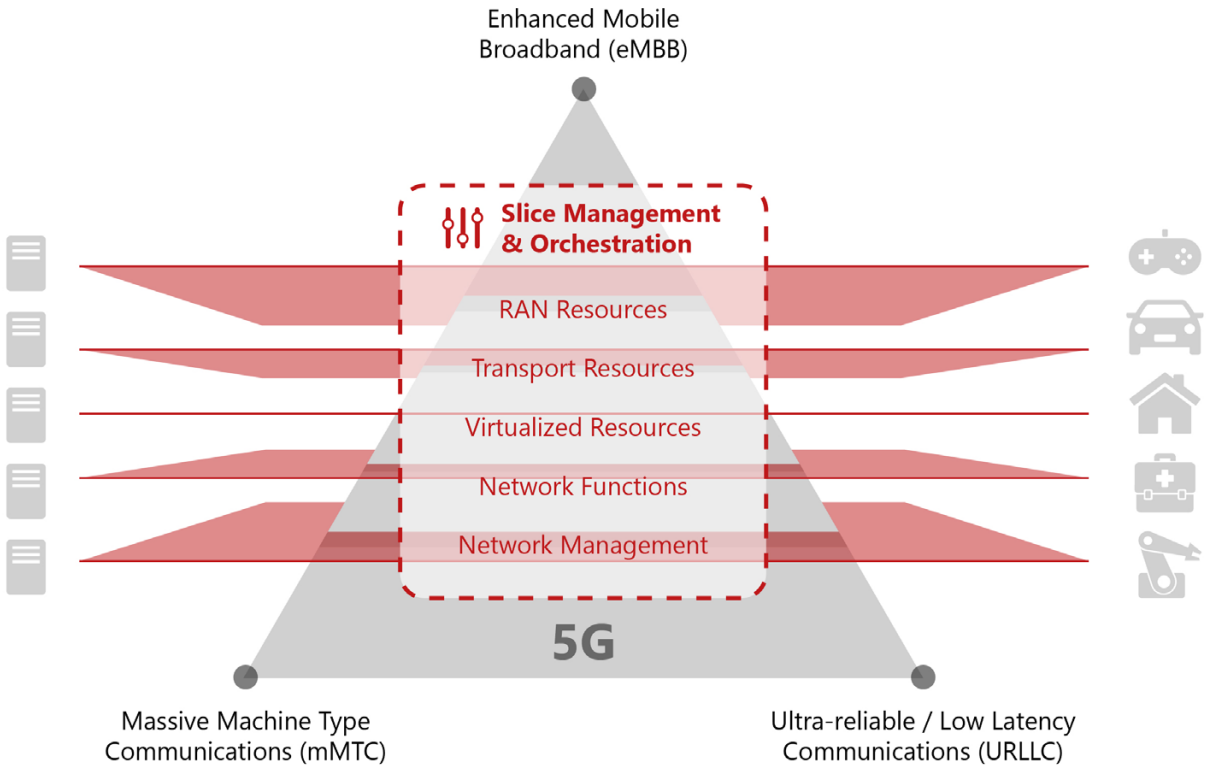
This technology therefore allows network operators to make more versatile use of their infrastructure and to offer performance-based, user-friendly mobile communications services. Whether a smart home communicating with its occupants, machines communicating with each other, or a vehicle communicating with its surroundings, an optimized network slice is set up for each of these applications. Network slicing functionality is therefore the key to supporting diversified 5G services.

Industry 4.0 and autonomous driving are certainly among the prominent examples associated with 5G. With the introduction of ever more intelligent driver assistance systems in mass production and the highly automated vehicles currently being developed or tested, expectations are rising among all those involved. The autonomous level 5 driverless car will certainly require a lot of research before it can be realized.

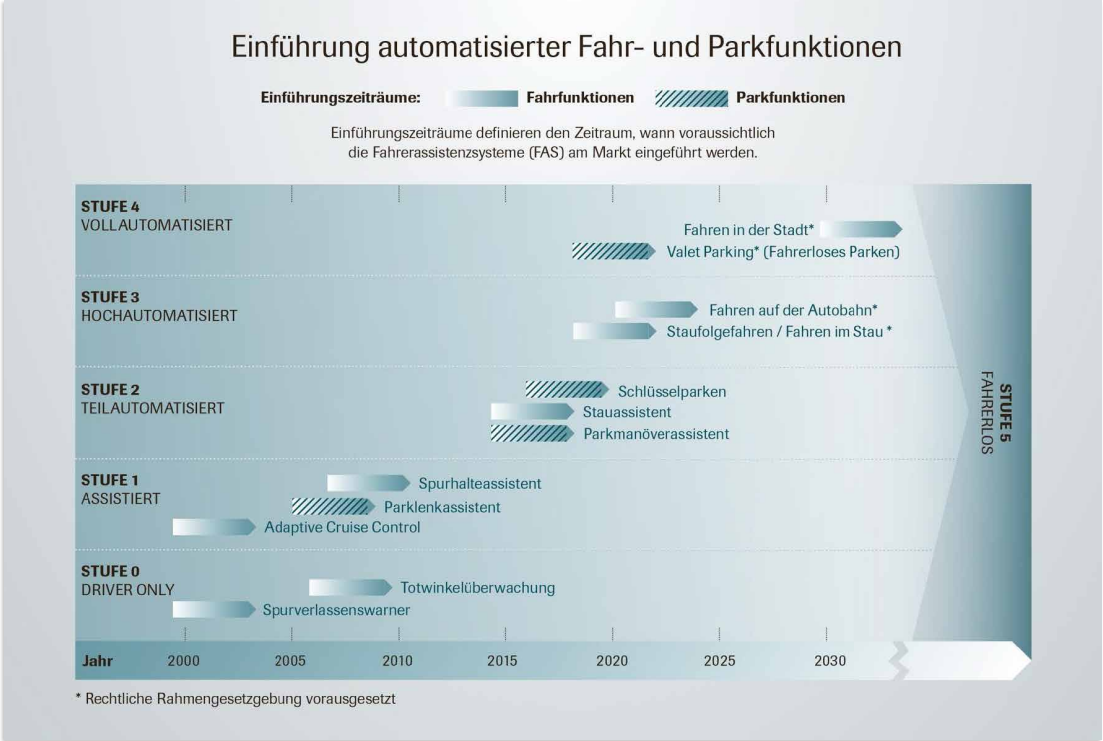
Automated tests

A completely driverless car will probably only appear on the roads with one of the next generations of mobile communications. Nevertheless, 5G is the first step toward a powerful, fully networked world – and thus the foundation for Car2X communication. Only 5G technology enables an extensive, practical, bidirectional networking of different sensors, actuators and control units via the air interface.

The development of apps, as they have been common on smartphones for a long time, will thus increasingly find its way into the car. The particular demands in terms of security and quality of all applications arising from communication between the vehicle and its surroundings, or the control of functions in the vehicle from outside, make an automated test environment indispensable.



1 The service classes of the 5G standard enable the provision of application-specific services and are provided as so-called network slices in the network.



2 In recent years, not only the number of available driver assistance systems has increased, but also their degree of automation. The German Association of the Automotive Industry assumes that automated functions will be successively developed over the next few years. As a result, automated driving will probably initially become possible in "controllable" situations (e.g. in multi-storey car parks or on the motorway). © VDA

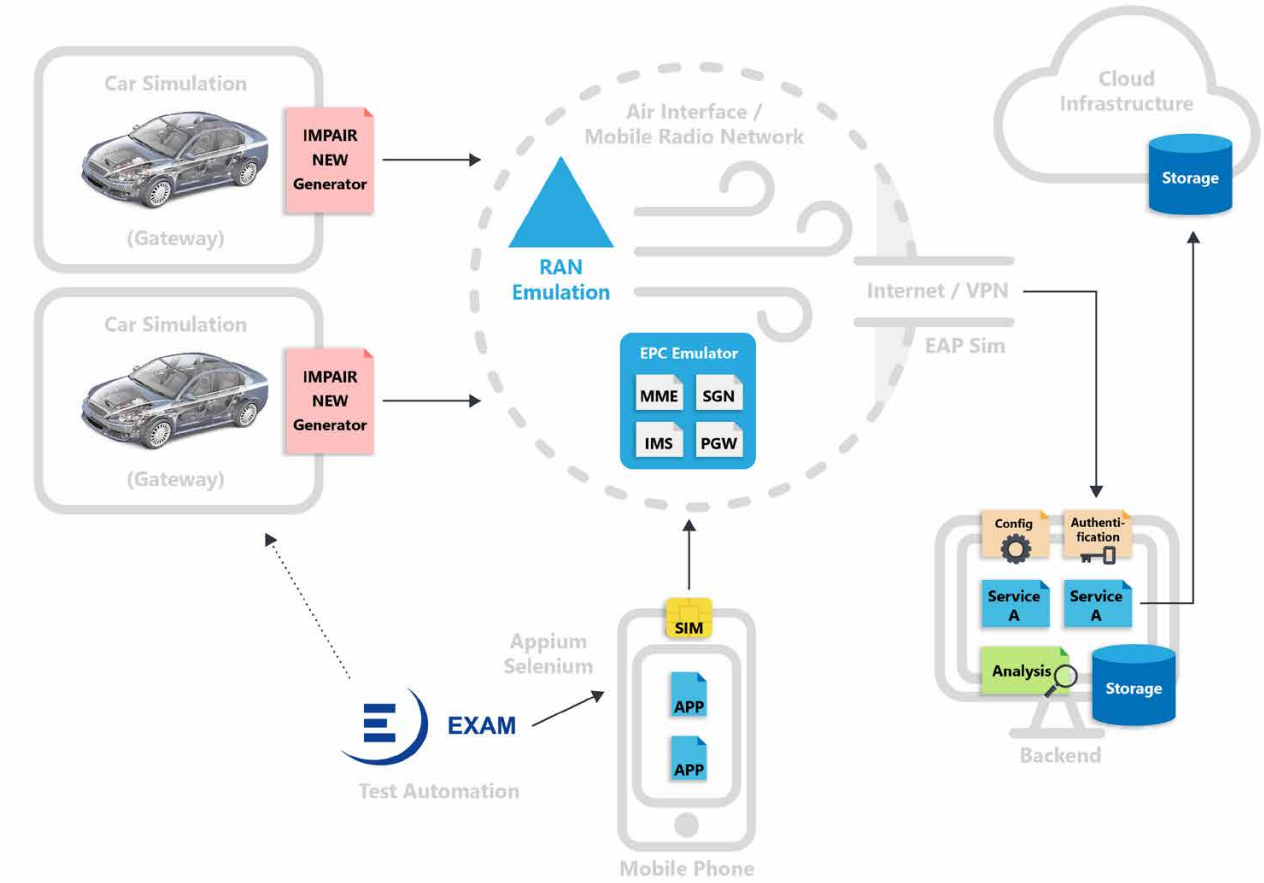
Test bench for mobile applications

This applies both to protecting against malicious hacking attacks and to a corresponding, clearly defined behavior in the event of failure of the basic mobile service. MicroNova is working together with EANTC on a solution for an automated test bench for testing mobile applications. This includes simulating the mobile network as well as the communication between vehicle, mobile UE and backend.

Whereas in the past the "device under test" (DUT) was the vehicle, new elements have been added in the age of networked cars. Besides the vehicle itself, mobile applications on the smartphone (mobile UE), the associated backend, and the mobile network are now also part of the overall system. This requires modified test systems to ensure the correct functioning of the overall system.

In the overall test, however, the mobile network in particular was only a "more complex" cable and played a rather subordinate role provided the data was transmitted correctly. The testing world will change in the context of software defined services – there will no longer be "one" service; rather, it will become more and more flexible and, as an essential component of the overall system, must nevertheless be tested accordingly. This requires more flexible simulations and test systems.

Test systems that can be automated with EXAM, for example, are already used today to ensure overall system functionality or to guarantee end-to-end protection. The correct function of the backend interface and the function of the smartphone application are central aspects here. This process uses a test rack with corresponding real ECUs, which is addressed by EXAM. It is also possible to communicate with the smartphone application via interfaces like Appium or Selenium. In this way it is possible to check the entire communication chain, from app to backend to test rack – repeatably and reliably. The more complex the test environment, the more vital structured, tool-based testing becomes.



In order to be able to test the ever-increasing number of networked functions in future, it will be necessary to use virtualization and simulation much more – this is the only way that all test scopes can really be carried out with a high quality of results. Mechanisms such as the simulation of ECUs have long been established and used in industry, but other components such as the air interface or the backend are still facing challenges.

In addition, there are test requirements that are difficult to replicate in a real mobile network. This includes adjusting poor network coverage or incorrect or "swallowed" data, etc. So far, manufacturers and suppliers have implemented all such aspects by means of complex "drive tests". However, these scale poorly and testing effort rises – and it rises even higher the more complex functions are operated in the vehicle via networking. For this reason, it is necessary to integrate the possibilities resulting from 5G into the field of action of the established test mechanisms for vehicle electronics.

3 Test system architecture: Using EXAM, the test engineers can address both the test bench with real ECUs and the smartphone apps.

Conclusion

5G will open up a variety of options for making vehicles and traffic itself more intelligent and safer. Comprehensive tests are necessary to ensure that these options reach customers securely and reliably. The major task is to consolidate existing test approaches in such a way that the end result is an integrated test with the highest possible degree of automation. This is the only way to ensure traceability and structure in the tests.

EANTC AG

EANTC AG is an independent network technology competence center that offers its telecommunications services and solutions to both manufacturers and users. EANTC was founded in 1991 by Herbert Almus, the current Chairman of the Supervisory Board, at the Technical University of Berlin, with a research focus on network technologies and multimedia applications (PRZ / FSP-PV). In addition to research and development, EANTC initially tested and certified FDDI (fiber distributed data interface) systems. Starting in 1993, the tests offered were extended to include ATM (asynchronous transfer mode) and other high-speed network technologies. Clients at that time already included almost all leading manufacturers of network components. At the end of 1999, EANTC was spun off as a stock corporation with the support of the TU Berlin. The company still cooperates closely with the TU Berlin today. The spin-off expands the range of services to include technologies such as multi protocol label switching (MPLS), IP (Internet Protocol) switching, triple play and voice transmission via the Internet (voice over DSL and voice over IP) as well as mobile radio technologies.

CPCM becomes COM5.Mobile

MicroNova's configuration solution for mobile networks has a new name: The Common Planning & Configuration Manager (CPCM) is now known as COM5.Mobile.

TEXT: Editorial staff PICTURE: © sdecoret / Shutterstock.com

Many well-known brands have been renamed in the course of time. Many in Europe still know Twix as Raider, and Toyota is soon to make an about-face: the Corolla became the Auris, which is becoming the Corolla. And at the end of October 2018, CPCM became COM5.Mobile.

The reason for the new name is the more differentiated design of the product, because almost at the same time as the name was changed, another member of the COM5 family "saw the light of day": COM5.Rail is developed especially for the railway market and premiered in September at this year's InnoTrans, the leading international trade fair for railway technology. While the "classic" COM5.Mobile continues to specialize in the configuration of mobile networks, COM5.Rail targets rail radio – GSM-R and ETCS (European Train Control System) or ERTMS (European Rail Traffic Management System).

The idea behind the name

In light of the clearer differentiation, it was important to the Telco Solutions team that the topic of "communication" was directly included in the name of the solution. With the increasing internationalization of both MicroNova and the department, the English spelling was set. The "5" in COM5 symbolizes both the upcoming 5G mobile communications standard and the five cornerstones of network management: Fault management, configuration management, accounting management, performance management, and security management – FCAPS for short.

For the users, everything remains the same. From the architecture to working with the solution and its features, COM5.Mobile will continue to offer all the functions required for optimum network planning and configuration in the future. The three expansion levels "Network Audit", "Network Audit Plus", and "Full Scope" also still exist. This makes COM5.Mobile the ideal solution for managing both the mobile network and, above all, the Radio Access Network (RAN), because the growing complexity of network technology is making a perfect configuration increasingly important – and 5G will take this to a new level.

Open concepts are essential in this regard, since they can be flexibly adapted to new circumstances while also taking into account the main management indicators such as time-to-market, quality, and efficiency. With COM5.Mobile, MicroNova offers a versatile, flexible best-practice solution, which is independent of the network supplier. The software combines the view of the often heterogeneous regional network and management structures and allows for expansion to a central database for overarching comparisons. The result is an optimally configured and therefore efficient network – for satisfied customers of mobile providers.

CPCM

The COM5 base platform (formerly CPCM) has been a successfully established system for the configuration management of mobile networks for many years. With Vodafone and Telefónica, two of the three providers in Germany have long relied on COM5. Mobile for a total of almost 90 million users.

Establishment of 5G BERLIN e.V. Innovation Cluster

In September 2018, partners from business and research launched the 5G BERLIN e.V. innovation cluster aiming to promote innovations associated with key 5G technologies for urban application environments.

TEXT: Editorial staff PICTURE: © sdecoret / Shutterstock.com

The 5G BERLIN initiative is driving digitalization in the German capital. For this purpose, a test environment is being set up for joint research projects, to try out 5G technologies, and to develop new applications. Furthermore, an information network is being created to provide the basis for new partnerships and to support the transfer of knowledge. The 5G BERLIN innovation cluster therefore constitutes a regional as well as national networking platform for start-ups, small and medium-sized businesses, research institutes, universities, large corporations, and public agencies.

5G test environment for urban applications

The 5G test environment is being set up on the North Campus of the university "Technische Universität Berlin", and will be used to test key 5G technologies for urban applications under real conditions. The infrastructure comprises 5G macro cells with smaller radio cells to provide local, large-bandwidth, and highly responsive communications. In order to achieve very high data transmission rates, streetlights are equipped and connected with 5G technology. The components for the 5G test environment are supplied and further developed in the overall system by the project partners, modeling all the relevant technology components of a 5G network.

Strong partnerships

The founding members include atesio, EANTC, the Fraunhofer-Gesellschaft, GasLINE, Highstreet Technologies, HyperMesh, Infotecs, and MicroNova. At the time it was established, other companies from the fields of passenger transportation, semiconductors, network equipment suppliers/operators as well as start-ups and trade associations expressed their interest in participating in the 5G BERLIN innovation cluster.

"MicroNova's commitment as one of the founding partners of 5G BERLIN e.V. underscores the potential we see in the new mobile communications standard. Many of the future business models have not even been put down on paper yet, let alone entered into development. However, there is a large number of applications in the pipeline," says Georg Kieferl, Head of Telco Solutions at MicroNova. "Our participation will enable us to play an active role in shaping the technology, and thereby to strengthen our innovation leadership in configuring and planning mobile networks. This will benefit our customers and their users."

AI for 5G

Interview with Prof. Dr.-Ing. Thomas Wiegand

TEXT: Editorial staff PICTURES: © metamorworks, Olivier Le Moal / Shutterstock.com

Prof. Dr.-Ing. Thomas Wiegand is one of the two directors of the Fraunhofer Heinrich Hertz Institute in Berlin and has been involved in mobile communications for many years. He was a driving force behind the foundation of the innovation cluster 5G BERLIN e.V., a partnership between research and industry to promote innovation relating to 5G. The editorial staff of InNOVAtion spoke with Prof. Wiegand about the newly founded association and about 5G technology.

InNOVAtion: What particular technological challenges do you see in the introduction of the 5G standard?

Wiegand: The technological challenges lie explicitly in the implementation of the ambitious key performance indicators (KPIs), such as 1 ms latency and a data transfer rate increased by a factor of 100-1000 compared to 4G. The better compression of future networks also poses a particular financial challenge.

InNOVAtion: MicroNova is especially active in the field of automatic rollouts and network configuration of multi-vendor and multi-technology radio access networks – what insights can you give our readers and customers with regard to 5G?

Wiegand: Operating future networks will become increasingly complex – networks must therefore configure themselves automatically. This will increasingly be realized automatically via software and artificial intelligence (AI). One challenge is the hardware-related design and alignment of base stations. Multi-vendor activities will only become interesting once regional and "private" 5G network licenses are awarded and will enable smaller providers to participate in the market for the first time.

InNOVAtion: What influence will AI have on network expansion and optimization?

Wiegand: 'Network slicing'[1] will for the first time provide a highly flexible virtual layer in the physical communication networks. In this case, for example, AI could predict demand in the specific network slices and optimize network utilization accordingly. Edge data centers[2] play a key role here, as they can perform latency-critical calculations locally. As a result, AI will have more and more influence on networks of the future. The 5G BERLIN association will intensively test network virtualization and network slicing on the 5G test field, where state-of-the-art edge data centers will use AI.

InNOVAtion: Many of our readers are from the automotive industry. What approaches do you see here through 5G? How can 5G BERLIN e.V. help to get these out onto the road?

Wiegand: The new mobile radio standard makes full use of its advantages in particular when it comes to latency-critical applications – i.e. applications in which there must be no delay in response time. 5G opens up completely new worlds here. The aim is to expand the network to a high degree of reliability so that safety-critical applications then become possible. In terms of autonomous driving, for example, a fast reaction time is essential, especially in dangerous situations. In addition, sensors generate an immense amount of data; the high transmission rate of 5G and the edge computing concept help to transfer and process these data volumes. Network slicing, mentioned previously, also allows networks to be divided up virtually according to requirements and applications – as flexibly as required and on demand. With its test field, 5G BERLIN can gain vital insights that can be used in a variety of ways – including for autonomous driving and networked driving with Car2X communication. The test field offers ideal conditions for developing and testing 5G test vehicles from the automotive sector in a real urban environment.

[1] *Editor's note: Here the network is divided into so-called disks with dedicated service quality. This ensures even ultra-reliable, delay-free services. See also article p.014 „Telco meets Automotive".*

[2] *Editor's note: A concept in which part of the cloud intelligence migrates back to the individual devices or sensors.*

"Purely decentralized data processing is not enough, networking must remain the focus if data is to be transferred and mobility guaranteed."

– Prof. Dr.-Ing. Thomas Wiegand, Executive Director, Fraunhofer HHI

InNOVAtion: Why do we need 5G when information is being processed locally again via edge computing?

Wiegand: Purely decentralized data processing is not enough, networking must remain the priority if we want to transfer data and thereby ensure mobility. However, latency-critical preprocessing can be carried out at very high speeds using decentralized processing. FPGAs are used as elements of edge computing. They supplement a "deep" cloud in such a way that latency-critical classification in real time is possible using AI, for example. The extension of the classic cloud to future "cloud layers" in 5G networks makes it possible to train AI in the deep cloud with large volumes of data, and to run it in the edge cloud for real-time applications, where less storage resources are required. A flow of data into the deep cloud with a lot of memory can in turn be used for online training of AI. Communication with very high data rates remains a central element of 5G.

InNOVAtion: From experience, we know that area-wide radio networks in particular are highly susceptible to interference and have gaps in coverage. What do you consider the main challenges for network operators, and when and how can these be tackled?

Wiegand: We are not a network operator, but the challenges are probably that, in addition to the auction fees for the 5G frequencies, immense financial resources have to be made available for network expansion in order to achieve a higher reliability than with 4G networks. The German government has scheduled the auction for the first quarter of 2019. From this viewpoint, it remains to be seen how much the three major operators are prepared to invest this time for spectrum allocation.

InNOVAtion: 5G works in the millimeter wave range, meaning that range and penetration of solid objects are severely restricted. How can a network with high coverage be realized despite this?

Wiegand: In the 5G standard there are basically two different bands, one at 3.5 GHz and then at 28 GHz. Only the upper band represents the real millimeter wave range, where shading effects can occur more often. However, this band primarily serves to provide a very high data rate for a high subscriber density in very close proximity to terminals by means of small cells, and thus it is not intended for nationwide network coverage. Part of the activities of the 5G BERLIN association is to install and test such small cells.

InNOVAtion: With 5G, it is not only consumers who will have significantly more bandwidth – how can companies benefit from the new technology? Can 5G BERLIN provide help here?

Wiegand: Companies can definitely benefit from the new technology. We're not just talking about large corporates that may take advantage of "private" 5G networks for an Industrial Internet of Things (IIoT) in their factories, but also SMBs and start-ups that can use the novel infrastructure for their innovative products. The virtualization of networks makes 5G appealing for both hardware and software companies. With its test field, 5G BERLIN can try out this wide variety of developments in an urban environment, and thus thereby turning them into market-ready products faster. This "unfair advantage" will in particular help start-ups and SMBs to quickly establish themselves on the market with their products.

InNOVAtion: Do you expect 5G to boost concepts around mixed, augmented and virtual reality (MR, AR & VR)?

Wiegand: It is only with 5G and edge computing that AR, VR and MR really become possible in the high-resolution field. At the moment end devices are simply too large and bulky, since the computing power must be present on them. This will change fundamentally with the low latencies and edge computing of 5G. The complex calculations, for example of video signals per frame (fps), can be done in the edge cloud and transmitted to the end device – such as VR glasses – with very low latency. This allows smaller end devices with low computing power, which also benefits battery life. Real-time transmission with very low latency allows VR glasses to be used without dizziness or headaches. Real-time transmission to several VR glasses is also possible, e.g. for the business case of major events with all glasses being synchronized.

InNOVAtion: How much are you thinking about 5G's successor, and what takeaway can you give our readers?

Wiegand: Further technologies are already being researched. The trend is likely to be towards the continued use of higher frequency bands, from higher millimeter wave frequencies beyond 100 GHz to the use of terahertz transmission. However, this has been purely speculative so far and it remains exciting to see which developments will come out on top.

COM5.Rail: Monitoring for Railway Mobile Radio Networks

Sustainable mobility requires rail as a reliable, high-performance means of transport. MicroNova contributes to this with COM5.Rail – the monitoring and analysis solution for optimum quality in railway mobile radio networks.

TEXT: Editorial staff PICTURES: © aapsky, alexdndz / Shutterstock.com

On 9 October 2018, on its journey from Munich to Berlin, ICE800 reached Nuremberg Central Station at 11:00 a.m. sharp. Only a few minutes earlier, it had flashed past two radio masts on the left and right of the high-speed track at Allersberg station at a speed of over 200 kilometres per hour - one of the masts is used for public mobile radio and the other for the railway communication network.

"ETCS" as a Europe-wide standard for train control systems requires seamless mobile radio network coverage along all tracks. The scenario described above clearly shows what COM5.Rail was developed for, among other things: To put it simply, the mobile radio systems of railway operators and "normal" mobile network providers must not interfere with each other.

A further important aspect for optimal railway mobile radio networks is the consideration of external factors such as vegetation, weather conditions, seasonal environmental factors or geographical information, etc. Major events such as the Oktoberfest, where additional mobile radio stations are set up or existing systems are reconfigured dynamically at short notice, are also potential sources of interfer-ence.

Monitoring and analysis of GSM-R and ETCS/ERTMS

COM5.Rail is a solution for the monitoring and analysis of GSM-R and ETCS/ERTMS (European Train Control System/ European Rail Traffic Management System). With their help, railway operators receive comprehensive functions to ensure the service quality of their mobile radio systems throughout the entire rail network.

Measurement data generated by the trains serve as the data basis. Depending on availability, the solution also uses the configuration and performance data of the public mobile network operators. COM5.Rail is thus able to identify sources of interfer-ence right down to the radio tower of the affected cell and in the best case even to incorrectly configured parameters.

The solution offers numerous functions for monitoring GSM-R and ETCS/ERTMS security. By permanently monitoring the ETCS/ERTMS signal data transmission, anomalies are quickly detected. In the case of faults, the solution generates auto-mated alarms and detailed error reports. COM5.Rail also frees users from onerous tasks: Graphical dashboards allow the user to focus on the essentials, and they alert in a targeted and automated manner.

Avoid faults in advance

COM5.Rail contains procedures and processes for the detailed col-lection, evaluation and presentation of previously gathered and processed information in order to avoid such fault cases in advance. In addition, the system makes it possible to record all events in the entire rail network for each trip with all transmission points over any length of time.

Our Partner: Triorail

MicroNova cooperates closely with Triorail GmbH & Co. KG on COM5.Rail: The company, which has been successfully estab-lished in rail transport for many years, supplies GSM-R modules, modems and test devices; these guarantee the best possib-le database. The systems are in-stalled directly in the trains and automatically deliver the data that COM5.Rail evaluates and processes via MicroNova's central Big Data platform.

ETCS / ERTMS

The ETCS together with the future, standardized ERTMS will replace the country-specific systems for the management and control of rail traffic in Europe. ERTMS is thus the optimized version of the European Rail Traffic Management System for the controlling and safeguarding of regional routes, which communicates track occupancy information through periodic reporting of the position of the locomotive over the GSM-R radio network of the train control system. Thus, faults in railway-specific radio networks have an immediate effect on train traffic and therefore on the economic success of the operator.

Based on the collected measurement data, KPIs are defined and evaluated using manual or automated analysis methods. In the event of incidents, the data can be accurately reproduced and compared to understand the triggers for a malfunction.

Configurable dashboards and geographic maps (geomaps) allow users to quickly identify anomalies or faults and their impact. Visually supported analysis procedures help to better understand relevant context and thus further improve established processes and procedures.

Key Features:

- Central system for recording, on-line based transmission, and evaluation of data
- Performance indicators are processed using modern analysis procedures
- Evaluation through Data Mining technologies
- Display of route sections down to the centimeter range
- Identification of potential sources of interference from public mobile radio networks
- Integration and utilization of external data sources

Interoperability and security

One of the main goals of the ETCS/ERTMS and the GSM-R network is making its use compatible across countries as well as technologies. When a train crosses a national border or leaves the operating range of an equipment manufacturer (radio access network, onboard, railway track system), both the roaming quality of incoming and outgoing connections as well as a full range of features for analyzing the operation of both the railway track environment and the train itself must be guaranteed. COM5.Rail helps to ensure this interoperability.

So that the railway operators can maintain their leading position in the area of operational safety, COM5.Rail offers numerous features for monitoring GSM-R and ETCS/ERTMS security, for example, railway emergency call (REC) or train emergency stop monitoring 24/7 (option). In case of faults, the solution can generate alarms or reports as applicable. The continuous control of the on-board signaling of ERTMS data transmission makes it possible to detect abnormalities reliably and quickly.

Troubleshooting

COM5.Rail offers a continuous real-time monitoring of the quality of service (QoS) for RX level and quality in the ETCS/ERTMS and the GSM-R network.

"Public mobile network providers design their networks to be highly dynamic, which is also due to temporary or external influences. Taking into account the changing vegetation over the course of the year alone would require the use of such a solution, since increasing foliage, for example, influences the signal quality. Summing up the many other relevant factors, COM5.Rail offers railway companies measurable added value".

– Georg Kieferl,
Head of Telco Solutions,
MicroNova

1 With COM5.Rail, environmental and temporary influences as well as other external data can be taken into account for predictive network planning.

The most important aspect of this is the detection of interference disruptions (e.g., intermodulation "IM3"), caused by interaction with other networks. Depending on its availability, data from public mobile network operators can be used to identify the source of disruption. COM5.Rail displays critical points as IM3 faults, along with their corresponding probability of error as well as the potential causes (Top-5 readout). In this way, a quick and targeted fault elimination is possible.

Also the optional automatic alarming for incidents, especially for railroad emergency calls or when QoS values fall below a defined level, is also one of the troubleshooting capabilities of the solution. Both events and KPI indicators as well as threshold values can be defined by the user.

All aboard!

With these capabilities, COM5.Rail helps rail operators minimize operational risks and extend value creation. A fast ROI, a reliable offering and pleased passengers are the result. *COM5.Rail – we keep you on track!*

COM5.Mobile - the proven basis for COM5.Rail

COM5.Mobile (formerly CPCM) has been successfully used for many years in the configuration management of mobile networks. Among others, Vodafone Germany and Telefónica Germany use the system. This know-how is the basis for the new project COM5.Rail, which is ideally suited for use in the railway sector, especially since the integrative use of the data offers advantages for all parties involved.

Keyword: Stability

High-performance enterprise IT thanks to applications performance monitoring

TEXT: Michaela Hall PICTURE: © RheinLand Versicherungsgruppe

In 1880, merchants, lawyers and citizens of Neuss, Germany, founded the fire insurance company "Feuerversicherungsgesellschaft Rheinland Aktiengesellschaft" to cover the greatest risks of the time. Their descendants continue to hold majority stakes in the RheinLand Versicherungsgruppe insurance group, which – now set up as a group of companies – still has its headquarters in Neuss, from where it offers insurance and asset protection via three distribution channels, each with its own brand.

Wanted: J2EE-optimized applications monitoring

Of the 100 or so IT employees in the group, 35 alone are responsible for smooth-running IT operations. The team has always attached great importance to professionally managed IT, including appropriate application monitoring. In earlier years, the company relied on a Nagios-based product to monitor all applications – from performance data such as processor or memory usage to the availability of database interfaces and the validity of certificates for various websites.

With its stronger focus on the Java Platform, Enterprise Edition (J2EE), which along with Microsoft's .NET platform represents the most important software architecture for companies, the insurance group has increasingly moved away from the open source world. The reason for this is that, in an open source environment, each new web connection would have required its own programming. Reiner Dohmen, Team Leader IT Operations, and his team therefore searched for a product that came with ready-made monitors.

After a search, ManageEngine's Applications Manager quickly became the focus of interest for monitoring the performance of enterprise applications. Due to the large number of satisfied testimonials and the range of functions offered, Reiner Dohmen decided to install a test version, with the intention of testing how quickly applications can really be connected – with success.

ManageEngine Applications Manager

In addition to fast implementation, the solution also scored points with its intuitive operation. Applications Manager allows you to keep an eye on more than 150 applications and servers by default – out of the box. "If we want to monitor a system service or application, we always set up a technical and a specialist monitor with the typical technical threshold for the service and a defined specialist threshold for testing the correct function. Information from the currently approximately 800 monitors is clustered. If thresholds are reached, or if technical functions are outside the limits, the software determines the category (warning or error) and sends an alarm depending on relevance," explains Reiner Dohmen.

It is important for the IT Team Lead-er to constantly use the monitoring data to determine the optimum threshold: "Over a period of time, this results in a profile of the service being monitored. On the one hand, this is used for quality management in terms of availability, and, on the other hand, for scaling systems with regard to effective utilization. The resulting optimization of monitoring essentially saves having to permanently check the systems, including with regard to possible latencies. Now, it is only when I receive an SMS or email with a fault message that I am certain that something is wrong."

In the meantime, the team has already gained a lot of experience, so that the staff can create Linux connectors fully automatically in the Applications Manager. Administrators have their own dashboard, depending on their area of activity, which informs them about relevant alarms. Once the on-call service has taken over from 7 pm onwards, alarms are sent by SMS to the mobile phone of the relevant staff member.

The IT team of the RheinLand Versicherungsgruppe also uses the reporting options when required: if a problem occurs, staff use parameters such as response times, RAM or CPU utilization for troubleshooting.

For example, if an application has several hundred sessions open at the same time, the memory will reach its limits. Thanks to Applications Manager, in such a case it is quickly apparent whether there is a need to take action for a device or not.

Reliability in a growing environment

Reiner Dohmen's IT team and the Applications Manager are now successfully monitoring well over 500 different applications and services. These include Active Directory Services, Apache, Tomcat, Weblogic, the MySQL database and the mail server for Lotus Notes. SSL certificates, the REST API and the team's own monitors are also entrusted to the Applications Manager.

The bottom line is an IT environment that works reliably and efficiently at all times despite the growth in services and data. "Applications Manager has become a central and important tool. A network like ours can no longer be managed manually. Here we are dependent on intelligent and above all reliable monitoring," confirms Reiner Dohmen.

In addition to the efficiency of the solution, the IT Operations team leader values the cooperation with the software publisher. For example, if a monitor is needed for a new application or service, the ManageEngine team always reacted quickly and competently. Even some monitors that are now available to all users in the Applications Manager were created on the initiative of the IT team of the RheinLand Versicherungsgruppe.

Conclusion – a stable IT environment

The introduction of ManageEngine's Applications Manager for Applications Performance Monitoring has paid off for the RheinLand Versicherungsgruppe: both staff at the head office and the associated agencies and, of course, the company's customers benefit from high-performance services available at all times. As a result, corporate IT also offers the stability that the established corporation has always stood for.

RheinLand VERSICHERUNGSGRUPPE

"We need intelligent and easy-to-use monitoring to manage a network of our size reliably and stably. We've found the right solution in the Applications Manager."

– Reiner Dohmen, Team Leader System Development, IT Operations

RheinLand Versicherungsgruppe:

- Sector: Insurance
- Employees: approx. 730
- Head office: Neuss
- Year founded: 1880

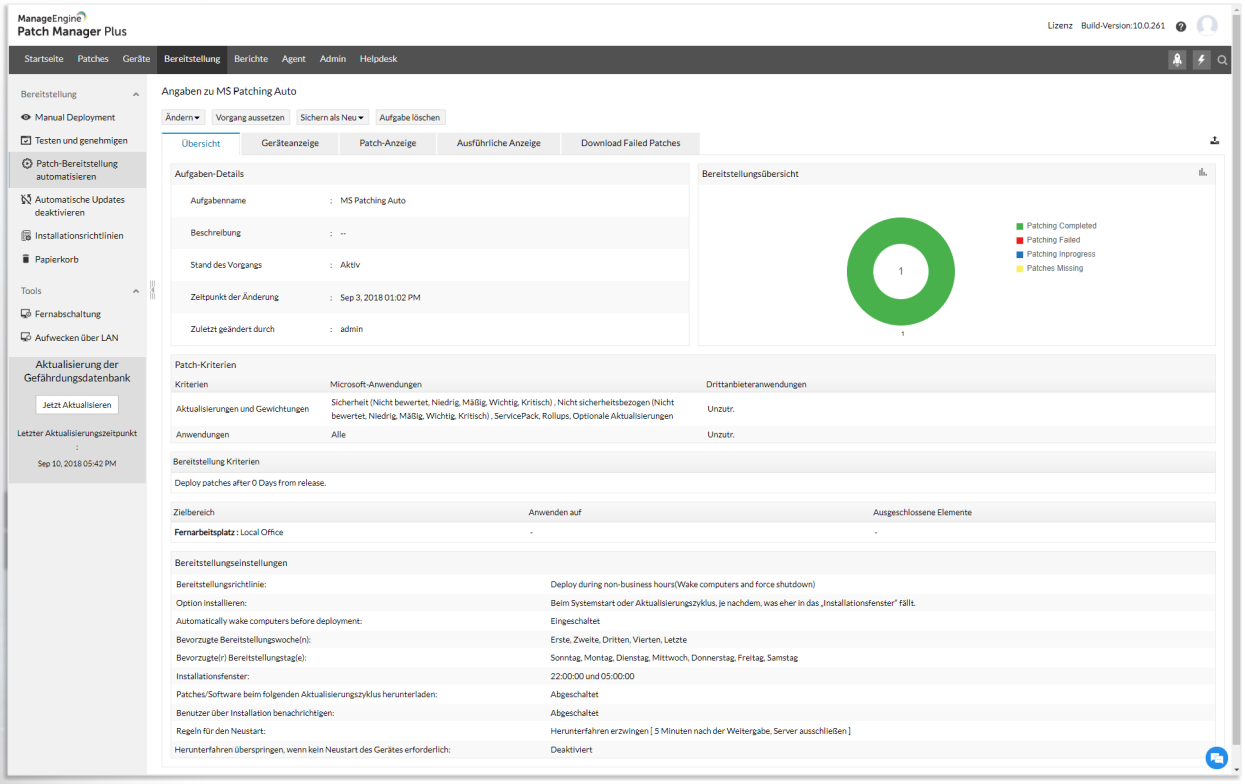
Customer benefits:

- Extremely simple to use
- Intuitive setup of new monitors makes everyday work much easier
- Very good cooperation with the software vendor
- Excellent performance

Powerful Trio for Greater Security

Automated patch management, browser management and monitoring of public cloud platforms: The new ManageEngine solutions Patch Manager Plus, Browser Security Plus and Cloud Security Plus help IT administrators better protect their corporate network from cyber attacks.

TEXT: Michaela Hall PICTURES: © Sergey Nivens / Shutterstock.com



1 Patch Manager Plus: Administrators can automate patch deployment across platforms from a single user interface.

Since the publication of the last InNOVAtion, ManageEngine vendor ZOHO has launched three new solutions, distributed in Germany exclusively by MicroNova. The following overview shows exactly what the products can do and how IT departments benefit from their use:

Patch Manager Plus

Cyber attacks such as 2017's Wanna-Cry attack repeatedly illustrate the importance of the timely deployment of patches for corporate network security. Many companies could have prevented the spread of the ransomware relatively easily – by updating their Windows operating systems in good time. In practice, however, the prompt installation of patches for operating systems and applications often fails due to the amount of effort involved: The Cisco 2017 Annual Cybersecurity Report, for example, assumes that companies only fix a fraction of vulnerabilities with patches – more than 90 percent of security vulnerabilities remain and present welcome targets for malware.

A remedy is available in the form of solutions such as Patch Manager Plus, which automates the patch management process and ensures that all current patches are consistently applied to operating systems and applications across all platforms. In addition to Windows, Mac OS and Linux, the new ManageEngine software also covers more than 250 third-party software applications, including Adobe, Java and WinRAR. To relieve the load on IT departments as much as possible, the solution can automate all the steps required for patch management – from synchronizing the vulnerability database, checking all endpoints on the network for missing patches, to installing them and regularly updating the corresponding installation status.

Before rolling out updates and bug fixes, administrators can test and automatically deploy them to thousands of systems, reducing the time required for patch management by up to 90 percent compared to complex manual processes. Another advantage of the solution is that the corporate network

is better protected against attacks because vulnerabilities in applications and operating systems can be eliminated more quickly.

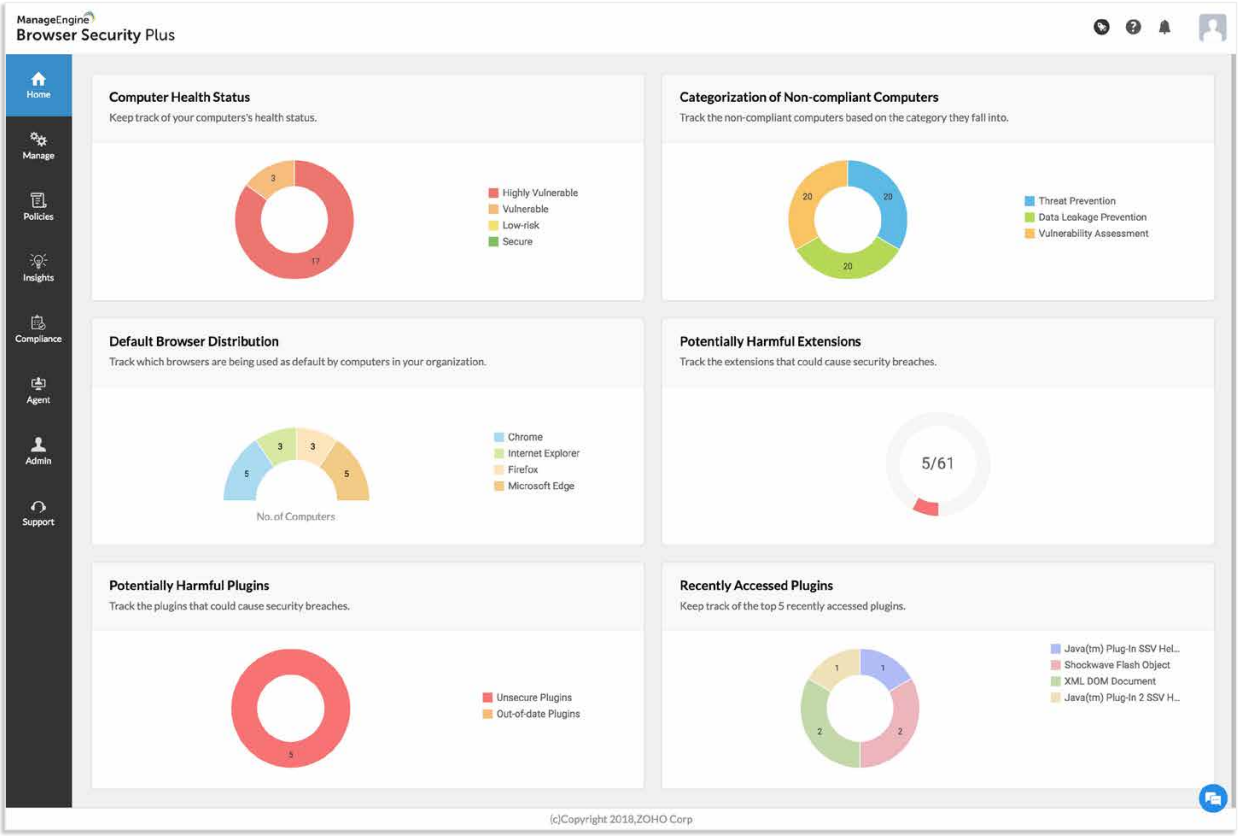
Patch Manager Plus is available as an on-premise or cloud version (for Windows environments only). Installed locally, the solution allows patches to be applied to desktops, laptops, servers, mobile devices and virtual machines from a single user interface.

Browser Security Plus

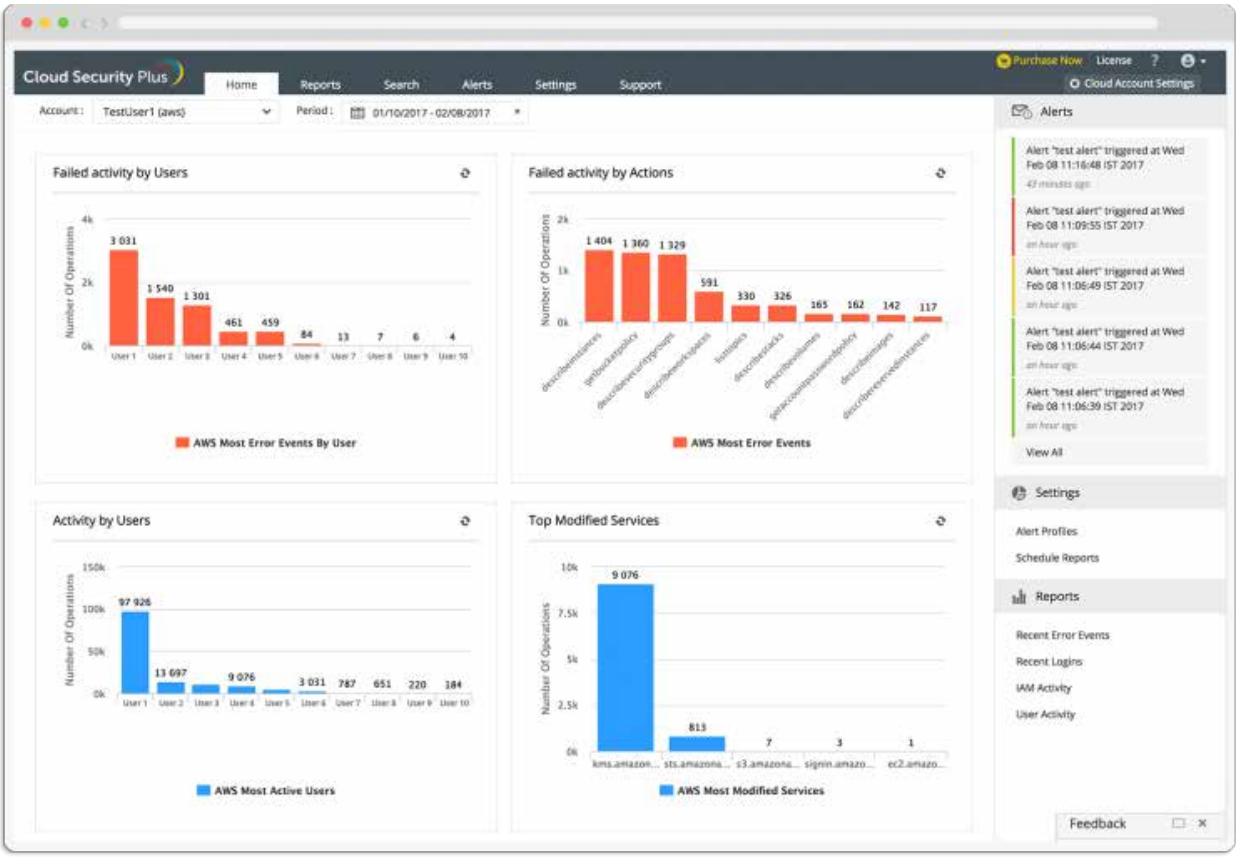
ManageEngine's second new solution, Browser Security Plus, addresses another popular target for hackers: unsecured browsers and web applications that increasingly offer direct access to company data via cloud-based products. According to the statistics portal Statista, almost 24 percent of exploit attacks in the 1st quarter of 2018 targeted browsers. Consequently, it is becoming more and more important for companies to optimally secure these programs.

ManageEngine's new browser management solution helps IT departments better protect the programs they use against cyber attacks. The solution can manage and secure many popular browsers such as Google Chrome, Mozilla Firefox, Microsoft Internet Explorer, and Microsoft Edge, as well as their extensions and plug-ins.

This gives administrators a complete overview of the browsers and extensions used within the company. They can more easily detect add-ons that are potentially prone to vulnerabilities and centrally set and enforce security policies for different programs. If required, the web browsers used can also be shielded against unauthorized access. In addition, administrators can restrict usage exclusively to trusted web sites and applications.



2 Browser Security Plus: The dashboard provides a quick overview of the browsers used within the company as well as their extensions and security settings.



3 Cloud Security Plus: The dashboard shows at a glance all the details of a cloud account selected from the drop-down list.

Cloud Security Plus

The third new software product, Cloud Security Plus, is also dedicated to protecting corporate data. The log management and monitoring tool for public cloud platforms such as Amazon Web Services (AWS) and Microsoft Azure gives IT administrators a complete overview of their AWS or Azure Cloud infrastructure.

Comprehensive reports, easy-to-use search tools, and customizable alerts help administrators easily and efficiently track and analyze events in cloud environments. This enables administrators to always respond appropriately and ensure smooth business operations in a secure, protected environment. Companies can take advantage of the benefits of the cloud – ease of deployment, scalability, and low cost – while meeting ever-increasing compliance requirements and security concerns.

Free trial versions

If you're interested, you can try all three solutions free of charge and without obligation. A 30-day trial version including all functions is available for download at www.manageengine.de.

Work Productively Thanks to monday.com

Visually appealing, intuitive and easy to use: monday.com is a project- and time management tool that helps teams work together more efficiently and communicate better. The product is now available from the distributor MicroNova.

TEXT: Julia Reuter PICTURES: © monday.com

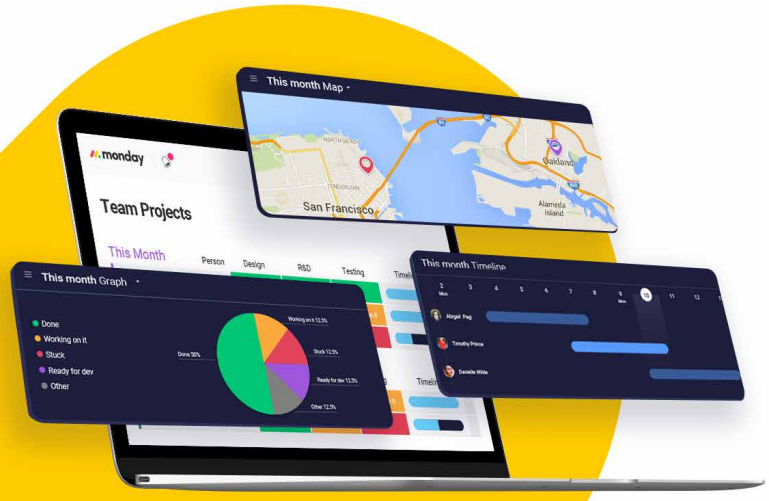
Many companies use various project-, task- and time-management tools or Excel lists to organize themselves or the work within a team or department – mostly developed over time, often as shadow IT. However, these generally only cover certain sub-areas, are often visually rather unattractive, and are not always very user friendly. It is difficult to maintain an overview of the multitude of information, projects, and tasks while at the same time working together with others.

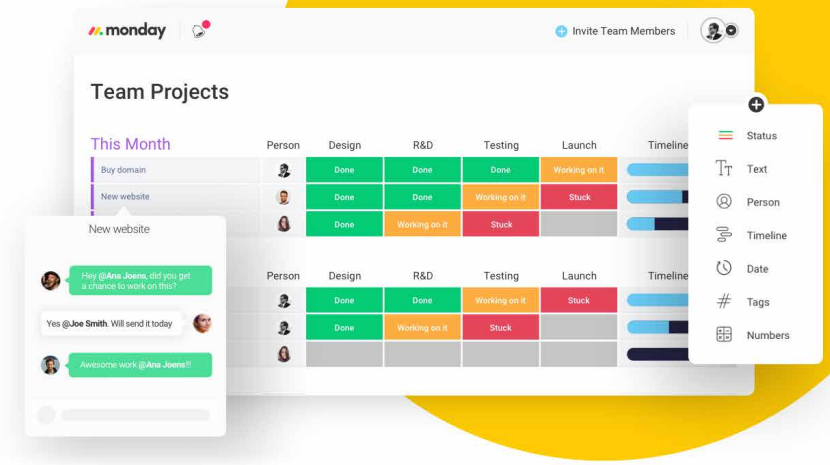
The Israeli company monday.com has therefore developed a solution that covers both the multifaceted organizational aspects and communication within the team. Relevant information should be easy to find and the current project status should be immediately apparent to all participants in order to reduce avoidable meetings and time-consuming searches through the email inbox. At the same time, using the tool should as far as possible remove the need for the time-

Free trial version

Anyone interested can test monday.com for 28 days free of charge and without obligation: Simply send an email to our monday team to receive your personal test account login. MicroNova will be happy to assist you during the test phase with German-speaking support. In addition, our team also offers German webinars that give an overview of the tool's functions. Our team is at your disposal for matters relating to registering for webinars and for questions regarding use or prices.

Please contact:
Email: monday@micronova.de
Phone: +49 8139 9300-337





consuming writing of emails for internal project coordination. For Roy Mann, CEO of monday.com, user-friendliness is particularly important: Working with the tool should be enjoyable for users and motivate them to be productive.

The result of this approach is the versatile and easy-to-use web-based tool monday.com, which can be used to depict and track business processes, tasks, and projects quickly and efficiently. The visually appealing interface and intuitive controls appeal to all user groups, as the tool can be used immediately even with no prior knowledge. New projects can be created, adapted and filled with individual tasks or steps within a very short period of time.

Everything at a glance

Team leaders can assign new tasks to their employees with a click and provide additional information, resources, or links for editing via the update function. Any queries to colleagues can also be conveniently made using the update function; they will then find the query in their inbox, which is visually similar to a Facebook wall. As with the social network, updates can be "liked" – a good way to recognize performance and motivate. The decisive advantage of team communication via monday.com, however, is that all information on a project is pooled, and as a result is more readily accessible.

The current status of a project can also be viewed by all participants at any time – without unnecessary meetings or email queries. Different graphical views help managers, especially in large-scale projects, to keep track of the different sections. All in all, teams can work more efficiently and cooperatively – regardless of whether they are in one office or spread around the world: Free iOS and Android apps mean monday.com can also be used on the go.

Secure yet open

monday.com is hosted on the Amazon Web Services infrastructure and the Google Cloud platform. The security model and checks for both platforms are therefore based on proven international standards: The solution meets the requirements of the EU General Data Protection Regulation (GDPR), and ISO 27001 and 27018 standards, among others. The tool can also be integrated with numerous solutions, including Slack, Google Drive, Trello, Asana, Google Calendar, Jira, Dropbox, Excel and Outlook, allowing customers to be seamlessly integrated.

Conclusion

monday.com is a versatile and customizable tool that enables teams to improve internal workflows, manage time, and increase productivity. 350,000 users from 76 countries are already using the solution. Customers include DHL, McDonald's, and Philips.

How does monday.com work?

The tool works on the basis of boards where all tasks of a team or a certain project are collected according to need. A number of templates are available to users making it easy to create these boards. For example, in addition to "standard" project and task planning, there are also templates for event planning, sales and marketing activities, employee on-boarding, process management, or the planning of surgical procedures. Once a board has been created, it can be extensively customized, for example by adding elements or columns, and filled with individual rows, called pulses. The creator of the board can also define whether other people are allowed to view or edit the board. It doesn't matter whether they are colleagues, customers or external service providers such as graphic designers or freelancers.

monday.com

Ten years at MicroNova

Five employees are currently celebrating their tenth anniversary at the company. We would like to thank everyone for their commitment and team spirit!

Serkan Salli already came into contact with carts GmbH – today ks.MicroNova GmbH – during his studies of electrical engineering with specialization in vehicle systems at the University of Kassel. After successfully completing his studies in 2008, he started his professional career at carts as a project engineer for transmission test simulation and later became a project manager for the CTR division (short for Component Test Rack). In 2015, he was promoted team leader and in 2017 he became department head for projects and support.

However, he felt drawn back again into the actual project business: In future, he will drive strategically important projects at the Kassel location as senior project manager. Serkan Salli particularly appreciates the technical expertise in the team. "Long-standing employees act as mentors and train our new employees. This enables them to integrate particularly quickly." After ten years, Serkan Salli still likes to remember his early days - when the entire team sat together until late at night, ordering pizza, working on the HiL and thus bringing the project to a timely conclusion.

After his training as a telecommunications electronics engineer and his continuing education as a technician, **Andreas Grimm** worked for several years in configuration management and industrial plant programming prior to joining MicroNova in 2008. Initially, he was in charge of the commissioning of the HiL test benches as well as the corresponding hardware and software adaptations. In 2016, he joined the Consulting and Services team supporting customers such as Audi and BMW. For one year now he has been supporting an automotive supplier with the introduction of EXAM, where he is responsible for the library development, the generation of test cases as well as the implementation of additional functions.

Andreas Grimm has always experienced the cohesion among his colleagues as very positive. "Even when I worked at other locations, I always had a contact person who was available to answer my questions." However, the father of two from Jetzendorf is also happy when he works in Vierkirchen. Because "working with my colleagues here is a lot of fun and the commute is short – it's a perfect fit for me".

In 2008, computer engineering student **Thomas Reiner** became aware of MicroNova during a job fair at his university, the University of Applied Sciences Ingolstadt (today: THI). A subsequent visit to the "open house day" in Vierkirchen convinced him completely to spend his practical semester at MicroNova. He started in September 2008 in the former network management division. This was followed by his diploma thesis on SDH networks and, after successfully completing his studies, a permanent position as a software developer. In the following years, Thomas Reiner worked on an element manager for Layer 2 network elements and a network management system for MPLS networks until he moved to Telco Solutions as a developer for today's COM5.Mobile products.

Although MicroNova has grown strongly over the years and accordingly many new processes have been created, Thomas Reiner greatly appreciates the fact that everyday working life has remained unbureaucratic. "What actually moves me, I can always clarify directly." Other reasons why the father of two from Altomünster still enjoys working for MicroNova are a lot of freedom and individual, flexible working-time models for all situations in life.

Rainer Moosburger had already worked in IT and web development for various industries when MicroNova founder Josef W. Karl offered him a job as a software developer. He accepted and joined the Test Automation department in September 2008. In addition to developing the EXAM software, he was also able to use his web development experience for the EXAM website, which he created himself. In the following years, he increasingly sought the contact with the customers, accompanied training courses, and coordinated the EXAM support. Today, as a project manager, he is not only responsible for the distribution of EXAM, but also takes care of customer-specific further developments and additional test automation service and product offerings. He is particularly motivated to see how much heart, soul and effort all his colleagues have put into the projects for years.

In his spare time, the father of two from Pischelsdorf enjoys mountain biking or going to the cinema with his colleagues. When asked why he hasn't accepted another job offer for so long, he just smiles: "In my opinion it's just too pleasant here."

Markus Wiedholz always wanted to have his finger on the pulse of technology and to help shape innovations. In order to achieve this, he completed a further education as a certified technician and business economist after his training as an energy electronics technician. Subsequently, he worked as a test technician in the automotive industry in Ingolstadt, where he first got in touch with MicroNova employees. They convinced him to start in the company's test automation division in November 2008 - luckily! Markus Wiedholz has played a major role in shaping EXAM over the past decade, helping to launch the training courses program and driving product management. Today, as project manager for sales and marketing, he is the interface between development and sales, and works together with colleagues from various locations and departments. He particularly appreciates the collegial cooperation in the team and also with the executives. "The open exchange and close contact to the members of the board is truly something very special". Despite all the professionalism, some things haven't changed - recently he even returned to the office he started his career in in 2008.

European Champions

The European Championships in Glasgow included the European Youth Championships (JEM) in gymnastics. Also present: Leonie Papke from TSV Jetzendorf, whom MicroNova has been supporting for many years.

© Fotos: Kerstin Will

Every country was allowed to compete with a team of five athletes at the gymnastics JEM, of which four sportspeople each presented their exercises on the apparatuses jump, uneven bars, balance beams and floor. Emelie Petz (TSG Backnang), Lara Marie Hinsberger (TV Lebach), Lisa Zimmermann (TuS Chemnitz Altendorf), Emma Malewski (MTV Pattensen) and Leonie Papke (TSV Jetzendorf) performed in the team of the German national team. The athletes were selected by Claudia Schunk, the national coach responsible for the junior section of the German Gymnastics Federation.

After Leonie Papke was able to show successful exercises at the qualification competition at the end of June in Chemnitz, in the preparatory training camp in Frankfurt and most recently at the international competition in Treviso/Italy, the chances of being nominated for the JEM were good - but due to the tough national competition it was certainly not an easy decision for Claudia Schunk whom to take to Glasgow.

After the podium training, it was decided on site who would use which equipment. Leonie Papke started at the jump and uneven bars and got into the team classification there. In front of a huge audience and in an impressive hall she opened the competition for the German team with good performances. In the end, the German juniors finished seventh after a successful competition and Italy became European Team Champion.

"We are happy for Leonie Papke and especially for the entire TSV Jetzendorf. It's fantastic what the many instructors are doing there. Such prominent successes of individual athletes are just the icing on the cake, so to speak. It should always be remembered what a valuable contribution the club makes to its environment. Hence, we will gladly continue to support it", says Orazio Ragonesi, CEO of MicroNova AG.

Interview with Josef W. Karl

Electric to China, Autonomous and Networked in Germany

The editorial staff of InNOVAtion spoke with Josef W. Karl (JwK), found-er, chairman of the supervisory board and sole shareholder of MicroNova, about the year 2018 and current plans.

InNOVAtion: 2018 was a rather difficult year in terms of global and German politics – how did MicroNova fare?

JwK: It's been a good year: we finished and moved into another company building. In the first quarter the number of employees passed 250 – our teams now number around 280 colleagues, which is something that impresses me every day. Even more importantly, I think that we are well prepared for the coming years.

InNOVAtion: In what way is the company well prepared?

JwK: MicroNova has been successfully active in both the automotive and telecommunications industries for a long time. In the automotive sector, we are represented with leading technologies in the fields of electrification of the powertrain just as in networked and autonomous driving, as well as with 5G in the telecommunications environment. Combining these topics takes testing and simulation to the next level. We are therefore increasingly pushing ahead with integrative projects. This is underlined by the article "Telco Meets Automotive" (p. 014). MicroNova has a lot of expertise and highly qualified employees for both worlds. We can and will play this card much more strongly. We are thus well positioned for electrification, IoT, Car2X communication, autonomous driving and much more. Like Aristotle, the whole is more than the sum of its parts.

InNOVAtion: To what extent is the whole more than the sum of its parts?

JwK: The complementary knowledge from the automotive and telecommunications sectors naturally brings customers direct added value in products and solutions. That's our ace card, no competitor can offer that as easily. But I'm thinking one step further and strongly in line with my proven motto "Quality costs money – lack of quality costs more". That was my guiding principle 30 years ago, and MicroNova still follows it today. It's probably even more important now than it was then. This integrative understanding of telco and testing, to use MicroNova jargon, is of course also an important point when it comes to factors such as quality or adherence to schedules and budgets. We want to give our best for our customers – both in terms of products and solutions and in terms of everything that accompanies them.

InNOVAtion: As you mentioned, MicroNova opened another company building this year – will all these topics continue to be directed from Germany in the future?

JwK: We are committed to Germany as a business location and to all our offices in this country. And it's true that we will be even more international in the future. This must be seen in the context of growth. We founded a subsidiary in the Czech Republic in 2015, as customer proximity is an important factor for us. Now 25 people dedicatedly work for MicroNova there, and do so very well across national borders with their colleagues from Germany, which makes me very happy. Looking at our activities and especially in the context of electromobility, the next step is to expand our presence in China. We are also keeping an eye on other European markets. Our healthy and organic growth shall continue.

InNOVAtion: A final word on IT management?

JwK: Yes, this is more than important and well deserved! The department has performed very well in recent years and simply achieved great things in 2018. It is therefore my personal wish to thank our customers for their trust and our employees for their commitment. The team has managed to significantly expand its already very good customer base. For example, we are able to supply well-known companies such as Chocoladefabriken Lindt & Sprüngli AG or Meggle with ManageEngine's IT management solutions. So the next time you're tucking into a Lindt chocolate: we had a little hand in that. (laughs) The two executive managers and I therefore agree that they will continue to strengthen this division, both organizationally and in terms of external communication. In 2018, we also took over German sales and distribution for the monday.com project management solution. We are confident that the first positive results will be followed by more.

More Space for Innovation – with a Campus Atmosphere

About one year after breaking ground on May 11, 2017, the time had come for MicroNova to move into its second building at Unterfeldring in Vierkirchen, Germany. This is how the Business Park Vierkirchen was created – space for innovation (#RaumFürInnovation) and a home with a campus atmosphere.

Around 140 employees now work at MicroNova's headquarters in Vierkirchen, north of Munich. This means around half of the staff is located at Business Park Vierkirchen, which consists of the two buildings at Unterfeld-ring 17 and 6 (the new building). The official opening of the new building took place on the second weekend of June 2018. The modern office building was naturally equipped with state-of-the-art building services right from the start.

And the first building, built in the early 1990s, benefited from the construction efforts too: The architecture is still impressive, and extensive modernization work inside – from miles of new network and power cables to fresh paint for the walls and new flooring – has helped keep the whole complex up to date in every respect. You can see plenty of photos of the construction progress on Facebook (https://www.facebook.com/MicroNova/) under the (German) hashtag #RaumFürInnovation.

MicroNova founder, Chairman of the Supervisory Board and sole shareholder, Josef W. Karl, said of the construction project: "It is very important for me to see MicroNova well positioned for the future in every respect. We work on outstanding technologies for our customers. A few years ago, when I moved from the Executive Board to lead the Supervisory Board, we set the course for continuity and innovation in corporate management, including the gradual introduction of my son Maximilian to the company; he is also the principal and majority co-owner of the new building. We've invested a lot in infrastructure and in the future."

Facts and figures

MicroNova has invested around seven million Euros in total. There was also a six-figure sum for both technical and visual renovation work in the existing building, and further measures for improving energy efficiency are already being discussed here. "The modern equipment in the buildings helps us in our daily work for our customers, for example through the telepresence systems," confirms Dr. Klaus Eder (COO). The activities mentioned for the entire campus-like facility underscore the founding family's ongoing commitment to the long-term success of the company.

In the new building, the infrastructure to build a charging station for electric vehicles is already in place, and the equipment needed to install a photovoltaic system is also ready and waiting. But even without these measures, the new building sets a good example from an environmental perspective: "The Business Park Vierkirchen has an innovative energy concept. Exterior shading slightly removed from the glass front prevents the façade from heating up in summer. Ventilation windows with burglary protection provide night-time cooling and relieve the burden on the air conditioning system in an environmentally friendly manner," explained architect Rita Obereisenbuchner at the opening. The aforementioned active cooling of the rooms takes place in the same way as heating via ceiling sails, which at the same time have a sound-damping effect. The heat energy comes from a local biogas plant.

The new building created space for 120 workplaces over three floors and roughly 3,000 square meters of office space at Unterfeldring 6. A total of 100 car parking spaces were created to ensure that employees will have easy access to their offices; 34 of these are in the new building's underground car park. Together with the nearby "S-Bahn" suburban train station – about five minutes on foot – MicroNova has very good transport connections. The site area of 4,000 square meters offers enough space for the modern campus-like architecture as well as plenty of green spaces, which also include a flower meadow instead of simple lawns; there is also sufficient reserve for a possible second construction phase if long-term corporate planning calls for it.

Excerpt from the architectural concept

With the modern, friendly character and the relaxed development of the site, the facility stands apart from the usual commercial areas, and the architecture of the surrounding area also benefits from the generous open spaces. The generous, green open spaces represent the high quality of life of the surrounding landscape. An integral part of the design is a great deal of transparency with maximum use of daylight.

"I am delighted to be able to contribute to the future of MicroNova through the Business Park Vierkirchen. I would like to thank everyone involved for the excellent building."

– Maximilian Karl,
Co-owner

Cooperation based on true partnership

The good cooperation with the municipality of Vierkirchen and the administrative district office in Dachau deserves special mention. It meant a great solution could be achieved with the mayor and local council in terms of designing the parking area, with a clear increase in parking spaces. The administrative district office in Dachau also provided support for the project by swiftly processing planning permission. "We see our choice of location justified again," adds Josef W. Karl. "It is not always the case that such processes run in partnership and promptly. I would therefore like to express my gratitude to all those involved."

Location

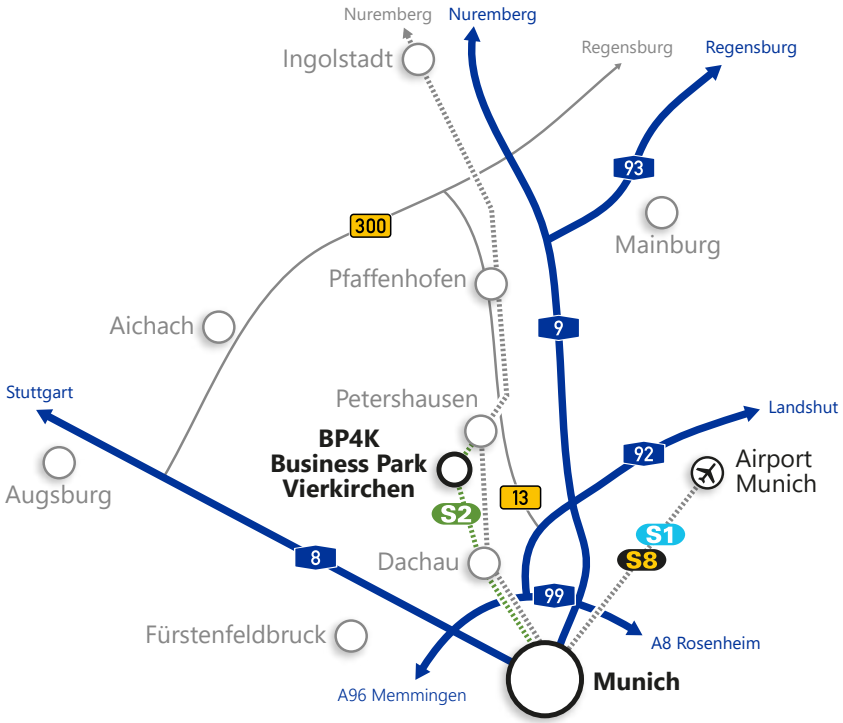
Work in the catchment area of Munich – close to the center, high quality of life and in the opposite direction to the flow of traffic: The Business Park Vierkirchen is located in the center of the industrial zone near the Vierkirchen-Esterhofen S-Bahn stop (line S2 – Petershausen). The Business Park Vierkirchen is also very easy to reach by road. Vierkirchen is located to the north of Munich, just 12 miles from the city limits. This means staff usually drive in the opposite direction to major traffic flows. Munich Airport is about 30 minutes away. The economically important centers of Ingolstadt and Augsburg are also within easy reach. The community is located directly in the triangle formed by Munich, Ingolstadt, and Augsburg.

"With the modern, friendly character and the relaxed development of the site, the facility stands apart from the usual commercial areas, and the surrounding area also benefits from the generous open spaces."

– Rita Obereisenbuchner, Architect

"Construction is a matter of trust, for which I extend my gratitude to the builders. With this good foundation, we have been able to realize this exciting project on schedule with enthusiasm and dedication".

– Christoph Ziegltrum, Principal Contractor



"Wherever possible, we rely on regional companies as partners."

– Orazio Ragonesi,
CEO MicroNova AG

"The modern equipment in the buildings helps us in the daily work for our customers."

– Dr. Klaus Eder,
COO MicroNova AG

How well MicroNova has been received by the Vierkirchen municipality is also shown by the ongoing support of the Business Park Vierkirchen. For example, residents help with lunchtime catering. The 140 employees have the opportunity to have a subsidized lunch every day directly in the cafeteria. "And we also rely on regional companies wherever possible," explains Orazio Ragonesi, CEO of MicroNova AG.

For example, MicroNova has maintenance and repair work carried out by Josef Schmid in the neighboring car repair shop. A cooperation agreement with the local petrol station operator allows employee discounts. “From the outset, it was important to me to work well together with the local community. Of course, this means much more than our long-standing commitment to the local Jetzendorf sports club, where MicroNova’s birthplace is, and extends to regional partners,” adds Karl. “And that, too, should and will remain so in the future."

Building shell

- 4,500 m³ of excavated material
- 2,350 m³ of concrete
- 278 t of steel

Façade

- 900 m² glass front
- 40 t of glass
- 30 t of steelwork
- 1,700 m of aluminum facade profiles
- 400 m² of aluminum sheetwork

Electrical and network technology

- 19 km of data cables
- 18.5 km of electric cables
- 349 automatic circuit breakers
- 4 network cabinets
- 3 server cabinets
- 6 sub-distribution boards and 1 low-voltage main distribution board

“It is very important for me to see MicroNova well positioned for the future in every respect. (...) We have invested a lot in infrastructure and in the future.”

– Josef W. Karl, Chairman of the Supervisory Board, sole shareholder and building owner

Publisher:
MicroNova AG
Unterfeldring 6
D-85256 Vierkirchen
Phone: +49 8139 9300-0
Fax: +49 8139 9300-80
Email: info@micronova.de

Editors:
Katharina Hampe
Regina Schwarzenböck
Stefan Karl (GP)
Martina Heinze

Design:
Christoph Buchner

Printed by:
Offsetdruckerei Gebr. Betz GmbH,
Weichs

Circulation: 2,500 copies

Frequency of publication:
MicroNova's InNOVAtion is published two times a year. Additional special editions might be published.

If you would like to place an order, change or cancel your subscription, please contact:
Phone: +49 8139 9300-222
Email: info@micronova.de

Printed on paper treated with chlorine-free bleach.