INNOVATION

Customer Magazine of MicroNova

MICRONOVA
Software and Systems

02-2020

Simulation platform NovaCarts Virtual

More flexible testing in connected mixed reality environments

New COM5.Mobile products for SDN

MicroNova supports software-defined networking

Endpoint Management in the cloud

New cloud version of ManageEngine Desktop Central

„Taking advantage of change“

Dear Reader,

Have you seen a VHS tape recently? Or made a trip by horse-drawn carriage? Probably not. The process of technological progress has consigned both – unintentionally – to the realm of nostalgia at best. At the moment there is one external factor shaping the pace of change: Quite a few experts consider the economic consequences of COVID-19 to be the most far-reaching since the Second World War. The pandemic has been a wake-up call for us all. We have questioned ourselves as individuals, as a society and at the economic level.

So what could be a positive effect of the pandemic? To take advantage of this (imposed) change! Victor Hugo once famously remarked: “And nothing is more powerful than an idea whose time has come”. But what does this mean for our customers, for our partners and for our team? Innovation has always been, and will remain, at the heart of what we do. The current situation in combination with other factors means that the time has now come for some ideas.

For example, MicroNova has for some time been making great progress with virtualization in the testing environment – and now offers the perfect solutions at the right time. So the article on NovaCarts Virtual is particularly recommended to our readers. Artificial intelligence for companies and fuel cell technologies are other irons that we currently have in the fire. And you will also find articles on these subjects in this edition.

In the telecommunications sector software-defined networking (SDN) and 5G are two drivers that will certainly make a stir. New services and businesses gain a critical edge from these technologies. And here MicroNova has once again used this transition to put its own strategy for the telco solutions area to the test and draw the correct conclusions. You can read about the result in this edition of InNOVAtion.

The pandemic has also further illustrated the vital importance of digitalization and technology. From the maintenance of communication in the private sphere through remote working to distributed research in the pharma area: IT is what supports everything. And here once again we report on a satisfied customer and new products from the IT management environment.

In this edition the reader is addressed not by our founder Josef W. Karl but by his son Maximilian Karl. As a relatively new company owner he makes a clear commitment to the MicroNova`s chosen path. Because amidst all this change it is good and above all necessary to retain an element of the tried and trusted – it provides the framework in which change can be used to innovate. We continue to be mindful of both.

I now wish you, as always, happy reading. And stay healthy!

Orazio Ragonesi

NovaCarts Virtual for Connected Mixed Reality Environments

Test environments that use both virtual and real components accelerate vehicle development and reduce the cost of validating ECUs.

TEXT: Franz Dengler PICTURES: © Iokanan VFX Studios / Shutterstock.com

The automotive industry is on the verge of a significant change: new functions such as autonomous driving mean that the proportion of software used in the range of vehicle features is constantly growing. The focus of value creation is shifting increasingly from hardware to software. In addition, car manufacturers are under high cost pressure, and new functionalities need to be developed in ever shorter periods. End customers today expect an automatic software update as soon as new features are available. The number of vehicle variants will also remain high in the future. This diversity is even set to increase when the performance features implemented in the software are taken into account.

Car manufacturers are therefore increasingly becoming software producers as well. To this end, development processes will also have to adapt to more closely match software development in the future. Conventional test strategies based on the V-model, which only test functions and ECUs together towards the end of a development phase, are no longer sufficient in themselves. This calls for expansion through agile processes. Furthermore, the above-mentioned variety of variants makes it necessary to test a great many combinations of ECUs and software for each increment.

The use of what is known as connected mixed reality (CMR) provides a solution to speed up development and functional testing while ensuring high quality over the entire development cycle. It involves a test environment consisting of real and simulated ECUs adapted to the test task in hand.

More flexible test environments and simulation in the cloud

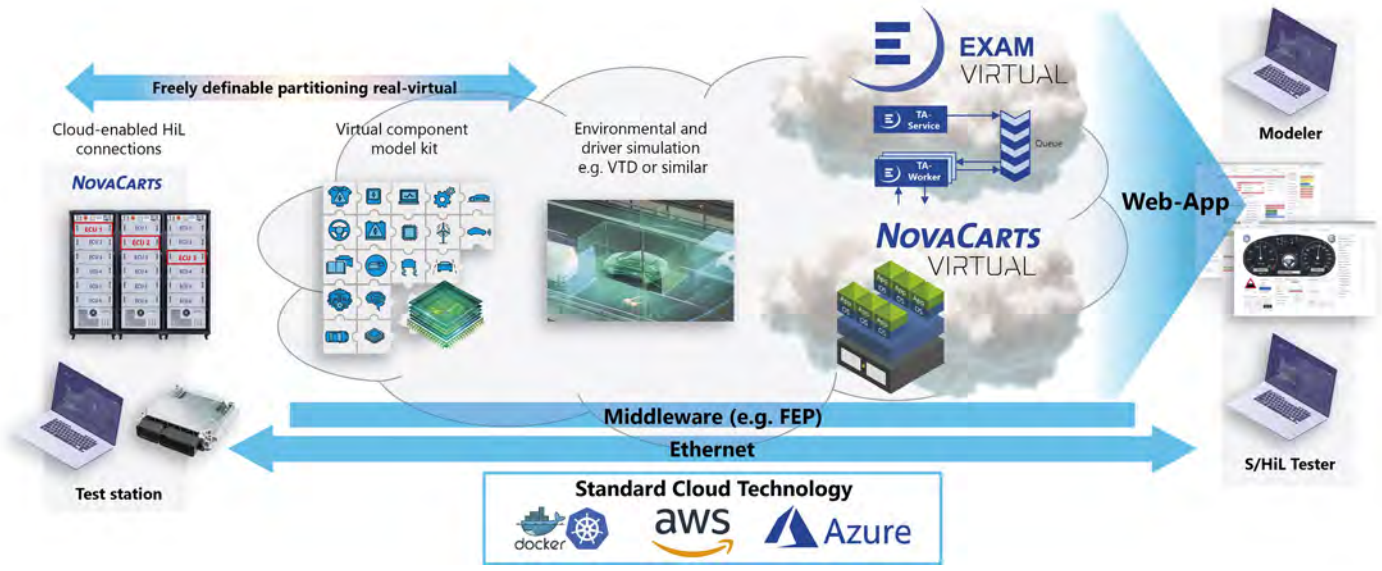
The CMR approach offers new possibilities thanks to a test environment that can be configured at runtime and the real-time operation of the simulations in a cloud. For example, a complete virtual simulation in the cloud is possible in addition to a complete real vehicle body with control units – or a mix of both environments.

The complete virtual simulation of a vehicle, including its environment, ECUs and interface communication, does not require any real test setups, meaning that even test sequences are faster than is conceivable in real time. Such virtual scenarios can also be computed by commercial cloud providers. However, operating a simulation with real ECUs in real-time does require local server clusters.

A significant advantage of mature CMR environments is the high modularity of the individual components, which allows test environments to be configured automatically. The administration and maintenance of the hardware setups is done centrally, so that the individual components are always up to date. This makes it possible to configure different test setups quickly and without errors, and manual activities are largely eliminated.

A CMR test environment usually consists of the following components:

- Control units with an associated hardware environment corresponding to a classic single-user HiL system
- Hardware used to interconnect individual ECUs to form networks (mainly for bus systems)
- Behavioral models for control units: these correspond to classic rest-bus simulations, but are usually more detailed.
- Environmental models, such as road-, driving dynamics-, engine-, driver models, etc.
- Environmental models that allow for geometric simulation, for example of roads, buildings, weather, plant and tree growth
- Sensor models that use 3D data to calculate which image a radar sensor, for example, would see
- Traffic models: In addition to individual vehicles, CMR environments can also be used to simulate vehicle networks, e.g. to simulate functionalities such as platooning (simultaneous starting at traffic lights, etc.) with little effort.
- Middleware: A powerful middleware is required to couple real and simulated components from different manufacturers, e.g. FEP (functional engineering platform).
- Test automation solutions: Cloud-enabled test automation software like EXAM forms the backbone of CMR applications, allowing even complex scenarios to be tested in a reproducible manner.
- Continuous integration platforms: These platforms are used to set up test factories to implement all aspects of testing.



1 Well established and long-standing components become cloud-capable.

A typical test procedure in a CMR environment is as follows:

- A new software component is ready for testing.
- It is checked into the CMR platform.
- Depending on the selected test setup, the required components are automatically connected and started via configuration scripts.
- The automated tests then start and test logs are created. These can also consist of videos for driver assistance scenarios, which can be evaluated should errors occur.

This approach enables a huge increase in productivity. The cycles from the creation of software to the first test result can be shortened from the usual months needed currently to the mere configuration and execution time of the tests.

Individual vendors cannot provide a complete CMR solution due to the complexity and high level of functionality. An ideal implementation of the CMR approach therefore calls for OEMs and suppliers to combine best-in-class solutions into a modular platform. Simulation models for radar sensors, for example, are best obtained directly from the manufacturer.

MicroNova offers the following best-in-class components for CMR solutions:

- Hardware components that can be controlled from the cloud. These create the conditions for the dynamic and simple configuration and operation of variable ECU networks. All assemblies in the NovaCarts portfolio feature real-time control via Ethernet. The bus systems can also all be operated from the cloud.
- Tools for modular configuration of simulation models in binary format without recompilation (NovaCarts Test Configurator). This allows simulation models from a toolkit to be easily combined to create complete simulations.
- And last but not least: NovaCarts Virtual, the virtual HiL simulation platform

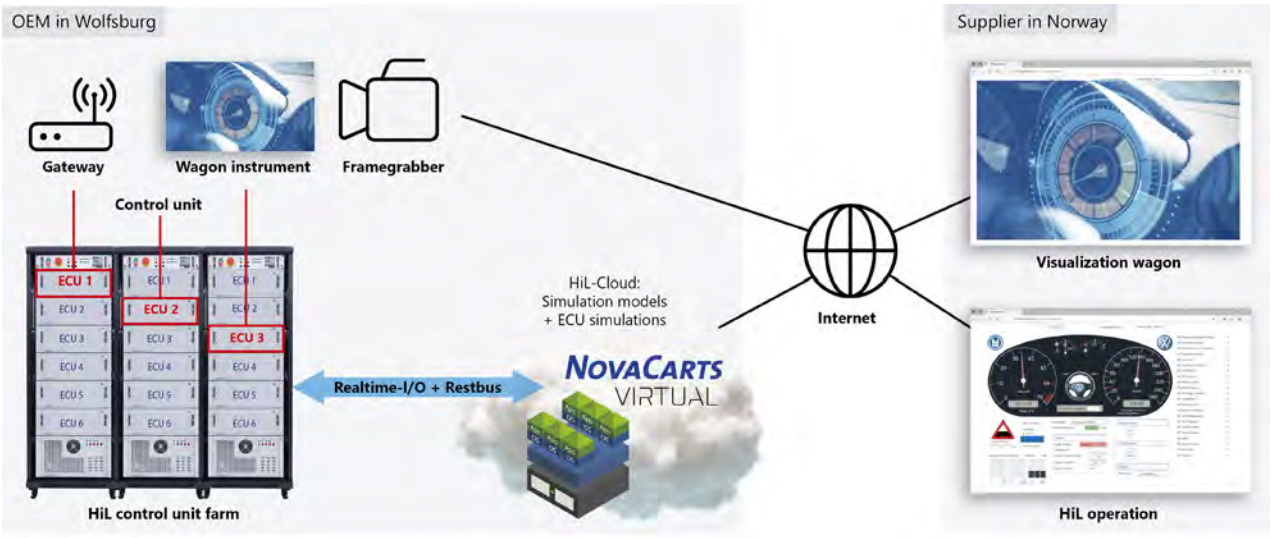
Real-time-capable simulations with NovaCarts Virtual

NovaCarts Virtual is MicroNova's real-time simulation software for use in CMR environments. It allows real-time simulations to run in a local cloud and hardware components connected via real-time Ethernet to be controlled directly.

NovaCarts Virtual is based on the HiL simulation platform NovaCarts, which has a proven track record spanning decades. Many components of NovaCarts Virtual correspond to the NovaCarts components that are used successfully in HiL systems around the world.

The following features make NovaCarts Virtual unique:

- **Real and virtual HiL simulations:** NovaCarts Virtual enables you to work with classic HiL setups as well as fully virtual simulations in a cloud. The latter can also be performed faster than in real time. In addition, any combination of mixing is possible.
- **Realization as a container image:** Users benefit from the sheer speed at which a test environment can be configured, eliminating the complex installation procedures that used to be required. Test configurations can also be easily versioned, meaning that a test setup for regression tests can be quickly and easily restored.
- **Completely modular (binary-compatible) design:** All simulation models are available as modular binary files and can be executed on all NovaCarts platforms (HiL systems and NovaCarts Virtual) without recompilation.
- **Identical configuration tools for real HiL systems and for the cloud:** The architecture of NovaCarts was developed in such a way that the proven configuration tools (NovaCarts Test Configurator) for HiL environments and NovaCarts Virtual are identical, dispensing with the need for additional training.
- **Rest-bus simulations from HiL systems can be used unchanged in cloud environments:** The use of bus/Ethernet converters (CANFD) allows a rest-bus simulation to be posted to the cloud as if it were coming from a LAN socket.
- **Operation of simulations via a web browser:** Complex simulation scenarios such as column traffic run largely automatically, making a simultaneous visualization of simulation variables of the individual vehicles via user interfaces no longer reasonably manageable. However, if situations occur that require manual intervention, users need an interface for individual vehicle simulations. NovaCarts Virtual allows individual simulations to be operated via a browser. Each individual simulation provides a web server for this purpose, allowing users to access the user interface of the relevant simulation in a browser.



2 Implemented scenario (PoC): remote test station

» **Standardized interfaces:** Their availability for all components is an important success criterion for CMR environments. For example, NovaCarts Virtual supports the following interfaces:
- *REST-API:* all simulations can be started and controlled via the REST-API.
- *FEP (Functional Engineering Platform):* NovaCarts Virtual can participate in an FEP network as a simulation component.
- *FMI/FMU:* FMU components can be integrated and operated in a NovaCarts simulation.

Central management of the entire vehicle body

The cloud-based CMR approach with NovaCarts Virtual allows suppliers and service providers to be better integrated into the development process. They have access to the current development status as well as to the overall structure of all ECUs involved at all times. This enables early testing with all communication interfaces that are relevant to the environment of the ECU in question, considerably reducing the testing time, since results are sometimes available within hours instead of weeks.

NovaCarts Virtual is already successfully used in numerous projects and is not limited to automotive applications. Thanks to its universal design, NovaCarts Virtual can also be used in areas such as wind power. Basically, all industries that require software and controller testing benefit from the use of mixed reality test environments. In addition to better resource utilization of the test systems, they enable cross-location collaboration and ultimately accelerate the development process, resulting in cost savings while maintaining consistent quality.

Test Virtualization – next steps

In the future, virtual and mixed test environments will also require an appropriate solution for automatically distributing test cases to the various execution instances in the cloud. Furthermore, test automation must also take place in a virtual environment.

Corresponding concepts are already being developed at MicroNova with the test automation solution EXAM and the Test Cloud Controller (TCC). The existing TCC is being extended for cloud operation. Learn more about this in the next issue of Innovation.

Artificial Intelligence for Companies

Companies can make operating processes significantly more efficient by using Artificial Intelligence (AI) applications.

TEXT: Editorial Team

Artificial Intelligence

The term "Artificial Intelligence" (AI) was coined by the American computer scientist John McCarthy at the Dartmouth Conference in 1956. Even in the preceding years, the concept of intelligent machines had already been the subject of extensive discussion, such as in the paper "Intelligent Machinery" by computer science pioneer Alan Turing in 1948. Here he presented, among other things, early ideas of genetic algorithms and neural networks.

Artificial Intelligence today refers to a branch of computer science in which algorithms are designed to attempt to imitate human intelligence.

What is currently generally referred to as AI is 'weak' artificial intelligence. An intelligence that has the same capabilities as a human brain, i.e. 'strong' AI, does not yet exist.

The basis for taking business decisions is often inadequate because the necessary information is not available in an appropriate form. All the necessary data is in fact present – it just needs to be made usable.

Methods of Artificial Intelligence have seen increasing use in recent years to analyze and structure data accordingly. Methods such as machine learning (ML), deep learning, and neural networks help recognize patterns in large volumes of data. Nowadays, a large number of different solutions applying these methods are available on the market. MicroNova helps companies find the right one and get the most out of AI technologies.

To achieve this, our Consulting & Services division offers a comprehensive range of consulting and development services which focus on data analysis and machine learning. The correct use of AI and data science allows companies to make productive use of existing information and to make many of their operational processes much more efficient.

Custom support for AI projects

Since every organization has different goals and issues when introducing AI-based technologies, every project starts with profound consulting: Using data pre-analyses and

workshops, our consultants first identify potential for improvement in the respective company and advise on the choice of the right method for the intended application area. The focus is on aspects such as costs, efficiency, and flexibility of the system.

After determining requirements and selecting the appropriate tool, the team of experts for data science and machine learning provide support throughout the entire project, from prototype development to the productive implementation of the solution within the organization. Methods from agile software development are usually deployed for this. Reliable, high-quality solutions are created on the basis of the individual requirements.

Artificial Intelligence webinar – technologies and potentials

In order to provide an overview of the topic of "AI for companies", our experts recently held a webinar that can be accessed at www.micronova.de/AI. According to a recent Bitkom study, three quarters of the companies surveyed were looking at the subject of Artificial Intelligence. The awareness that AI is one of the most important technologies of the future is certainly there – but the majority, by their own account, need help with the practical implementation.

In the webinar our experts present the basic technologies of Artificial Intelligence and demonstrate different use cases. Other focal points are "AI in industry", machine learning, and neural networks. However, the central issue is the successful implementation of AI projects and what companies need in order to achieve this.

AI in practice

To help you stay on top of the numerous technical terms or to further familiarize yourself with the topic, MicroNova provides an orientation guide for "AI in practice" at www.micronova.de/AI The guide briefly explains processes related to AI and their possible applications. We start with learning methods such as supervised, unsupervised and reinforcement learning, as well as clustering and statistical regression from the field of data analysis. The website will be updated continuously adding new terms as well.

Consulting Offer

Whether building the necessary IT infrastructure for scalable AI solutions or optimizing existing AI initiatives: We will be pleased to help you with the challenges you're facing when it comes to using AI.

For detailed information please visit www.micronova.de/en/consulting or contact us at +49 8139 9300-0 or sales-testing@micronova.de.

"NovaCarts Shift-by-Wire" provides maximum testing flexibility

Maximum flexibility and accuracy when testing gear selector ECUs for various vehicle projects: MicroNova has fulfilled this wish from Audi AG with its 'NovaCarts Shift-by-Wire' HiL system.

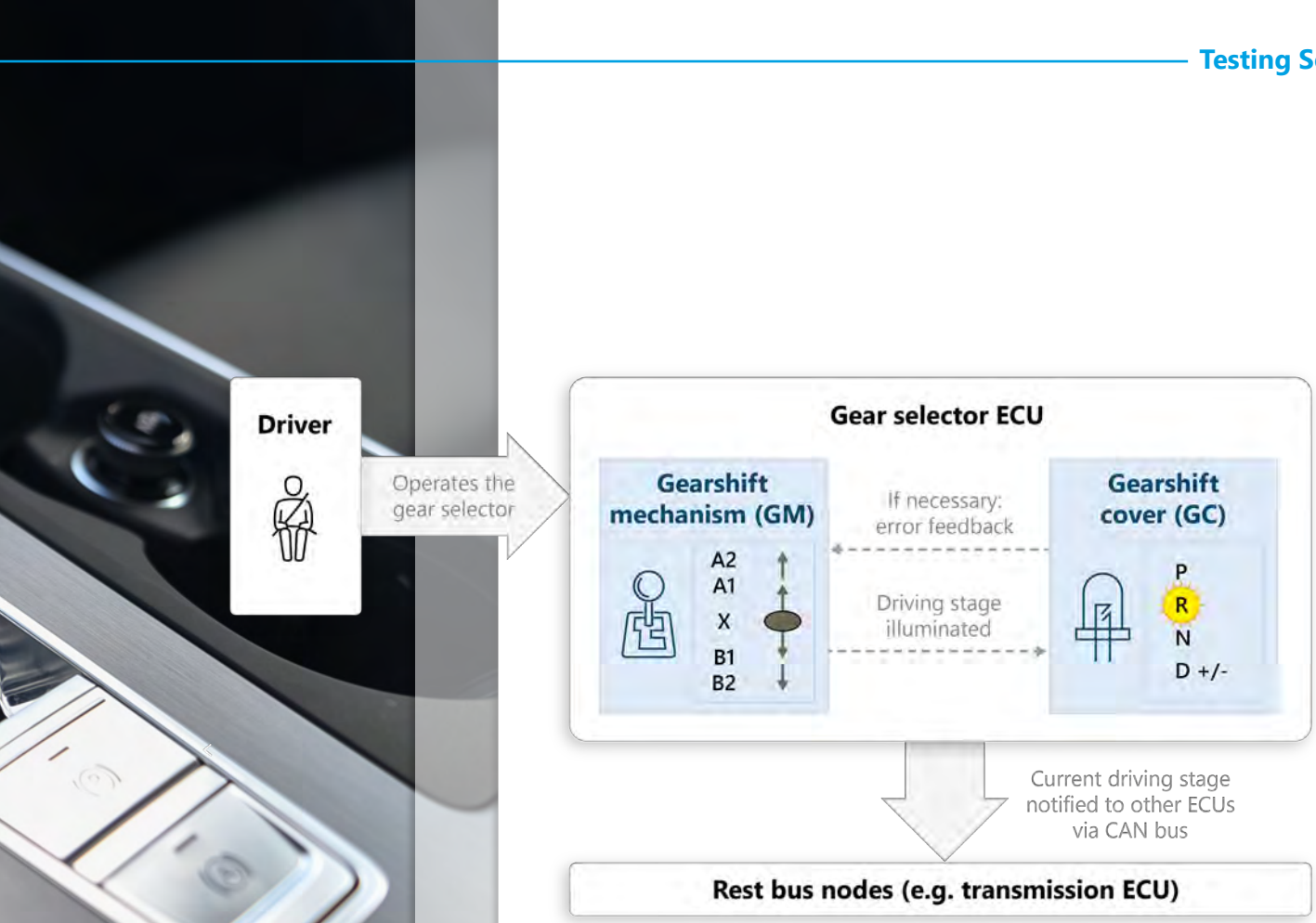
TEXT: Stefan Edelmann, Christian Latta

When the first generation of the component test bench for gear selector ECUs of the modular longitudinal kit (MLBevo) was delivered to Audi in 2013, it was impossible to foresee the challenges this hardware-in-the-loop (HiL) system would face: Originally designed for just one vehicle project, the NovaCarts experts at MicroNova have repeatedly adapted the test bench on site over a period of five years – without any significant downtime. In the meantime, gear selector ECUs from a total of five vehicle projects have been tested on the system. Converting between the individual projects only took a few minutes each time.

Because of this consistently reliable performance of man and technology, Audi ordered a new test system for gear selector ECUs from MicroNova in 2018. This time, the system was to be designed to offer maximum flexibility for different vehicle projects from the outset.

The gear selector ECU

The functional principle of the gear selector ECU (cf. fig. 1) is critical for the test bench concept. The ECUs being tested – or 'DUT' (Device Under Test) for short – of the various vehicle projects each consist of two components: a 'gearshift cover' and a 'gearshift mechanism'. The driver uses the gearshift mechanism to specify a driving stage (e.g. 'P' for park, 'R' for reverse, 'N' for neutral and 'D' for drive). This is indicated on the gearshift cover by LEDs, which are turned on or off depending on the selected driving stage. The required communication between gearshift cover and gearshift mechanism is provided by a LIN (Local Interconnect Network) connection. In addition, the gearshift mechanism handles communication with the ECUs, which also need the information about the currently engaged driving stage (e.g. the transmission ECU). This is provided via a CAN bus (Controller Area Network).



1 Functional principle of a gear selector ECU

The test bench concept

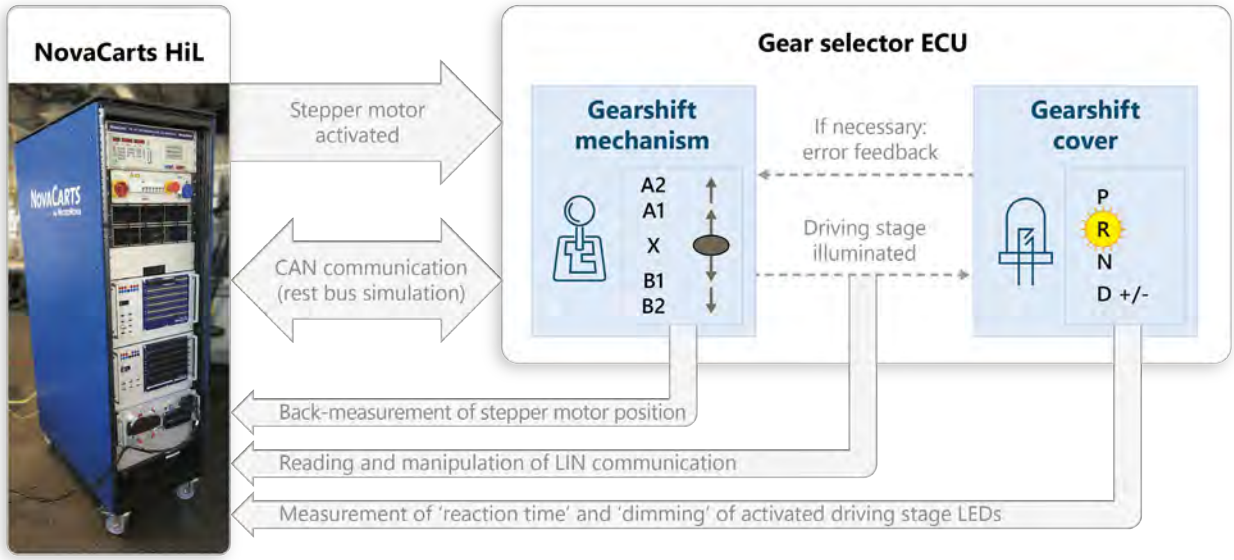
Based on this functional principle, HiL system developers at MicroNova have – as requested – designed and implemented an extremely flexible test system. 'NovaCarts Shift-by-Wire' has three main slots, which contain the individual components of the ECU:

The pure real part group comprising gearshift cover and gearshift mechanism has been created in slot 1. As described above, the two sub-components communicate via LIN interface. The HiL real-time system reads this communication at any time, thereby allowing the test engineer to make a quick analysis.

Slot 2 contains a 'probe plate adapter', which includes only the 'bare' circuit board of the gearshift cover. Closing the probe plate adapter stabilizes the board while simultaneously pressing conductive needles onto a number of test points on the board. These needles can be used to measure analog voltages, resistances, and PWM signals (e.g. to determine the LED brightness at a particular driving stage). In addition, a specific error injection (e.g. overvoltage) can be applied via signal manipulation.

"MicroNova has shown us how well existing know-how can be applied using NovaCarts HiL systems. We obtained results which even the ECU manufacturer considered impossible."

– Christopher Schepp, Department "Development Drive Sensors", Audi AG



2 Controlling the gear selector using the NovaCarts Shift-by-Wire HiL system

The following scenario shows a typical application of the probe plate adapter: If a driving stage is specified, the corresponding LED on the gearshift cover board must be activated. The brightness of the LED ('dimming value') should depend on the ambient brightness, defined by the test engineer on the HiL system. Using the probe plate adapter, the PWM signal can be accurately measured at the test point of the corresponding LED.

In slot 3 there is another probe plate adapter, into which a 'bare' circuit board of the gearshift mechanism is clamped. In this case too, all test points can be measured and errors can be fed in. However, the special feature of this adapter is a high-resolution stepper motor, which can implement exact positioning requests with an accuracy of up to approx. 0.003 degrees per step.

The stepper motor has a lever arm, which has an embedded original magnet of the gear selector, in the same way as it is installed in the magnetic sensor system of the gearshift mechanism. In the real vehicle, this magnet is mounted on the underside of the gear selector, a few millimeters above a hall sensor, which is located on the gearshift mechanism board. If the driver changes the driving stage, this causes the magnet to move. The gearshift mechanism controller must react to this movement accordingly within a specified time. The movements triggered by the driver can be precisely reconstructed in all limit ranges and even beyond by means of the stepper motor. The stepper motor can be controlled within the required real-time cycle (1 ms). A driving stage request can therefore be realized fully automatically in the gearshift mechanism probe plate adapter.

Maximum flexibility in DUT communication

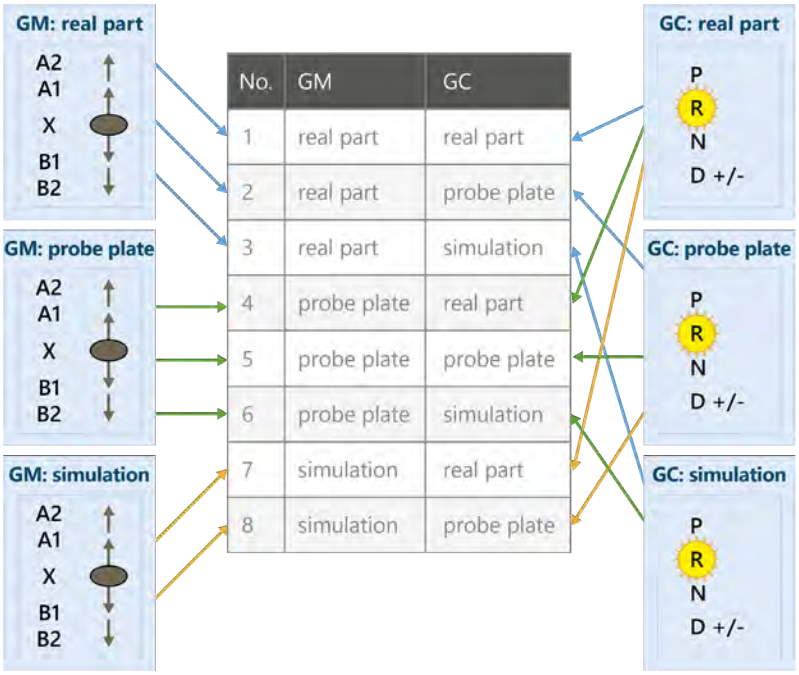
The described communication of gearshift mechanism and gearshift cover via rest-bus (the ECUs which communicate with the gear selector ECU in the vehicle) can be interrupted at any time and at any point. To this end, 'LIN/CAN multiplexers' are installed in the test bench; these act as switch points. This also allows other faults to be simulated, such as a short circuit to supply voltage/ground or a cable break.

However, the special feature of 'NovaCarts Shift-by-Wire' is the possibility of having the DUTs communicate with each other via LIN in any setup, for example the gearshift mechanism board in the 'real part slot' with the gearshift cover board in the probe plate adapter slot. Furthermore, MicroNova's modeling experts

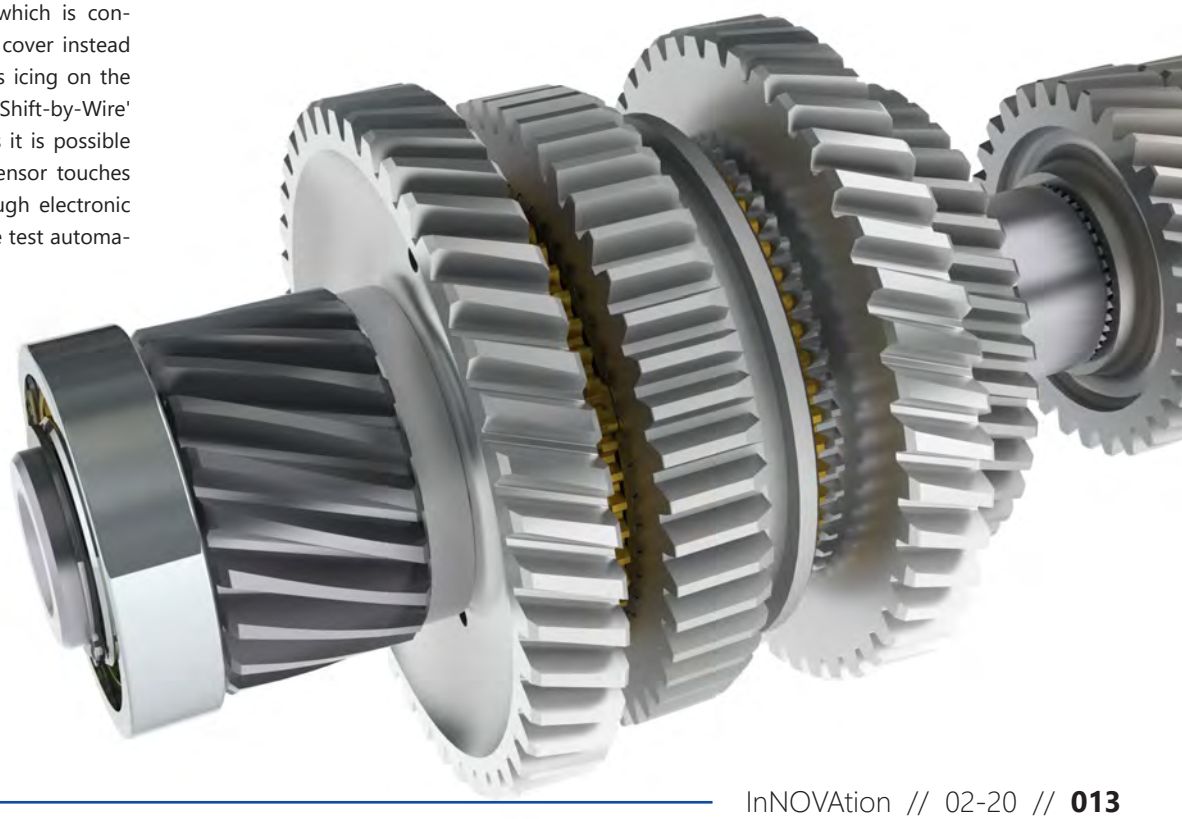
have developed independent, real-time-capable behavioral models for gearshift cover and gearshift mechanism, which communicate with the partner ECUs that are each available as a real part. This allows further automated tests to be carried out in up to eight configurations, which would be extremely difficult to simulate with 'real' ECUs. In practice, users are won over by the reliability and stability of the system, as well as by the straightforward operation of the test bench via the NovaCarts software.

Satisfied clients and testers

"MicroNova has shown us how well existing know-how can be applied using NovaCarts HiL systems. We obtained results which even the ECU manufacturer considered impossible", says Christopher Schepp, 'Drive Sensors Development' department, Audi AG. What is meant here is the 'functional film', which is part of the gearshift cover. This contains capacitive elements that usually send signals to the gearshift cover by the driver's touch to activate or deactivate certain functions. MicroNova's HiL system developers have developed a hardware simulation to do this, which is connected to the gearshift cover instead of the original part. This icing on the cake of the 'NovaCarts Shift-by-Wire' project therefore means it is possible to simulate a driver's sensor touches fully automatically through electronic control (e.g. through the test automation solution EXAM).



3 Possible configurations on NovaCarts Shift-by-Wire



Certified functional safety

What do up to 100 million lines of code in a car mean for 'Functional Safety'? MicroNova has answers and a new partnership.

TEXT: Steven Bailey PICTURES: © ParabolStudio / Shutterstock.com

How very different today's cars are from those of older generations – or even from cars of just a few years ago. In 2005, between six and seven million lines of code were used in a car; in 2020, this number has risen to around 100 million lines. To put the increase of programming code in our vehicles into some kind of context: Boeing's latest aircraft model, the 787 Dreamliner, uses about 14 million lines; the Android mobile phone operating system requires between 12 and 15 million lines. And the latest smartphones do not exactly suffer from a lack of functions...

Even in cars – and of course in trucks, buses, and so on – this sheer volume of code is up against many specific tasks that it is used to perform. A 2020 study by Volvo showed that software in cars controls around ten million decision events in the source code. This corresponds to a ratio of 1:10 of 'decisions to lines of code'.

How is the market responding to these increasingly complex systems? In this context, what about the increase in traffic on our roads? After all, right now there are around 1.4 billion cars in the world, and this is expected to double by 2050. Given these figures and the ever more crowded roads, the issue of road safety is becoming increasingly important.

Safety in the spotlight

In the area of government regulations, it is quite clear that requirements have become stricter. Legislation is increasingly taking into account whether and how a company actively gives consideration to the health of motor vehicle drivers and passengers. In some countries, fines and even prison sentences are now possible where these requirements are not complied with.

A lot has been done on this topic, especially in 2011 and 2018: The International Organization for Standardization (ISO) launched and extended the 26262 standard on 'Functional Safety' with a second edition. Worldwide, car manufacturers have quickly implemented the standard in accordance with the outlined framework conditions.

What does the ISO 26262 standard mean?

Since 2011, additional requirements have applied to all IT systems in automobiles that contain electro-

nic control units and software components relevant to the life cycle of safety systems. This affects both development and production processes as well as management and service processes. The aim is to minimize potential hazards caused by malfunctions of the E/E safety system. The key challenges for car manufacturers are:

- to keep development costs and the financial risk from liability for safety defects as low as possible
- to meet requirements on the manufacturer side regarding the certification of all tools according to ISO 26262, and
- to define risk tolerance and risk management at an early stage.

Crucial factors for safety

Essentially, three aspects determine the safety requirements and the safety level of a system:

- The severity: If a system were to fail, how bad could the safety consequences be for the occupants or nearby pedestrians, or for other vehicles?
- The likelihood: How likely is it that a situation occurs concurrently and causally liked with the analyzed failure pattern and could lead to a hazard?
- The controllability: In the event of a system failure, how high is the possibility of avoiding damage through the timely reaction of the persons or vehicle systems involved?

MicroNova: a partner for safety

In light of the above, it is hardly surprising that since the introduction of the ISO standard, car manufacturers have expected their suppliers to provide appropriate certification for the entire product or to support them in the course of ISO development. This is where MicroNova comes in as an experienced and reliable partner: In 2019, for example, after decades of close and successful cooperation, two clients accordingly expanded various projects from the 'Consulting & Services' environment. MicroNova subsequently provided support with functional safety analyses both in the development and test phase in accordance with ISO 26262 – a cooperation that continues successfully to this day.

One of the projects focuses on the qualification of a 'virtual electronic control unit' (vECU), the other on the qualification of a complete software tool chain. Both cases use 'ISO 26262-8, Part 8: Supporting processes' with section 11 as the specification. The aim is to confirm and verify the Tool Confidence Level and the Automotive Safety Integrity Level (ASIL). This was achieved on the basis of and by using method 1a under 11.4.8 from ISO 26262-8, Part 8, section 11: The team reviewed use cases to determine how the tools should be used to complete a classification and qualification of each tool according to functional safety standards.

Procedure

ISO 26262 requires tests under normal operating conditions for the qualification of a software component, as well as tests with errors added to the system. This also tests the reaction to abnormal inputs. As part of the analysis, potential hazards and risks are identified (HARA, hazard analysis and risk assessment) and functional safety use cases and potential requirements for them are defined and ultimately added to the complete product definition.

The information collected makes it possible to determine the impact of a tool on functional safety, known as the

Tool Impact (TI) level. The Tool Error Detection (TD) can also be defined accordingly. The following procedure is used if a software tool can cause or fail to detect safety-related errors:

- TI 1: no impact
- TI 2: impact

Determination of the TD when using the tool:

- TD1: high probability to detect/ prevent potential tool errors
- TD2: medium probability to detect/prevent potential tool errors
- TD3: all other cases (low/unknown)

Determination of the 'Tool Confidence Level' (TCL):

		Tool error detection		
		TD1	TD2	TD3
Tool impact	TI1	TCL1	TCL1	TCL1
	TI2	TCL1	TCL2	TCL3

From solution to comprehensive offer

The practical experience gained from these two projects marked the start of a comprehensive consulting and project offer from MicroNova Consulting & Services. 'Part 8: Supporting processes' is one of many sub-specifications in ISO 26262. MicroNova is currently already qualifying employees for further sections of ISO 26262 at TÜV, the German Association for Technical Inspection. The team is also taking TÜV courses to pass the exams for the 'LEVEL 1: ISO 26262 Functional Safety Engineer' or 'LEVEL 2: ISO 26262 Functional Safety Professional' certificates.

While the functional safety project work continues, MicroNova Consulting & Services has expanded its portfolio and offers the following services:

- Development of safety requirements
- Ensuring requirements traceability
- Safety analyses (FMEA, FMEDA, FTA)
- Organizing verification and validation activities
- Tool qualification
- Preparing assessments
- Optimizing functional safety processes (V-model or agile)
- On-site support

Joint test automation with Validas AG

Automotive companies have recognized that maintaining documents manually takes a lot of time and resources, making it not only expensive but also more error-prone. A software solution with as much automation as possible can provide relief – over the entire life cycle. This also applies in the context of functional safety.

This is where the test automation solution EXAM, developed jointly by AUDI, Volkswagen and MicroNova since 2006, comes into play. In the fourth quarter of 2020, MicroNova expands EXAM in the form of an upgrade to support 'ISO 26262-8 Part 8: Supporting processes' and 'Part 11: Analysis and qualification of the Tool Confidence Level and the Automotive Safety Integrity Level' on a semi-automatic level. To achieve this, MicroNova has relied on its cooperation with a recognized industry leader who is also a preferred partner of TÜV-Süd and TÜV-Nord: Validas AG.

This is a company that has been working as an expert for library and tool qualification since April 2000. Together, Validas and MicroNova offer an EXAM plug-in for functional safety, the EXAM ISO 26262 QKit. It can be used to integrate ISO 26262-related products or solutions into the environment and documentation of car manufacturers or suppliers. A report, plan, safety manual and a verification or validation report can be prepared for the classification – all conforming to ISO 26262.

ISO-TÜV qualification: always included

The software framework for the QKit can be executed on site and in the customer project to create generic compliance reports. They document compliance with the required safety standards. This cooperation with Validas AG ensures that the tool qualification process is TÜV-certified.

Car manufacturers and suppliers using the EXAM ISO 26262 QKit can therefore be sure that their EXAM project is appropriately qualified and can be explicitly certified if required. The technology in the software framework on which the EXAM ISO 26262 QKit is based has been jointly designed and created by Validas and TÜV. It is flexible and model-based and consequently ensures that every tool or complex series of tools in a toolchain can be qualified.

The approach is not limited to EXAM: During a series of training sessions and workshops, as well as during development, MicroNova has already gained experience how tools and processes of this software framework can

also be used for the validation of other tools. Using Validas' documented and TÜV-certified compliance methodology, MicroNova's consultants are able to take the necessary steps to qualify any tool with and for customers.

Process workflow

The first step in this process is a generic analysis of tools and documentation to create a structural model. This model contains all relevant aspects, from usability, work processes and results to interfaces. Adding potential errors and attenuations turns the structural model into the analysis model. Potential errors can be either detected or avoided by applying this together with the associated tests and limitations ('attenuations').

The result of this first phase is a tool simulation based on the functional safety concept. The second step is to create a test model. Tool-specific test cases are added to a database with the established functional safety test methodology – this is where Validas' decades of experience come into play. The bottom line is completion of the model: Usability, work processes, results and interface receive certified evidence of functional safety with regard to the test code.

Last but not least, all parts of the previous work packages must be integrated to obtain a QKit. This also includes adapting the user and developer manual as well as generally all documentation templates in which the structural model, the analysis model, and the test model have been analyzed for completeness. In addition, import and export of the test lists must be executed and compared with the predicted results of the QKit integration test.

A validation and verification ('V&V') phase for the 'QKit Release Candidate' must also be formally planned and implemented to ensure compliance with the safety standards. Only then can clearance be effected. The final step is to carry out the validation and verification process. This includes filling out checklists for each part of the QKit and its creation process, which is used subsequently by functional safety auditors. It is also necessary to draw up a V&V report documenting the associated results and findings, if applicable. Any V&V problems must be resolved before publication. The result is a QKit that can be run on any version or product update in order to verify functional safety compliance.

Conclusion

For several reasons, functional safety has become an indispensable building block for a wide range of activities within the automotive industry. Based on its own expertise and in cooperation with experienced partners, MicroNova offers automotive companies with the EXAM ISO 26262 QKit plug-in a market-ready solution for functional safety and also provides comprehensive consulting services. This ensures that companies continue to maintain the ability to act in the automotive environment while reducing complexity and costs. Our team will be happy to answer any questions.

Consulting services

For detailed information on the consulting services offered by MicroNova and the EXAM ISO 26262 QKit please contact us gladly under **+49 8139 9300-0** or sales-testing@micronova.de.

Best of Both Worlds

MicroNova and Smart Testsolutions are combining their test technologies for fuel cell controllers.

TEXT: Editorial staff PICTURE: © Alexander Kirch / Shutterstock.com

Fuel cell technology is seen as a promising alternative to a pure battery electric drive, especially in the commercial vehicle sector and on long-distance routes. Daimler, for example, has just presented its fuel cell truck, which is claimed to have a range of up to 1,000 kilometers. Fuel cells supply the electric motors of such vehicles (fuel cell electric vehicles, FCEVs) with the necessary energy for the drive. Hydrogen and oxygen are converted into electrical energy and water by chemical reaction in a small cell. Several cells are combined to form so-called fuel cell stacks in order to produce a sufficient quantity of energy to power the vehicle.

Specialist measurement technology and HiL systems for fuel cell control units

Established companies from the automotive industry such as Daimler, Bosch, and Toyota are working flat out to develop fuel cell stacks that are as cost-effective as possible and

thus marketable. MicroNova and Smart Testsolutions GmbH are combining their expertise in the fields of fuel cell measurement technology and HiL applications in order to offer car manufacturers time-saving, cost-efficient, comprehensive test solutions for validating the associated fuel cell control units (FCCU).

Measurement technology specialist Smart Testsolutions has established itself as a major player for car manufacturers when it comes to monitoring fuel cell electronics. A particular focus is on systems for checking individual cell voltages in fuel cells (cell voltage monitoring/CVM). This also involves solutions for connecting the individual cells of a stack (cell voltage pickup/CVP). The company also offers test technology that simulates individual voltages in a fuel cell stack.

Validation of fuel cell control units with NovaCarts

The HiL platform "NovaCarts Fuel Cell" from MicroNova supports manufacturers, suppliers, and service providers worldwide in reliably securing electronic control units in the development process. The HiL simulator was developed to allow comprehensive testing of control units for fuel cells: NovaCarts Fuel Cell simulates the entire fuel cell stack and the environment of the associated control unit in the vehicle. This includes all relevant interfaces, such as the SAE-J2799 communication interface for data exchange between the vehicle and the hydrogen filling station.

The versatile, scalable HiL system is therefore ideally suited for completely safeguarding new functions in control units for fuel cell stacks and can also be expanded for future FCCU technologies via firmware update.

Harnessing synergies for a best-in-class test solution

Smart Testsolutions has now entered into a technological cooperation with MicroNova in order to enable manufacturers of fuel cell control units to in future carry out more extensive tests, including overall testing. "The targeted use of synergy effects is intended to give us technological leadership in fuel cell applications," explains Wolfgang Neu, Managing Director of Smart Testsolutions. "Working with MicroNova, we will also be able to support our customers in future with ECU tests that require comprehensive HiL applications."

"With our powerful NovaCarts platform and more than thirty years of experience in automotive testing, we provide targeted support for the development of alternative and electrified drives," says Dr. Klaus Eder, COO of MicroNova, explaining the reasons for the cooperation. "Combining the innovative concepts of both companies enables us to offer a technologically mature solution while significantly reducing both total cost of ownership and total cost of test."

Interview with: Reinhard Jahn (Telefónica Germany)

Reinhard Jahn is Head of OSS Engineering at Telefónica Germany GmbH in Munich. InNOVAtion talked to him about the "new" COM5.Mobile.

TEXT: Editorial staff PICTURE: © Corona Borealis Studio / Shutterstock.com

InNOVAtion: Mr. Jahn, Telefónica Germany is the "midwife" of COM5. Mobile, what does its productization mean for your company?

Reinhard Jahn (RJ): With MicroNova as our partner, we have been very successful over the last two decades in implementing the possibility of daily delivery of radio configuration data to our Telefónica radio network. Thanks to this long-term cooperation, we have of course been able to provide feedback on what future developments should look like. The aforementioned productization of COM5. Mobile has given us the necessary flexibility and a very good time-to-market to support the introduction of new features to our network in a fast and reliable way. This plays a very important role, especially with the rollout of 5G now beginning and our extensive 4G rollout.

InNOVAtion: The introduction of the COM5.Mobile Optimizer and Integrator has also brought about a conceptual reorientation. What is it that you find particularly convincing?

RJ: With the Integrator, we now can quickly and reliably carry out the daily configuration of new radio stations as well as modifications within the network. This gives us the necessary freedom and the technical possibility to execute both our continuing 4G rollout as well as the 5G rollout in a highly efficient manner. With the Optimizer, we have given our employees working to optimize the radio network an additional practical tool with direct added value. It allows them to make major improvements to the network on a daily basis, creating the best possible experience for our many millions of customers. It is a very significant step forward for us to be able to set essential parameters ourselves.

InNOVAtion: What functions would you like to see in the future? What potential do you see for future configuration systems?

RJ: Looking to the future, I would like to see further development towards zero touch integration. This capability will play an important role with the advancing "cloudification" of networks and the introduction of Open RAN. We expect fundamental changes in the entire software and network architecture, especially with a view to the future of 5G. The requirements and flexibility in mobile networks will need to increase significantly if the service classes standardized in 5G are to be used economically. In this respect, we are also focusing on future-oriented and expandable solutions. As complexity grows, the degree of automation in the integration and optimization process is becoming increasingly crucial in order to make the best possible use of the high network investments in the mobile communications market. This will therefore also be a key point in the catalog of requirements for such config systems.

InNOVAtion: The Radio Designer integrated into Optimizer significantly improves time-to-market. How important is this function for you and ultimately for your company's customers?

RJ: The introduction of a new technology in particular is always associated with a variety of tasks and challenges for network operators, which is a completely natural process. However, an enormous amount of experience is required to ensure smooth integration into existing networks – our employees have that experience. What is more, a great deal of flexibility is also required when it comes to the efficient adaptability of the tool landscape. And that is what our partners and their solutions achieve. Introducing Radio Designer, part of the COM5.Mobile Optimizer, enables us, for example, to integrate new features and functions into our network and make them available to our customers faster. This configurability naturally saves us costs, but above all it allows us to take our customers' network experience to an even higher level as quickly as possible, and to do so in a tangible and measurable way for all relevant areas of application.

InNOVAtion: Mr. Jahn, thank you very much.

Telefónica Deutschland

"The requirements and flexibility in mobile networks will need to increase significantly if the service classes standardized in 5G are to be used economically".

– Reinhard Jahn,
Telefónica Germany

With SDN/NFV to a powerful 5G network

Software-defined networking and network functions virtualization provide a revolutionary way of configuring, optimizing and maintaining customer-oriented mobile networks. Background and options.

TEXT: Ingo Bauer PICTURE: © metamorworks, Andrew Krasovitckii, MSSA / Shutterstock.com

We have already reported in detail about 5G radio technology and its enormous importance for business and private life in recent customer magazines. There is no doubt that 5G is a key technology for a future-oriented infrastructure – and will contribute to economic development like no other. The all-pervasive coronavirus crisis shows us every day how important seamless, cross-border networking is for the continued existence of the globalized world. Even in global politics, 5G is seen as a critical element in the digital economy and in society.

Industry, agriculture, transport, healthcare, urban infrastructure, private households – 5G technology will link all the different domains of a country and enrich them with a wide range of new services. At the same time, demand for these new services is growing – driven mainly by industry – in the areas of real-time data acquisition from countless sensors and devices. Extremely high bandwidths with low, guaranteed latency and high reliability for critical applications are key to this.

New approaches to network design and architecture are required if these growing demands are to be met. Mobile network operators (MNOs) are facing increasing pressure to rapidly deploy new technologies to meet ever-increasing customer expectations. To achieve this, they must develop, scale up, and roll out innovations as quickly and cost-effectively as possible. However, in order to ensure economic efficiency and to protect previous investments, concepts are also needed to integrate or transfer the network's legacy technology into new forms of architecture in a cost-effective and efficient way.

Revolutionary Configuration Options

But how can MNOs meet these challenges? Two of the main methods or architectures addressing these network requirements are software-defined networking (SDN) and network functions virtualization (NFV). Together they represent a revolutionary opportunity for operators to configure, optimize and maintain a customer-oriented mobile network.

SDN is a network architecture that relies on control by software and is completely decoupled from the hardware. The underlying concept is the separation of the data layer (data plane or user plane) from the management and control layer (management plane or control plane). The associated opening of the previously restricted, proprietary network platforms creates the

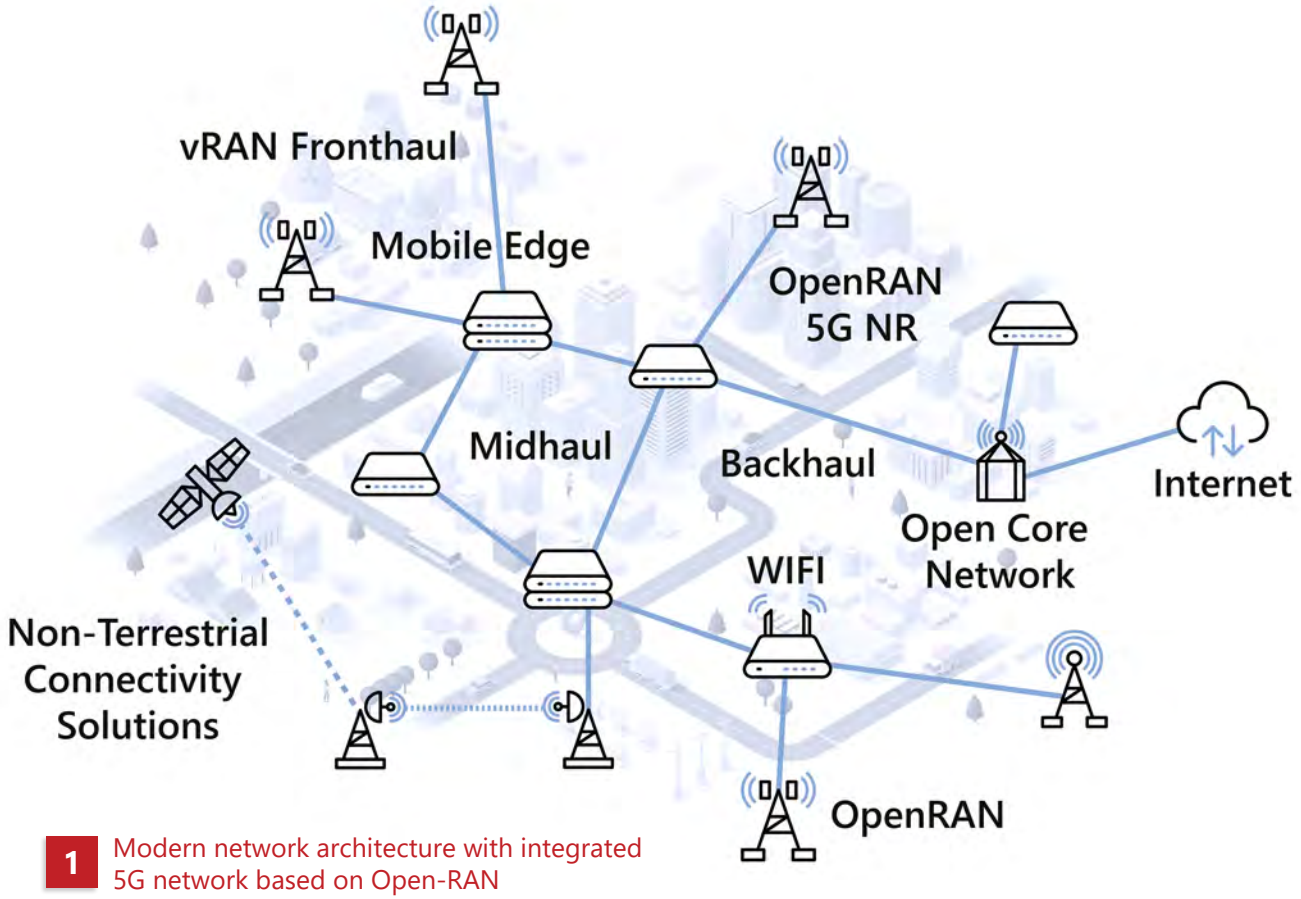
basis for a centrally managed and programmable network that can therefore be managed very flexibly: new components can be added with little effort and can automatically receive all information relevant to them. Changes made via a network controller are quickly applied to the components concerned and do not need to be configured or assigned individually.

As the name suggests, NFV is a method for virtualizing network functions and services. It is based on a technology that abstracts network functions (e.g. route calculation and traffic control), decouples them from the proprietary hardware, and allows them to run as independent software on virtual machines. NFV was first presented at the SDN World Congress in 2012. It laid the foundation for the development and use of vendor-independent, standardized hardware and software solutions for building networks. The use of commercial off-the-shelf (COTS) hardware and virtual networking capabilities provides significant benefits to operators in terms of cost, time to market, vendor independence, scalability, and agility.

Interaction between SDN, NFV and COM5.Mobile

The NFV and SDN technologies are not directly dependent on each other – but they are interrelated and share similarities. Both are based on the principles of virtualization and abstraction, which they implement differently with regard to functions and abstract resources. SDN separates forwarding functions and control functions within the network.

The idea underpinning this separation is to create a centrally managed network. As mentioned above, NFV is based on abstracting network functions from the hardware, which in turn supports SDN, as it provides the infrastructure to run SDN software. This allows a purpose-related joint use of both approaches, using standard hardware, thereby providing wireless service providers and, where applicable, campus network operators with a flexible, agile, and efficient network architecture.



1 Modern network architecture with integrated 5G network based on Open-RAN

MicroNova addresses these very requirements with its new product line, COM5.SDN. The main focus is on migrating existing technology to the new structures. This enables valuable integration of new network and service technologies into the network operators' ecosystem.

COM5.SDN forms the basis for various tools and products - starting with COM5.SDN Mediator, which offers an entry point into the SDN world, up to the future product COM5.SDN Radio Intelligence Controller, a non-real-time radio controller (or non-RT-RIC for short). A roadmap has thus been created covering the core areas of coming system architecture. The following sections describe the key functions of these product variants.

COM5.SDN Mediator

MicroNova is collaborating with its partner highstreet technologies (see page 30 f.) on the standardization of the interface for operation and maintenance within the O-RAN architecture (cf. InNOVAtion 1-2020, page 21) – the O1 interface. It forms an API between the service management and orchestration (SMO) platform and the network elements and managed elements defined in O-RAN.

COM5.SDN Mediator makes it possible to integrate different network technologies (2G, 3G, 4G, and 5G) into an SDN-/NFV- or Open-RAN-compliant architecture. It relies on the basic mechanisms developed in COM5.Mobile for automating integration and optimization use cases. These include, for example, existing vendor-specific network adapters for equipment from Nokia, Ericsson and Huawei, the existing policy engine, including operator policies in place, a connection to external planning tools and the zero touch configuration mechanism, to name but a few.

The northbound interface provides a fully functional, fully configurable Netconf/YANG server (YANG: "yet another next generation", a data modeling language) that can be filled with the corresponding YANG models. An internal parameter database is used to map the corresponding, vendor-specific models to it, and missing parameters are served via the stored policies and templates.

The COM5.SDN Mediator thus establishes the basis for the successful migration of existing architectures, including the network, to a sustainable consolidated next-generation architecture.

COM5.SDN Radio Controller

COM5.SDN Radio Controller follows the O-RAN paradigm by providing a global network view using a logical, centralized controller. The focus is on a vendor-independent, standardized southbound interface based on O1: a REST interface to a web-based user interface is supplemented by further such interfaces to other (RAN) apps, such as the COM5.SDN Radio Intelligence Controller. For a high degree of automation, the controller provides an abstraction of network keys, KPIs and configuration parameters. As this always involves a customer-specific mapping, corresponding clarification is necessary in the run-up to integration.

In its basic role, the COM5.SDN Radio Controller provides the functions of a classic element management system (EMS) with regard to fault, configuration, accounting, performance, and security management (FCAPS). The following overview lists the main functions of the COM5.SDN Radio Controller:

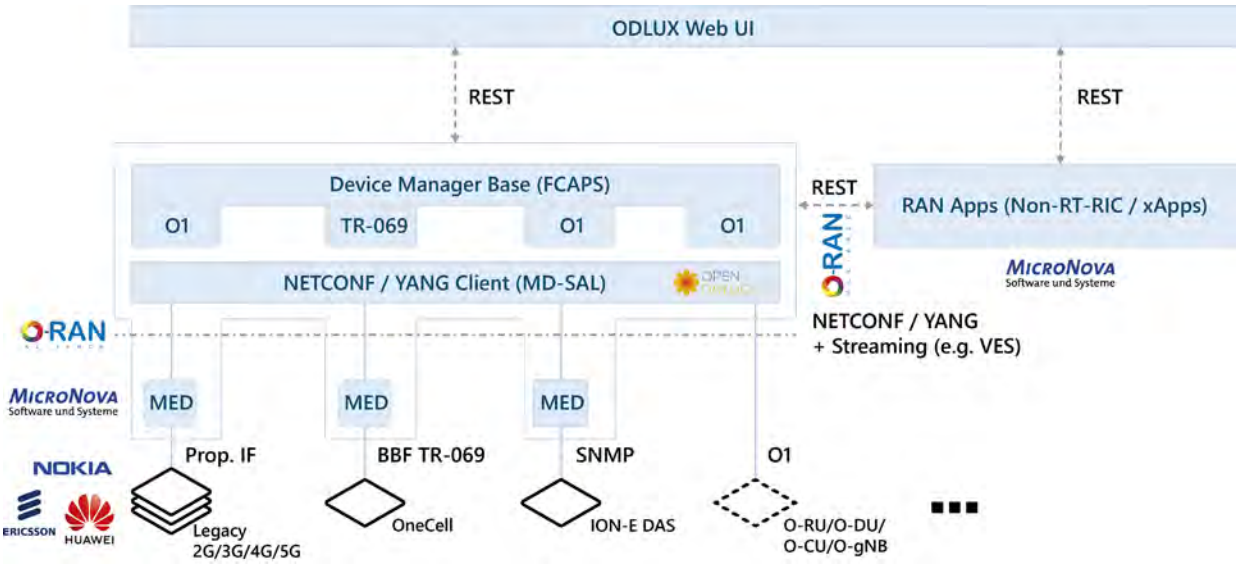
- Reading out the entire network configuration and topology
- Automatically adopting network planning data for the configuration of the static part of the network
- Supporting integration use cases for an initial configuration of the O-RAN components (roll out) while supporting different split scenarios
- Providing RAN resource management
- Reconfiguring and optimizing the network
- Performing RAN parameter changes
- Allowing RAN feature activation/deactivation
- Reading out performance parameters cyclically from the network
- Reading the RAN component error memory
- Providing all parameters and functions via a REST interface for other RAN apps

In its initial implementation, the COM5.SDN Radio Controller was integrated into an ONAP (open network automation platform) environment and realized on the basis of the OpenDaylight framework. The COM5.SDN Radio Controller essentially consists of the following components:

- RAN Configuration Manager
- RAN Statistic Manager
- RAN Topology and Inventory Manager

COM5.SDN Radio Intelligence Controller – AI & ML

The non-real-time-capable COM5.SDN Radio Intelligence Controller (non-RT-RIC) – latency greater than one second – extends the COM5.SDN Radio Controller to include methods from the field of artificial intelligence (AI) and machine learning (ML) or, more precisely, deep learning. The main goal is to support smart RAN optimization. This includes functions such as service & policy management,



2 Setup of the network management layer for an SDN-based RAN with COM5.SDN Mediator, COM5.SDN Radio Controller (device manager base) and COM5.SDN Radio Intelligence Controller

RAN analytics, and AI/ML model training for the near-RT-RIC (real-time controller, latency <1s). The non-RT-RIC can be seen as a closed loop for automated service provisioning including optimization.

Based on the data collected in the network for configuration, performance, and fault management, and combined with the stored operator policies, the COM5.SDN Radio Intelligence Controller generates and optimizes the AI/ML models that are transferred to the real-time controller (near-RT-RIC) for runtime execution via the standard interface (A1). Example models may include: spectrum utilization patterns, network traffic patterns, user mobility patterns, handover patterns, and service type patterns including the expected quality of service.

The combined controller function comprising non-RT-RIC and near-RT-RIC forms the core functionality of modern RAN management and provides the basis for efficient service and quality management (required for network slicing with quality-of-service delivery), as well as automated real-time optimization for mobility and handover management.

The open architecture provides for expansion possibilities through so-called RAN apps. This allows 5G-like RIC functions to be provided to their associated counterparts of these legacy networks using 2G-, 3G-, and 4G-related RAN apps.

Conclusion

In addition to the introduction of 5G, the transition to a complete SDN architecture will keep network operators busy over the next few years and require them to take many critical decisions. It is precisely the choice of new components and the associated vendors that will lay the foundation for the future of MNOs and their economic survival. Topics such as open source in commercial use or open, vendor-independent architectures, combined with political pressure, are creating greater challenges for network operators than ever before.

With the new product line for SDN, MicroNova is expanding its COM5 portfolio to meet these challenges. By partnering with highstreet technologies, and through its membership in 5G Berlin e. V., MicroNova has access to a complete 5G system environment for researching, developing and testing new functions from which mobile network operators and ultimately their customers benefit. Based on proven solutions, COM5.SDN Mediator ensures the secure transfer of legacy networks into an SDN architecture. COM5.SDN Radio Controller and COM5.SDN Radio Intelligence Controller provide solutions for the issues of the future discussed – with a powerful 5G network.

Open-RAN, SDN and NFV for Radio Access Networks

With the new COM5.SDN product line, MicroNova offers an O-RAN-compliant solution for operating the Open Radio Access Network.

TEXT: Ingo Bauer **PICTURES: © Sylverarts Vectors, yum-yum / Shutterstock.com; © macrovector / Fotolia.com**

O-RAN, or Open-RAN, lays the foundation for a standardized, open network architecture and hence for flexible, agile networks and innovative business models. SDN and NFV provide the basis for Open-RAN architecture. One of the biggest challenges in implementing an Open Radio Access Network is developing the necessary virtual network functions, where the focus is on indicators such as scalability and performance.

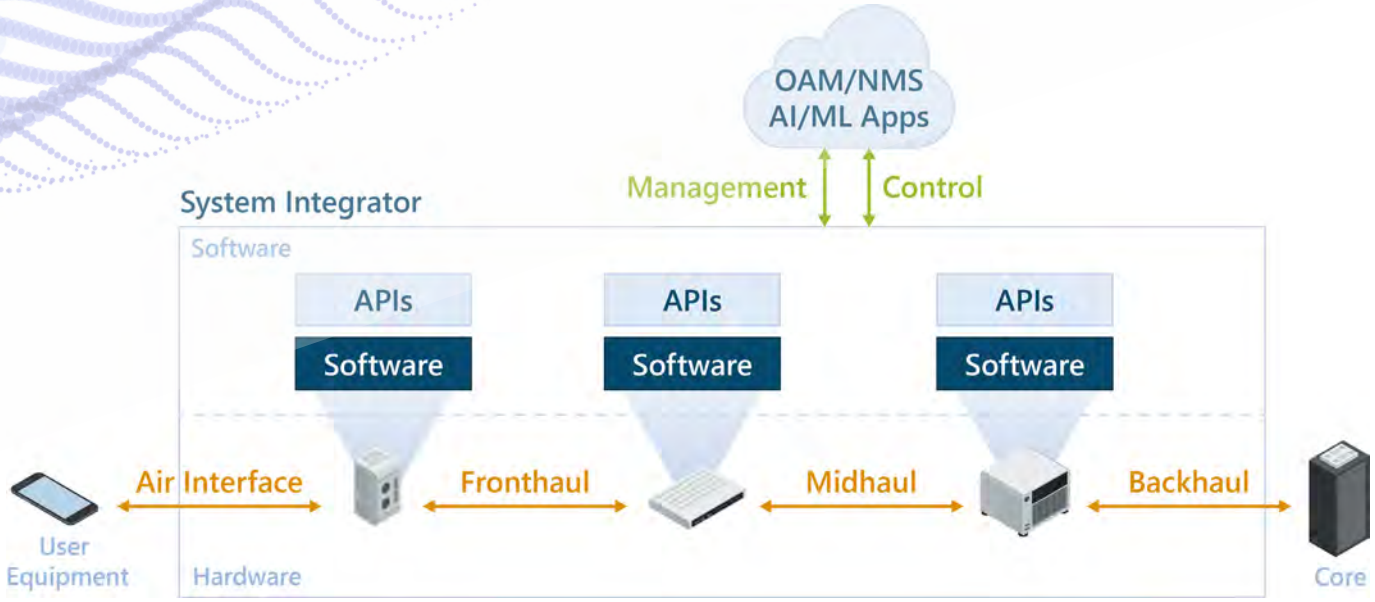
Compared to closed, proprietary systems, O-RAN offers significant advantages for the development and operation of increasingly complex mobile radio networks due to its openness. Studies show that savings of up to 50 percent are possible by using this type of architecture, in terms of both CAPEX and OPEX. The powerful trend towards professional platforms such as O-RAN, developed by the open source community and freely available, provides the basis for function-oriented solutions and apps.

Standardizing these apps allows them to interact seamlessly within their platform, thereby ensuring that specialist companies can develop cost-effective, highly flexible "partial" solutions. With over 15 years of experience in automating the configuration and optimization process for the radio access network, MicroNova is making a significant contribution to the standardization of the O-RAN-O1 interface. This Open RAN management standard forms the basis for the development of the COM5.SDN product family, and is already integrated into the first COM5 applications.

Virtualization as a basis

So far, the use of SDN/NFV has most notably been limited to the core and transmission network (transport). However, the Radio Access Network (RAN) infrastructure represents the largest part of the investment and operating costs of a mobile network operator. This network segment is nevertheless still tied to proprietary hardware and software, limiting companies' flexibility in its deployment and their possible choices. The current political debate on network security and equipment vendors in particular is presenting operators with new challenges.

The emergence of the virtual Radio Access Network (vRAN) and the Cloud/Centralized Radio Access Net-



1 Building a virtualized RAN - Open RAN architecture

work (C-RAN) saw the first attempts to also apply SDN/NFV to the Radio Access Network (RAN segment). The two technologies, or architectures, are primarily concerned with virtualizing and centralizing base band units (BBUs). However, these approaches are based on a proprietary implementation, and they do not eliminate vendor tie-in. Nevertheless, studies by mobile network operators show that the introduction of virtualization technologies can result in savings of up to 50% in OPEX and 30% in CAPEX.

This is why there are growing calls for an open RAN architecture based on standard interfaces. The APIs are intended to ensure that it is possible to interconnect RAN components – RRUs (remote radio units) and BBUs, including core connections – from different vendors. This so-called Open-RAN architecture is basically not a new concept. Major mobile network operators have invested heavily in research, development, and field trials in recent years. This topic has been essentially driven by two organizations.

» The Telecom Infra Project (TIP), founded in 2016, is an association of network operators, service providers, software vendors, and integrators that aims to redefine and drive forward classic concepts for the construction and provision of telecommunications infrastructure. An essential aspect is to develop, test, and provide standardized, open, and disaggregated solutions (with the separation of hardware and software components).

» The O-RAN Alliance is a consortium founded by international network operators in 2018 to further develop RAN technology. The focus is on the introduction or specification of a new, open, fully programmable RAN based on software modules and commercially available hardware (components-off-the-shelf; COTS), so that BBUs and RRUs from different vendors can communicate seamlessly with each other.

An important step in the development of the Open RAN ecosystem was an agreement between the two organizations to exchange information and reference specifications and to conduct joint proofs of concept and integration testing. The most important concepts of the O-RAN architecture are briefly outlined below:

Openness

The openness or standardization of interfaces is the most important aspect of the concept. For it is only then that easily adaptable, scalable, vendor-independent radio networks can be built. It is precisely the open interfaces that support the provision of multiple vendors, thereby enabling a competitive and dynamic vendor ecosystem. This is particularly important for smaller radio network operators in order for them to be able to introduce their own services or adapt the network to their requirements.

Intelligence

The network is becoming increasingly complex with the introduction of 5G and the flexibility it brings with new services, classes of service, assured quality, and network slicing, etc. Conventional methods do not allow this complexity to be controlled, and it is therefore more difficult and costly to deploy, optimize, and operate the network. Automating the most important use cases for integration as well as optimization and quality assurance is therefore vital to operate the network economically.

The use of new methods from the field of artificial intelligence is becoming increasingly important to enable the dynamic allocation of radio resources and to automatically optimize the efficiency of the entire network. AI-optimized closed-loop automation can be achieved in combination with open interfaces, potentially heralding a new era of network operation.

Software-Defined und RIC

The key principle of the O-RAN architecture is to extend the SDN concept, i.e. to decouple the control plane (CP) from the user plane (UP) to the RAN. Furthermore, the introduction of AI methods both on the network side (near-real-time-RIC) and on the management side (non-real-time-RIC) is an O-RAN Alliance paradigm.

RAN-Virtualization

An essential aspect of the O-RAN architecture concept is the "cloudification" of the RAN. It is based on a division (disaggregation) of the radio access network into two areas: firstly, a separation of hardware and software, or control plane and user plane (CP/UP-split), and secondly, a functional split of the base station into the following:

- **RU – Radio Unit:** The radio unit comprises the transmitting and receiving unit including the transformation of the analog radio signal into digital signals to be forwarded to the DU. In addition to functionality, factors such as size, weight, and power consumption are decisive criteria for the design of the RU.
- **DU – Distributed Unit:** This is the distributed unit located near the RU. It contains a subset of the classic eNB/gNB functions (RLC, MAC, and parts of the PHY layer). It is implemented in legacy systems on proprietary hardware (BBUs). As part of the O-RAN concept, it is planned to implement it as a software solution, executable as a virtualized element on standard COTS hardware.
- **CU – Centralized Unit:** The centralized unit contains all the functions of the higher protocol layers (RRC and PDCP layers).

The main benefits of this split architecture are scaling and the introduction of vendor-independent hardware components for the RAN. The latter aspect has a positive effect on CAPEX and OPEX. It also provides the basis for the introduction of new technologies such as mobile edge computing (MEC), which enables a significant increase in performance and less latency in the radio access interface.

Nevertheless, the implementation of a virtual RAN places enormous demands on the underlying infrastructure. Performance improvements, reliability, and low latencies can only be achieved with an appropriate fiber optic network between the units concerned.

Standardized Interfaces

The O-RAN architecture defines and standardizes interfaces between the individual components of the disaggregated RAN. The aim is to achieve true interoperability between the components and thus be able to use different device manufacturers. Besides the introduction of open source (see below), this is the most important issue for a flexible, vendor-independent network.

White-Box Hardware

In addition to the interfaces, the O-RAN Alliance has set itself the task of specifying and standardizing the hardware for base stations to a significant extent – so-called white-box hardware. The reference platform supports separate methods and provides detailed diagrams of the hardware and software architecture for BBUs and RRUs.

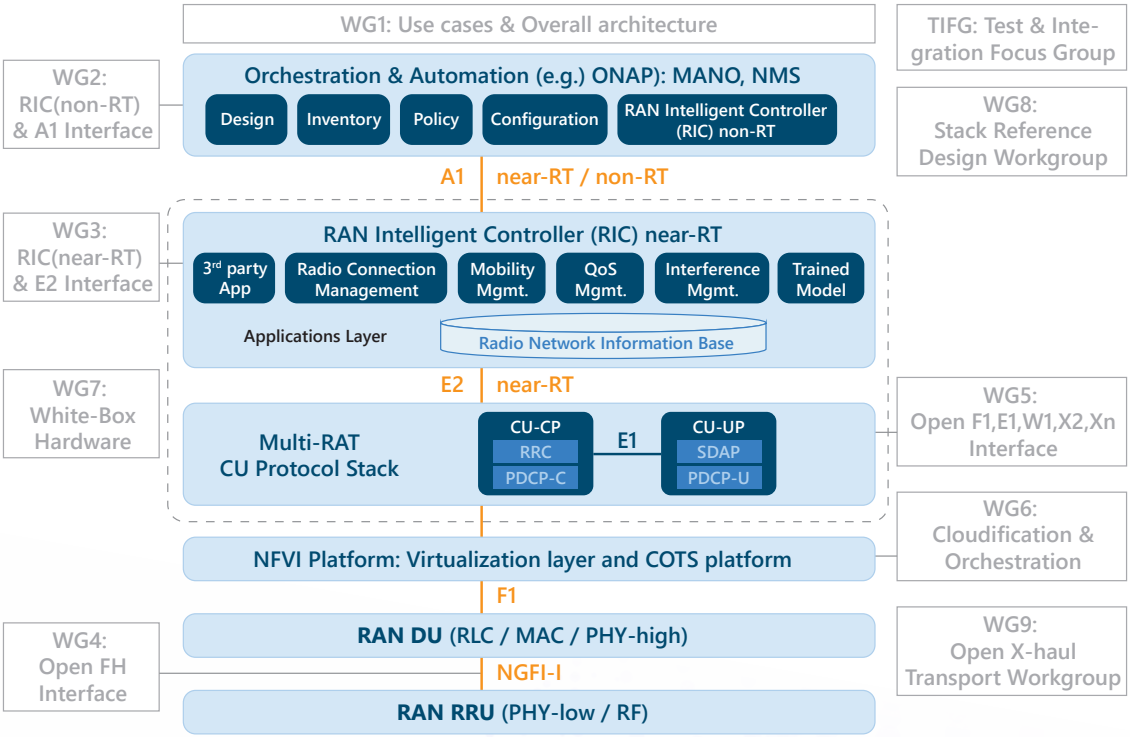
Open Source

The O-RAN Alliance mainly relies on the open source community for the implementation of a reference application and provides it with significant assistance. Many components of the O-RAN architecture are made available through the community as open source, including protocol stacks, PHY layer processing, the virtualization and orchestration platform, etc..

By transforming the RAN from a closed, vendor-specific system environment to an open, standardized, multi-vendor, AI-based, hierarchical controller structure, there is also the option of allowing third-party vendors access to the RAN. In this way, O-RAN also enables third-party providers such as MicroNova or network operators to develop innovative services as so-called RAN apps. The O-RAN platform (SMO – service management and orchestration framework) can thus be seen as a first RAN app store.

Conclusion

By participating in the standardization of the O1 interface, MicroNova is making a significant contribution to the development of the open RAN management standard. The resulting innovative strength benefits all parties involved – MNOs as well as other technology companies, since it enables them to develop new services and business models.



2 O-RAN-Alliance (Architecture in Workgroups)

New cooperation for 5G technologies

Cooperation on Software-defined Networking (SDN) and Network Function Virtualization (NFV) – 5G Technologies in Focus.

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

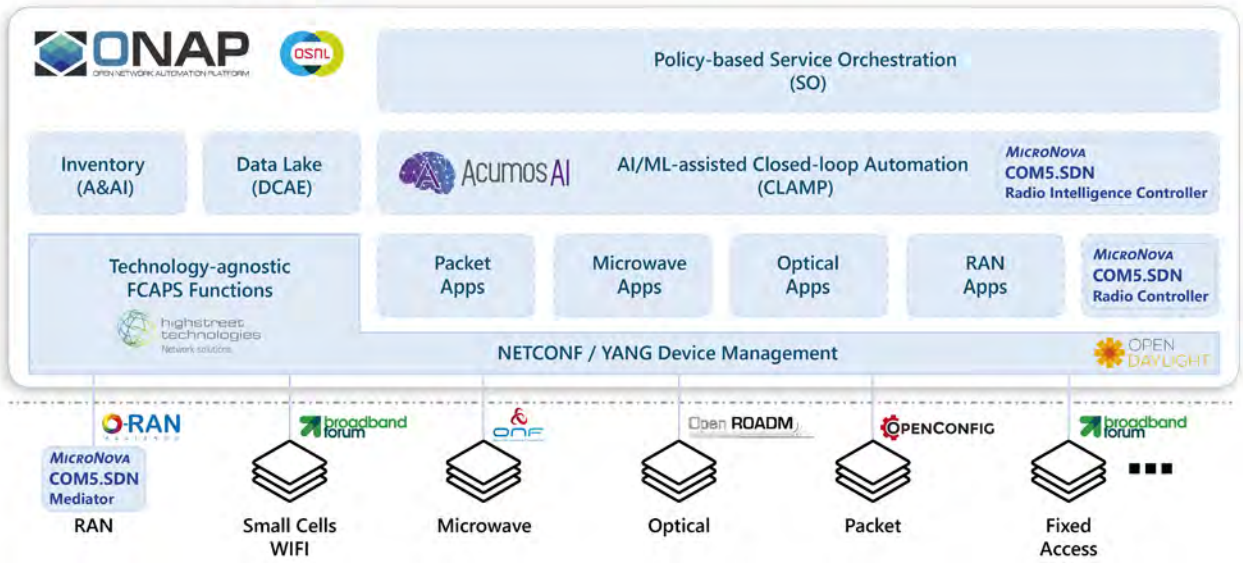
MicroNova and Berlin-based highstreet technologies GmbH have been officially working together as partners since October 2020. The particular objective is to support mobile network operators (MNOs) with the introduction and operation of 5G and the associated technology shift.

highstreet technologies and MicroNova aim to help major MNOs to further optimize the configuration and operation of their networks with projects based on SDN technology. In this context, MicroNova is already involved in the "Open SDN & NFV Lab" (OSNL) in Berlin, which was brought to life by highstreet technologies; the OSNL is also affiliated with the 5G Berlin e. V. innovation cluster, of which MicroNova is a founding member.

"Thanks to our partnership with highstreet technologies and the OSNL, we have been able to add COM5.SDN to our product portfolio alongside COM5.Mobile, with some key product variants for software defined networks. This puts MicroNova in a position to offer an integrated SDN solution to operators of public networks and especially in the new 5G-driven market segment of campus networks," explains Ingo Bauer, Head of Product Management Telecommunications at MicroNova.

Open Source Ecosystem for 5G Use Cases

The OSNL has a powerful infrastructure and an ecosystem based on open source, the Open Network Automation Platform ONAP, allowing SDN/NFV applications to be developed, tested and integrated. This enables highstreet technologies and MicroNova to map complete end-to-end use cases for 5G for MNOs – from the implementation of proofs of concept and the realization of research projects to the development of commercial carrier-grade solutions.



1 The OSNL Ecosystem

"The range of applications in the 5G sector, from the smart city to networked vehicles, appears to be unlimited," explains Alfons Mittermeier, Managing Director of highstreet technologies GmbH. "Our team has extensive knowledge of dedicated wireless technologies. Combined with MicroNova's long history in the mobile environment, this will enable us to jointly offer comprehensive end-to-end solutions, including training and support."

Supporting New Business Models for Mobile Network Operators

"Our companies have already been following a common path for a number of projects and customers for some time," explains MicroNova CEO Dr. Klaus Eder. "We will now further formalize and strengthen our partnership, both in technological terms as well as from a commercial point of view. We see an opportunity to work together to offer mobile communications companies in the 5G environment significant added value, for example in the areas of consulting for engineering, artificial intelligence, and machine learning or in the integration of services. This will ultimately help MNOs to offer their customers new services and enable new business models."

About highstreet technologies

The telecommunications and software experts at highstreet technologies have a long track record in developing network management systems. Since 2015 they have been applying their expertise to the new world of SDN & NFV. highstreet technologies has gained extensive experience in the integration of transport and RAN equipment into the SDN & NFV platforms OpenDaylight and ONAP through the technical management of ONF, ONAP and O-RAN PoCs. As an active member of the O-RAN Alliance, the highstreet technologies team makes a significant contribution to the standardization of APIs. In addition, highstreet technologies contributes open source software to ONAP and tests ONAP in OSNL, the Open SDN & NFV Lab in Berlin. The company, together with partners such as MicroNova, operates an ONAP installation as part of the 5G Berlin e.V. innovation cluster, an association of universities, research institutes, and companies, from which a largely O-RAN-compliant 5G network in central Berlin is managed. highstreet technologies is currently assisting several network operators in the USA and Europe with the introduction of ONAP.

Efficient Active Directory Management for BRUNNEN

ADManager Plus automates routine AD activities at BRUNNEN

TEXT: Editorial staff PICTURE: © Brunnen

Baier & Schneider GmbH & Co. KG:

- Sector: Stationery
- Employees: approx. 830 in the company group
- Sales revenue: € 130 million (2018)
- Headquarters: Heilbronn
- Established: 1877

With its core brand BRUNNEN, the Schneider Group is one of Europe's largest paper processing companies. Founded in Heilbronn in 1877, the family-owned company produces millions of exercise books, calendars, pads, business books and notebooks as well as gift wrap paper at its German and one Swiss location every year. The company, which employs around 830 people, generated sales of more than 130 million Euros in 2018.

The starting point – high manual effort

The IT department at the Schneider Group consists of about 20 employees working centrally from Heilbronn. One of the team's less popular but necessary tasks is the creation of users in the Active Directory (AD). In addition, there are constant changes due to staff leaving the company, name changes, and new roles or locations, which make maintaining the AD very time-consuming.

Like many other companies, the Schneider Group also relied on Microsoft's Active Directory onboard resources, which can be used to easily perform simple tasks such as creating users, groups, and computers. However, these tools quickly reach their limits with more complex tasks consisting of several sub-steps, and it is not even possible to edit several users simultaneously.

Another disadvantage is having to maintain the AD manually. Since many applications access AD data for logon, any errors can quickly propagate through multiple instances. The high susceptibility to errors as well as the enormous administrative effort caused the company to look for a suitable software to manage the Active Directory. Six solutions were evaluated, three were extensively tested – and finally ADManager Plus from ManageEngine was selected. The decisive factors were simple operation, the clear structure, and, in particular, the automation functions.

The solution – ADManager Plus

The new product quickly became a tool that the IT department would no longer like to be without in their daily work. ADManager Plus is permanently integrated via a single sign-on and is activated when a browser is launched.

For example, the IT team can then configure multiple user accounts simultaneously, manage and modify groups and computers, and delegate AD tasks and group policies.

"Users can now be easily created using templates, which would otherwise have had to be done by hand. It's a great relief," confirms Klaus-Peter Neimeier, Head of IT Infrastructure at Baier & Schneider GmbH & Co. KG. The templates used for this purpose were created or adapted quickly and easily by the IT department using drag & drop. Unused fields or tabs have been removed or predefined, so that only department, location, function, etc. need to be selected. "Different spellings or typing errors are now a thing of the past," adds IT manager Peter Nickel. Using linked conditions, ADManager Plus even fills in fields automatically and completes the address after a location has been selected, for example. By the way, an account for Exchange and Skype for Business is created at the same time as new AD users are created – without any additional effort on the part of the IT department.

The automated off-boarding process for employees leaving the company also makes work easier. Here, ADManager Plus first automatically sets the employee's account to inactive on the leaving date and removes it from all groups. The account is also automatically erased completely after a defined period.

The result – less time required, greater security

This automated process in ADManger Plus – like many others – saves valuable IT time while improving IT security. The latter aspect also benefits from the integrated reports that the company behind the BRUNNEN brand uses extensively. Peter Nickel is thus informed on a regular basis about which passwords are about to expire or which users have passwords that never expire. "Thanks to ADManager Plus, we can immediately see which user accounts and computers are inactive and who is a member of which group. So, we can regularly monitor who has administrative rights. This is important in order to prevent security vulnerabilities from arising in the first place due to incorrect administrative rights."

Conclusion – fewer sources of error through standardization and automation

The Schneider Group was able to standardize and automate many tasks related to AD management by implementing ADManager Plus. The IT department is relieved of routine manual tasks, potential sources of error are reduced, and IT security is enhanced. At the same time, the solution is user-friendly and enables comprehensive reporting.

"The great benefits of the templates in ADManager Plus are standardization, less sources of error, and enormous time savings."

– Peter Nickel, Head of IT & Organisation, Baier & Schneider GmbH & Co. KG

"Users can now be easily managed via templates, otherwise this would have had to be done by hand. What a relief."

– Klaus-Peter Neimeier, Head of IT-Infrastruktur, Baier & Schneider GmbH & Co. KG

Customer benefits:

- Fewer errors through the use of templates
- Time-savings through automation
- Very user-friendly
- Extensive reporting

News from ManageEngine: Desktop Central

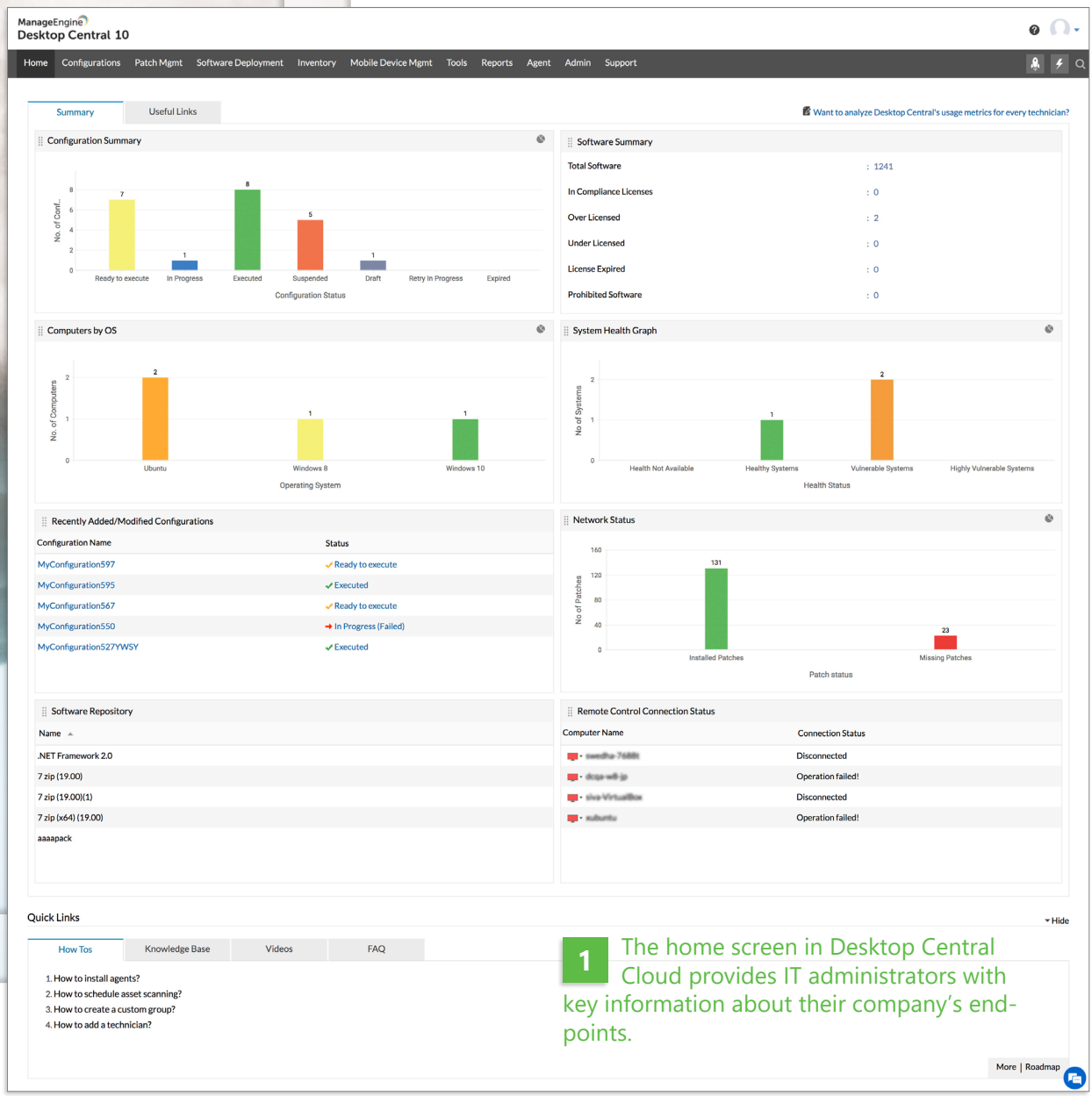
Desktop Central – the Unified Endpoint Management solution from ManageEngine – is now also available as a cloud version. It allows companies to efficiently manage their endpoints without having to rely on their own infrastructure.

TEXT: Editorial staff PICTURES: © ZOHO, © ManageEngine, © PHOTOCREO Michal Bednarek / Shutterstock.com

ManageEngine recently launched a cloud edition of Desktop Central, its desktop and mobile device management solution. This allows IT departments to efficiently and cost-effectively manage, configure and remotely maintain all of their company's endpoints (PCs, laptops, smartphones and tablets) on a SaaS basis. Being cloud based, it no longer matters whether a state-of-the-art, high-performance infrastructure is available.

Recurring tasks such as installing patches for applications and operating systems, distributing new software or setting up new devices can quickly and easily be automated with all variants of Desktop Central. IT departments can also use the solution to manage IT assets and software licenses. The on-premise version also allows you to distribute operating systems and create OS images. Unlike the on-premise variant, the cloud version of Desktop Central currently does not support patch management or software distribution for Linux devices.

Like all other cloud solutions from ManageEngine, the cloud edition of Desktop Central is hosted in a European data center for European customers. It is available in four variants: In addition to a "Free Edition" intended for small businesses with up to 25 computers and 25 mobile endpoints, there are the "Professional", "Enterprise" and "UEM" editions, each offering different functionalities.



1 The home screen in Desktop Central Cloud provides IT administrators with key information about their company's endpoints.

Endpoint management tips for seamless remote working

Never before have so many people around the world worked from home as during the COVID-19 pandemic. With remote workers using a variety of devices connected to the Internet, endpoint security has never been more critical. To help IT departments enable workers to work securely and seamlessly from remote locations, ManageEngine has compiled the most important endpoint management tips for companies. You can view these tips (in German) online at

» https://www.manageengine.de/endpoint-sicherheit-home-office

Cloud-Edition

For more information about the Cloud Edition of Desktop Central and a free 30-day trial, please visit :

» https://www.manageengine.de/desktopcentral

Protect Data or give away 1.6 Million Euros?

Lost data costs money (see below) – Data Loss Prevention software is the cure. For being able to offer tailored services, Safetica Technologies has adapted its licensing model.

TEXT: Julia Reuter PICTURE: © Marc Roura / Shutterstock.com

Hopefully you have prepared well for data loss: get ready for crisis communications, lawyers, patents and technologies that are no longer secret, and a lot of lost money and nerves... Wouldn't it be better to minimize the risk of such a scenario from the outset by taking appropriate measures? Safetica's Data Loss Prevention (DLP) software offered by MicroNova reliably protects companies. Because every, yes EVERY company has information that should not or must not be disclosed to the outside world. From complex patents to pay slips or simple emails. Nowadays, business operations are always based on data, even if they are 'only' supporting IT systems.

If there are external or internal attacks, or if employees are careless, with just one click the entire company can quickly come to a grinding halt. Things can get very expensive: In 2019 the average cost of data loss and downtime per incident was around €1.6 million, according to Dell's Global Data Protection Index 2020 Snapshot. And it is not just the amount of damage, but also the likelihood of such an incident occurring that justify using a DLP solution: 75 percent of the companies surveyed in a BITKOM study in 2019 stated that they had been victims of data theft, industrial espionage or sabotage since 2017; an increase of 50 percent within this period. Another 13 percent suspected an incident, which means a total of 88 percent were affected.

Small and medium-sized companies with special requirements

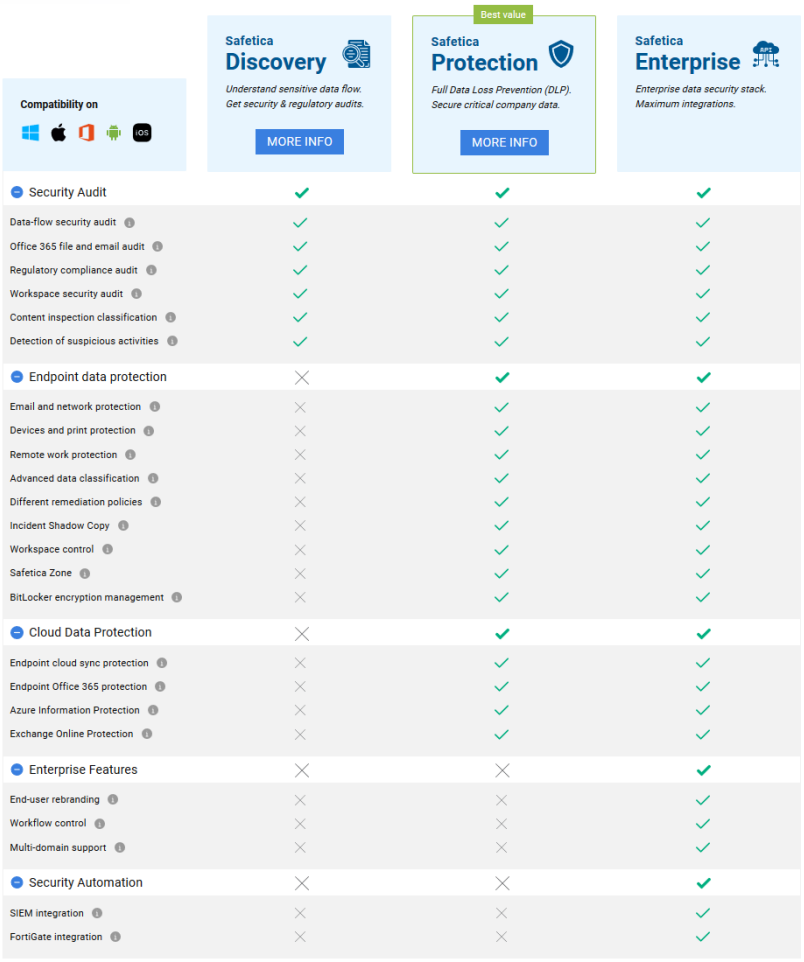
According to the above BITKOM study, the most frequently affected companies were those with ten to 99 employees – so it is by no means just large corporations. It is precisely the much-cited mid-sized companies, as the noted innovative backbone of the economy in Germany as well as in many other countries, that is an 'attractive' target for attacks. And especially here the companies have particular requirements for suitable functionality at a reasonable price-performance ratio. This is exactly where Safetica Technologies comes in with its smart new licensing model for version 9.6: Companies only pay for the functions they really need. Details about the new 'Discovery', 'Protection' and 'Enterprise' versions are shown in the graphic on page 37.

Safety for the home office

When developing version 9.6 of its DLP solution, Safetica Technologies explicitly focused on home offices, the number of which has risen significantly

[1] *https://www.computer-automation.de/steuerungsebene/safety-security/datensicherheitsloesungen-nicht-mehr-ausreichend.174557.html and https://www.delltechnologies.com/de-de/data-protection/gdpi/index.htm*

[2] *https://www.bitkom.org/sites/default/files/2020-02/200211_bitkom_studie_wirtschaftsschutz_2020_final.pdf*



Compatibility on	Safetica Discovery *Understand sensitive data flow. Get security & regulatory audits.* MORE INFO	Best value Safetica Protection *Full Data Loss Prevention (DLP). Secure critical company data.* MORE INFO	Safetica Enterprise *Enterprise data security stack. Maximum integrations.*
Security Audit	✓	✓	✓
Data-flow security audit	✓	✓	✓
Office 365 file and email audit	✓	✓	✓
Regulatory compliance audit	✓	✓	✓
Workspace security audit	✓	✓	✓
Content inspection classification	✓	✓	✓
Detection of suspicious activities	✓	✓	✓
Endpoint data protection	✗	✓	✓
Email and network protection	✗	✓	✓
Devices and print protection	✗	✓	✓
Remote work protection	✗	✓	✓
Advanced data classification	✗	✓	✓
Different remediation policies	✗	✓	✓
Incident Shadow Copy	✗	✓	✓
Workspace control	✗	✓	✓
Safetica Zone	✗	✓	✓
BitLocker encryption management	✗	✓	✓
Cloud Data Protection	✗	✓	✓
Endpoint cloud sync protection	✗	✓	✓
Endpoint Office 365 protection	✗	✓	✓
Azure Information Protection	✗	✓	✓
Exchange Online Protection	✗	✓	✓
Enterprise Features	✗	✗	✓
End-user rebranding	✗	✗	✓
Workflow control	✗	✗	✓
Multi-domain support	✗	✗	✓
Security Automation	✗	✗	✓
SIEM integration	✗	✗	✓
FortiGate integration	✗	✗	✓

in the wake of the coronavirus crisis. Since March 2020 many previously hesitant companies have introduced home office functions for their workforces at a rapid pace. However, the protection of sensitive data is particularly critical when users connect remotely to the corporate network using their work equipment. It must also be possible to observe internal compliance policies applicable in remote working environments.

To ensure all of this, Safetica has extended or added a number of functions to its DLP solution. In order to ensure that confidential documents can be quickly identified as such in the home office, the new version allows users to classify data. Once enabled by the administrator, users can define the confidentiality level of a file themselves via the document properties. To prevent misuse, users can only select higher levels (e.g. "internal", "restricted" or "classified") by default. In addition, data classifications can now be combined for your own DLP policies. This allows companies to create policies for specific types of data, such as internal documents that also contain sensitive financial data.

Precise definition of policies

Another new feature is the Work Activity Report, which quickly provides a complete overview of data transfers and DLP incidents, even in home offices. Furthermore, it is possible to encrypt external data carriers such as USB sticks – the contents of a data carrier can only be made accessible again by the authorized user using the client program "Safetica Agent" on the user PC. On top of this, the transfer of data for remote equipment can be defined granularly by organization policies and therefore also be restricted according to legal and compliance requirements.

IT departments can define the extent themselves according to their needs: Sensitive or confidential data can be comprehensively protected against unauthorized data transfer. The enforcement of defined policies can be extended to all common data channels available in companies. Since the Safetica client installed on the endpoints works independently of any server connection, data is protected even if a user's computer is not logged into the VPN.

Data protection – everything, everywhere, always

The result of the introduction of version 9.6: Companies have even greater flexibility when it comes to protecting sensitive data against loss or theft in home office environments. IT departments can access new DLP policies for remote desktop file transfers and user-based data classification. Classifications in the DLP policies can also be combined.

Do you want to protect your data effectively and prevent it leaving your company without authorization? We have the right tools and will be happy to advise you. In German-speaking countries the new version is available exclusively from MicroNova – please contact our team if you are interested: safetica@micronova.de.

monday.com: Make Teamwork efficient

Lots of project management tools promise efficiency – it's nice that there is finally some proof for these claims; Forrester Research has produced such evidence for monday.com.

TEXT: Julia Reuter PICTURE: © dvoevnore / Shutterstock.com

Whether a project team in a large corporation or the entire workforce in small or medium-sized enterprises (SMEs): The more tasks, the more complex it becomes to coordinate work. Project management and collaboration tools promise a solution. But how can measurable added value be demonstrated? The platform monday.com commissioned the renowned market research company Forrester to answer this question.

Measuring the 'Total Economic Impact'

The Total Economic Impact (TEI) – a methodology developed by Forrester – examines the potential return on investment (ROI) that a company can achieve by providing a solution. To determine the relevant figures for the use of monday.com, Forrester followed and interviewed an Internet marketing company with around 100 employees for one year.

Prior to introduction of the tool, the company found it difficult to keep a uniform overview and control of the campaign management processes. They realized greater efficiency in the management of campaigns after switching to monday.com. The teams achieved productivity gains through improved communication and were able to use available templates and automation features. The workplace environment was characterized by greater transparency.

Members of the team were able to work more independently, as task elements could be systematically assigned to the 'owners' of the tasks. Real-time updates on the progress of campaigns allow managers to better manage their teams.

A gain of 15,600 man-hours per year

After one year of using monday.com, the company saw a total weekly saving of three working hours per employee. The entire organization noted a reduction of around 15,600 man-hours for process management. Furthermore, the time to launch marketing campaigns – the 'time-to-market' so to speak – was reduced by around 27 percent.

In terms of ROI, the solution began to pay off for the company after just three months. To put it in figures, the marketing firm recorded a productivity gain of 525,095 US dollars. The shorter time-to-market was reflected in a plus of 134,525 US dollars, not even taking into account some factors that emerged during the qualitative survey; for example, the team was more motivated and committed because of the noticeably better process workflows.

More satisfied customers thanks to excellent team cooperation

In addition, since the introduction of monday.com, customers have given positive feedback in terms of transparency and insight into projects. In this way, tool-based and consequently excellent teamwork contributes to ensuring stable customer relations and follow-up orders. The complete Forrester report with all facts and figures is available to downloaded free of charge at https://monday.com/customers/tei-report.

Ideas for the Future

Dear Reader,

In the past my father, MicroNova founder Josef W. Karl, has been providing insights into the work and views of the Supervisory Board at this point. Some time ago he reported on the company succession he had set in motion for the long term. I am pleased that he remains actively involved and continues to provide supportive insights to help our Board members work at their best. Today, as owner, I would like to address the future.

Over and above the organizational "how" described, we are naturally also take care of the "what" – because MicroNova is so much more than just some legal structure. The company is a source of income for our colleagues, who work so passionately on innovations for our customers. Naturally, we have long-term plans in place to keep this arrangement thriving.

Mobility will remain central to our company. The technological transition in the powertrain is only one of the current challenges. My goal is for MicroNova to continue to play an important role here and set standards – however challenging the current environment. The Testing Solutions team has recently developed pioneering virtualization concepts and amassed considerable expertise in the AI field. Successful projects with customers in the power generation sector have already demonstrated the potential to leverage this know-how for other industries. We will work to this end and to open up further fields.

Just like mobility, connectivity will be a further pillar of our daily life. The coronavirus crisis has given a massive boost to the already growing significance of remote working. During the lockdown, private video conferences have even helped people overcome physical isolation on multiple occasions. This trend toward increasing connectivity will continue. For MicroNova, pressing ahead with the ongoing opening up of new areas while retaining our extensive expertise in management of mobile networks will remain important.

As the third pillar, IT management will continue to play a key role. The whole world is talking about digitalization. No new business model, platform, or smart application can operate unless backed by reliable and powerful IT infrastructure. We want – and will continue to ensure – that administrators and IT departments are empowered to provide a stable IT infrastructure. We will continue to intensively cultivate existing partnerships and expand our portfolio to include new partners and their solutions to complement our offering.

In short: The path of MicroNova will be an evolutionary one, in line with the company's history to date. Over the next 10 to 15 years, our work will focus on mobility, connectivity and reliable IT systems. Continuing this diversification fits with our values. As before, our approach is organic rather than growth at any price, ensuring reliability for customers, partners and employees.

Furthermore, I would like to take this opportunity to reaffirm my gratitude to all those who are so committed to MicroNova – particular our customers and never more so than in recent months. A massive THANK YOU to all employees, especially for their understanding during the COVID-19 crisis! Finally, I would like to thank our management team for getting the company in good shape to face such challenges with foresight and for striving to achieve our long-term goals. I am proud to be part of it and to have the chance to contribute my ideas for our common future. I will do all in my power to ensure that, collectively, we can remain on the same proven and successful path that has served MicroNova so well for over 30 years.

Maximilian Karl

With warm regards,
Maximilian Karl

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: 1,500 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 9300-0
Email: info@micronova.de