

Special Issue

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WAGO shows the advantages of the new mobile radio standard.



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INDUSTRIAL AUTOMATION

MASTERING THE DIGITAL FUTURE WITH CO-CREATION

The corona crisis has significantly boosted the digitalization of mechanical engineering. With its open automation solutions, WAGO is a much sought-after partner that's poised to offer even more flexibility in the future.

"While there was a lack of courage before, more and more IT tools are now being used to network production," says WAGO CEO Dr. Heiner Lang in describing this trend. This change shifts the focus to WAGO with its open automation solutions, cloud connectivity, edge computing, and diverse communication solutions. "We've hit the sweet spot with our customers."

Increase customer value: To ensure this remains so, WAGO supports and promotes innovations that simplify the work of its customers time and time again. According to Dr. Lang, not all solutions must originate from WAGO itself. "We want to create an open, transparent, interoperable WAGO Automation platform that is not proprietary, but openly interfaces with the outside world for co-creation, participants and partnerships."

Innovating together: WAGO underpins this approach with its new partnership in Bosch Rexroth's ctrlX Automation. Companies enrich the open platform with their products and create new solutions through co-creation. WAGO is initially involved through the open and simple connection of its I/O systems to the ctrlX CORE control platform via EtherCAT® – thus showing users new ways to get the job done.

Leveraging 5G: Partnerships also play an important role for WAGO in the introduction of 5G. WAGO experts use a technology demonstrator to show how communication with the mobile communications standard can function in the future. Next, concrete use cases will be co-developed with customers before the Swedish network supplier and project partner Ericsson tests the controllers in its 5G network. This is the way, experts hope, for true plug-and-play.

Digitalization mastered: WAGO is the backbone of a smart connected world – this has been demonstrated by many successful projects. In the current one with Linde, the task was avoiding increased loads and efficiency losses in the highly flexible operation of Linde's air separation plants. A jointly developed cloud-based monitoring system now ensures this. At the heart of the system is the IoT Gateway of the PFC200 Controller, which uses cloud connectivity to collect data and transfer it to the cloud.



Enabling More Freedom

Corona acts as a fire accelerant for digitalization. As a result, mechanical engineering is becoming increasingly adept at using new technologies. Particularly in demand: simple and flexible systems that offer users complete freedom and space for innovation-promoting cooperation.

WAGO stands for the greatest possible, real-time openness. We offer a modern system architecture with future-proof technology solutions. But we have not reached our goal – systems must become even simpler and more flexible. That's why we support and are committed to innovations that promote openness, interoperability and partnerships.

Take 5G, for example: We are working on a controller with integrated 5G functionality. We want to give our customers a jolt of inspiration and chart together where the journey in 5G and digitalization is heading. Thankfully, our strong partnership with the network equipment supplier Ericsson is supporting us during the market launch.

WAGO is your partner in digitalization! Our joint project with Linde uses our PFC200 Controller and cloud-based monitoring of its air separation plants – a prime example of how digitalization and co-creation enable resource conservation and sustainable business. Are you about to take a step into the digital future? Let us inspire you with our employees, projects and solutions!

Dr. Heiner Lang
CEO

INDUSTRIAL COMMUNICATION WITH 5G

5G MOBILE TECHNOLOGY AS A BACK-BONE FOR INDUSTRY 4.0

A world-changing technology: According to many experts, the new mobile communications standard 5G has what it takes to not only boost the world of mobile consumer communications. It holds massive potential for Industry 4.0 and the Internet of Things thanks to greater data performance and more potential applications. Now is the time to lay the foundation for the future of production with partners and projects.

According to a new report, China anticipates more than 560 million 5G users by 2023. This summer publication made those tracking the introduction of 5G technology in Europe sit up and take notice. It is a huge number that says a lot about Chinese efforts when it comes to 5G coverage. Nevertheless, it could disappear behind another variable that – at best – can only be roughly estimated right now: the many billions of active devices that will migrate to the new communication standard to exchange sensor data, control commands or software updates. Similarly, machines, autonomous vehicles and robots will keep in touch with the intelligence guiding them via this mobile network.

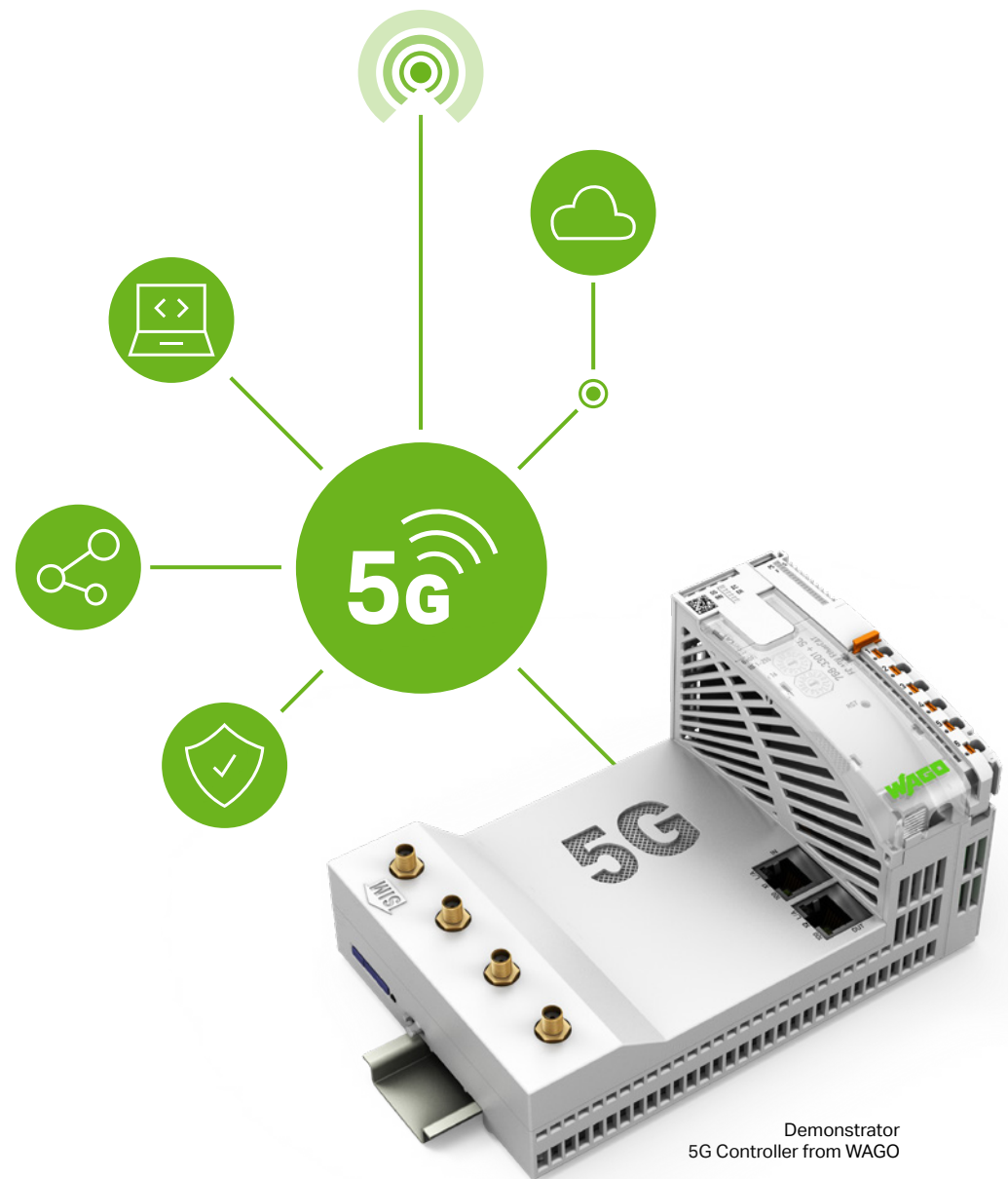
From the industry's perspective, which has been working for several years on the next level of automation for factories and plants, the new functionalities of the 5G standard offer an almost endless field of possibilities: With up to 20 gigabits per second, it's 100 times faster than today's LTE; with a latency of less than one millisecond, new technology operates in near real-time; and with protected, permanently reservable frequency bands, no essential demand from earlier "cable versus radio" debates remains unfulfilled.

Good news for enterprises: Looking again at the consumer world, end-user network expansion is also a measure of a technology's maturity and availability. And here, the gap between China and the rest of the world is wide. For more than 40 percent of private mobile users in China to enjoy 5G connectivity in two years, more than 18 5G base stations per 10,000 inhabitants should be online – figures that Germany is still miles away from. If a 5G sign lights up in the mobile device here at all, it will likely be a 5G non-stand-alone network, i.e., built on the existing 4G infrastructure.

But the essential news for industrial manufacturers is different: Industrial production does not have to put its robotic hands in its tinny lap until the providers are ready to install radio masts at their own sites. This is because the Federal Network Agency, which is responsible for the matter, worked with companies and enterprises when allocating frequencies, making it possible for companies to set up their own regionally limited networks. Campus networks, or more correctly private networks, are now possible without any problems, opening the factory gates wide for cooperation, testbeds and proof-of-concept studies.

Sponsored projects create benefits: Cooperation is good politics. For example, the state government of North Rhine-Westphalia alone is already funding 24 innovation projects with nearly 36.8 million euros in a second round. These include 5G innovations such as parcel deliveries with drones, real-time translation into sign language, and the intelligent control of cranes in the Port of Duisburg. A project funded with 2.5 million euros is preparing the development of 5G products and services for Industry 4.0 applications: In the "5G4Automation" project, WAGO is working with several other companies and institutes to ensure that small and medium-sized companies, in particular, benefit from the new methods and solution modules related to 5G.

Let's look east again and the growing competition from that direction: It's no surprise that China is also in the process of creating new uses for 5G technology, with its major industrial centers in mind. For example, it plans to expand the industrial penetration rate of 5G to over 35 percent in the next two years. Enough incentive not to wait, but to get started here in Germany, too!



Demonstrator
5G Controller from WAGO

Partnership with Ericsson Facilitates 5G Deployment

Shortly before going to press, it became official: The contract negotiations for a partnership between WAGO and the Swedish network equipment supplier Ericsson for the product launch of 5G-capable devices were successfully concluded. The cooperation offers WAGO the opportunity to provide devices in the future that are tested for their suitability within the Ericsson 5G infrastructure right out of the box. Evaluations in the 5G TestLab in Gothenburg, Sweden, will show whether the devices meet the requirements for the new communication infrastructure. Many WAGO customers will use a private network from Ericsson. The tests save time-consuming implementation measures and protect against unwanted complications during operation. Since the controllers in the Ericsson network are already tested, WAGO experts anticipate true plug-and-play capability.

INDUSTRIAL COMMUNICATION WITH 5G

LEVERAGE THE FULL POWER OF 5G

OUR EXPERT



»We need to look at appropriate use cases where the full impact of 5G technology can be seen.«

Dr. Heiner Lang
CEO

What obstacles still need to be overcome?

Lang: The fact that no chipsets are available is a huge obstacle. The requirements have not yet been met to run through many different applications. In this respect, our proof-of-concept now comes at exactly the right time to determine what is really in demand. In this way, we can quickly offer products as soon as the chips and modules are available. Since we are working with 3D printing in our demonstrator, we are extremely flexible.

When will your 5G controller be ready?

Lang: We will demonstrate the first results of our proof-of-concept this fall, but deliberately without building a concrete use case. A demonstrator will bring 5G to life and show how this type of communication can work – interactively, of course. We will be ready to answer questions and are looking forward to as many inspiring discussions as possible.

According to its mission statement, WAGO forms the backbone of a smart connected world. It is therefore only logical to also tap into the emerging mobile communications standard 5G – after all, it is considered the backbone of industrial production for the future. WAGO CEO Dr. Heiner Lang explains how well WAGO and 5G fit together and what benefits will result.

Why is it important to you whether information comes from a cable or a router?

Dr. Heiner Lang: For us as an automation company that offers the simplest and most open automation possible, it is vital to keep up with the trend toward wireless communication and, in this context, to devote ourselves to 5G. In a few years, we will experience a completely different automation landscape – which is why we are building up the necessary expertise. In addition, WAGO devices are used for control and regulation tasks. We believe that these devices are ideally qualified for communication tasks, for example, using the new 5G standard. Despite what some people say about 5G merely saving an ETHERNET cable, we are pursuing a different strategy and will integrate this technology into our devices.

What is the specific benefit of 5G for users, and why should it be integrated?

Lang: As we move toward more system autonomy, 5G will play a major role: Just think about resilience. In the future, systems will also have to analyze themselves, repair themselves, and communicate and interact with other machines and systems. Machines will have to come together more dynamically in the future using robotics. Ad hoc communication must be established and be flexible enough to accommodate such applications. You can only achieve such flexibility with 5G. But security is also an issue. That's why we already have a modem in our devices to ensure that the connection is secure over the entire distance. This way, we can work with customers to exploit the full potential of 5G.

We currently use 4G modem technology in our controllers. But what 5G can do will be very different. That's why, with 5G, we're not looking at the functionalities that we've implemented in the past, such as decentralized stations that perhaps exchanged data via SMS or simple protocols. A 5G solution via private networks, for example, will open up completely new application fields. For many applications, it will be crucial to monitor communications, connect services, and communicate with the outside world via interfaces such as OPC UA. The challenges we are trying to solve in practice are what specific parameters are required for this and how they are implemented.

What are the next steps?

Lang: We are currently working on building a controller with 5G functionality as a demonstrator. We're not spending too much time on theoretical considerations, but rather generating practical benefits very quickly via proof-of-concepts. Then we have to look for suitable applications in which the full impact of 5G technology becomes visible.

Isn't it too cautious to tackle 5G with just one controller?

Lang: No – we don't believe that we must be present on a broad scale with products right away. We are more interested in giving our customers a kick-start. Together, we want to think about where the journey with 5G and digitalization could go. To this end, we are taking the lead, and in this sense, having an integrated modem in our controller is the first step. After all, it will enable us to map any control and regulation functionalities over the wireless link. Now we want to identify the application cases by consulting our customers.



AUTOMATION ENGINEERING

»THE KEYS TO OPENNESS«

WAGO integrates its manufacturer-independent CODESYS V3 Automation Software into the engineering process. Dr. Sven Kreft, Head of Product Line Software, highlights the reasons and advantages for customers.

Why is WAGO integrating CODESYS V3 into its automation engineering?

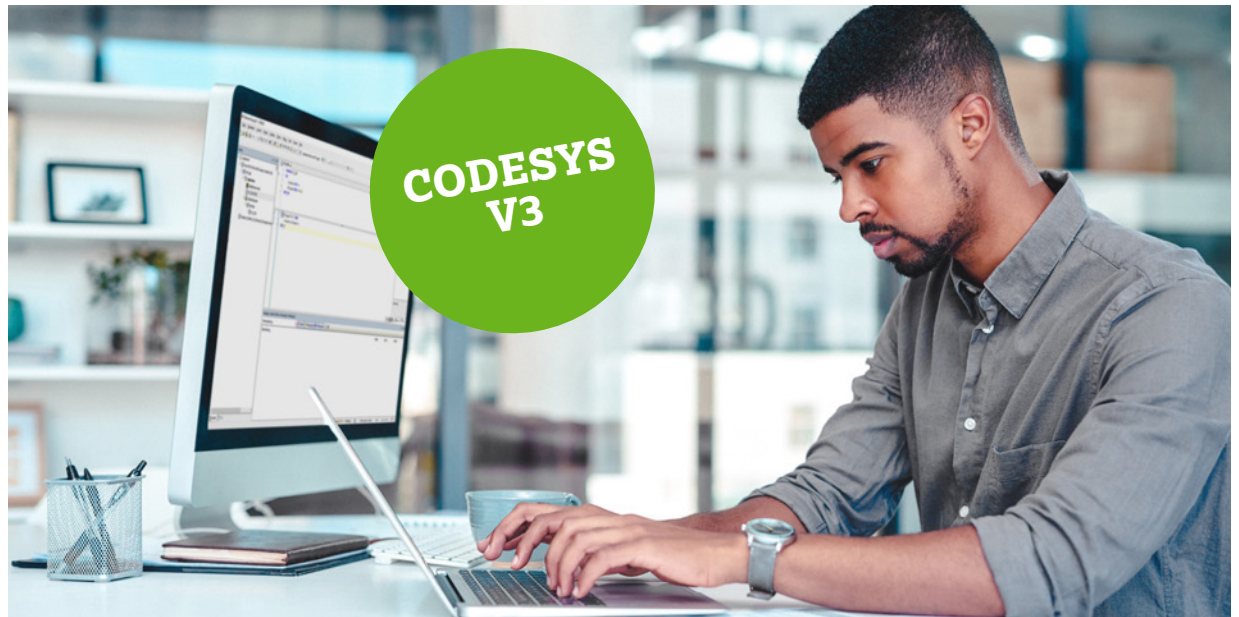
Dr. Sven Kreft: We place open standards at the center of our business because we believe that our customers – as well as ourselves – cannot develop everything alone. We are convinced that the future lies in strong partnerships and co-creation. Active communities and complementary partners ensure that the wheel does not always have to be reinvented and that a large number of individualized solutions are created that customers need due to increasing complexity. Open standards are the basis for this, which is why we are open for CODESYS V3.

OUR EXPERT



»The possibilities, the willingness and ultimately also the chances for co-creation are increasing almost daily. We are certain that we have chosen the right platform with CODESYS V3.«

Dr. Sven Kreft
Head of Product Line Software



How does CODESYS V3 contribute to openness, which characterizes WAGO's automation solutions?

Kreft: IEC 61131 is the open standard for programming real-time capable industrial controllers – it is mature, established, and widely used. CODESYS V3 is the standard for IEC 61131 development; many thousands of application developers use CODESYS. Additionally, more than a thousand different industrial controllers and panels are supported independently of the manufacturers. These are the keys to openness.

What does the customer get from CODESYS V3?

Kreft: The possibilities, the willingness and ultimately also the chances for co-creation are increasing almost daily. We are certain that we have chosen the right platform with CODESYS V3. First, the system has been on the market for a long time, and it offers the functions and technologies used for modern automation today. Secondly, CODESYS has proven time and again that the system is kept absolutely up-to-date. Third, vendor independence and interoperability create new opportunities for our customers.

The new WAGO Compact Controller 100 will be the first WAGO product available with CODESYS V3. Why this device?

Kreft: With the WAGO Compact Controller 100, we offer a small controller with integrated I/Os. This controller is attractive for a wide range of applications because it is inexpensive, powerful and compact. The engineering of CODESYS fits these characteristics perfectly; therefore, we decided to offer the WAGO Compact Controller 100 with CODESYS.

Can customers who have already invested in e!COCKPIT also use CODESYS V3?

Kreft: Yes, of course! Both systems are based on the same platform; programming and compiling IEC 61131 programs works identically. For example, all libraries available under e!COCKPIT will remain available.



**Engineering with CODESYS V3:
WAGO Compact Controller 100**

WAGO is opening up to CODESYS V3 and will offer controllers with manufacturer-independent automation software in the future. The first new device in the 751 Series, the new WAGO Compact Controller 100, will be available this September. The small controller is perfectly suited for engineering with CODESYS V3 because it is inexpensive, powerful, compact, and thus versatile. Like all WAGO controllers, it operates with a real-time Linux® operating system and supports standard fieldbus protocols. Thanks to integrated I/Os and its design as a rail-mounted device, as well as its removable wiring level, it can also be mounted in a space-saving manner and is easy to handle. In short: the perfect addition to the WAGO controller portfolio.

WAGO ANALYTICS

MAXIMIZING THE VALUE OF MACHINE DATA

When it comes to optimizing a machine or system, the challenge is usually improving and quantifying process knowledge and transferring the results back into the process. WAGO Analytics supports users with custom solutions from data acquisition to its profitable use. Our expert Dr. Jan Jenke explains how this works in six steps.



To capture machine and sensor data, users need different hardware products that provide the corresponding data pool. WAGO offers a wide range of components for this purpose. The devices support all standard interfaces and established industrial protocols. In addition to the WAGO I/O System 750 with the PFC family of controllers and various modules for measurement and sensor data acquisition, WAGO IoT Boxes are available for retrofits. They are incredibly versatile and ideal for simple machine and system connection. The data can be forwarded to a cloud service or edge computer. The WAGO product portfolio also covers these areas.

Data analysis – locally or in the cloud: The data obtained can be processed and analyzed both directly on site at the machine or system and in the cloud. The cloud's advantage is that all data is available at any time and company-wide. By using edge computing, the data can be analyzed directly in the system. This is where the advantages of Docker® technology come into play. The PFC200 Series Controllers and the new edge devices are Docker®-ready. This allows use of state-of-the-art software and numerous applications within the custom analytics solution.

Collecting raw data from various data sources: First, the relevant data sources are identified together with the relevant domain expert. Read-out from the various machine and system interfaces is independent of the specific protocol. Values are accessed from the controller directly, and additional sensors are installed if necessary. The objective is to integrate the analytics solution into the existing controller, so the automation engineer responsible for the system is consulted on the data acquisition setup.

Processing the data: The data is then time-synchronized. The relevant information is extracted and decoded in a uniform format. Irrelevant data is filtered out and removed. In addition, relevant metrics are calculated continually.

Continuous data acquisition: Then, a custom data logger for the machine or system is put into operation. The data is stored and used for in-depth analysis. A variety of useful data is generated through continuous data acquisition.

Explorative data analysis and selection of the right representation: Finally, exploratory data analysis and selection of the right representations take place. In offline analyses, dependencies and relationships are extracted, interpreted and visualized. Rare events are revealed. The close cooperation between the data scientist and domain expert achieves the first successful identification of potential for optimization. If the desired use case cannot be represented with the data from the existing database, either new sensors are installed or the test plans are adapted.

Integration into the operating process: In the next step, the analyses and visualizations that have been optimized for the machine or system are integrated into the operating process. Once again, the automation engineer is consulted about integration into the control system.

Leveraging correlations and optimization potential: In this way, the customer exploits the interrelationships and potential for optimization, benefiting from the advantages of a tailored analytics solution. If necessary, this solution can be expanded in a further iteration for the next use case.

OUR EXPERT



»WAGO works closely with customers to develop tailored solutions for the profitable data use within the specific application.«

Dr. Jan Jenke
Innovation & Technology

CLOUD CONNECTIVITY



A SECURE PATH TO THE CLOUD

Linde has developed an air separation system that permits extremely flexible operation according to the situation on the electricity market. To prevent this innovative operating method from causing increased loads or efficiency losses in the system, Linde has set up a sophisticated cloud-based monitoring system. WAGO ensures that the measurement data are reliably transmitted to the cloud through the cloud connectivity solution.

The air separation plants designed by Linde work almost like Rumpelstiltskin spinning straw into gold: The systems produce valuable chemical elements from air, such as oxygen for the healthcare industry, nitrogen for food manufacturers and argon for the electrical industry. However, there is nothing magical about the system. Instead, the gymnasium-sized systems with their signature towers are the result of incredible feats of engineering. The method for gas separation that underlies these systems was developed by the company's founder, Carl von Linde, in the 19th century and is called the "Linde process" in his honor.

However, it takes a large amount of electricity to break air down into its constituent parts. "This process represents a great opportunity for the global energy transition because industrial systems of this type can make a substantial contribution to the integration of wind and photovoltaics into the energy system," explains Dr. Oliver Slaby, Head of IT for Plant Operations at the subsidiary of Linde Engineering. This is possible by making operation more flexible in line with the electricity supply: If a lot of wind and solar power are available, then the systems run at their highest output levels; if less renewable energy is available, they can be throttled down, or even idled.

This variable operation places significantly higher demands on system technology than a conventional operation with largely constant output. Therefore, Linde Engineering developed a new technology concept, called FLEXASU®, which allows them to operate the air separation systems with a high degree of flexibility. A sophisticated monitoring and analysis system prevents the load changes from reducing the performance and lifespan of the systems. One core component of this system is the IoT Gateway in the PFC200 Controller from WAGO, which uses cloud connectivity to collect and send data to the cloud.

Higher availability, better performance: To see what air separation systems can offer for the energy transition, one only has to look at Vejle, a town in the southeast of Denmark, where Linde Engineering has installed a FLEXASU® pilot system. It differs from conventional systems in several ways, including the fact that the plate heat exchanger, the core of all air separation systems, is equipped with numerous sensors. "Plate heat exchangers cool the incoming air. At the same time, they heat the products generated in the system as they are emitted," explains Paul Heinz, Conceptual Design Engineer at Linde Engineering. The frequent startup and shutdown sequences in the systems cause thermal stress, which can strain

the heat exchanger in certain circumstances. "In the worst case, small leaks could arise. Production would then have to be stopped for repairs, and the interruption in operations would be costly," says Heinz.

Therefore, experts from Linde Engineering monitor the thermal state of the heat exchanger blocks using the installed sensors. Based on this data, which is collected at one-minute intervals, the engineers can use simulations to predict the lifespan of the blocks. Should it become apparent that a component will soon reach its load limit, the employees replace it promptly or alter the change mode of operation to prevent stress on the components. "Such a predictive maintenance approach increases the availability of the systems," explains Heinz.

In addition, the sensor data also reveals how system performance can be improved – for example, by showing where the local temperatures in the components deviate from optimum levels. Using this information, the process can be adjusted to reduce the system's energy consumption. This turns the monitoring experts into advisors on system operation. This service benefits not only plant operators within the company, but also external companies to which Linde sells its air separation systems.

Reliability from the desert to the tundra: The consolidation of data, and the analyses, simulations and predictions using them, are performed in Microsoft Azure, the cloud service offered by the US software company. Among other advantages, this makes it possible to work with data from anywhere in the world, which is a major advantage since the Linde air separation plants are often installed in remote regions.

But how does the data get to the cloud? Linde Engineering relies on WAGO for this crucial step. With its cloud connectivity functions, the IoT Gateway in the PFC200 handles data encryption and secure transfer to Microsoft Azure.

There was a whole series of reasons for selecting WAGO, according to the Linde experts. Among others, Paul Heinz cites the robustness required for this application. "Our systems often operate in locations where extreme climate conditions are the norm. We were impressed by the fact that WAGO's product is just as suitable for use in the desert as in the tundra," he explains. The more isolated the location is, the more important it is that data recording and transmission can be carried out and operated remotely. "With WAGO, this is no problem. Even configuration is done remotely," says Dr. Oliver Slaby. The installation is child's play and requires no special knowledge.

Cellphone infrastructure is also not always reliable at more remote locations. Systems operators here can benefit from the data buffer offered by the IoT gateway in the WAGO controllers: If the connection goes offline temporarily, data is collected from the buffer later and transmitted, so no measured values are lost.

Agile and committed: Slaby also cites WAGO's ATEX certification as a benefit. "Many of the systems that Linde Engineering provides are used for processing flammable or explosive media. This requires controllers that are certified for these highly explo-

sive areas." Last but not least, Slaby emphasizes the many good experiences that Linde Engineering has already had in other areas when using WAGO products. Linde uses WAGO solutions in other domains.

In addition to technical qualities, WAGO also impressed its customer with agility and level of involvement in the implementation. "We needed fast, flexible support during the development of our pilot systems. The experts at WAGO did a really marvelous job: They successfully completed their part within only two weeks," says Slaby.

Linde Engineering now wants to translate its flexible-load air separation system concept into a new product line. This will make the company a trendsetter in the energy transition – and an example for the entire process industry. The potential for the company's load management is substantial when applied to other technological fields. And WAGO will continue to stand beside them as a reliable partner.



»Our systems often operate in locations where extreme climate conditions are the norm. We were impressed by the fact that WAGO's product is as suitable for use in the desert as in the tundra.«

Paul Heinz
Conceptual Design Engineer,
Linde Engineering



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Dr. Oliver Slaby
Head of IT for Plant Operation,
Linde Engineering

LEAN MANAGED SWITCHES

MONITOR AND CONFIGURE NETWORKS INTUITIVELY



ETHERNET is a critical piece of communication infrastructure within industrial and building automation. However, IT specialists rarely perform the implementation, commissioning and maintenance of ETHERNET installations. In order to ensure reliable, robust installation, high availability and high security nonetheless, WAGO now offers lean managed switches. The new switches complement WAGO's line of network infrastructure solutions with numerous advantages, particularly for network diagnostics.

Simple, unmanaged switches detect the devices connected to the ports independently and distribute the data packets efficiently within a network. However, so-called managed switches are used if higher demands are placed on the network. They can be used, for example, to increase the network's uptime and security.

However, not all functions of a fully managed switch are always used in customer networks. For this application, WAGO now has the Lean Managed Switches in its product range, which offer the essential management functions and can be configured and administered easily and intuitively.

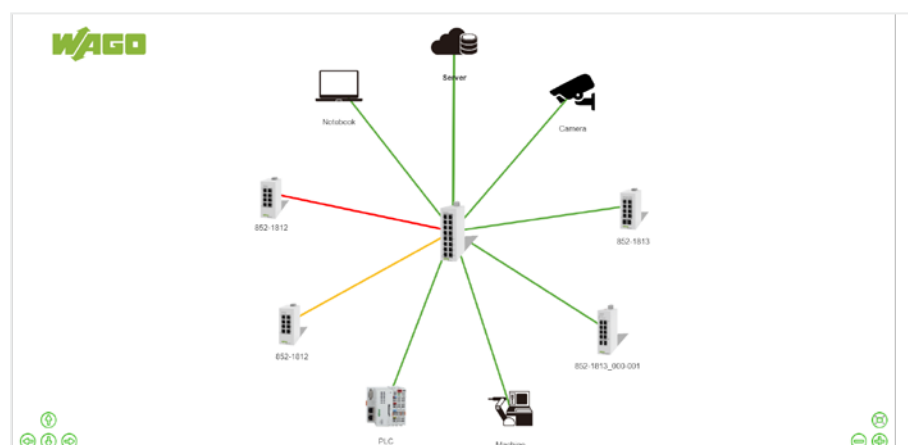
Clear usability: WAGO has placed a great emphasis on creating an intuitive and easy-to-use interface. Web-Based Management allows installation, commissioning and diagnostics to be performed

without extensive IT knowledge. Users enter the switch's IP address in a standard browser and then directly access the diagnostic dashboard or network view (topology map). The diagnostic pages of WAGO's Lean Managed Switches accelerate system troubleshooting. The individual connection status is clearly indicated by green, yellow, red traffic lights. The alternative administration via command line interface with SSH or SNMPv3 also ensures acceptance of the lean managed switches among IT specialists.

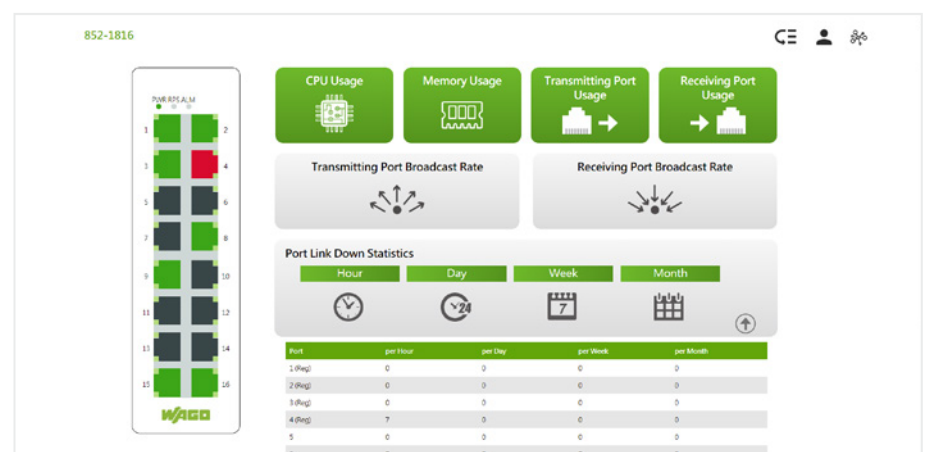
Security and availability: Optional disabling of unused ports or authentication of network subscribers according to IEEE802.1X ensures higher network security. For example, if an authenticated and learned network node is disconnected from the port, the port is immediately displayed in red in the diagnostics dashboard. If an unauthenticated subscriber is now plugged into the port, it will not be able to access the network.

Additionally, WAGO's new switches support the Rapid Spanning Tree Protocol (RSTP) for meshed and ring networks and handle Ethernet Ring Protection Switching (ERPS) for up to two rings per switch. The resulting ring topology makes the networks very reliable because a single cable break does not lead to a complete network failure.

The lean managed switches allow faults to be identified quickly. This means that – unlike conventional systems – extensive IT knowledge is no longer required for rapidly troubleshooting the network.



Errors in the network are immediately detected by the clear diagnostic pages.



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