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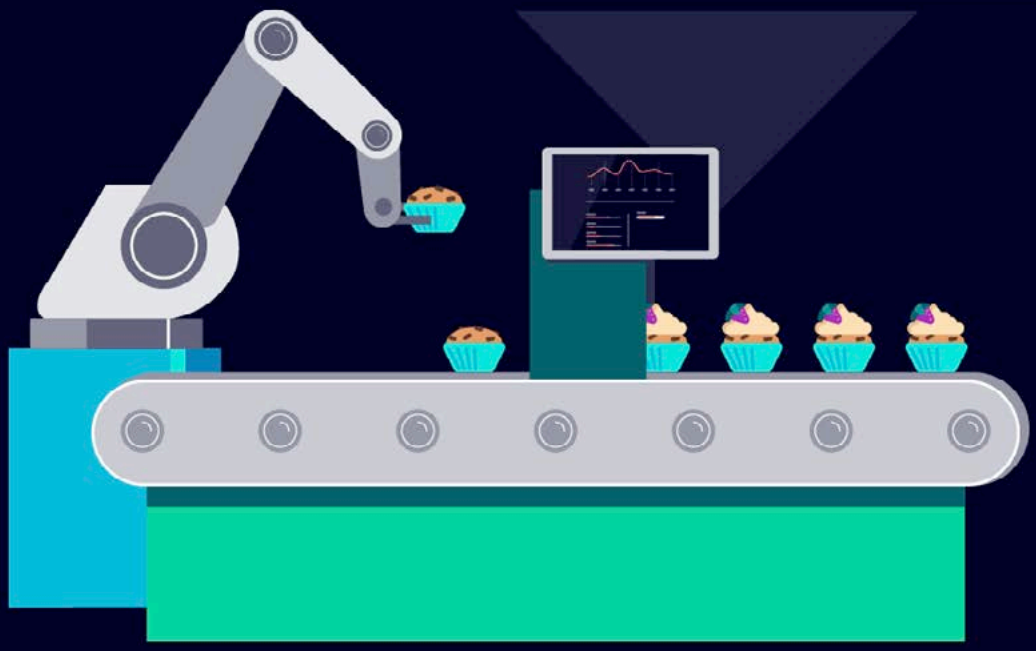


WHITEPAPER

# Industrial Edge in the Food and Beverage Industry

Computing power at the edge of the network
**siemens.com**

The rapid development of the Internet of Things (IoT) leads to a steady increase in the volume of data generated in production by beverage and food manufacturers. Cloud computing – as one of the basic technologies of industry 4.0 – has established itself in recent years to process the growing flood of data and evaluate it ad-hoc.

In most cases, it is not even necessary to forward all the data that arrives at the endpoints of the IoT to a cloud. Instead, the edge of the production network can be equipped with the appropriate computing power.

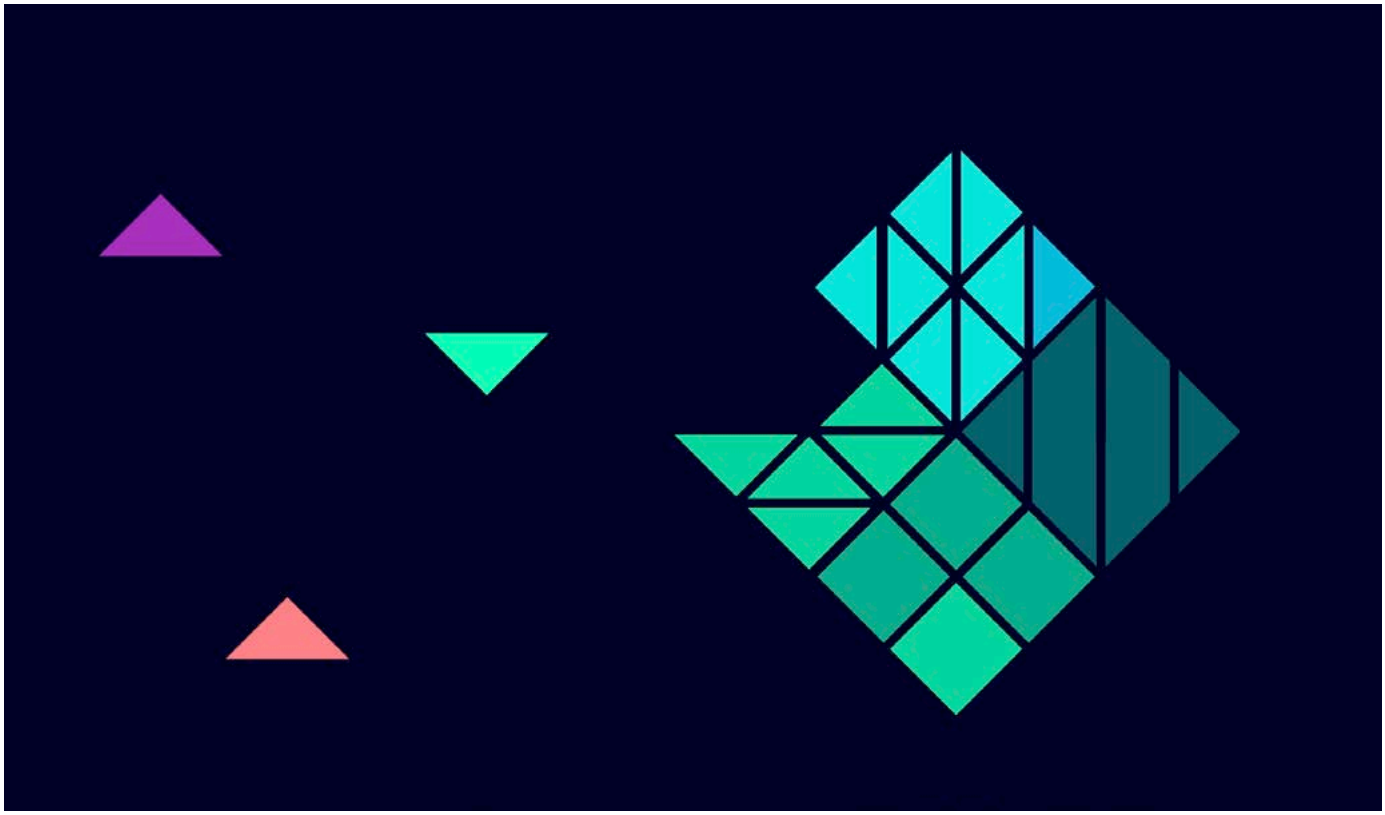
This means that even computationally intensive tasks – such as the use of artificial intelligence (AI), machine learning or block-chain technology – can be solved at high speed.

## More freedom in automation technology

In the production environment, every second is often important, so that data movements into and from the cloud cost too much time and require a high bandwidth.

Industrial automation systems of the future must be adaptable and agile, and edge computing – in combination with the cloud – is currently proving to be the most promising solution. It closes the gap between central data processing and the devices connected to it in the factory.

This next generation of digital automation offers many new freedoms and enables new use cases that were previously impossible due to limitations such as low bandwidth and long latencies. This facilitates, for example, predictive maintenance and reduces plant downtime and energy consumption.



Edge computing literally means moving parts of the cloud closer to the sensors – where the data is actually generated.

# Table of Contents

**Local and cloud-based data processing**
The Industrial Edge solution from Siemens is based on proven hardware and software as well as cloud technology mechanisms and integrates the advantages of local and cloud-based data processing.

Its architecture includes the edge management system, edge devices and edge apps. The open solution can be easily integrated into existing automation environments and can be used without special prior IT knowledge.

Edge computing adds data processing capabilities to automation platforms. Machine data can be immediately analyzed and stored on the shop floor without any further transmission paths, thus increasing the performance and productivity of the automation solutions.

Siemens Cloud Apps & Services and Siemens Industrial Edge create an ecosystem any smartphone user knows – only for industry: IT companies program applica- tions that users can buy via a global app store and then load onto their machines' edge devices.

# Edge computing:
# Great benefits for the food and beverage industry

When it comes to analyzing production data in real time and thus permanently optimizing processes in factories and plants, the food and beverage industry today has many possibilities: On servers locally or centrally in the public and private cloud, on site at the plant or in a server farm via Internet access, on their own or via service providers.

**Saying goodbye to local data processing**
Many companies in the industry are now saying goodbye to traditional local data processing, which keeps all hardware and software in the company.

This usually requires too much effort for software maintenance and the associated processes such as update handling and IT security cannot be solved efficiently and economically enough.

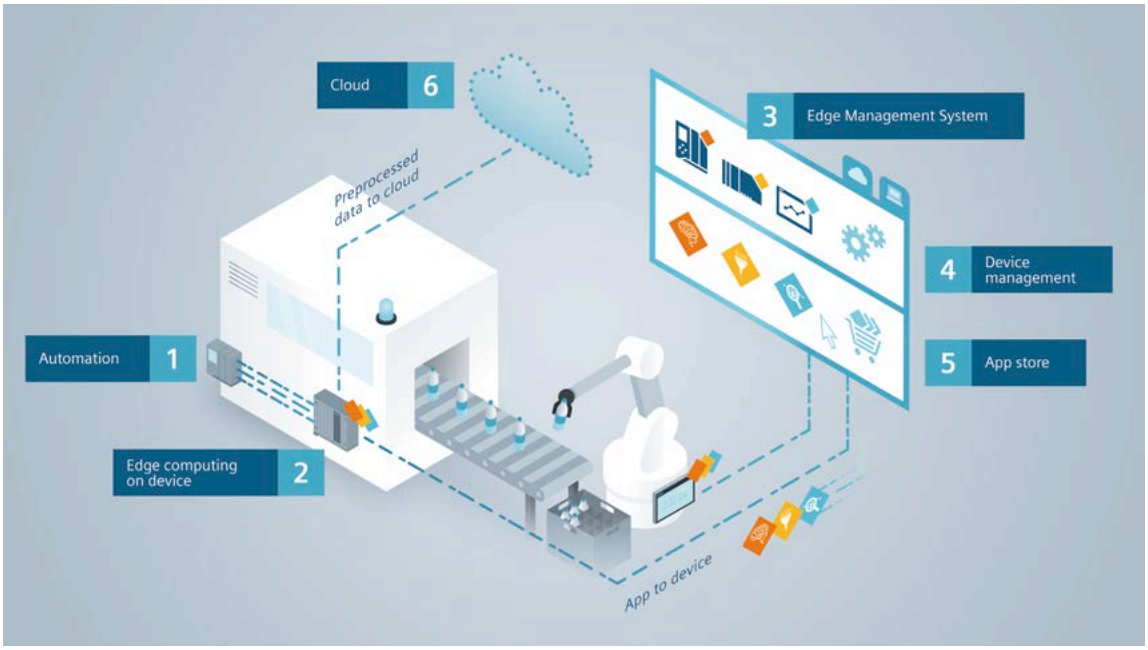
The required devices are usually installed and set up here once. Data is usually transferred via local networks or external storage media.

Device updates always involve an intervention in the IT infrastructure, which is why they are rarely carried out.

Cloud computing is the exact opposite. Here, data is transferred to a central data center, processed and the result played back.

While the server farm in the cloud is very powerful, the actual amount of possible data is often limited by the insufficient bandwidth of the connection – which usually makes it impossible to comprehensively utilize all the process data generated.

A powerful industrial computer is located directly at the machine and thus enables resource-saving processing of the data streams.



**Equipping network edges with intelligence**

Edge computing is nothing more than shifting computing power to the periphery of the network. The processing close to the machine means that even high-frequency data, which only allow a short feedback time (latency), can be processed without problems and used effectively. But this is far more than just powerful hardware on the shop floor.

With the help of highly developed analysis methods, edge computing extends existing automation methods by machine-oriented data processing – and this directly in the production.

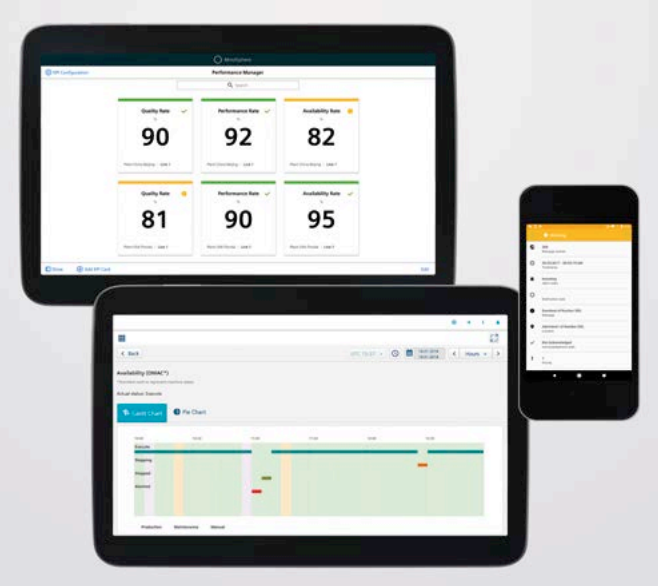
The applications are usually managed and installed via the cloud. However, local administration of edge apps and edge devices is also possible.

Edge computing has therefore the advantage over local networks that applications can be updated at any time without having to intervene in the productive process. The direct connection to the cloud also enables edge devices to upload processed data directly and continuously.

Edge computing technology represents an interface between local and global data processing. A powerful industrial computer is located directly at the machine and thus enables resource-saving processing of the data streams.

Edge computing can also be used to address some of the challenges that arise in process control with the help of cloud solutions. For example, the latency of data transmission, the processing of the enormous amounts of data generated in a plant and, in many cases, also the inadequate network connection.

This is a great advantage especially in the F&B industry with its many heterogeneous systems and machines, most of which are not yet connected to the Internet via IoT gateways.




**Extension of classic automation technology**

Edge computing is not only a way to prepare production data before it is transferred to the cloud – it also offers new ways of using data in production. This brings artificial intelligence and machine learning, for example, closer to the data source.

And last but not least, edge computing makes it easier than ever to integrate devices into an infrastructure for administration and maintenance, making system management in the intelligent factory more efficient, secure and cost-effective.

At the same time, flexibility increases, since the systems can now be kept up to date at all times via functional, feedback-free updates – and that for the system lifecycles that are common in automation.

In the future, automation components such as SIMATIC controllers, SIMATIC HMIs or SCALANCE network components will not only be supported by edge devices.

They are also equipped with integrated edge computing capabilities to profitably process larger amounts of data from the systems and to gain insights for a continuous increase in productivity.


This is accompanied by new applications such as condition monitoring or predictive maintenance, which are finding their way into classic automation technology.

Using mobile terminals, employees can be alerted in the event of sudden malfunctions or a foreseeable need for maintenance and these can intervene immediately without major breakdowns of machines or complete systems.

Decentralized data processing and analysis on production-related edge devices or integration into the automation system via so-called edge apps has a number of further advantages, especially for the F&B industry.

For example, secure data storage on site and more security when processing business-critical data. This is because data protection regulations and company guidelines often prohibit transmission to cloud servers outside the country or to the company's own IT infrastructure.

**Faster detection of complex anomalies**

With computing capacities directly in their production facilities, F&B companies also have better chances of detecting complex anomalies.

In this way a beverage manufacturer can use edge computing to more quickly analyze a variety of factors that affect the filling of a bottle.

For example, the temperature of the product, the filling speed and the size of the container as well as other external factors such as air temperature and humidity or time of day.

By quickly correcting the identified causes of irregularities, production processes can then be optimized.

Thanks to the increased performance directly in the system, anomalies are also detected that would go unnoticed in the cloud if only data analyses were carried out.

The food and beverage manufacturer thus gains new insights into its processes directly on site. This is invaluable. Every second in which such an irregularity in the production line remains undiscovered, it can lead to rapidly rising costs.

**Predicting imminent system failure at an early stage**

In practice, it could look like this: A juice manufacturer equips its conveyor belt with an edge device that stores and analyses all information such as running direction, speed and power consumption.

If the intelligent edge app installed on the device registers an increasing power consumption at the same conveyor belt speed, it sends a maintenance recommendation to an employee's smartphone or Smartwatch and the employee can act immediately.

By combining cloud-based and local, process-oriented data analysis with edge computing, an imminent failure can now be predicted with a high probability up to 36 hours before the actual event.

Many devices installed in the field today provide a myriad of additional diagnostic data, most of which is no longer in use. However, if used correctly, they could also further increase system availability.

In a rapidly changing market, beverage and food manufacturers need all the benefits they can achieve with new technologies.

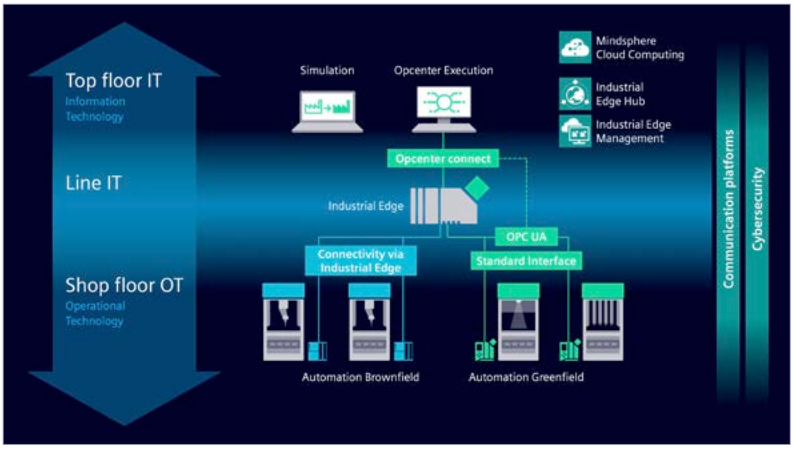
Faster time-to-market with new products and faster plant conversion during the production process are key challenges for the F&B industry today.

**Hybrid solutions are usually the right approach**

Edge computing is not an end in itself, but a means to achieve specific goals based on the specific needs of the enterprise. It must be clear that cloud and edge computing are not mutually exclusive, but rather conditional.

When deciding on one of the two approaches or – as will usually be the case – on a hybrid solution, it will therefore depend on the framework conditions and the business objectives of the deployment.

In the food and beverage industry in particular, where production facilities are often outdated and investment funds are low, a step-by-step approach to implementing edge computing is an obvious choice.




# **5 Steps** for a successful edge implementation in your company

In the whitepaper "Moving to the Edge", produced jointly with Siemens, Frost & Sullivan state: "Smart factories leverage edge computing to improve productivity, efficiency, and time-to-market. Business leaders should adopt edge computing to reap business value. Manufacturers able to embrace a combination of edge and cloud computing technologies will be best positioned to meet the changing dynamics of the industrial environment."

With their "5 Steps to a Successful Edge Implementation", the consultants recommend concrete guidelines for the step-by-step introduction of the technology in the company:

**1. Connect systems and sensors**
Start by connecting your assets to SCADA/MES. Attach sensors wherever required. This would be the first step to start collecting and assessing data.

**2. Invest in edge infrastructure**
Install edge computing solutions in-house or subscribe to a well-established cloud provider's edge computing service.

**3. Secure device interfaces**
Configure security options for all connected devices. Secure existing access control and enable additional access control options to improve security. Frequently check for software updates and install as they arrive.

**4. Train resources**
Train and deploy IT and operational resources in the business so that they know how to work with edge computing and IoT devices.

**5. Make frequent iterations**
Business processes that make use of edge computing need to be revisited frequently. Devise a way to find sufficient bandwidth to deliver insights from the data sources to the necessary decision-making points within the organization. As processing capabilities of edge increase, organizations will be empowered to make further use of the technology.

Click here to download the Frost & Sullivan white paper "Moving to the Periphery".

> "Industrial automation systems of the future will need to be adaptable and agile in nature, and edge computing is emerging as the most promising solution.
>
> Frost & Sullivan

# Siemens Industrial Edge:
## More than just hardware boxes for factory use

The Industrial Edge concept from Siemens, with its combination of hardware and software, integrates the data generated in production with globally quality-assured digitization functions – on locally installed edge computers that are tailored to the respective digitization task.

This creates a relatively open environment where machine and plant manufacturers as well as technology providers can develop useful edge applications as part of the Industrial Edge ecosystem and publish these apps as certified partners through the Edge App Store.

Each user can also develop and implement their own edge apps to meet their specific needs. For this purpose, Industrial Edge has its own development platform for the simple and error-free programming of applications.

Runtime software ensures connectivity to the connected automation devices and to the higher-level edge management.

An IoT interface enables both the further processing of process data in higher-level IT systems and the administration and updating of the applications themselves.

**Coordinated concept**

The complete solution Siemens Industrial Edge with cloud based or locally hosted edge management includes a backend, various edge devices and a variety of edge apps.

All three components are coordinated with each other, can be adapted to individual conditions with little effort and can be scaled in performance.

The edge management system is the central infrastructure that centrally manages all connected edge devices, monitors their states, and updates the apps.

This ensures that the latest version of the apps is always distributed efficiently and securely to all devices.

The installation of the apps on the edge devices is possible without any retroactive effects, regardless of the operating status of the respective machine.

The edge runtime integrates a holistic security concept that allows stable operation of one or more applications side by side and also guarantees a secure software environment for their execution on the edge devices.

Part of Siemens Industrial Edge computing is also a security solution for protecting data in the cloud as well as devices and data in the system.

The interface to the automation technology of the machines is on robust Simatic industrial PCs based edge devices.

These are completely decoupled from the actual process and form the hardware and software infrastructure for recording and processing large amounts of data in real time.

They are also equipped with edge runtime software that provides connectivity for both data acquisition from the connected automation and edge management, as well as access to device functions via a driver toolbox.

The edge runtime software also provides a secure app environment for performing functions in the edge devices.

**The range of Industrial Edge Apps continues to grow**

The Industrial Edge Apps offer exactly the right degree of flexibility and application possibilities for the edge devices. These are software modules programmed in high-level languages for a wide variety of tasks.

This allows data generated in the process to be directly processed, edited and analyzed locally. Or it can be transferred in aggregated form to superimposed IT systems or local or external cloud systems such as the open, cloud based IoT operating system Siemens Cloud Apps & Services.

A typical application is the monitoring of drive parameters in order to detect sporadic malfunctions or slowly increasing wear and to make maintenance work more predictable. This contributes to higher availability and productivity.

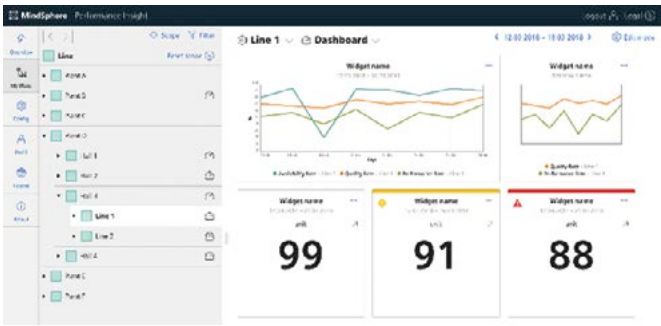
The access of these applications to the runtime software of the edge devices enables further innovative applications in the field of diagnostics and analytics in the automation and production environment.

With this solution, large amounts of data, for example from high-frequency vibration sensors, do not have to be sent completely to the cloud, but can be analyzed on site and then only the results transferred for further evaluation.

The current portfolio of applications includes the "Flow Creator" App, with which workflows for data acquisition and evaluation can be easily implemented.

A further application supports the user in obtaining an overview of the automation components of a plant: This Inventory App records installed components with their respective versions and makes them available centrally, e.g. as an inventory list for ERP systems.

The advantage of this solution is that it already contains all the necessary functions for Industrial Edge and can therefore be implemented without any in-house development work.




**Different methods for cloud connectivity**

Basically, there are two different methods of cloud connection: Via external hardware – as a so-called black box for machine and system controls – or as an integrated solution, for example as function blocks in the PLC or as an app in an edge box.

In the external version, information from the system is collected by a separate edge device and then sent to the cloud via secure communication. The MindConnect Nano or MindConnect IoT solution, for example, can take on this task.


These products are designed for scenarios in which the machine or system control should remain untouched and safety updates must not influence the automation side.

An integrated solution using MindConnect's function blocks uses existing Simatic S7-1500 hardware, such as the plant control system, and extends its functionalities to include the option of securely sending data to the cloud.

The PLC thus helps to avoid unnecessarily increasing the network load. A communication processor with IT security functions supplements the system if required.

Even if the data to be generated and the Siemens Cloud Apps & Services are already set as a platform, in many cases a mechanism for secure data transfer is required.

Under the name MindConnect, Siemens offers a broad portfolio of solutions for this. Industrial Edge can be used in both new and existing plants. All that is required is the integration of one or more edge-enabled devices.

For example, old systems can be integrated into an edge solution using the Simatic IPC227E embedded industrial PC.

The compact IPC can be easily connected to the automation on the machine via integrated interfaces in order to record and process production data directly.

Open interfaces such as OPC UA and cloud protocols such as MQTT (Message Queuing Telemetry Transport) ensure that Industrial Edge can be integrated into different IT environments. It is also conceivable that the edge application's intelligence could be completely detached from the network.

The Simatic TM NPU module for the S7-1500 and ET 200MP controllers shows what such a solution could look like. This module has an AI-enabled chip on board for the efficient execution of neural networks that can be trained for their task in the cloud.

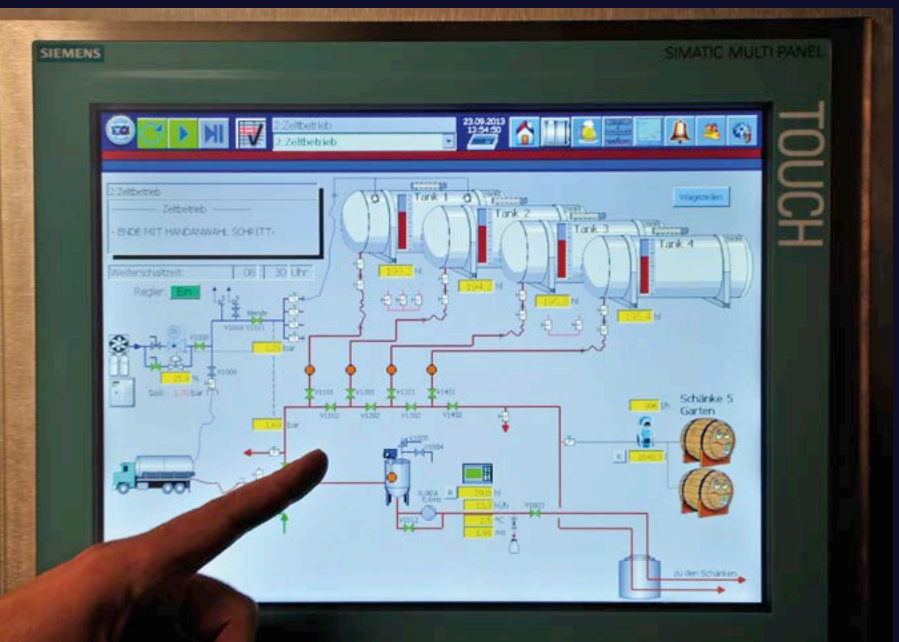
The solution can be easily integrated into the automation system and can be scaled as required. Since Artificial Intelligence can move so close to the automation level, it will redefine to a certain extent the edge of edge computing in the future.

# **Perfect overview of beer sales:** On the Wiesn and in the Olympic Stadiumy

Around six million liters of beer are served every year at the Munich Oktoberfest. Since 2010, Simatic S7-300 PLCs and software from Siemens have been transporting the barley juice in the Paulaner festival tent of Winzerer Fähndl safely, quickly and, above all, well cooled to the taps via an underground ring line at a depth of two meters. One year later, Bräurosl also took over the system, followed by the Hacker festival tent in 2012.

Previously there were two to three tanks at five different locations, but today four containers with 28,000 liters of beer each are stored at a central location. This not only saves space, but also facilitates delivery and distribution in the tents. In addition, sales and processing can now be monitored at any time – via web browser, tablet, PC or smartphone. At the taverns, a so-called "Maß-O-Meter" – similar to a speedometer – indicates the current speed of the beer, which runs at up to 25 centimeters per second through the pipeline to the eleven taps.

With real-time demand forecasts, deliveries can be better planned, and tanks more optimally filled. Increased transparency increases sales by reducing dispensing losses.




## Data analysis in Siemens Cloud Apps & Services increases beer sales

Almost 10 years after the premiere of this world-wide unique solution, such a beer line is now also available in Munich's Olympic Stadium. The logistic expenditure was enormous so far, in order to bring the beverage halfway cool to the fans in the standing range inside the stadium – especially on hot summer days.

In the past, more than 600 barrels had to be cooled and kept ready at a large event, but now one push of a button is enough to allow up to 5,000 liters of beer cooled to 2 degrees per hour to flow from the cooled pipes into the cups. If barley juice is left over at the end of a concert, it can be pumped back into the tanks, where the temperature is maintained for several days. The closed circuit guarantees optimum quality and significantly fewer dispensing losses.

Here, too, Siemens automation technology is used to control the system. In addition, numerous sensors continuously measure temperature, flow rate, CO2 content, consumed quantity at a total of 36 dispensing points, and the timing of demand. Together with other information such as weather data or the music tracks played, the collected data is transmitted to Siemens Siemens Cloud Apps & Services where it is analyzed. The two MindApps "Performance Insight" and "Notifier" can be used to derive and display options for optimizing logistics and serving.

Click here to download the complete case study.

# Artificial Intelligence:
# An important factor for edge computing

According to the "IT Trends" study by IDC's market researchers, by 2022 around 40 percent of cloud services used will include edge computing and 25 percent of these endpoints and systems will run AI algorithms. This will create a new, highly distributed IT architecture where network connectivity will be critical.

According to a forecast by market research company ABI Research, edge-AI computing will also experience a considerable upswing in the coming years.

In their Artificial Intelligence and Machine Learning study, the experts expect "business-critical applications, a lack of reliable and cost-effective connectivity options, as well as the desire to avoid expensive cloud deployments, to drive the shift from AI processing to cheaper edge hardware."

**AI Training continues in the cloud**

By 2023, sales of such AI-enabled edge devices are expected to grow to 1.2 billion, up from 79 million in 2017, increasing their market share from currently around 6 percent to an estimated 43 percent.

Nevertheless, according to the analysts, cloud service providers will continue to play a central role in the "AI matter", especially when it comes to AI training. The more complex the task, the larger the required learning data set.

However, the typical systems in which the AI algorithms are subsequently used have such scarce computing and storage capacities that they are only suitable for data collection.

The algorithms, on the other hand, are trained in a central AI service in the cloud or in a data center.

The IT market research company Gartner therefore even considers edge computing technology to be "absolutely necessary in order to be able to master many of the challenges of industry 4.0".

In a study, it explains: "The need for real-time insight and immediate action, the current network limitations, the high amount of data and the speed at which this data is generated by sensors and endpoints, require the use of edge computing solutions and the processing of the data closer to its source."

**Decisions within milliseconds**

Edge-AI allows real-time operations that lead to rapid decisions and actions. This type of detached data processing is therefore particularly important in areas where milliseconds are important, such as autonomous vehicles or medical technology.

But even in the production facilities of the food and beverage industry, self-sufficient algorithms that can make decisions very quickly and without delay on an edge device can become vital.

For example, when it comes to accident protection for employees or when serious malfunctions can be rectified immediately. Production parameters can also be adjusted more quickly, and sources of error minimized.

# New opportunities with the new Industrial 5G mobile radio standard

The new 5G mobile radio standard not only promises comple tely new possibilities for smartphone use. It also plays a decisive role in the development towards industry 4.0 and, in conjunction with edge computing, opens up completely new opportunities.

With high data rates, a reliable, high-performance broadband transmission and ultra-short latency times, Industrial 5G makes comprehensive wireless networking of production, maintenance and logistics possible, thus significantly increasing efficiency and flexibility in industrial value creation.

### Focus on communication between machines

In contrast to today's mobile radio technology, the new stand ard focuses very strongly on communication between machines. The 5G application area "Massive Machine-Type Communication" (mMTC) allows a large area network coverage as well as the connection of hundreds of thousands of IoT devices per square kilometer. And this with a reac-tion speed in the lower millisecond range, for example when cameras on a packaging line detect a foreign object and a robot arm has to come to a standstill immediately.


Another novelty: For the first time, 5G offers companies the opportunity to set up their own self-sufficient mobile phone network and manage it themselves. In the current stu dy of the Capgemini Research Institute "5G in industrial operations: How Telcos and Industrial companies stand to benefit" shows that industrial companies' expectations of 5G technology are more than high.

In Germany, for example, 28 percent of the industrial companies surveyed want to apply for their own licenses for the industrial use of 5G frequencies. Three quarters of the interv iewed executives even believe that "Industrial 5G will be the key factor for the digital transformation in the next five years".

According to the survey, the planned fields of application inc lude real-time analyses with edge computing, video surveillance, remote control of distributed production, AI-enabled or remote-controlled movements or remote operations via Augmented Reality/Virtual Reality.

"5G enables flexible management of edge and cloud resourc es with very low latency times," says the report, highlighting a significant advantage. This is a decisive added valu e of this technology in the production environment. However, the Capgemini study also points to a catch: "However, it will take some time until all the functions of 5G are available."

Click here for the study on 5G in the industry.

# Terms and Abbreviationsy

**Artificial Intelligence**

Artificial intelligence (AI) in the strict sense is an application in which machines perform tasks that normally require human intelligence such as learning, judgment and problem solving. For this purpose, tools and technical solutions are developed with which humans can work better as they enhance their abilities.

**Automation systems**

Industrial automation systems use computerized control systems and robots i.e., automation machinery to replace human decision making and involvement in manufacturing processes. For example, automated machining tools and mobile components perform processing and finishing operations on materials, and automated conveyor systems move the parts and components through the various manufacturing stages.

**Cloud computing**

Cloud computing is the provision of IT resources over the Internet, such as storage space, computing capacity, databases or network components. In addition to the scalability of virtual IT resources, the main advantage of cloud computing is cost savings.
This is because IT resources are only used as much as they are needed in a cloud system. As a result, there are no fixed costs for hardware and software licenses.

**Fog computing**

Cloud computing is the provision of IT resources over the Internet, such as storage space, computing capacity, databases or network components. In addition to the scalability of virtual IT resources, the main advantage of cloud computing is cost savings.
This is because IT resources are only used as much as they are needed in a cloud system. As a result, there are no fixed costs for hardware and software licenses.

**Edge computing**

Edge computing is a distributed, open IT architecture that features decentralized processing power and lays the foundation for mobile computing and IoT technologies. In edge computing, data is processed by the device itself or by a local computer or server and not transferred to a data center.

**Internet of things**

The Internet of Things (IoT) makes it possible to intelligently link physical things and applications via the Internet. With the help of their sensors, the connected devices collect data that they can exchange and make available to each other and via the Internet.
With Siemens Cloud Apps & Services, Siemens provides companies and software developers with a complete operating system for the Internet of things. The cloud based, open platform connects products, plants, systems and machines and thus makes it possible to transform masses of IoT data with comprehensive analyses into insights and thus into added value.

**Latency**

Latency time, also called reaction time or time delay, is the time between the triggering impulse for any action and until it actually begins, i.e. until the system reacts. During this time the total action is invisible, almost hidden, latent.

**Published by**
**Siemens AG**

Digital Industries
Factory Automation
Vertical Sales Food & Beverage
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Article No. DIFA-B10284-00-7600


**For the U.S. published by**
**Siemens Industry Inc.**

100 Technology Drive
Alpharetta, GA 30005
United States