*Functionalities of the Edge PCs from Phoenix Contact.*

## Applications focus

"The specific applications for edge and cloud consulting in the industrial context are classic connectivity and data infrastructure applications. In edge computing, these include above all the brownfield connection of machines in order to leverage the added value of the data without exchanging the PLC or accessing the logic of the machine," Korte added. "This is mainly about connectivity with data buffers and data pre-processing. Of course, new machines are also equipped with the possibilities of the Edge, here the applications can be executed both on a separate Edge Device and directly on the PLC, as in our case with PLCnext Technology."

He said that the typical use cases of the cloud here are data visualization using dashboards and optimization of the machine. For optimization, both statistical methods and artificial intelligence can be used, e.g. for predictive maintenance or, as with Proficloud.io, predictive energy. In general, smart services play a major role here.

One of the greatest challenges for automation engineers is the convergence of information technology and operation technology. Here, the networks are growing together and it should be possible to access and, if necessary, even influence the machine data by means of IT-typical standards. This poses a great challenge to classic automation technology, since a simple connection to IT systems is not readily possible here. However, this is crucial because the availability of data as well as cybersecurity are a basic requirement for the successful use of edge and cloud computing.

"The open architecture of PLCnext Technology makes it possible for automation engineers to either install edge applications on the Linux system or as OCI containers on their own, or simply use existing apps by leveraging the PLCnext Store. This is crucial as not everyone has in-depth Linux know-how. Thus, data availability is no longer a major challenge here," Korte added.

## Software-driven innovations

*Standard IT solutions combined with sophisticated software algorithms.*

Dr. Christopher Anhalt, Vice President Product Marketing, Softing Industrial Automation GmbH said that "nowadays, innovation in industrial production is software driven. For deeper process integration, more efficient and more flexible production processes, and "smarter" products – software is usually key."

He said that it may help to distinguish two separate aspects of this situation. First, there are established software technologies, IT standards, proven products and services, which can help to build economies of scale. Cloud technologies fit that description. In some vertical markets, the adoption of cloud started much earlier than in industrial production. Currently, we observe how the industrial market segment is taking more and more advantage of standard IT and cloud, too.

Second, there is software-driven innovation which enables progress and new solutions, specifically for the industrial segment. Sophisticated algorithms for artificial intelligence and machine learning are examples that drive the development of new solutions for industrial production.

"It is the combination of both aspects, the potential of standard IT to build scalable and efficient solutions, plus the potential of sophisticated software algorithms to solve specific challenges in industrial production processes, which drives the increasing adoption of edge- and cloud technologies in the industry," Anhalt said.
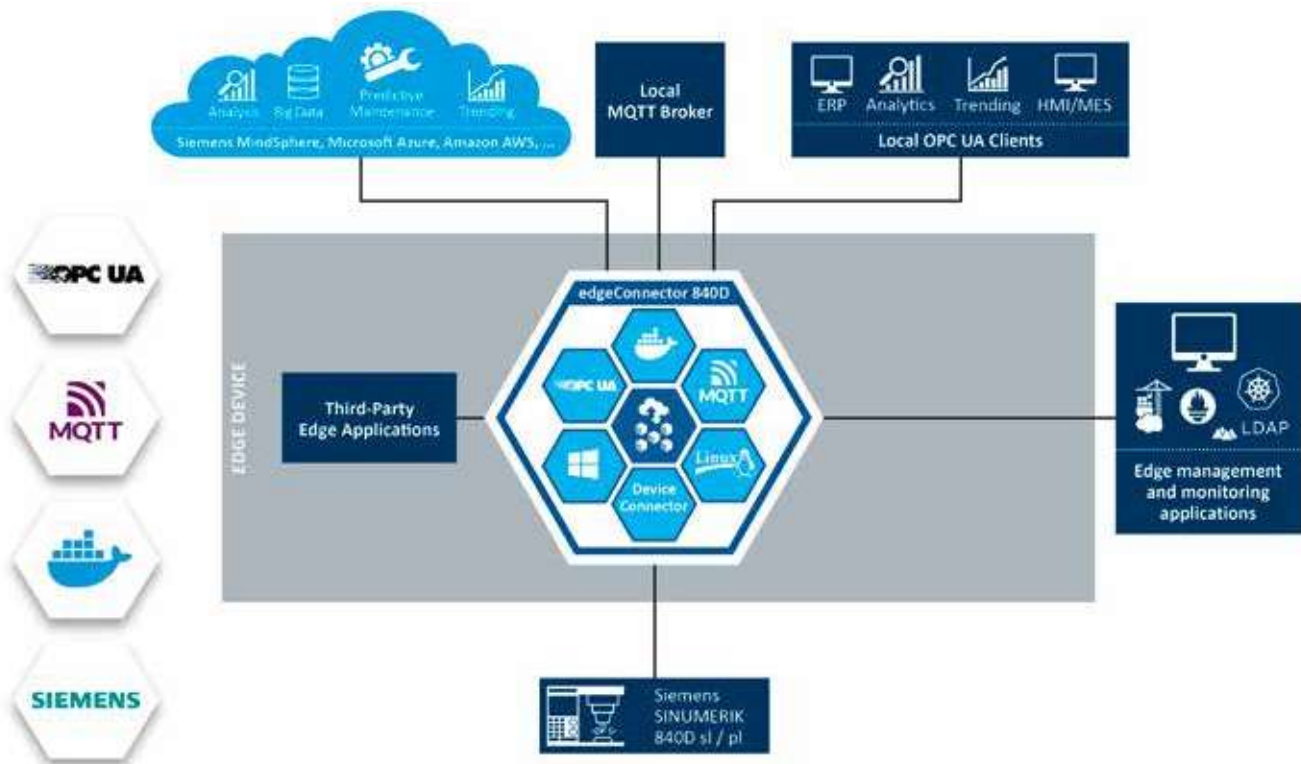
*The containerized software modules from Softing Industrial edgeConnector Siemens, edge Connector Modbus, and edgeConnector 840D can be used to implement machine connectivity for many applications.*

### Industrial edge and cloud computing

Anhalt said that, as outlined above, edge- and cloud computing goes hand in hand with economies of scale and the benefits that standard IT technology can bring to any industry. In particular, edge and cloud computing help to cut costs for IT infrastructure and for operation, independent of the specific software application and its benefits.

In this context, it is also worth noting – again not a technical benefit, strictly speaking, but still – that many edge and cloud computing solutions require limited investment. Software can be consumed as a service, with pay-per-use or consumption-based pricing models. This means there should be room for trial and error, as cost can be easily scaled up and down.

"Regarding technical benefits, it is the combination of edge and cloud computing which lets user take full advantage of software and innovative applications. For example, complex, AI based models for machine learning may require the computing power and resources of a central cloud platform. The result on the other hand can be deployed on edge, taking full advantage of reduced latency times," Anhalt said.

### Unique technology

When asked to provide a technical description of what makes this technology unique, and how it is being applied to industrial applications, Anhalt cited two examples. First, software

virtualization, which is a generic standard IT technology. Second, the enrichment of machine interfaces with semantic information, is a challenge that is more specific to industrial production environments.

"Software virtualization, the availability of software modules as so-called containers, means that software can be deployed largely independently from the hardware layer. The same software module can run on a simple IPC, on a rack server, or even on a central cloud platform," Anhalt said. "Users can choose between standard software products to manage container-based software solutions. As a specialist in machine connectivity, Softing Industrial offers containerized software modules that can be used to implement machine connectivity for many applications. The software can be managed efficiently at the edge level through IT-driven operational concepts."

Now, as for semantic information, machine data as it is made available by usual machine- and device interfaces in brownfield projects, is unstructured. With new software solutions for edge and cloud, it is now possible to enrich such unstructured data with semantic information and to provide central governance for such mechanisms.

"Working with an interface that contains semantic information makes it easier for software developers to create their applications. The benefits are multiplied because such a semantic interface can be defined in a unified, abstract way. In this way,

multiple machines from different vendors or even multiple production sites look the same for software applications running on a central platform. The OPC UA standard and information models as defined by this standard play a major role in this context. R&D organizations are currently looking at how to apply AI to simplify the creation of information models and to map unstructured data into such models," Anhalt said.

### Industrial edge and cloud solutions

Speaking about edge and cloud applications requiring access to machine data, we have seen many PoCs and trials for quite a few years. But broader rollouts in production have remained slow or have not happened yet at all. So, on the application level in real-world projects, we still see the usual suspects that continue to dominate the discussion, rather than highly sophisticated applications taking full advantage of the latest developments in AI and machine learning.

As might be expected, energy management and related aspects of sustainability are relevant today. Predictive maintenance, tooling, and job scheduling are interesting for every company operating CNC machines. Basic dashboarding and OEE applications, to compare efficiency and performance between multiple production sites, for example, continue to offer benefits for many users.

As outlined above, edge and cloud computing addresses generic questions of IT infrastructure as well as the deployment of
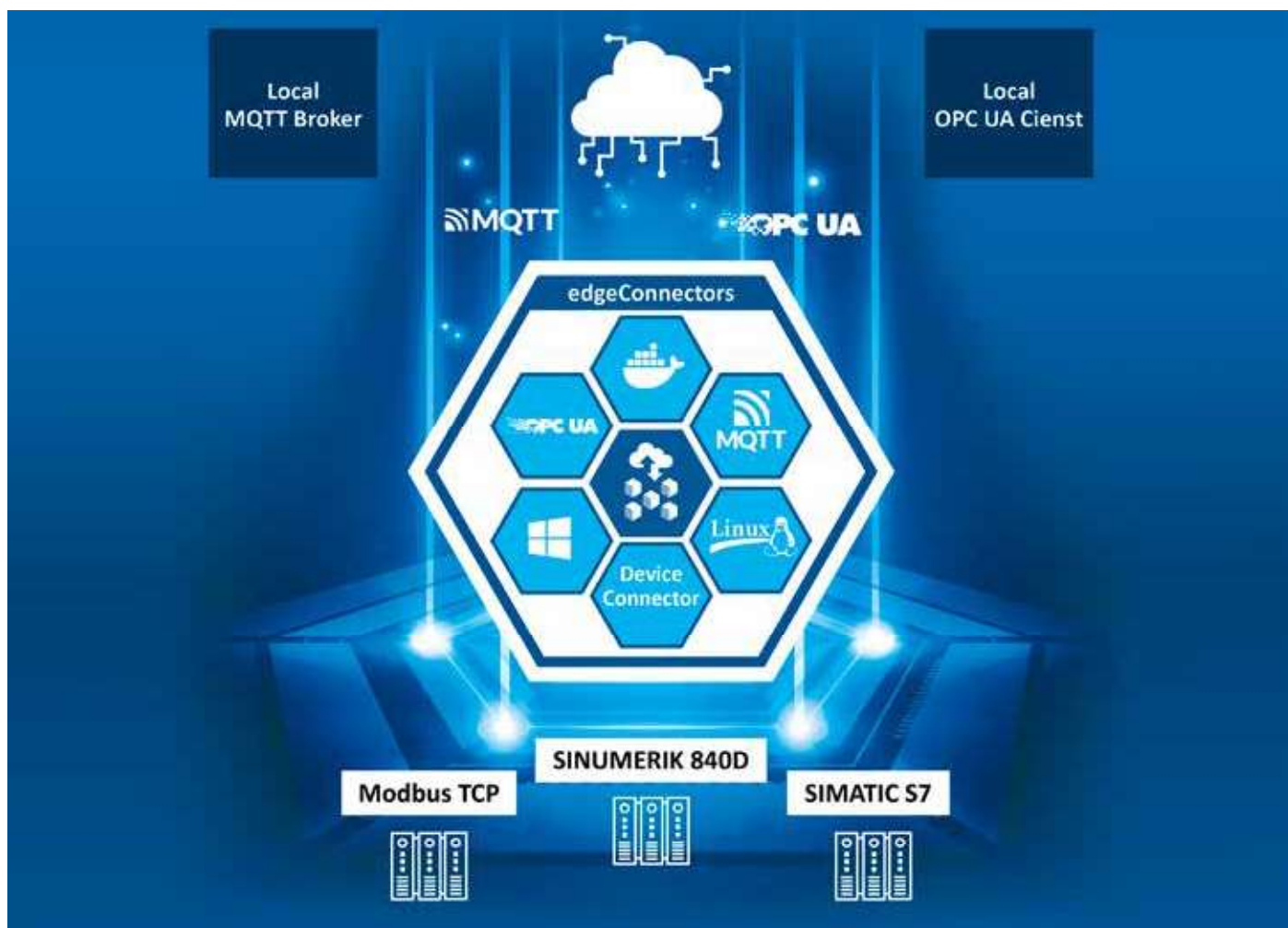
*The Docker-based edgeConnector 840D connects SINUMERIK 840D controllers to industrial IoT applications.*

the most innovative software algorithms in a broad range of industrial applications. One could argue that there is hardly a challenge that automation engineers face which cannot be addressed by edge and cloud.

## System interoperability
*Importance of openness and no proprietary technologies, interfaces or protocols.*

Marc Fischer, Global Marketing Manager Industrial Edge at Siemens said that, as more devices generate more data, the need for real-time processing, analysis, and actions directly next to the production or machine control becomes even more critical, making edge computing an attractive solution.

"Artificial intelligence and Machine Learning have been integral in providing the processing capabilities required to analyze the large volumes of data generated by IoT devices. These technologies provide benefits at production level / shop floor or even in the cloud. Low coding and ready-to-use frameworks and tools now also enable experts from the "traditional" automation world to use these technologies and thus generate a value

add," Fischer said.

"Edge computing and cloud computing are the infrastructure to deploy and manage such applications. Moreover, virtualization is increasingly reaching the shop floor because software can be hosted much more flexibly, the administrative effort is reduced because much is centralized, and the computing power of virtualized and containerized infrastructures can be dynamically allocated and always assigned to those processes that currently need it."

He added that cybersecurity is becoming increasingly important and computing power is becoming cheaper and can also be used on the shop floor for very compute-intensive processes. This also enables industries with very high IT security standards and sensitive data or critical processes to enable edge computing applications without a cloud connection and to keep all data and processes on-premises.

## Potential impact on manufacturing
Fischer said that Industrial Edge brings IT computing power to the shop floor, providing flexibility to keep sensitive data locally or send pre-processed data to a centralized data center

or cloud server. This allows manufacturers to have full control over their data.

"It's particularly beneficial when low latency, high bandwidth, and data security are required. It can also facilitate the convergence of Operational Technology (OT) and Information Technology (IT) by enabling data transparency from the shop floor to the IT level. For instance, Siemens Industrial Edge is used to collect and combine data from different sources, closing the gap between the shop floor and the cloud, and enabling end-to-end vertical data integration," he said.

Further advantages of Edge Computing with Siemens Industrial Edge: IT (analytics, AI/ML, etc.) is brought to the shop floor in a convenient and standardized way and running directly alongside automation, hence merging the two worlds of PLC programming and high-level language programming or low-coding for IT/OT convergence.

"You can also manage edge applications and associated software and hardware from a central location across machines, lines or even production sites, even worldwide. When productively rolling out these systems (we are talking about hundreds or thousands of edge