SIEMENS

Industrial Edge

Real-time intelligence in process plants

Planning your supply chain efficiently, optimizing the utilization of your plant capacity or enhancing your energy and resource balance: To accomplish all these tasks, companies today require their plants and processes to deliver up-to-date, reliable information. However, especially when it comes to flexible data evaluation solutions, centralized process control or IT systems are reaching their limits: In many cases, low bandwidths, long latency times and a high integration effort are major factors which can impede the efficient use of data. This White Paper demonstrates how Edge Computing can help to overcome these obstacles on the path towards a broader usage of process data in the process industry. Industry-compliant approaches, such as Industrial Edge, represent a technically and economically viable solution for collecting and evaluating the data generated by process plants. Users can thus obtain all the information they need to optimize their workflows and processes.

Edge Computing: From the centralized system to the edge of the network

Making the intelligence of the cloud usable directly on premises

Edge Computing actually does mean "computing on the edge". The term refers to the relocation of data processing and data evaluation activities from the centralized IT system to the process at the edge of the network. This technology thus provides an interface between local and global data usage. A powerful industrial computer installed directly on the machine enables the efficient use of data streams while at the same time conserving valuable resources.

Thanks to data processing on the machine, even high-frequency data, which only allows short latency times, can be used effectively without any problem. But many more factors come into play than just powerful hardware on the shopfloor. By employing advanced analytics, Edge Computing enhances existing automation procedures by data processing on the machine – directly inside the plant.

Therefore, Edge Computing has a major advantage in comparison to local networks: Applications can be updated at any time without having to intervene in the production process. And thanks to the direct connection to the cloud, Edge devices can upload processed data directly and continuously.

Furthermore, Edge Computing makes it possible to address certain challenges resulting from the use of cloud solutions for process control:

- the latency of data transmission
- the processing of huge volumes of data generated by the plant
- insufficient network connection
- concerns with regard to know-how and data protection

Software updates enable software updating cycles which would otherwise only be possible in cloud infrastructure. For digitalization to be successful, it is essential that software changes, optimizations or corrections are transferred to the plant as quickly as possible – and Edge Computing also provides the technical prerequisites for this.

Extension of conventional automation technology

But Edge Computing has much more to offer than just preparing production data before transmitting it into the cloud – it also brings cutting-edge methods such as Artificial Intelligence and Machine Learning closer to the data source. Last, but not least, Edge Computing makes it much easier to merge devices in an administration and maintenance infrastructure, making system management in the intelligent factory more efficient, secure and cost-effective. At the same time, companies enjoy more flexibility because functional, feedback-free updates help them to keep their plants up to date at all times – despite long plant life cycles as is usual in the field of automation.

Edge Computing services reduce the data volume to be transmitted, and thus also both the data exchange and the transmission path. All of these are compelling reasons why Edge Computing is a technically and economically viable solution to gain new insights and optimize workflows – also and especially for process plants.

Industrial Edge: Edge Computing for industry

The data integration challenge

Even in today's world, many companies in the process industry are still making insufficient use of process data for decision making – despite the fact that automation and process control systems are available. There are several good reasons for this: The degrees of automation, and thus the data collection and transmission options, vary greatly depending on the plant type, industry and region. Furthermore, the installation of additional data collection interfaces or functions in existing plants requires considerable effort. In many cases, ongoing plant operations must be interrupted, and the cost of production downtimes adds to the investment costs. And last but not least, this form of data usage requires sufficient bandwidth for data transmission to the IT level. Especially in view of the fact that the volumes of data generated by a process plant can be really huge, this results in long latencies which, in many cases, make it impossible to benefit from process information as a basis for timely decisions – let alone real-time decisions.

Here Edge Computing represents an attractive alternative to conventional solutions: It is comparably easy to integrate into existing plants. The intelligence and computing power are hosted on a separate Edge device – a computer which reads out the sensor data, prepares it and makes it available on the local level, or transfers the selected and compressed information to the IT system or a cloud provided with appropriate security mechanisms. This Edge device is able to operate autonomously to a large extent and even without continuous connection to the corporate IT, which reduces the communication load and thus also the requirements for bandwidth and network availability.

The process environment challenge

With Edge devices being used close to, or in certain cases even in the process, they must be suitable for use in industrial environments. In addition, open and secured interfaces to the process and IT levels must be available for the Edge solution to be able to operate with the existing IT and OT landscape.

Thanks to its unique combination of hardware and software, the Industrial Edge concept from Siemens combines the data generated during production with globally quality-assured digitalization functions – on local Edge computers tailored to the individual digitalization task. This creates an open environment which both machine/plant manufacturers and technology providers can use to develop useful Edge applications as part of the Industrial Edge ecosystem and publish these apps as certified partners via the Edge App Marketplace. And of course, every user is free to develop and implement their own Edge apps which perfectly match the corresponding requirements.

Industrial Edge and AI

According to the "IT Trends" study by IDC market researchers, approximately 40 percent of the cloud services used will include Edge Computing by 2022, and 25 percent of these endpoints and systems will execute AI algorithms. Edge AI enables real-time operations and thus provides the basis for speedy decisions and actions. In the same way, algorithms operating autonomously on an Edge device can also make decisions in production plants – immediately, without delay.

Industrial Edge comes with a specific development platform which makes the programming of applications both easy and robust. Connectivity based on the Runtime (device) and the management system (cloud/on-premises) enables app deployment – i.e. assigning and transferring the application to an Industrial Edge device in a user-friendly manner. Higher-level IT systems further process non time-critical process data and take over the administration and updating of applications.

The Industrial Edge ecosystem from Siemens

A perfectly matched concept

The Industrial Edge ecosystem consists of three different types of components: various Edge devices hosting the runtime environment, a large number of Edge apps which can be procured e.g. via an Edge hub with an Edge Marketplace connected to it, as well as cloud-based or locally hosted Edge management. All three components are matched to each other, can be easily adapted to individual circumstances, and scaled in performance.

Industrial Edge Hub

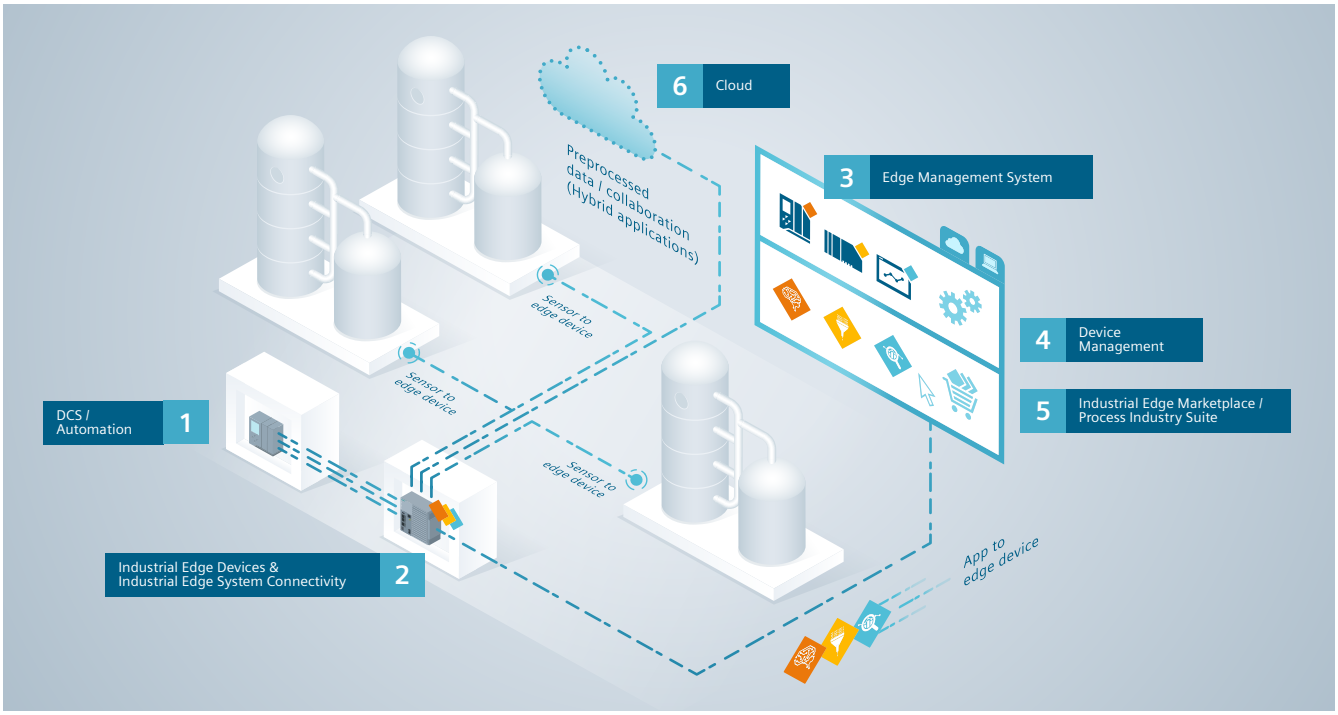
The Industrial Edge Hub (IEH) is a customer portal which is connected to the Edge Marketplace and allows users to manage their available licenses and applications. In addition, this portal provides access to product documentation.

Industrial Edge Management System

The Industrial Edge Management System is the central infrastructure which you can use to manage all connected Edge devices in one central place, and to monitor their status. Furthermore, it allows you to centrally update your apps to the latest version and always have them distributed to all devices efficiently and securely. The apps can be installed on the Edge devices without retroactive effects and independent of the operating state of the corresponding plant.

Industrial Edge devices with runtime environment (Runtime)

The Edge Runtime integrates a holistic security concept which enables the stable operation of one or several applications next to each other and also provides a secured software environment for their execution on Edge devices. Siemens Industrial Edge Computing also includes a security solution for the protection of both the data in the cloud and the devices and data in the plant. Dedicated Edge devices provide the interface towards the automation components, for example on the basis of Siemens Industry PCs, or "Edge-enabled" devices, such as network devices which implement an additional Edge Runtime.



Siemens Industrial Edge consists of the cloud-based or locally hosted Industrial Edge Management System as the backend, and of the Industrial Edge devices and Industrial Edge apps which prepare the data and transmit it to other systems, such as a cloud solution, if required.

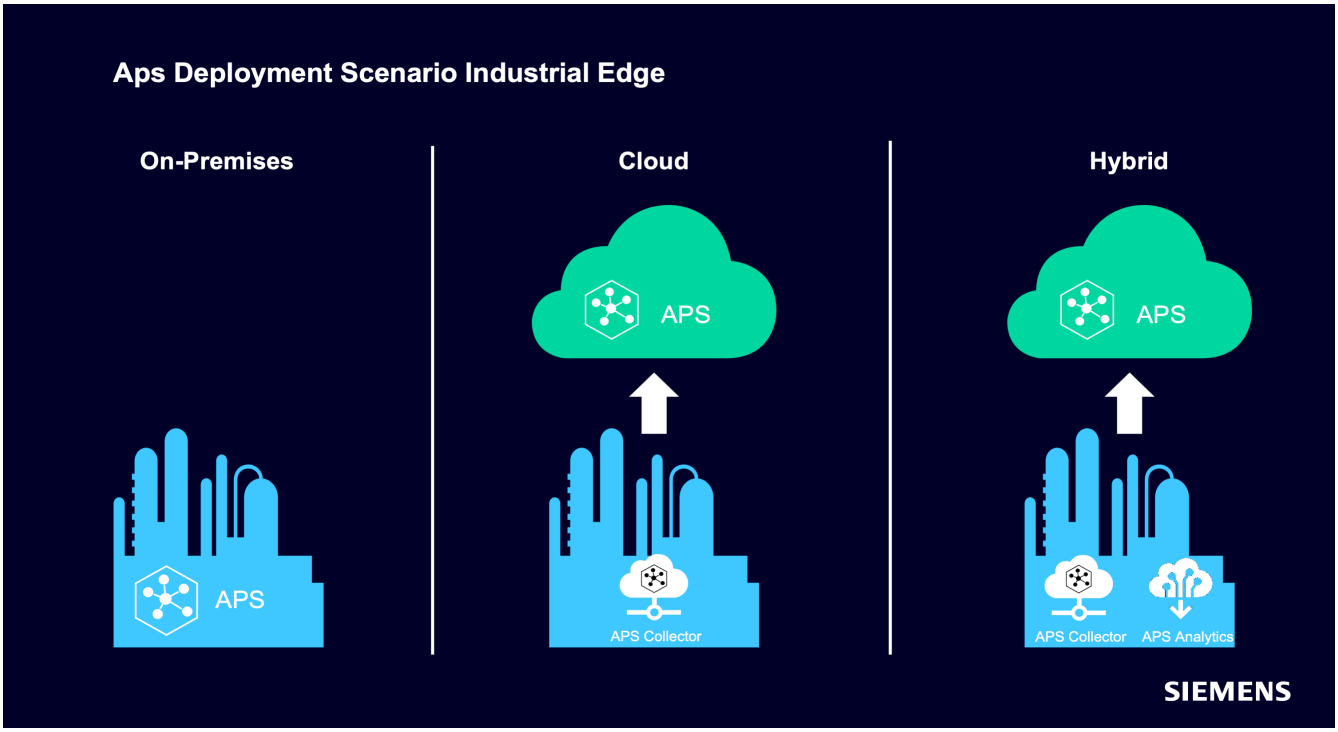
Edge devices are completely decoupled from the actual process and provide the hardware and software infrastructure for the collection and processing of huge data volumes in real time. They are equipped with an Edge Runtime software component which ensures the connectivity of data acquisition from the automation components connected towards the Edge Management System, and towards the cloud infrastructure for further processing. Furthermore, the Edge Runtime software provides a secured app environment for the execution of functions in Edge devices. The runtime environment features a modular structure and can be flexibly extended on the basis of the Docker IT standard. Available components or communication protocols can also be combined with apps from third-party providers or self-developed software.

Edge apps

Industrial Edge apps are software modules which are programmed in high-level language and serve for various kinds of tasks. They enable the direct processing, preparation and local analysis of data generated by the process or, alternatively, the transfer of data to higher-level IT systems in an aggregated form or to external cloud systems such as MindSphere, the open, cloud-based IoT operating system from Siemens.

The Cloud Data Collector from the Asset Performance Suite (APS) is a prime example: an Edge software application which is part of the open software suite. Plant data is transferred via the APS Cloud Data Collector running on-premises on an Edge device in the plant. It collects the diagnostic, historical and P&ID data configured and securely transmits it to the Asset Performance Suite, where the data is harmonized, contextualized and interpreted. In addition, it is installed on a Siemens Industrial Edge device within a perimeter network and also collects diagnostic data from field devices, data from process control systems (DCS), as well as historical process data. This Edge app allows the Asset Performance Suite to gain deeper insights into the plant behavior and addresses the OT/IT integration challenges for the contextualization of relevant plant data based on an open ecosystem approach.

Thanks to the flexibility of the Industrial Edge system with connection to a cloud such as MindSphere, the functionalities of the Asset Performance Suite can be distributed between the Edge and the cloud depending on individual requirements and technical conditions.



The functions of the Asset Performance Suite can be distributed between the Edge and the cloud to fulfill specific requirements.

Industrial Edge Apps: Matched functionality for specific applications

New ways of data collection provide speedy results

The Industrial Edge apps bring just the right level of flexibility and application options to the Edge devices. The spectrum of deployment scenarios possible is wide and varied. A typical application is the monitoring of drive parameters for the de-tection of sporadic failures or slowly increasing wear and tear in order to facilitate maintenance scheduling. Besides this, there are various other fields of application which are of par-ticular relevance especially to companies in the process industry – for example the integration of distributed plants or plants stretching over large areas, such as pumping stations or pipelines, in which case the connection to a central control system often does not make sense from an economic point of view. Furthermore, Edge makes it easier to implement central tasks on a local level.

Example 1: Valve status monitoring

Industrial Edge allows you to use process data in order to de-termine, for example, the current status of a valve. Based on this data, cutting-edge algorithms can be run – e.g. in a cloud or on-premises solution – in order to suggest the best maintenance strategy based on the current status and existing resources. Afterwards, an Edge device installed on the premises analyzes the current status. If there is a need for mainte-nance, the device notifies the maintenance management team in order to ensure that e.g. a solenoid valve can be replaced in a timely manner.

Example 2: Predictive maintenance of pumps

Assemblies, such as pump units, can be easily equipped with sensors, the data of which is evaluated via an analytic app installed on the Edge device. This allows, for example, the analysis of an altered acoustic profile indicating early signs of wear and tear, and the timely scheduling of maintenance work in a resource-optimized manner. Edge Computing can also help to determine potential for optimizing a plant. Here is just one example: A company can analyze concrete process data in order to determine the cost/benefit ratio of a planned modernization project. Nowadays, ready-made kits are availa-ble for this and many other types of applications. The battery-operated IIoT sensors included in these kits are easy to install and then automatically connect to the Edge device. Edge Computing solutions of this kind can be implemented with minimum effort and without interaction with existing process automation components.

Example 3: Contextualized root-cause analysis to facilitate fault detection

The Asset Performance Suite software on the Edge device makes it easy to establish a semantic relation between errors by contextualizing all the data sources available. This also allows top-down navigation to the defective asset. All the information is shown in a concise manner directly on the asset, including recommendations for eliminating the fault. This approach provides an excellent basis for further analyses because model-based data can be used in addition to current data.

Industrial Edge Apps as a window towards the Industrial Internet of Things (IIoT): The results obtained from data analyses can be used on various end devices in order to optimize product quality, performance, availability and energy consumption in a target-oriented manner.

Integration into machines and plants

Implementation of Industrial Edge

There are various approaches and options for implementing Industrial Edge in processes and plants. To reduce the obstacles to the use of Industrial Edge, Siemens has developed a workflow which structures the implementation approach as follows:

Step 1: Selecting the functionality

- The user purchases the Industrial Edge application and software tools required.
- Alternatively, users can program their own Industrial Edge application, for example via Mendix.

Step 2: Architecture

- It is up to the users to decide whether or not they want to host their management system locally (on-premises) i.e. next to the plant or centrally in any type of cloud (e.g. MindSphere).

Step 3: Edge Management System

- Apps and updates can be installed on Edge devices without retroactive effects and independent of the operating state of the corresponding plant.

Step 4: App use

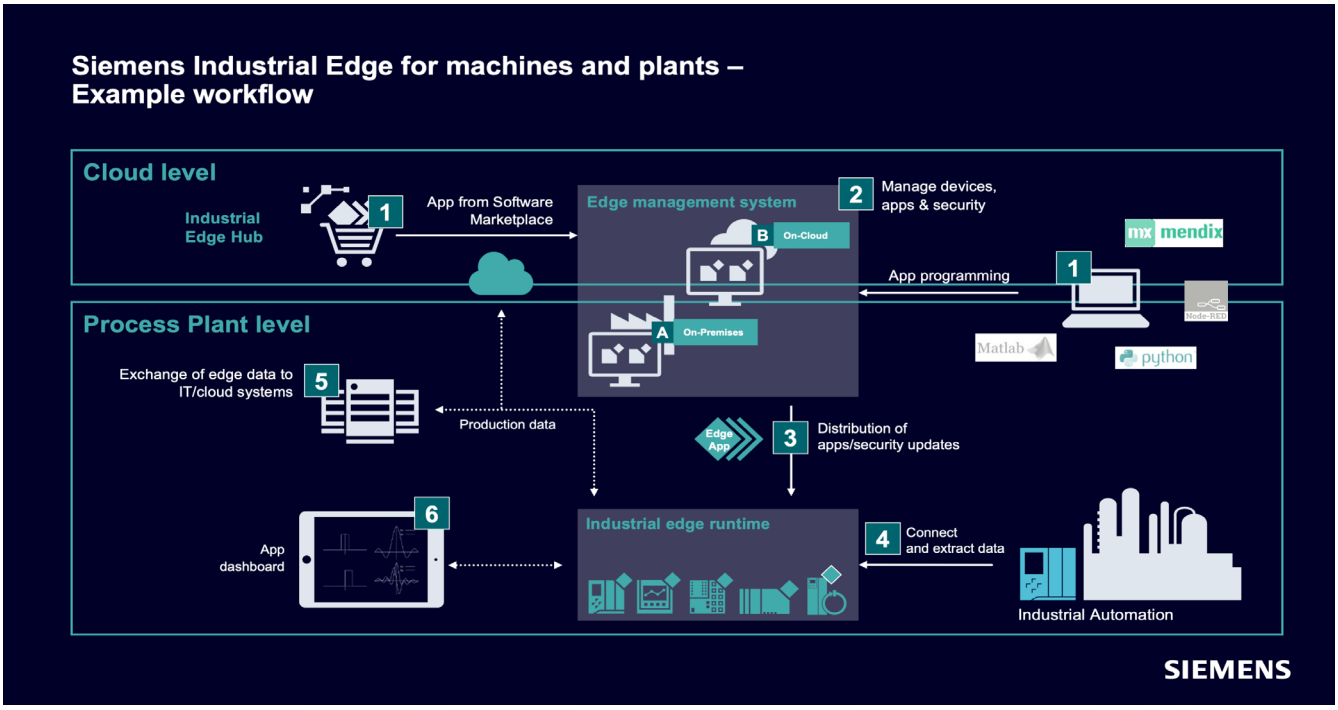
- Edge apps are ideal for users to extract data. Furthermore, data can be processed close to the field using connectivity apps and Edge devices, as well as additional intelligent sensors.

Step 5: Data collection

- Data is collected and processed securely – on premises or in the cloud.

Step 6: Data evaluation with Industrial Edge apps

- Users can analyze, manage and optimize plants and processes on Edge App Dashboards.



The workflow example shows how users can implement Industrial Edge on their machines and in their plants.

Integration with the NAMUR Open Architecture and modular plants

NAMUR Open Architecture

The NAMUR Open Architecture (NOA) aims to make production data easily and securely usable for plant and asset moni-toring as well as optimization. NOA transmits the data of smart sensors, field devices and mobile devices to the plant.

NOA is ideal for expanding brownfield plants. In addition, it is compatible with current developments in automation, such as the Advanced Physical Layer (APL) or the modular approach (Module Type Packages, MTP), making NOA future-proof for greenfield installations.

To support NOA, the following three concrete types of Edge applications must be available:

- Apps for the collection of NOA data in the field (field connectors)
- Apps for the semantic mapping of data from the field to the NOA information model (PA DIM)
- An app which implements the OPC UA server required by NOA

Automation of modular plants

The modularization of production plants is a key instrument for enhancing the necessary flexibility of processes and plants. Module Type Packages (MTP) represent a solution approach to modularizing process plants. These packages include a non-proprietary, functional description of the automation of process modules for integration into orchestration systems, such as conventional process control systems.

New applications for Industrial Edge

By extending the automation pyramid and making use of the data thereby becoming available, NOA opens up a large spectrum of applications, especially also for data-based services with Industrial Edge.

Being able to access additional data enables advanced evalua-tions and process optimization, for example for field device monitoring, process analysis devices and electronic equipment, but also for the plant or fleet management of mechanical components and plant sections.

Siemens Industrial Edge allows users in the process industry to implement numerous relevant use cases in the fields of data collection, preprocessing, forwarding and analysis.

In modular plants, the Edge Connector brings together all the relevant data at the corresponding organizational levels and thus enables, for example, the definition of setpoints.

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