WHITEPAPER

Gaining Advantage at the Edge

Unveiling the value of edge computing

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Executive Summary

Edge computing brings real-time processing power, the hosting of applications and data storage closer to where it's needed. This delivers a range of benefits including greater performance, faster response times, reduced latency and improved resilience, optimization of available bandwidth and strengthened cybersecurity.

It is widely anticipated that edge computing will have a transformative effect across a wide spectrum of industrial automation applications. Combined with IIoT (Industrial Internet of Things) technology and AI-powered analytics, edge complements cloud-hosted storage and applications to realize the full value of production data in a range of process industries.

This paper discusses the role and benefits of edge computing in the industrial automation space, where it can improve operations by uniting cloud and control environments to enable advanced data aggregation, analysis, reporting, and asset management. The practical issues and challenges in the ongoing deployment of edge technology in today's industrial process environment are outlined, together with future opportunities for the technology.

The capabilities and applications of ABB's Ability™ Edgenius Operations Data Manager are also introduced. Enabling the secure transfer of OT (Operational Technology) data to the cloud, this industrial software application platform makes data from many connected devices and systems available to flexible deployable applications for efficient visualization, analysis, reporting, and action.

Applications on Edgenius take advantage of ABB's fast, flexible, near-the-data-source Streaming Calculation Engine that unlocks the full potential of operational data collected from IIoT-connected devices and control systems. Edgenius thus supports more efficient, agile process management and automation by making this information readily available to analytics and other value-added applications such as visualization and asset condition monitoring – either in the cloud or on the on-premise edge.

It’s all about the data

Today’s digital networked economy is characterized by a relentless drive to greater efficiency and resilience, underpinned by the need for organizations to create ‘more from less’.

Like other industry sectors, process control and automation operators must optimize the quality, resilience and sustainability of their operations in the face of numerous challenges including increased global competition, rising costs and a broad spectrum of cybersecurity threats.

In this competitive and fast-evolving commercial landscape, there’s pressure on plant owners to maximize returns from their existing assets. Opportunities for short-term efficiency gains must be balanced with longer term strategic objectives, in parallel with a responsibility to embed sustainability across all areas of their operations.

The key to plant owners’ wider digitalization strategies lies in transforming the flood of real-time operational data – from potentially thousands of sensors, actuators, pumps, motors, level meters and other connected field devices and control systems – into actionable insights that can help secure sustainable business advantage in an increasingly challenging and volatile competitive landscape.

Next to the growing data the demographic shift holds a major challenge to plant owners as they need to ensure that the know-how is kept in the organization and smoothly transferred to younger generations. The technology also needs to be adapted to the next generation workforce and support companies to stay at the top of the curve.

Understanding edge and its potential

Analyst Gartner has predicted that by 2025 three-quarters of enterprise-originated data will be created and processed at the edge, outside remote data centers or the cloud. [1] Valued by Fortune Business Insights at almost USD 12 billion in 2022, the global edge computing market size is anticipated to grow to nearly USD 140 billion by 2030.

Edge has been identified as one of this decade's biggest technology shifts, reflected in its fast-growing adoption by organizations and the rapidly expanding range of edge-based solutions coming to market. Complementing other industry trends including Cloud, Artificial Intelligence and Machine Learning, it will be an enabler for a world of real-time applications from robotic surgery to self-driving cars.

Edge will also have a transformative role in the world of industrial automation, where it can help companies optimize their use of the exponentially increasing volume of data gathered from IIoT devices and control systems that are used extensively in a wide range of production processes.

Industrial plant owners are constantly seeking new ways to optimize the efficiency, reliability, and profitability of their operations encompassing multiple levels ranging from plant and processes through to the entire enterprise. Data holds the key to this.

However, the fact that most average plants are currently making use of less than 20 percent of their available data indicates that there is still some way to go in creating the necessary infrastructures to facilitate its collection, storage, and analysis and enable its conversion into usable knowledge. In many cases, the root cause has been a combination of limitations in available processing power and network bandwidth, concerns around cybersecurity and a general lack of skills and interfaces in accessing and analyzing data.

This is where edge computing comes in. Simply put, edge computing takes computing power, hosted applications and data storage closer to where it's needed, delivering a range of benefits including faster processing, improved security and optimizing available bandwidth.

By deploying edge computing resources within a wider ecosystem that embraces cloud, data analytics and AI/ML, the efficiency of industrial automation applications can be transformed by leveraging the full potential of IIoT connected devices, control systems and the large amounts of data they produce.

An example of this synergy between technologies is the use of cloud's effectively limitless computing resources and data storage capacity to 'train' process optimization models, fed by data that's been collected at scale from IIoT devices in the field. In turn, edge computing allows these models to be executed in real time in the field, enabling devices and systems to respond quickly and intelligently to the demands of their environment.

[1] This source is https://www.gartner.com/smarterwithgartner/what-edge-computing-means-for-infrastructure-and-operations-leaders

Data in context: powering process optimization with edge, analytics and AI

Industrial plants create vast amounts of data which holds significant opportunities for improvement however even today not all of this data is being used. To stay competitive companies need to identify a data analytics strategy that spans from site, edge and to the cloud to fully leverage the potential that lies in this data.

Modern manufacturing plants produce a lot of data. Putting this in context, 2,000 different devices or systems – each with around 100-200 sensors collecting data every second – would generate over 2,000 terabytes of data (2 petabytes) every month.[2]

It's this same deluge of data that offers the potential for optimization at a process, plant or enterprise level. The challenge resides in collecting and combining the data from different sources, contextualizing it, transforming it into knowledgeable insights, and then delivering it to the appropriate persons for timely action.

Key elements of this new digital experience provide automation users with the benefits of a combination of AI-enabled analytics and edge software to analyze operational data at the point of production. The deployment of flexible, edge-oriented solutions can also predict issues and prescribe actions to enable better asset operations, predictive maintenance strategies, and improved tuning of production processes.

Edge solutions also work with higher-level applications, where operations data can be combined with other types of information and engineering technology data for strategic business analysis. These applications could be deployed on premise or in hybrid/cloud configurations.

Leveraging AI and ML practices and domain expertise, digital models, services, and applications can provide actionable insights across areas of operational excellence, performance management, asset integrity, safety, sustainability, and supply chain optimization. Insights will connect back to the systems and users that need to be aware and take action.

[2] This source is https://www.forbes.com/sites/samsungsds/2020/01/06/3-must-haves-for-intelligent-manufacturing/?sh=56e187e0670eume of data gathered from IIoT devices and control systems that are used extensively in a wide range of production processes.

Edge and cloud: complementary technologies compared

Whenever there's an apparent choice of two technologies performing similar functions, it is tempting to try to identify which one is best. While edge computing and the cloud both offer their own distinct advantages, selecting which one is best for a particular application depends on the user's business and operational needs, as well as requirements around key issues such as security. Moreover, there are some situations where using the two technologies together can prove highly effective.

Edge computing is deployed on premise, it locates processing power in immediate physical proximity to the devices and systems it serves – such as sensors, pumps, motors and actuators in an oil and gas, metals, paper, food and beverage, life sciences or water treatment plant. This contrasts with cloud-hosted computing resources that are hosted in a remote data center, maybe hundreds or even thousands of kilometers distant from an industrial facility.

Performing processing at the figurative 'edge' of the network – namely at the point of data production – can significantly reduce the bandwidth requirements and associated costs of transporting massive amounts of data between field and cloud. Executing applications at the edge rather than at a distant location also dramatically reduces system latency, the round-trip time between data's point of origin and where it's processed. From an automation and process control perspective, edge thus presents a compelling choice for industrial applications requiring real-time control or interaction with sensors and other devices where system latency is undesirable.

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Edge provides a flexible near the data source environment to host applications and analytics.

Co-locating computing power at the site where data is produced – whether it's a mine, offshore windfarm, or oil platform – also mitigates the potential cybersecurity risks of connecting an industrial facility to a remote data center over public networks. While both private and public clouds provide high levels of intrinsic security, the ability to keep commercially sensitive data on premises at all times, where it's not subject to unauthorized exfiltration and scrutiny, gives plant owners the assurance of ultimate ownership and control over their data.

Edge's capability to connect, compute and control close to the source thus offers significant appeal from a security perspective. A cyberattack on a single edge node, for example, can be contained without compromising security for other edge devices on the network. Furthermore, retaining data on site obviates any potential legal or regulatory issues around the storage and processing of sensitive information in other jurisdictions.
The ability of Edge nodes to operate effectively autonomously provides welcome resilience when cloud services are temporarily unavailable due to network or cloud failures. This makes them an appealing choice in environments such as remote industrial plants or mobile vehicles that may be constrained by intermittent connections to the Internet.

Another key advantage of edge computing is its scalability, enabling it to readily adapt to satisfy evolving business needs. Installations can easily be expanded to account for greater volumes of data, multi-node scaling with the deployment of numerous edges, and additional applications as a production plant's requirements expand. This makes it quick, easy, and cost effective to push applications and other updates to multiple sites at scattered geographical locations – all without disrupting service continuity while also realizing significant savings in time and travel costs with a consequent reduction in environmental impact. This can be particularly beneficial in an era of increasing investments, for example by renewable energy providers operating unmanned or remotely managed sites at often hard-to-reach or inaccessible locations.

Edge solutions also play a key role in enabling higher-level applications, where operations, information, and engineering technology (OT, IT, ET) data can be integrated for strategic business analysis. These applications can be deployed either on premise, or in hybrid/cloud configurations.
The complementary attributes of edge and cloud computing make the two technology approaches particularly appealing when they are combined in a modern process control environment. In particular, cloud is an ideal solution for non-real time tasks such as long-term process optimization, based on the deep analysis of large data sets collected from IIoT devices and control systems in the field. Another specific illustration of this combined approach is the use of cloud to train models using data from IIoT devices and control systems. These models can then be executed at the edge, yielding better insights into operational data whilst also allowing more efficient control.

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The combination of edge and cloud is also an enabler for applications that harness the capabilities and benefits of AI, Machine Learning, and specific domain expertise.

It drives a range of actionable insights across areas such as operational excellence, performance enhancement, asset management, safety, sustainability, and supply chain optimization.

A cloud-hosted continuous emission data analytics solution, for example, could be used to monitor the fleet-wide performance of emission monitoring instrumentation. Real-time monitoring of instrument health and performance could be used to demonstrate and report ESG (environmental, social, and governance) regulatory compliance. Furthermore, instrumentation data collected at the network's edge can be used as a basis for condition-based monitoring, with automated notifications to plant personnel helping to anticipate and provide advanced warnings of potential system failures that could otherwise affect plant or process performance and result in costly unscheduled downtime. Here edge offers an appealing conduit for the collection and management of standardized device health status and alarm signals from instrumentation devices by different manufacturers, as enshrined in the NAMUR NE 107 standard.

Realizing the value of edge in a data-driven industrial automation environment

Edge complements cloud and other emerging technologies in an ecosystem that changes the modern automation landscape. Collectively, these components provide an agile, secure, and freely scalable computing environment that embraces data storage, processing, and AI/ML-powered data analytics to optimize plant efficiency, reliability, safety, and sustainability. It also opens new business models and sources of value based around digital capabilities.

Here are four specific use case examples that illustrate the benefits of combining edge and cloud technologies in a modern process automation environment:

1. From OT to cloud:

Problem

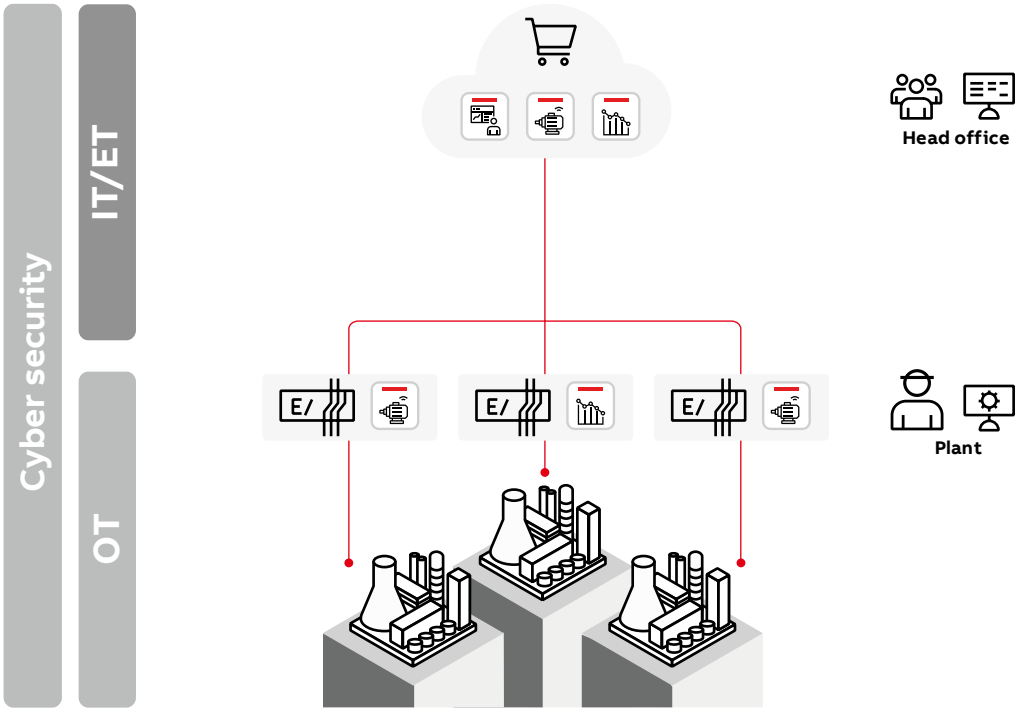
Lack of data access and different levels of information at different parts of the company

Solution

Using Edge gateway to forward data from individual plants to cloud level

Value

Harmonized access to information and secure OT/IT dataflow



2. Advanced computing capabilities:

Problem

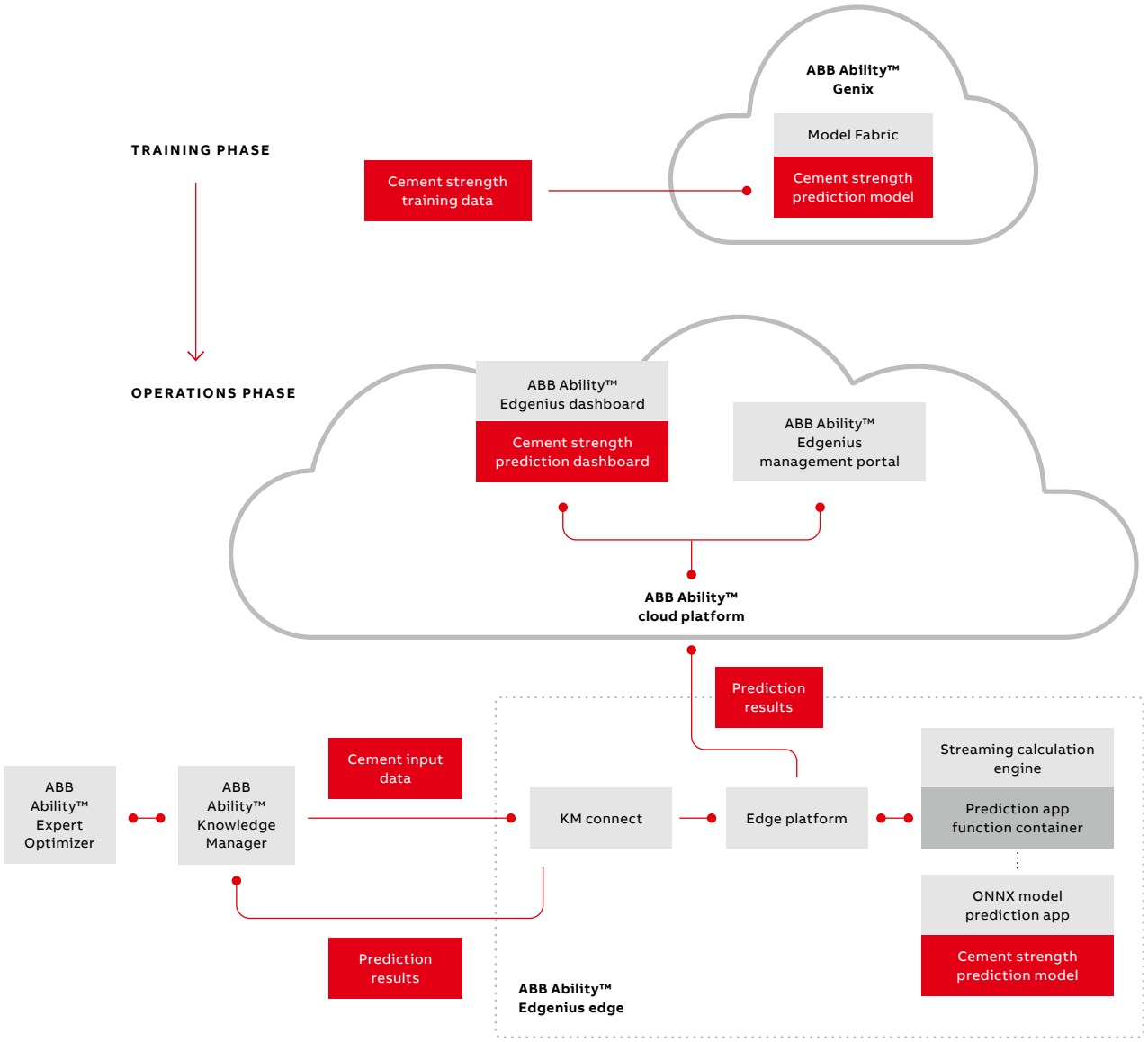
Complex algorithms cannot run in existing ecosystem and there is no established MLOps strategy

Solution

Train AI/ML models on cloud level and deploy them on the edge close to the source of production

Value

Production optimization and increased competitiveness



3. Condition monitoring and predictive maintenance:

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Problem

High maintenance cost and unplanned plant downtime due to faulty field instrumentation

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Solution

Use edge together with a field device management software to capture diagnostic data

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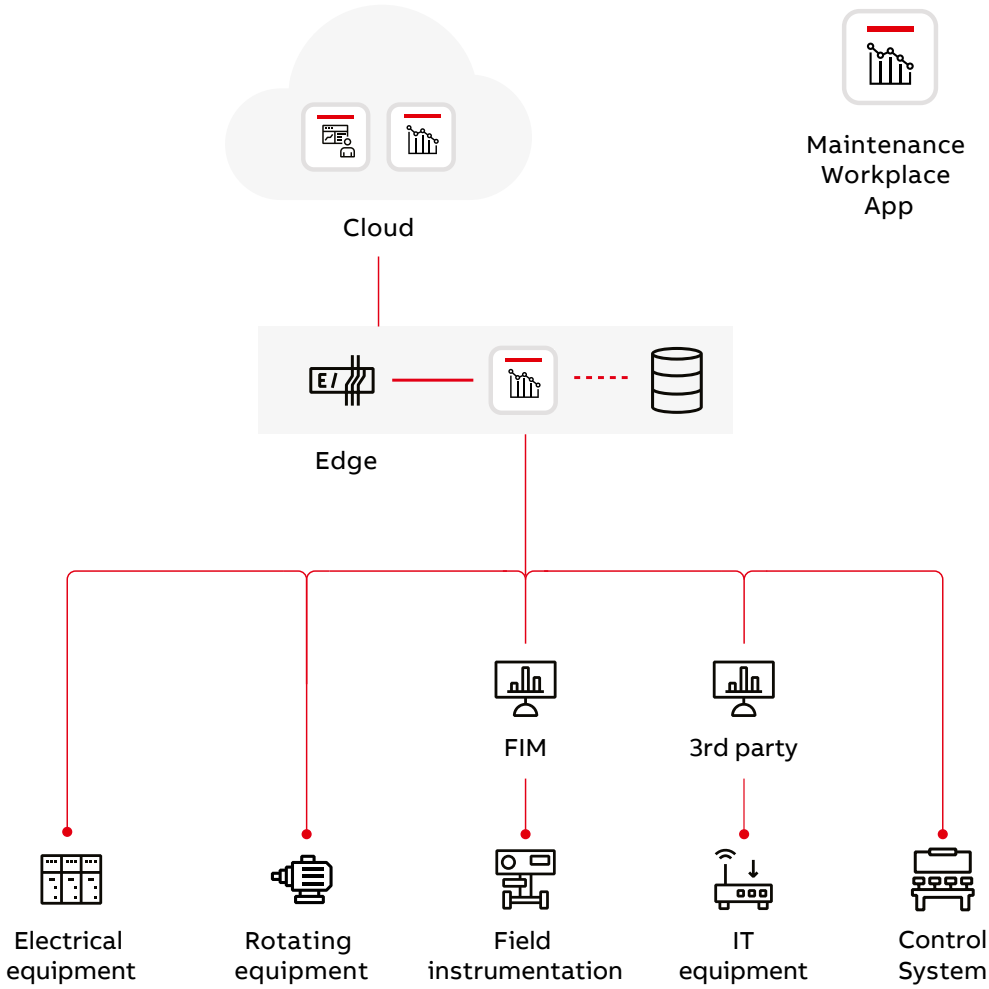
Value

Enable higher level maintenance strategies for field instruments and increase plant uptime



4. Integrating edge computing into a process automation environment:

Problem

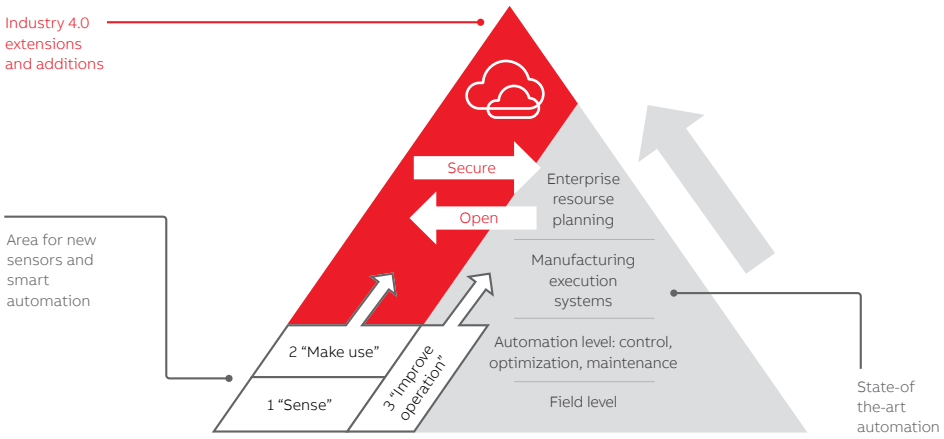
Existing control system hierarchy makes it difficult to innovate

Solution

Using edge as secure and open NOA second channel

Value

Protecting the core process and enabling a new ecosystem for value adding applications



Developed as a response to the challenges of poor data utilization in many 'brownfield' process plants operating decades-old legacy systems, the NAMUR Open Architecture (NOA) enables the straightforward and cost-effective addition of a secure second communications channel, transporting additional real-time data from edge devices in the field in parallel to core process measurement data.

Established in 2016, NOA is a vision for how to apply digital technologies to control systems without disrupting proven workflows in process-oriented industries including chemicals, food and pharmaceuticals. NOA aims to make production data easily and securely usable for plant and asset monitoring as well as optimization. The guiding principles for NOA are:

- Uncompromised plant safety and plant availability
- Secure interface between Core Process Control (CPC) and Monitoring & Optimization (M&O)
- Consistent approach for new and existing production plants
- Agile implementation based on existing standards
- Security by design – automation security as an integral aspect of system design
- Usability, reduction of complexity and economic efficiency
- Verification of Request (VoR) to enable secure communication towards the control system

NOA adds a layer to a Distributed Control System that enables extra functions to be added by providing an open and secure environment for integrating IT components from the field up to the enterprise level. With this new approach, operators can extend the capabilities of their control systems to include new functions such as asset and device management, optimization, and planning, without impacting on the core functions of the Distributed Control System itself and without the time or risks previously associated with making changes or upgrading.

By enabling edge and cloud technologies to be easily integrated into the Distributed Control System, the NOA approach will now allow users to fully unlock the possibilities of Industry 4.0 by enabling the improved flow of data throughout an organization that can be securely accessed as and when required to allow informed decisions and actions.

This data can be sent to the cloud for processing, where it can support service and maintenance teams with a range of valuable configuration, asset health monitoring, status reporting, diagnostics, predictive maintenance, and optimization functions. Crucially, the second channel provided by NOA protects core processes by removing the burden of increased data traffic levels on existing channels that can potentially impact seriously on plant performance, safety, or availability.

Verification of Request (VoR) is a second key concepts of NOA, allowing controlled information traversal between IT and OT domains (from M&O to CPC).

Introducing ABB Ability™ Edgenius

ABB Ability™ Edgenius Operations Data Manager is the digital enabler that connects cloud and control environments. Flexibly deployed on-site, at the edge of the network or in the cloud, it allows organizations to realize significant operational benefits by making data from devices and systems available to other applications for aggregation, analysis and action. This is achieved via a growing range of easy-to-use value-added applications from ABB.

Edgenius can be deployed either virtually, or in hardware as a powerful, compact appliance that can be located in close proximity to field devices and control systems. Data privacy and integrity is safeguarded by enhanced security at device, edge and cloud level.

Edgenius connects to various field devices and control systems on the southside as well as to the cloud northbound. Thanks to its various operational modes the cloud can be an integral factor of a solution but it does not have to. In 'disconnected' or 'connect-on-demand' mode Edgenius provides a pure on-premise edge without cloud connectivity which is desirable for situations where internet connection is sparse, not available or not desired due to privacy concerns.

A key component of Edgenius is its powerful Streaming Calculation Engine that leverages real-time data collected from smart field devices. This data is made available to locally hosted AI-enabled applications – for tasks including visualization, analysis, and reporting – with extremely low latency to the field and control system.

The Edgenius Dashboard application enables self-service access at plant, region or enterprise level to operational data from edge devices, a DCS or KPIs generated through edge computing. Data is visualized via intuitive dashboards that are accessible via web browser from a PC or tablet. This ease of visualization simplifies day-to-day production analysis and performance monitoring as well as plant benchmarking and fleet-level asset management.

A fleet of edge nodes and associated applications can be conveniently deployed, configured and administered across the entire enterprise via the ABB Edgenius Management Portal. Taking advantage of Edgenius' flexible, fast, near-the-datasource analysis engine, the wide range of available applications allows process automation users to unlock critical insights from previously 'inert' control data. This capability drives smarter, better-informed decision making and supports more efficient, reliable, and sustainable plant operations.

For field device management ABB Ability™ Field Information Manager (FIM) can be connected to a Edgenius using OPC UA Pub/Sub to forward field device diagnostic data from the field to the edge and have it available for asset performance dashboards to improve plant uptime.

Integration of control system data via ABB Ability™ System 800xA using the 800xA Publisher allows Edgenius to seamlessly leverage process values as well as alarm and event data and to make it available for advanced analytics and process optimization.


4:22 PM
85%
M63001 - Motor
0
100 %
M64001 - Motor
0
100 %
Total energy consumption
150
90
30
240
120

ABB as a partner for your digital journey

Unleashing the full potential of real-time operational data is key to driving greater efficiencies at a process, plant and enterprise level. As a world leader in process automation and digitalization solutions for the energy and process industries, ABB is an ideal partner to help organizations gain business advantage by connecting cloud and control environments through the use of edge computing.

By harnessing advanced data aggregation and analytics – enabled by ABB's own Ability™ Edgenius Operations Data Manager and value-added applications – plant owners can benefit from smarter, faster, data-driven insights that drive tangible improvements in operational performance.

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