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ISSN 1470-5745

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The Journal of Industrial Networking & IIoT

2022 IIoT Technology Progress Report 6

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Key issues for 2022...

Welcome to the January/February 2022 issue of the Industrial Ethernet Book, and coverage of two defining issues for our time: the Industrial Internet of Things (IIoT) and IT-OT convergence.

Both of these topics are critical areas of technological development as companies continue to pursue digital transformation objectives.

Industry experts provide their perspective on the state of the Industrial Internet of Things in the cover story which starts on page 6. Our 2022 progress report explores how IoT technology is being implemented into complex industrial environments as part of digital transformation strategies, and leverage a wide range of connectivity solutions.

Key technologies include the emergence of Single Pair Ethernet and Ethernet-APL, software connectivity trends provided by OPC UA and MQTT, and new options for leveraging solutions for wireless systems and machine learning.

But experts are also noting that all the technology needed is already available, and development is more a matter of adoption. We're just starting to understand how to make IIoT happen in a way that is simple and affordable for most businesses.

Beginning on page 36, IEB presents a special report on IT-OT Convergence, and solutions bridging the gap between Information and Operations Technology for smart manufacturing.

Industry experts weigh in and provide their perspective on the state of IT-OT Convergence in the modern manufacturing plant. This special progress report takes a look at cybersecurity, enterprise data connectivity and how common network diagnostic and management tools can increase IT-OT effectiveness.

In this special report, IEB reached out to industry experts to get their insights into the latest insights into IT-OT convergence, cybersecurity concerns, and all of the technical megatrends that are providing new management and diagnotic tools for helping to meet this challenge.

Together, IT and operations teams must go beyond responding to problems. Instead, they are key players in their companies' transformations, helping to seize new business opportunities that make companies more competitive, more efficient, and more secure.

We hope you find this latest issue of the Industrial Ethernet Book both informative and useful in your role as industrial networking performance continues to take the lead in world class manufacturing.

Al Presher

Contents

Industrial Ethernet Book

The next issue of Industrial Ethernet Book will be published in **March/April 2022.**
Deadline for editorial: March 5, 2022 **Advertising deadline:** March 10, 2022

View Industrial Ethernet Book website for latest news: www.iebmedia.com.

Editor: Al Presher, editor@iebmedia.com
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Published by IEB Media Corp.
Box 1221, Fairport, NY, 14450 USA
ISSN 1470-5745

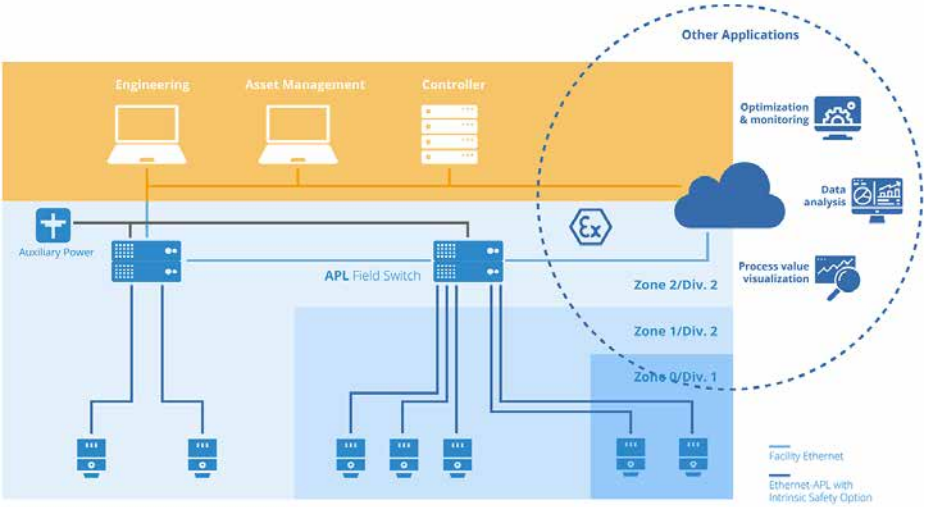
EtherNet/IP protocol adds support for process automation standard

The EtherNet/IP network specification has been updated to add support for the Ethernet-APL physical layer for use in process automation applications.

ODVA ANNOUNCED THE ETHERNET/IP Specification has been enhanced to enable EtherNet/IP networks to support the Ethernet-APL physical layer for process automation. Licensed Vendors for the EtherNet/IP technology can immediately start developing EtherNet/IP components for Ethernet-APL, including controllers, power switches, field switches, and instrumentation.

Ethernet-APL is the new intrinsically safe, two-wire extension of 10BASE-T1L (IEEE 802.3cg-2019) Single Pair Ethernet that meets the requirements of the process industries. The advantages of Ethernet-APL include communication speeds of up to 10 Mbit/s, hazardous area protection, power to field instrumentation, and long cable runs of up to 1,000 meters (IEC 61158-2). Ethernet-APL devices adhere to IEC TS 60079-47 (2-Wire Intrinsically Safe Ethernet) in order to ensure "intrinsically safe" ignition protection. The Ethernet-APL physical layer overcomes the challenges of using fast, high bandwidth Ethernet at the field level in process plants with hazardous locations and a large geographic footprint.

"This announcement is a culmination of many years of cooperative work to bring Ethernet-APL to industry. ODVA is pleased to continue to expand the capabilities of EtherNet/IP for process automation with the inclusion of Ethernet-APL in the EtherNet/IP Specification," said Dr. Al Beydoun, President and Executive Director of ODVA. "With the aid of Ethernet-APL, EtherNet/IP will be able to expand precise, efficient Ethernet-based control and commissioning across field instrumentation. The full use of EtherNet/IP in process installations will enable concurrent seamless connectivity from the field devices to the controllers, to Industrial IoT applications, as well as the edge and cloud for prognostic analysis."



SOURCE: IETHERNET-APL

The goal is networking the entire automation pyramid.

The support for the Ethernet-APL physical layer is another key step in the adaptation of EtherNet/IP to meet the full requirements of the process industries. Completed enhancements for EtherNet/IP which benefit applications in process industries include NAMUR NE 107 diagnostics, HART integration, IO-Link integration, and support for the next generation of digitized device description files, including FDT and FDI. Inclusion of the Ethernet-APL physical layer will allow for end users to take full advantage of the benefits of EtherNet/IP in process plants, including industrial control hardware, an object-oriented foundation, and standard internet protocol compatibility including TCP/IP, HTTP, FTP, SNMP, and DHCP. With support for functional safety with CIP Safety, device defense with CIP Security, time synchronization with CIP Sync, and fault tolerant redundancy with parallel redundancy protocol (PRP) and Device Level Ring (DLR), process automation installations with EtherNet/IP can benefit from network and device health monitoring, built in security and safety, and remote device configuration.

The first Ethernet-APL controllers, power switches, field switches, and instrumentation that support EtherNet/IP are expected to be available in 2022 once the conformance testing certification process is complete. Visit odva.org to obtain the latest version of The EtherNet/IP Specification including EtherNet/IP for Ethernet-APL.

*Technology report by **ODVA**.*

Visit Website

PLCopen benchmarking – a different approach

PLCopen intended to show several areas of activities during the SPS: from guidelines to use the Object-Oriented Programming within the industrial environment, the extended harmonization of the interface towards robot controllers, and benchmarking.

"PLCopen Benchmarking is something different at PLCopen for 2 reasons", said Eelco van der Wal, Managing Director of PLCopen. "Although PLCopen normally deals with the software environments, it was the best choice to define a benchmarking tool for measuring the performance of the different CPU architectures. Nowadays the CPU suppliers can tune their architectures to the specific needs. However, the needs of the industrial world in general are not clearly specified for them. The strict need for the real-time processing parallel to other operations is not so much known in other industries and needs clarification between the CPU suppliers and the control suppliers."

PLCopen did benchmarking in the past with a focus to different user applications, including motion control. Today Benchmarking is back on the drawing board, but with a different scope. With this new initiative, the benchmark can indicate the effective performance of the different processors and architectures as used in the industrial controllers, and thus help in the selection of the optimal architecture for the control supplier in a very early stage.

*Technology report by **PLCopen**.*

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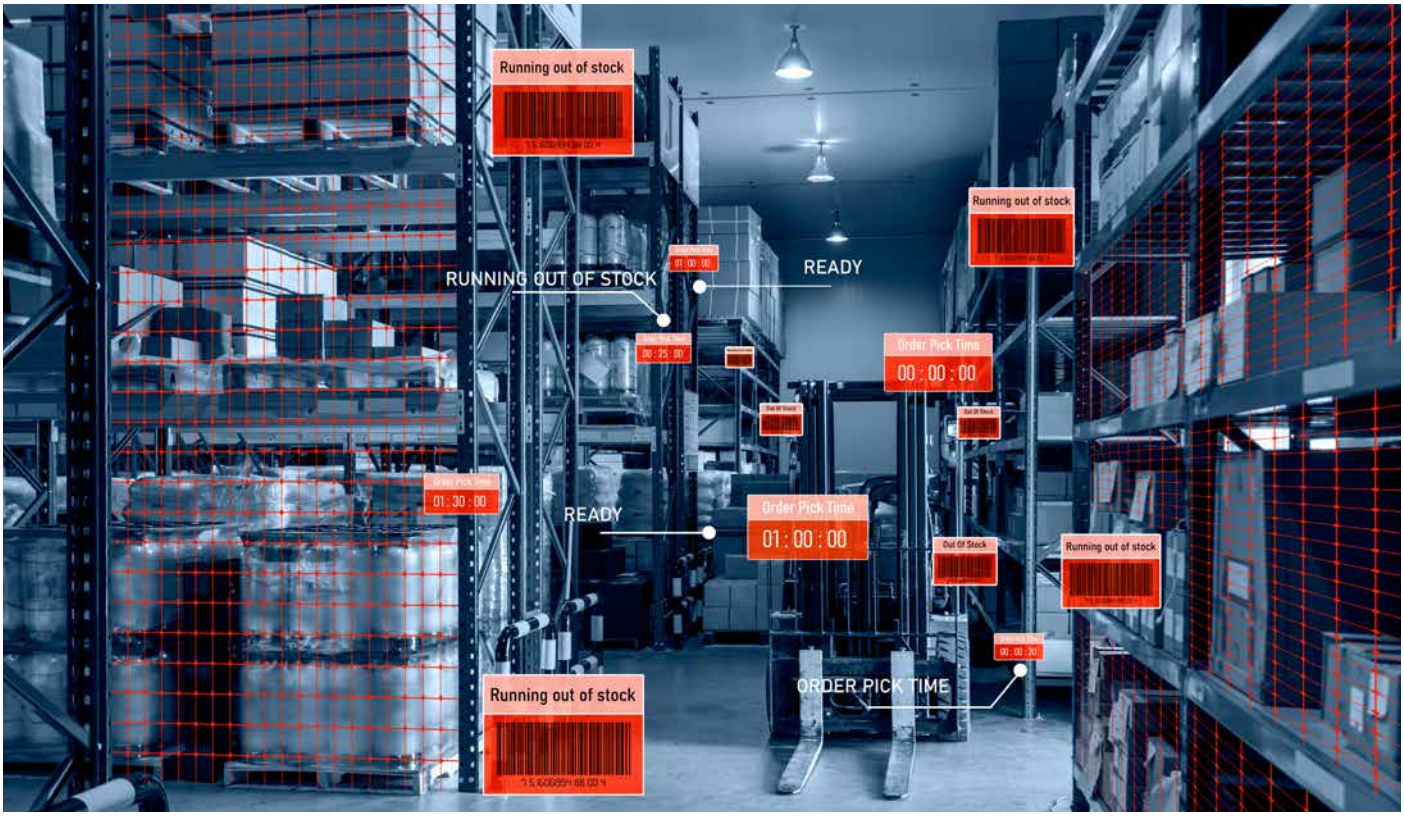
New Automation Technology **BECKHOFF**

Industrial Internet of Things 2022 Progress Report

Industry experts provide their perspective on the state of the Industrial Internet of Things. Our 2022 progress report explores how IoT technology is being implemented into complex industrial environments as part of digital transformation strategies, and leverage a wide range of connectivity solutions.



Connectivity is the foundation for smart systems – and smarter machines, and the gateway to achieving digital transformation in the factory.

INDUSTRIAL INTERNET OF THINGS (IIoT) technology is driving a wide range of new networking solutions, from the sensor to the cloud, that are enabling new levels of digital innovation with a goal of transforming global manufacturing.

For the 2022 IIoT progress report, IEB reached out to industry experts to get their insights into the development of the Industrial Internet of Things and perspectives on the megatrends shaping and enabling development of the IIoT.

Key technologies include the emergence of Single Pair Ethernet and Ethernet-APL, software connectivity trends provided by OPC UA and MQTT, and new options for leveraging solutions for wireless systems and machine learning.

But experts also note that all the technology needed is available, and it's more a matter of adoption. We're just starting to understand how to make IIoT happen in a way that is simple and affordable for most businesses.

SPE, OPC UA and MQTT

Connectivity solutions drive innovation

According to Dr. Al Beydoun, President and Executive Director at ODVA, the leading megatrends driving the IIoT forward include the emergence of two-wire Ethernet connection technologies, OPC UA for information applications and the use of MQTT to create cloud connectivity.

Technology megatrends

"ODVA supports Internet Protocol (IP) to the industrial edge by advancing 2-wire Ethernet technology such as Ethernet Advanced Physical Layer (Ethernet-APL) and Single Pair Ethernet (SPE). Multi-stack IIoT devices have the ability to support EtherNet/IP to real-time controllers, OPC UA to on-premise IIoT information applications, and MQTT to cloud IIoT applications," Beydoun told IEB recently.

"MQTT is a lightweight publish/subscribe network protocol that is an option to transport data from automation devices, including those running on EtherNet/IPTM, to the cloud. Minimal network bandwidth is required making MQTT a scalable method to connect existing devices to the internet at a low cost. MQTT adoption has been gaining momentum across automation, but in particular in industries such as automotive and oil & gas," Beydoun said.

He added that prognostics is a critical IIoT trend that will change the way that maintenance is approached and what expectations are regarding production down time.

"The ability to monitor for excessive vibrations and sounds or to look for out of tolerance changes such as media pressures, motion travel times, or electrical resistance levels can provide early warnings of device degradation. This can allow for time to order and replace faulty components, including an extra buffer in case of part number mistakes,

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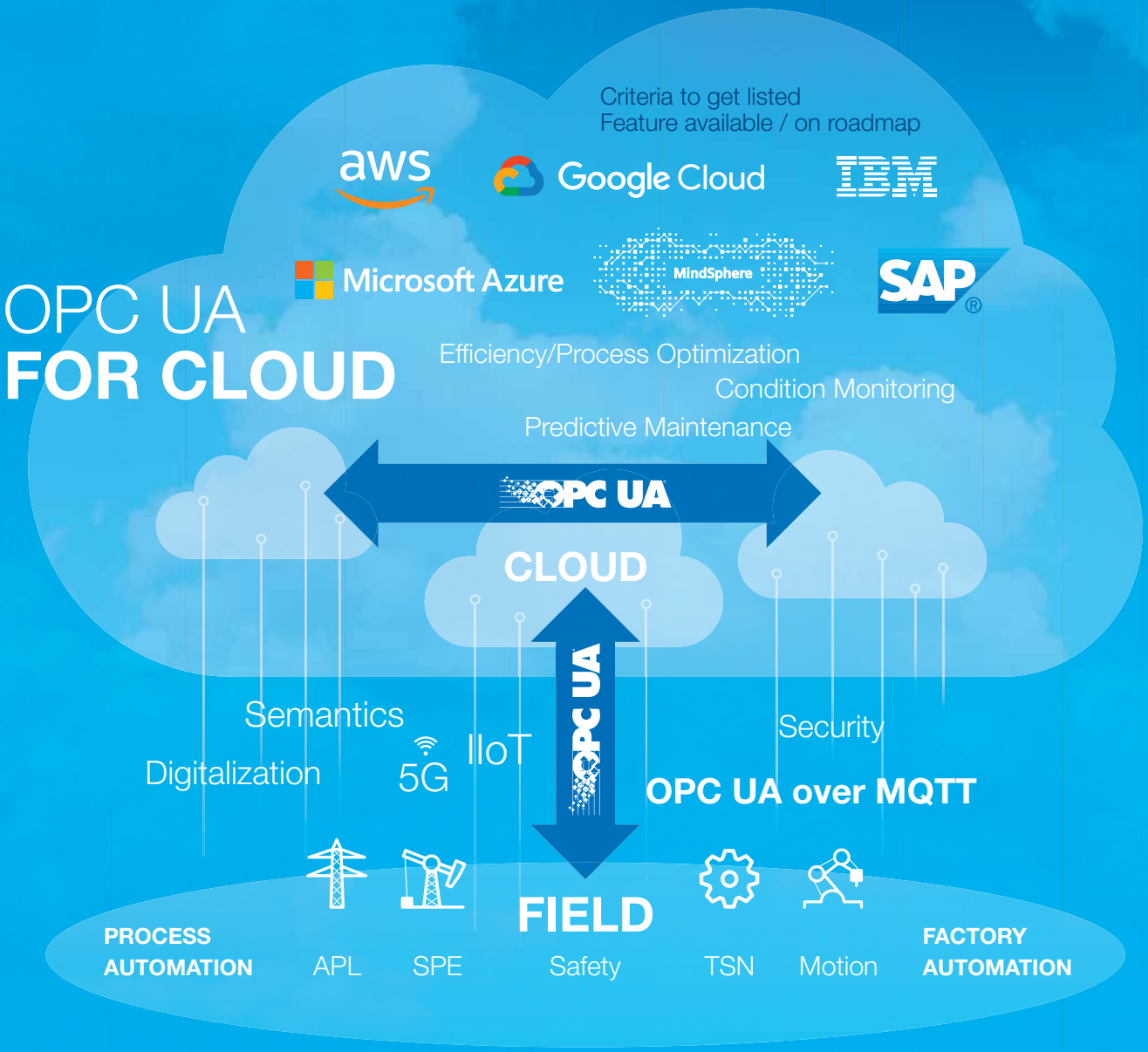

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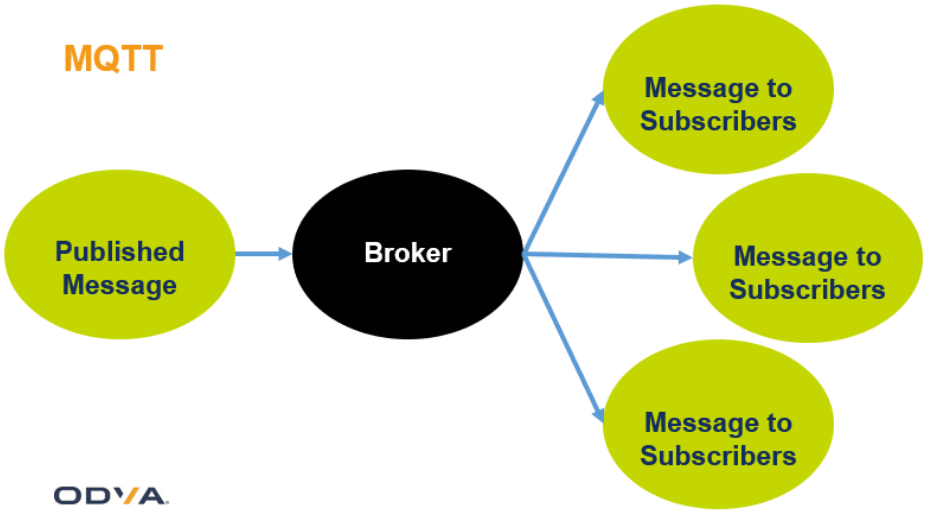


SOURCE: ODVA

MQTT is a basic option to push data from existing automation networks such as EtherNet/IP to the cloud.

training, or delays. Not only can unplanned plant shut downs be reduced, but unneeded preventative maintenance can also be minimized," he added.

Potential benefits

Beydoun said that MQTT is a basic option to push data from existing automation networks such as EtherNet/IP to the cloud. Messages can be published from devices to a broker and then sent to subscribers. The presence of a broker allows for some additional security mechanisms to be put in place, although basic security principles would still apply regardless. The lightweight nature of the protocol also means that existing networks won't be overly taxed by pushing valuable diagnostics data up to the cloud via TCP/IP.

With prognostics, device manufacturers can embed capabilities into the firmware of their devices and can leverage their engineering expertise to provide pre-determined engineering boundaries that indicate normal operation as well as indications of pending failure.

These pending failure warnings could provide specific timelines to allow for proper scheduling of maintenance and replacement. For example, if resistance on a coil exceeds +/-10% of specification an initial warning with the longest timeline of action needed can appear, with escalations as further degradation takes place.

Remote connections to these devices can allow for updating of parameters if needed and for monitoring of device health over time.

Addressing challenges

"Leveraging MQTT gateways to connect to existing automation networks with large installed bases, like EtherNet/IP, can reduce the amount of labor time required to move data to the cloud to create new prognostic, health, or operational tracking metrics," Beydoun said. "This approach is scalable, allows data value from existing devices to be unlocked at a reasonable cost, and allows for easier future changes and expansions versus ad hoc approaches. The low cost and lightweight advantage of MQTT can also be a disadvantage as data context is not inherently included and must be added as a separate step."

From a prognostics perspective, embedding capabilities into devices and even networks can reduce the burden on controls engineers to create custom PLC programming or data scientists to develop cloud-based algorithms to look for out of tolerance device or machine behavior.

Automation engineers and maintenance personnel work tirelessly to keep plants and factories operating at the best efficiency with the most uptime, but are oftentimes put in challenging positions of trying to solve device issues in the middle of the night and/or on the weekend. It's sometimes difficult or even impossible to connect with the appropriate manufacturer support resources outside of regular business hours. Built in prognostics directly from manufacturers allows for their valuable expertise to directly benefit controls engineers and maintenance personnel when they need it the most.

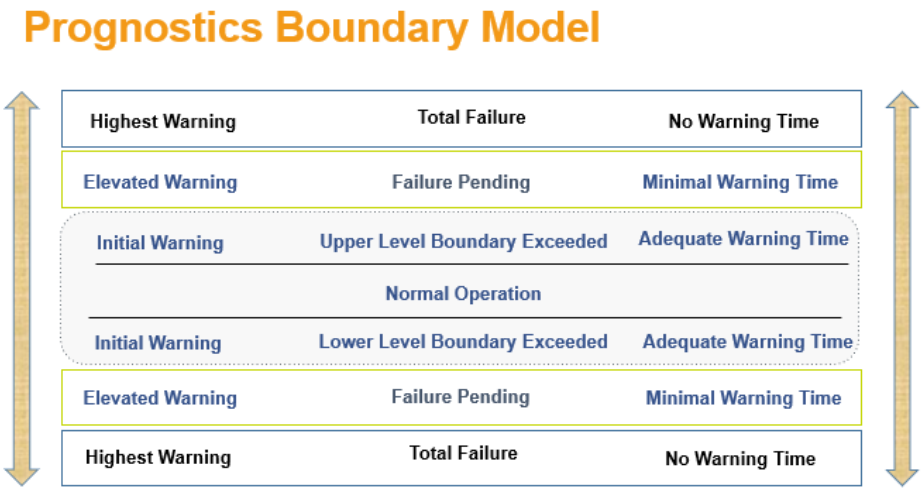
IIoT progress and impact

"IIoT has been moving faster than most technological shifts within the automation space, especially with the recent challenges and opportunities posed by the pandemic," Beydoun said. "Cost is a significant constraint as existing capital investments must be leveraged and return on investment must be proven on a small scale before wide spread implementations take place."

Additionally, worker education takes time to roll out as does acceptance of new ways of doing things. This extra time isn't all bad as some technologies that were initially leveraged for IIoT solutions have been shown to be inadequate for the long term due to issues such as security and scalability.

The additional time to pilot and prove out technologies has also allowed for the best long-term solutions to win out and for improvements to be made to those solutions during pilot phases. CIP SecurityTM is an example of a critical underpinning of IIoT that has seen significant development over the past few years with the most recent additions of user level authentication and resource-constrained device support.

"Overall, there has been a tremendous amount of progress within the automation space as a result of IIoT. 4G and now 5G machine connections to support providers have allowed for service to take place remotely, wireless connections to devices have allowed for additional operational functionality as well as easier troubleshooting and parameterization, and cloud-based analysis has allowed for preventative maintenance to reduce downtime in critical operations," he added.



SOURCE: ODVA

Prognostics boundary model.

continued on pg. 10

Smart infrastructure charting the course for the IIoT

Networking technology is factoring in current trends shaping industrial transformation, but connector innovations in particular are playing a special role. The focus is on reliable "All for Ethernet" solutions for industrial applications, and meeting the challenges of the future with connectivity options.

DIGITALISATION IS ADVANCING UNIFORMLY networked corporate processes in development, production and sales. Presenting appropriate and expedient infrastructure solutions for easy access to the IIoT, technology is factoring in the current trends and developments shaping the industrial transformation, and connector innovations are playing a special role.

Ethernet is being deployed in more and more areas of automation and is the connecting element for IT and OT (Operational Technology). In order to be able to implement correspondingly robust networks for industrial use, HARTING is constantly developing and refining its range of reliable Industrial Ethernet connectivity.

Not on location in Nuremberg for the SPS Show, HARTING provided IEB with information on all its new connectivity solutions for industrial transformation: All for Ethernet, All for PCB, All for Energy, as well as new connectivity solutions for automation, electrification and decarbonization.

SOURCE: HARTING

The new variants of the T1 Industrial Interface for Single Pair Ethernet.

"Big Picture" of Connectivity+

"We think Connectivity+ in a consistent triad: the societal megatrends of sustainability, (de)globalisation and demographic change are the drivers for the technological megatrends of modularity, autonomy and digital twins. They are our guard rails for Connectivity+," explained Dr. Kurt Bettenhausen, Board Member for New Technologies and Development. "Based on these societal and technological megatrends, we are developing products and solutions that always put customer benefits firmly centre stage. In brief, we are shaping the connectivity of the future with solutions that deliver innovative added value for our customers."

All for ETHERNET

Ralf Klein, Managing Director of HARTING Electronics, emphasised that "we are constantly developing our Ethernet offerings and enabling our partners and customers to build robust networks for industrial use with our products. By combining IP-based communication and smart sensor technology, we can redefine the automation pyramid from sensors all the way to the cloud."

The Ethernet protocol has become the most important communication standard for industrial automation. Increasing transmission rates and the trend towards miniaturisation are demanding new approaches in data infrastructure. The new and space-saving Physical Layer Single Pair Ethernet (SPE) is now also conquering the last areas of the field level.

The associated connectivity solutions from HARTING include:

- new variants of the T1 Industrial (IEC 63171-6) in M12 and M8 enclosures
- hybrid concepts for SPE plus power according to IEC 63171
- RJ Industrial Multifeature
- preLink RJ45
- ix Industrial - with special focus on PROFINET applications
- HARTING M12 according to the new IEC 61076-2-010 standard

All for PCB

The technical megatrends of modularity and flexibility are more important than ever before in device development. In addition, development times are becoming shorter and prototyping is gaining significance.

All for Energy

"Increasing energy efficiency is relevant to all areas of industry - the trend towards conserving resources is also a technology driver here," emphasised Norbert Gemmeke, Managing Director of HARTING Electric.

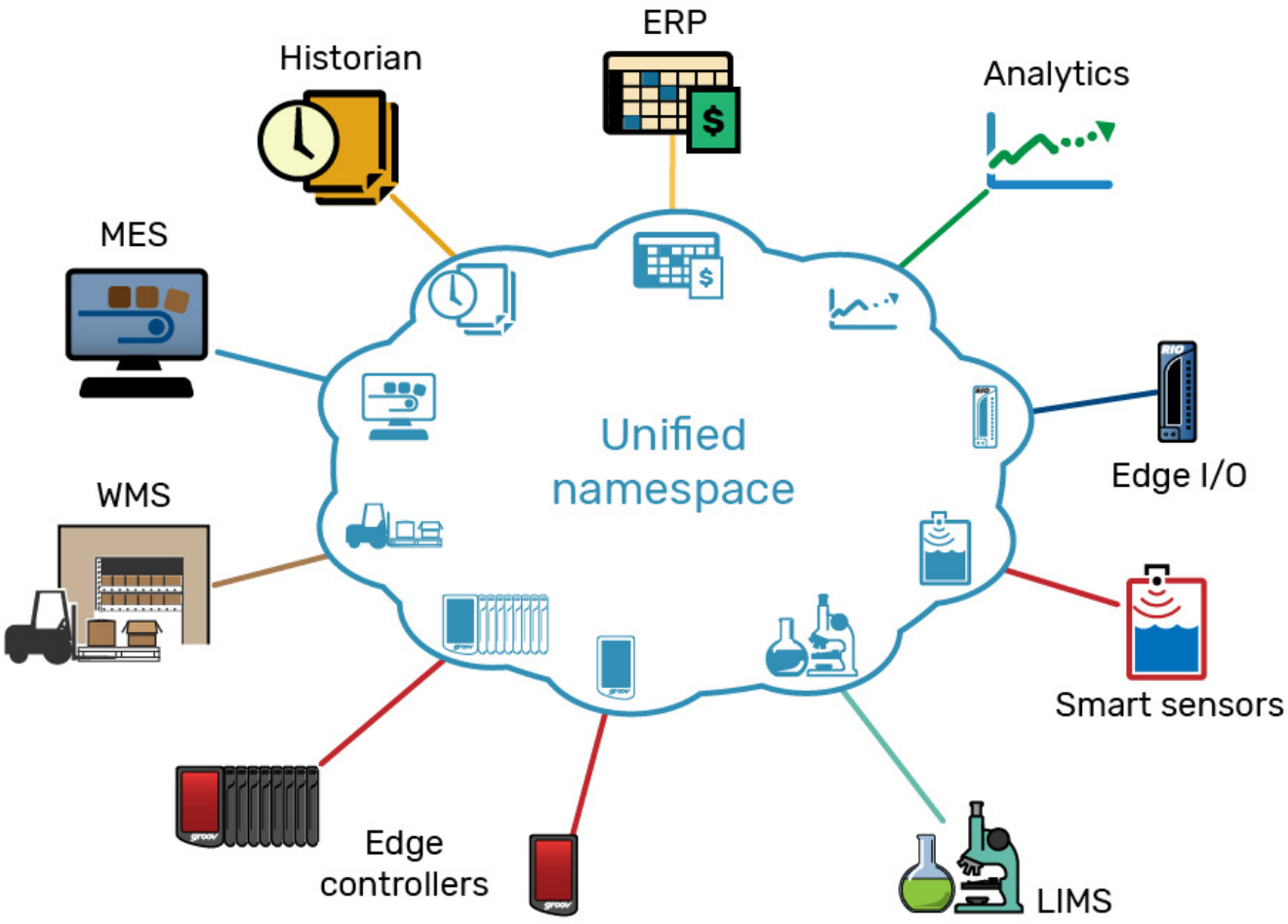
The safe and trouble-free connection technology for modular battery storage units forming energy storage systems (ESS) ranks as a key topic. Christian Schumacher, Managing Director of HARTING Customised Solutions, said "cable assemblies are the be-all and end-all here in terms of efficient plug & play in assembly. Prefabricated and customised, they shorten installation times, minimise the wiring effort on location, while providing maximum safety."

Miniaturisation & modularisation

The trends of miniaturisation and modularisation continue to drive technological development in the industry forward and are constantly demanding new solutions and products. In addition to the Ethernet and PCB solutions, HARTING is also presenting solutions from the field of "heavy-duty" industrial connectors.

*Technology report by **HARTING**.*

Visit Website



SOURCE: OPTO 22

The MQTT/Sparkplug B architecture defines clear roles and behaviors for MQTT clients and their data, adapting the underlying MQTT framework to better support typical SCADA/IIoT use cases.

Development of IIoT applications

CIP Security is a key technology that Beydoun says will ensure the security of critical automation applications as IIoT development intensifies. CIP Security allows for different security profiles to be applied to a device as a part of a defense in depth approach to allow for a balance between security and resource needs.

EtherNet/IP devices enabled with CIP Security can reject data that has been altered (integrity), reject messages sent by untrusted people or untrusted devices (authenticity), and reject messages that request actions that are not allowed (authorization).

He added that ODVA is also collaborating with the OPC Foundation to develop an OPC UA Companion Specification for CIP. This will allow valuable factory floor information from EtherNet/IP to be made available at the edge and the cloud via OPC UA for enterprise-wide analysis.

Sending data to and from the cloud from EtherNet/IP to OPC UA will be accomplished by providing useful information including discovery, identity, diagnostics, status, parameter and much more from CIP devices. The OPC UA companion specification to CIP will ensure that data will be available to enterprise and IT systems with proper context and semantics (i.e., meaning) for quick trend analysis and insight generation.

Open source solutions

Collaboration and compatibility as priorities

Josh Eastburn, Director of Technical Marketing at Opto 22 told IEB that new open source software technologies and initiatives are making on impact on the IIoT, and provide a way to deal with technical issues such as scalability and connection security.

Technology megatrends

Eastburn said that the Eclipse Sparkplug working group has made strides over the last two years in gathering contributors to the open-source projects pushing towards the release of a formal Sparkplug specification.

In 2022, we're looking forward to seeing the fruits of all that collaboration. A formal specification of the Sparkplug payload definition for MQTT, along with testing tools to help vendors verify compatibility with the specification, will strengthen guarantees of interoperability and increase adoption.

Potential benefits

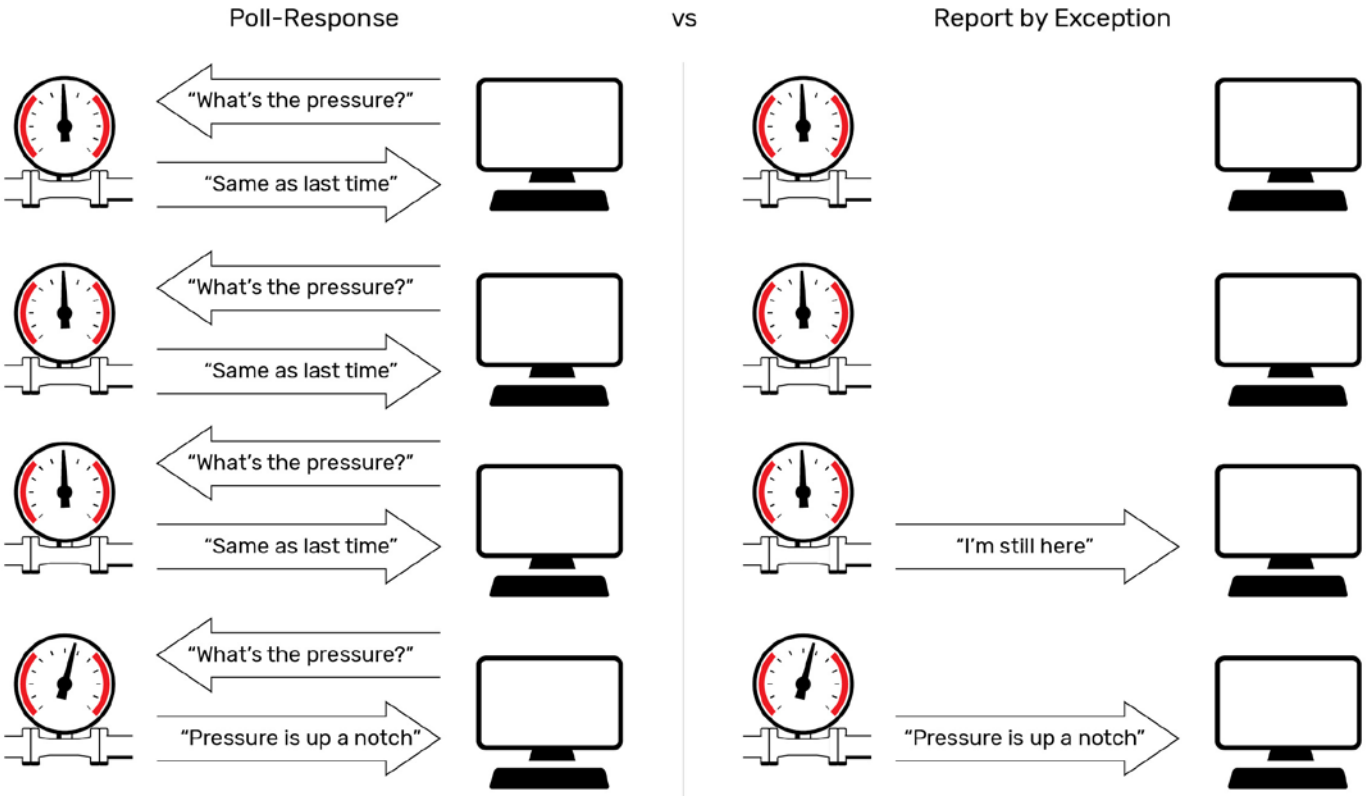
"MQTT solves the problem of scalability and connection security for IoT applications. However, it doesn't address interoperability and provides only limited client state awareness. It can work for industrial applications, but these limitations challenge wider adoption," Eastburn said.

"Sparkplug enhances MQTT for industrial applications by defining interoperable formats for MQTT topic paths and payloads as well as additional state awareness mechanisms. Together, these features enable auto-discovery of MQTT data, interoperable data exchange across domains, as well as the representation of more complex data types, metadata, and asset models," he added.

Automation challenges

Eastburn noted that most IIoT applications today still rely on point-to-point connections between software and hardware, like PLCs and sensors.

Infrastructure based on REST/HTTP or traditional industrial protocols is costly to scale up and produces data that may require additional translation and enrichment before it provides useful information. Security may be



SOURCE: OPTO 22

Poll-response protocols generate a lot more network traffic than report-by-exception.

non-existent, requiring extraordinary measures in order to safely integrate IT and OT networks.

Sparkplug simplifies data infrastructure, using MQTT as a foundational technology. Engineers can build systems that communicate securely among millions of clients while consuming 80 - 90% less bandwidth than traditional protocols, and Sparkplug reduces tedious tasks like tag mapping and client configuration because most of these details are abstracted away.

Progress and IIoT impact

"Smart devices were only the beginning of the solution. For industry, the bigger concern is the long-term cost of ownership, which has kept it from being a realistic vision for all but the largest organizations," Eastburn added. "We're just starting to understand out how to make IIoT happen in a way that is simple and affordable for most businesses. It turns out that doesn't necessarily require ubiquitous smart devices. In fact, there is more interest in extracting useful data from all the dumb devices we already have. With broader Sparkplug adoption, we'll be able to do that quickly, affordably, and repeatably."

Development of IIoT applications

He said that cybersecurity is a top concern inhibiting IIoT development that cannot be fully addressed by application-level solutions like Sparkplug.

"We need to see more hardware vendors taking on the challenge of providing IT-compliant networking and security technologies in automation devices if IIoT is really going to take off," he concluded.

"It's a matter of adoption"

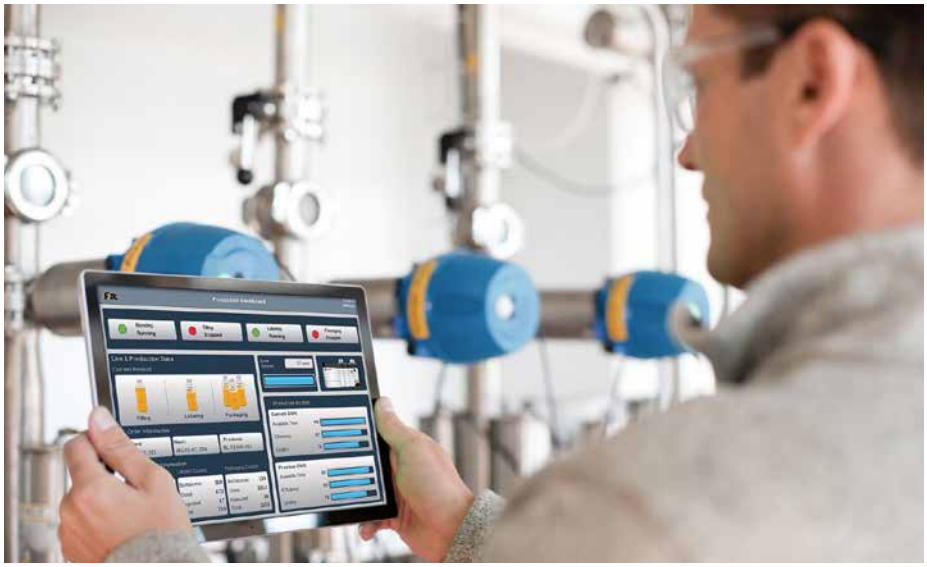
Technology offers new possibilities.

Brian Taylor, business director, Safety, Sensing and Connectivity at Rockwell Automation told IEB that wireless communications, machine learning and providing key technologies but also that all of the technology needed is available. Development of IIoT applications is more an issue of adoption.

Technology megatrends

"There's a lot of growth potential for wireless in production environments. It's still largely underutilized, more so in manufacturing operations than in remote industrial operations," Taylor said. "One reason wireless hasn't taken hold yet in manufacturing is because people go with what they know. And in manufacturing, people are simply more comfortable and familiar with using wired communications."

"Still, it's important to understand the benefits of using wireless. Specifically, it can deliver cost savings over wired communications



SOURCE: ROCKWELL

More companies are using data to detect problems sooner and increase productivity.

SOURCE: ROCKWELL

IIoT adoption has a steep learning curve and requires companies to develop new skillsets.

and provide easier access to IIoT data, which is the lifeblood of digital transformation initiatives. We could see wireless usage grow soon given the large number of brownfield facilities that need to be updated," he added.

Taylor said that machine learning is another technology that will continue to take hold and transform industrial operations in 2022.

There's been a strong focus on artificial intelligence (AI) applications in the industrial world in recent years. Machine learning applications and deployments are still only in their infancy. So far, it's mostly startups and early adopters that are embracing the technology. But that's likely to change soon. Because there's tremendous potential in using learning algorithms to understand the performance of machines and help them perform better.

Potential benefits

"Wireless communications are ideal for sensors and other data-producing devices that can help companies track the health and performance of their production assets. Wiring sensors can be a costly and time-consuming process for existing equipment. Wireless options are more cost effective," Taylor said.

More importantly, he noted that smart wireless sensors can provide access to data that – once cleaned and contextualized – can help companies operate more efficiently and with less unplanned downtime. By tracking the parameters that are important to them – whether it's motor temperature, vibration and voltage, or the speed of a belt – companies can identify issues early and potentially take corrective action before failures occur.

In remote operations, wireless can play an even bigger role. In mining, for example, it can help with remotely connecting and locating people, deploying autonomous transportation, and running ventilation-on-demand systems.

Machine learning can help companies take the performance of their machines or equipment to another level. Today, companies may have access to the raw data from these assets, but they may not have deep expertise in data science and industrial processes to turn the data into useful insights. Solutions like add-on modules for industrial controllers can use machine learning to predict anomalies or estimate operational variables. This can help drive improvements in throughput, product quality, process integrity and more.

Automation challenges

"Once implemented, wireless communications can help automation and control engineers identify issues earlier and take corrective action before failures occur, often resulting in less unplanned downtime," Taylor added. "That said, installing and troubleshooting wireless often requires other skillsets like IT. Understanding what to do with all the data also requires other skillsets like computer science. So, before wireless addresses challenges for control engineers, they will likely need to consult and collaborate with others."

His perspective is that machine learning will help engineers more easily and quickly identify and diagnose machine issues. Especially after a machine learns over time, it should significantly reduce the amount of time engineers spend walking around a factory floor diagnosing issues.

IIoT progress and overall impact

Taylor said there was strong interest in the IIoT early on. And certainly there were trailblazers who led the way and helped us get where we are today, with 9 in 10 manufacturers now saying digital transformation is important to their success.

"There's no denying, however, that IIoT adoption has been slow and steady. It has a steep learning curve and requires companies to develop new skillsets. It requires new investments, although those investments can start small. And many companies have simply held off investing until the use cases and value of IIoT technologies were well established, which they clearly have been," he said.

"Today, we're at a turning point. Companies are realizing that digital transformation is vital to staying competitive. Their resiliency has been tested by the pandemic, supply chain disruptions and a global skills shortage. Now, they're turning to automation and digitalization to remain productive and profitable amid these challenges," he added.

More companies are using data to detect problems sooner and increase productivity. Smart sensors on conveyor belts, for instance, can reveal areas of contamination. Smart sensors can also provide early warning of issues like bearing failures. Even safety data can play a role by providing a detailed picture of where, when, and why safety-related downtime is occurring.

Development of IIoT applications

"All the technology needed is available. At this point, it's a matter of adoption," Taylor concluded.

The skills shortage is a major factor that's driving adoption today. U.S. manufacturers cite an inability to increase revenue growth as the top consequence of not being able to fill jobs. Now, companies are using IIoT technologies in a wide range of ways to help mitigate this challenge.

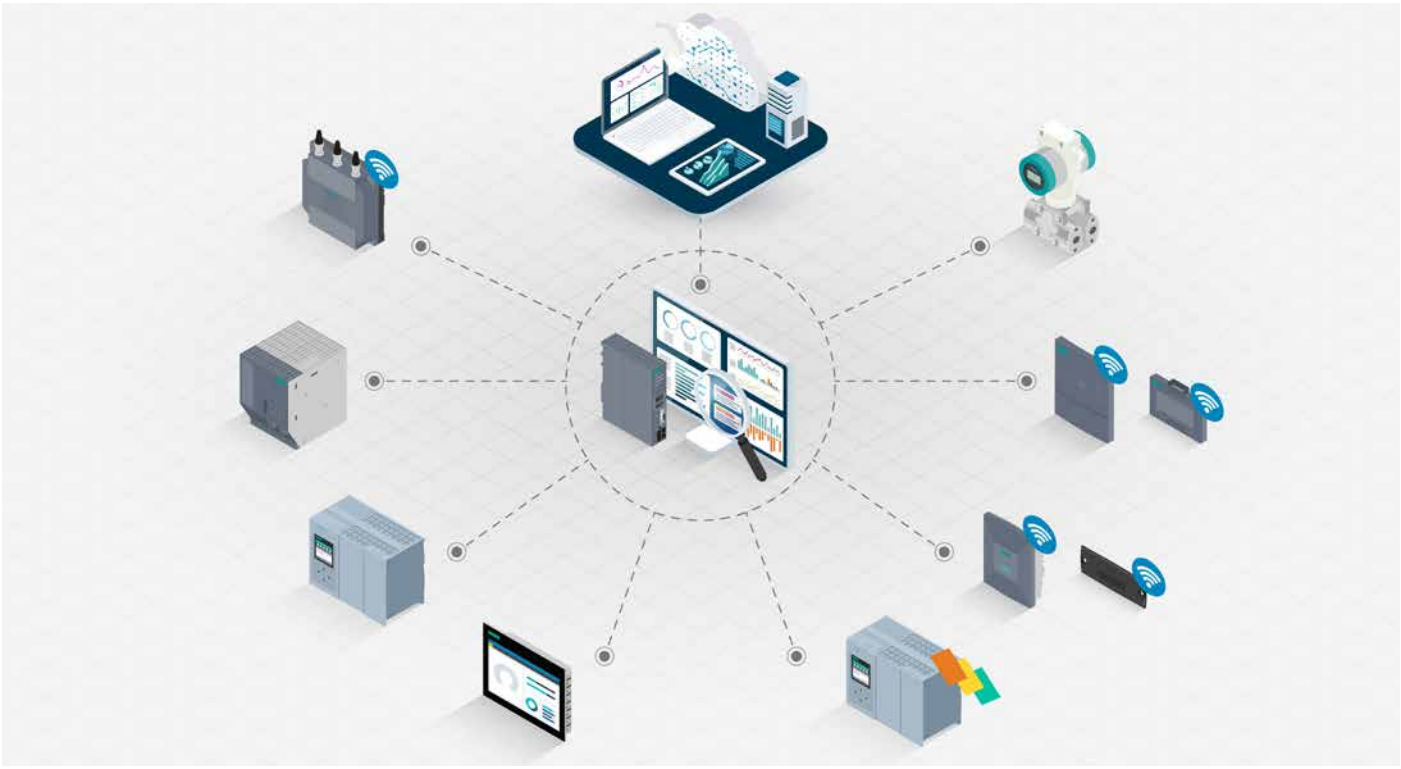
They're closing knowledge gaps and creating more connected workforces. They're using smarter devices that leverage AI and machine learning. They're using smart devices to enable preventative maintenance.

When implementing new technologies or techniques, like wireless communications, industrial professionals can learn a lot just by looking to their own homes. They can keep the control systems in their plants wired just like they'd keep the alarm system and smoke detectors in their home wired. But smart sensors aren't essential to uptime, so they don't need to be wired. Just like how smart TV remotes, lights or doorbells probably won't threaten your safety if their battery dies.

"All of that said, adopting IIoT technologies right now can be more difficult due to the instability in global supply chains during this pandemic. As supply chains are stabilized, companies will be more able to prioritize developing IIoT applications to address issues and provide business value," Taylor said.

IIoT architectures revolutionize production management

Ever shorter response times, increasing volatility and almost unmanageable complexity are bringing production challenges into sharp focus. But the IIoT is providing a new architecture for factory automation which enables an ultra-flexible production concept for companies – for greater adaptivity and resilience.



SOURCE: SIEMENS

In the industrial IoT, all automation components and smart objects are flexibly linked to one another and connected to cloud systems

THE DEFINING ARCHITECTURAL PATTERN IS still the so-called automation pyramid, which is characterized by a hierarchical structure and, due to lower bandwidths and processing capacities in the past, a compression per level. Production orders are controlled from the top (management level) to the bottom (field level) and enriched by additional (local) knowledge (e.g. robot programs) depending on the level. On the other hand, status information, sensor data etc. are compressed from bottom to top to an increasing degree.

Ultra-flexible manufacturing

However, to allow a new level of flexibility, the automation pyramid needs to be opened up. Fixed chains of processes will play an increasingly smaller role in the ultra-flexible manufacturing of the future; instead, there will be flexible machine parks that will be used dynamically, i.e. based on workload, for individual production orders. Fleets of automated guided vehicles (AGVs) will handle the transport of materials and semi-finished products. Other operations will involve multi-operable manufacturing islands, for example, in which skilled workers carry out a wide variety of assembly tasks and which are also controlled dynamically and based on orders.

Production chains will also become more resilient. If there is a sudden order peak or, conversely, a resource bottleneck, fast reconfiguration of manufacturing structures virtually in real time should be possible.

This will have a range of consequences: Firstly, infrastructure networks available as in every place equally will be required to operate the AGVs and reconfigure the machine parks. Secondly, factory management can no longer be top-down, but must be supplemented by data from the field level. This involves, on the one hand, information such as "Material XY has now arrived at production island 123" and, on the other hand, status data from devices such as power supply units to allow targeted and fast detection of any faults.

Finally, the factory of the future needs to function as an organism that is continually optimized and developed. It must be possible to access all required information at the press of a button, without needing to adapt control programs, for example.

Costs for data will be almost zero

In particular, the availability of all information is essential – also without knowing the specific use case beforehand. Its importance can be compared to that of Gutenberg's invention of the printing press. Before the printing press, replicating and distributing information (in the form of books) was extremely expensive and error-prone; it was necessary before the "copy job" to carefully consider which books were worth replicating and which were not.

However, with the invention of the printing press, costs decreased to a minimal level so that all authors could publish their work with low financial risk – and recipients could then decide what was useful and would therefore be bought and what would be forgotten.

For the factory of the future, the digital transformation and the IIoT play a similar role to Gutenberg's printing press. In this case, also, it is now the case that the replication, storage and processing of data is almost free, and this data is no longer only used in the context of advance planning, but is (possibly) used when it transpires to be important at some time in the life cycle of the factory.

SOURCE: SIEMENS

In the Fürth factory, RTLS transponders are the visible sign of data-driven production management.

However, this necessitates architecture that goes beyond silos and hierarchical aggregation. This data-driven factory allows incremental learning because new benefits can be obtained from the data step by step, application by application. The IIoT, as a result, provides the basis for data-driven management of the processes, all the way to the development of AI applications for specific, complex tasks.

Factory management consequences

What does this mean specifically for production management? In the data-driven factory, for example, a production order is not simply put into production, but automatically reconciled with the actual availability of the material at the assembly site. This eliminates search and waiting times, which instead can be utilized productively. By integrating predictive maintenance, it is possible to synchronize unplanned maintenance work with production planning in advance. Ultimately, the IIoT architecture provides the basis for new factory layouts, in which only a loose link between individual machine parks exists instead of a fixed production chain. The control and the coordination of machine utilization, mobile transport vehicles and robots, material flow, and employees are crucial here – and can only be regulated based on "real-world information".

Which technologies and concepts are required for this? A few examples:

Mobile machines and robots: Industrial Wireless LAN and Industrial 5G are used for the communication between mobile machines and robots. Here, 5G in particular will offer an infrastructure that also meets real-time requirements/offers significantly greater bandwidth for the implementation of even complex applications (e.g. use of autonomous transport vehicles on a large scale).

Integration of assets without communication capability – things become smart objects: Radio frequency identification (RFID) and real-time locating systems (RTLS) enable data-based integration of movable assets that possess no communication capability themselves, e.g. material boxes, intermediate products, and tools. RFID enables the direct identification at machines or transfer points and – when smart labels are used – can also serve as permanent identification. RTLS offers identification and localization in real time and – when display transponders are used – can also enable new ways of human-machine communication.

Predictive maintenance: Sensors and field devices supply data from machinery and equipment on site that is not directly needed for automation. Intelligent devices – such as Sitop power supplies with communication capability – can feed the data directly into the factory management, e.g. to collect power consumption profiles. Since many sensors are already connected to a programmable logic controller (PLC), the PLC can also be used as a "data collector" via suitable modules.

At the core of this architecture is a high-performance and flexible network infrastructure that meets the special requirements of OT (availability as top priority with tiered quality-of-service levels), supplemented by a management platform for operation, diagnostics, and optimization.

Data captured in this way can be used in different architectures and applications. Edge devices handle this data close to the process. A cloud-based solution with Data Lake enables comprehensive evaluation and serves as a basis for factory management. Moreover, the data can be distributed across multiple sites and even beyond company boundaries. As a result, suppliers and customers can also feed delivery or demand information in real time into the system of the data-driven factory.

Practical examples

These concepts have found initial use in various Siemens factories. The factory in Fürth is considered a "low volume/high mix" manufacturing plant, i.e. an unusually diverse variety of products is produced, but in strongly fluctuating and sometimes low quantities. In comparison with mass production, secondary processes such as material transport or setup times play a much greater role than if the same product were to run on the line day after day.

Ultimately, it entails the reversal of the former Industry 2.0 paradigm, which sought economies of scale through a high output quantity. In Fürth, this is achieved by moving away from permanent work spaces and by introducing dynamic self-organization instead of predefined cycles. The Simatic RTLS real-time locating system plays a key role here. Every material container ("black box") is equipped with an RTLS transponder, which also has a display. This means the position of the order materials can be tracked at all times. However, in contrast to conventional production planning, the order is only displayed to the worker when the material is on site, making expensive mistakes a thing of the past.

A further application of RTLS is in AGV management. Although each AGV is intrinsically safe and stops at obstacles (e.g. when two AGVs meet), this results in time-consuming evasive maneuvers where the AGVs slowly edge past one another. It is better to control the vehicles from a control center, for example in order to stop a crossing AGV until the main route is clear or to provide an alternative route in the event of disturbances – a task perfectly supported by RTLS.

An example of how suppliers can also be involved in the IIoT architecture can be found in the Siemens factory in Karlsruhe, which was recently named "Factory of the Year". In cooperation with Würth Industrie Service, an electronic Kanban system for so-called C parts (screws, bolts etc.) is operated here. The products are supplied in RFID-tagged containers. When a container is empty, the worker places it on a specific shelf equipped with RFID readers. The container number is read out via mobile wireless communication based on SCALANCE M routers and transferred to Würth order management. In this way, instead of waiting for a manual order, Würth detects volatile requirements immediately and can react to them within a very short time. This means lower workload with higher process quality and adaptivity for both sides – Siemens and Würth Industrie Service.

Collaboration, creativity, technology

The results show it's often relatively small steps that put companies on the right path. The required technologies are ready and have been extensively tried and tested. But to realize IIoT applications, the way we work together needs to be rethought away from departments and towards multifunctional teams. Collaboration, creativity and the right technologies are key to the factory of the future.

Markus Weinländer, Head of Industrial Connectivity Products, ***Siemens.***

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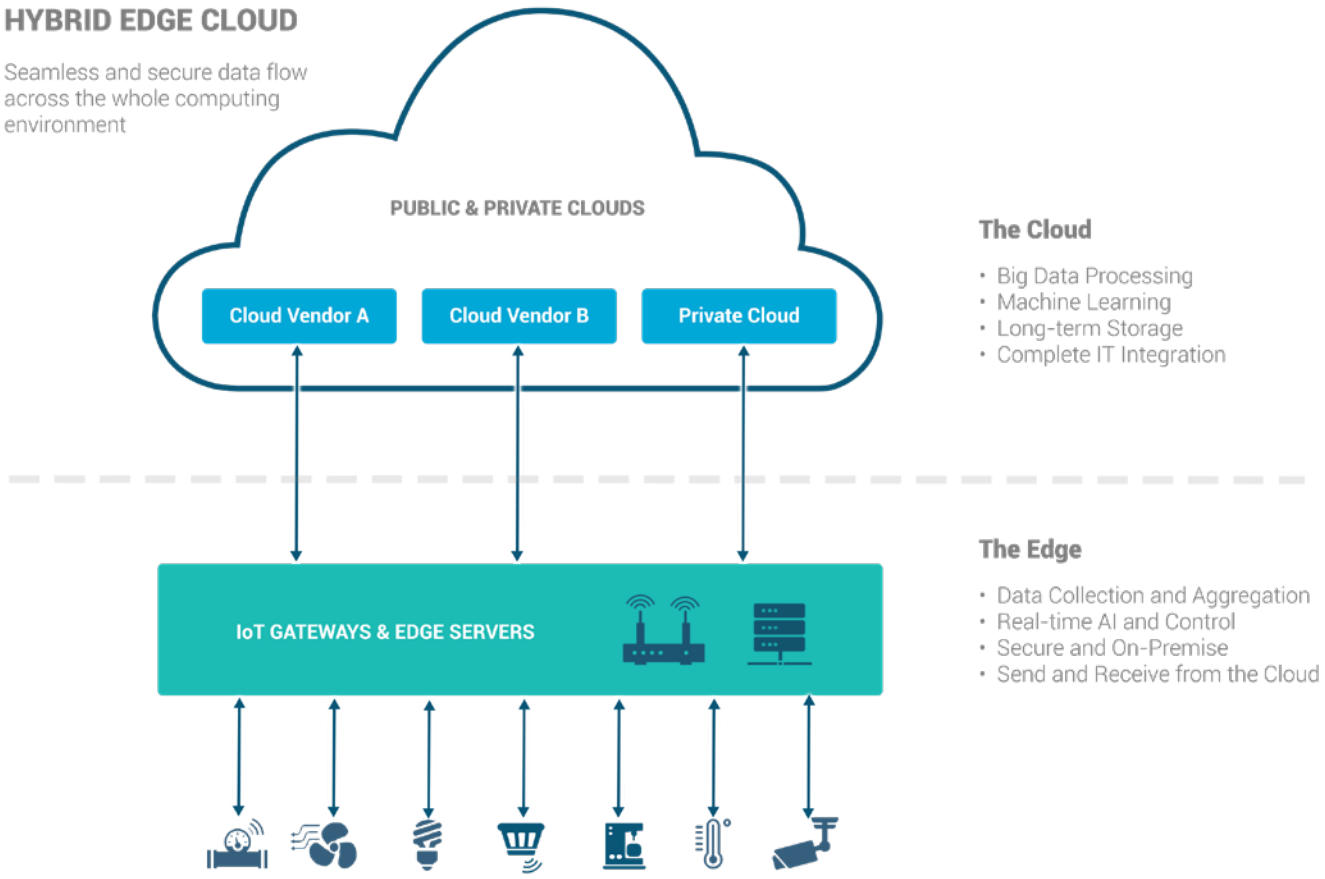
AI and hybrid edge-cloud to dominate IoT in 2022

Top predictions for edge computing are related to technology advancements, architectures and impact to industries. The effect of edge computing on blockchain, and other digital ledger technologies, will become clearer in a few years. Similarly, 5G's impact on edge computing is still too early to predict.



SOURCE: IO TECH

One prediction for 2022 is that organizations are finding that processing edge data needs to be performed at the edge, and in the cloud or enterprise.

FIVE PREDICTIONS FOR EDGE COMPUTING in 2022 include a proliferation of artificial intelligence (AI) and machine learning at the IOT edge and edge-cloud architectures as the norm.

IOTech's has reported a series of 2022 predictions are related to technology advancements, architectures and impact to industries.

The company believes that the effect of edge computing on blockchain and other digital ledger technologies will become clearer in a few years. Similarly, 5G's impact on edge computing is still too early to predict.

"This past year, we've seen edge computing emerge from pilot programs to deployments," said Jim White, CTO, IOTech. "We believe 2022 will be the year that edge computing is fully integrated into the architecture of every major industrial IoT system."

Prediction 1: There will be pervasive adoption of AI/ML at the edge

The new status quo is that edge systems will incorporate AI and machine learning. Simple rules engines and edge analytics are already at the edge. Today, organizations demand more intelligence at the edge. The raw compute to run AI/ML at the edge was a prohibiting factor, but this is no longer the case.

While training ML systems will largely occur in the cloud or in the enterprise, ML models running on lighter AI runtime engines at the edge are more common place and will soon be the norm.

Visual inference has been a leading use case, but other AI/ML solutions are soon to follow. Edge platform providers will play a key role in developing solutions that can easily integrate AI/ML technologies.

Prediction 2: Hybrid edge-cloud architectures will be the norm

It's not edge compute "or" cloud compute, it's a case of "and". Organizations are finding that processing edge data needs to be performed at the edge and in the cloud or enterprise. Although initially there was much excitement related to the cloud providers reaching down to the edge, the reality is that there are significant challenges in moving all edge data to the cloud and performing all the processing in the cloud.

The cost of data transport, latency issues and security/data privacy concerns are among the chief challenges. Likewise, the raw processing power of the edge and ability to do deeper exploration of the edge data over longer periods of time for better insights means edge computing alone is not a solution.

Solutions must allow for the right processing at the right levels, and this calls for hybrid edge-cloud architectures.

Prediction 3: The industrial sector emerges from edge/IOT research mode

The industrial sector is becoming focused and organized in its effort to offer new solutions at the IoT edge. Businesses in manufacturing, building automation, and smart energy are in full "build" or "buy" mode for IoT edge solutions.

Many large industrial sector businesses are fully committing to grow their edge/IoT products and strategy. Buy mode leads when companies need to accelerate digital transformation.

Prediction 4: Customers will demand solutions rather than pieces/parts

Companies looking to benefit from edge/IoT technology are looking for more fully integrated solutions. They want immediate tangible business outcomes and are not interested in receiving a bucket of technology parts that they then have to pull together themselves.

For system integrators, it means developing the right technology partnerships to pre-assemble and deliver complete solutions to customers. Integrators will naturally gravitate to edge products that are inherently more open and flexible as these will be easier to integrate and adapt to more use cases.

Prediction 5: Realization that K8s is not enough edge management

Organizations deploying and orchestrating IoT/edge applications are discovering that Kubernetes is not always a fit in resource constrained edge environments. Furthermore, K8s only addresses part of the edge management need. There is more to edge management than managing/monitoring containers.

An edge management solution must deal with preparing, managing, and monitoring the host edge nodes, allow for rapid configuration changes, and even assist in sensor/device onboarding. K8s will be part of some edge management solutions – where there are more resources or smaller K8s solutions (K3s as an example) can be applied.

However, the thin, resource constrained, network constrained, latency concerned, sometimes non-containerized, OT device-touching environments demand alternative and more complete edge management solutions.

In addition to these predictions, the company also offered these insights:

Traditional IT hardware OEMs will need to develop edge/IOT strategies

Edge solutions don't start with the selection of IT hardware. They start by addressing the challenge that is being solved or the outcome that is needed and then building the right system to meet these requirements. As the IoT edge becomes ubiquitous, all layers of the architecture need to be an effective part of the solution. IT hardware OEM vendors need to ensure they have a vision and strategy in the edge/IOT space or risk becoming irrelevant or a commodity to edge customers.

Digital twin standards are needed to ensure pace of innovation

The current lack of a digital twin standard is hampering adoption and requiring organizations to roll their own interoperability solutions or be locked into a single provider's implementation. With digital twin technology increasingly becoming a sought-after part of the IoT solution, a standard is the next logical and crucial step to drive innovation.

The use of digital ledger technology (i.e., block chain) will start to grow

The need to deliver data from the edge with trust and confidence--and to be able to govern its ownership and distribution given the distributed nature of edge data—clearly points to the use of block chain and other digital ledger technology. At some point in the not-so-distant future, organizations implementing edge solutions will want to monetize edge data and will look to properly protect, label, distribute and score edge data.

Noise level for edge and 5G will continue

From an edge platform perspective, 5G provides a bigger, stronger, less latent pipe between the edge and the enterprise or cloud. Because it can reduce latency, 5G can allow more processing to occur in the cloud.

5G could become more interesting to edge/IoT solution providers as telecos work toward implementation of private (or semi-private) 5G installations in factories, stores, campus, etc. that allow more "things" to be connected but in a secure and isolated way.

COVID sped up challenges that were already exhibiting

Supply chain issues and human resources challenges were already beginning to be exhibited prior to the pandemic. COVID accelerated and heightened these issues for organizations. As businesses and industries emerge from the pandemic, 2022 cannot be a return to normal.

Companies must innovate and use technology to address the aforementioned challenges. Therefore, IOT edge adoption will accelerate. It will be the year that companies transition from research and pilot programs to launches and deployments at scale.

Partnership with Google Cloud to provide integrated Edge-Cloud solutions at scale

IOTech's IoT platforms, Edge Xpert and Edge XRT enable Google Cloud customers to extract and process data from a broad range of OT devices at the edge.

IOTech announced it is expanding its partnership with Google Cloud to offer smart and integrated edge-cloud solutions for enterprise companies. With this partnership, industrial users including manufacturing, building automation, and smart energy can now deploy smart, no-code and integrated edge-cloud solutions at scale.

This expanded partnership will impact industrial IoT deployments which come with certain challenges including OT/IT integration. The northbound communication protocol to Google Cloud is typically MQTT or REST while the southbound communication protocols include Modbus, BACnet, Ethernet/IP, S7, OPC-UA and many more. Other challenges industrial users face include the ability to extract data from old, and legacy IoT devices and the ability to control what data specifically is sent to Google Cloud, mainly for security, latency and/or cost reasons. Edge computing capabilities and features therefore play an increasingly important role in industrial IoT.

The partnership allows the industrial user to deploy a smart, no-code and integrated edge-cloud solution at scale. IOTech's Edge Xpert typically resides on the edge gateway or server level while Edge XRT can reside on legacy or resource-constrained hardware such as MCUs and PLCs, typically found at the far edge.

Both platforms come with 20 plus OT connectors including Modbus, BACnet, Ethernet/IP, S7, OPC-UA, and many more. The platforms also include an SDK making it easy for customers to build new OT connectors, if required. Seamless data integration with Google Cloud is provided as standard.

"IOTech is excited to be a Google Cloud Edge ISV partner. The integrated edge-cloud solution allows for fast deployments, reducing the time to value. Adding an OT device is enabled through simple configuration and no coding skills are required," said Keith Steele, CEO of IOTech Systems.

*Technology report by **IO Tech.***

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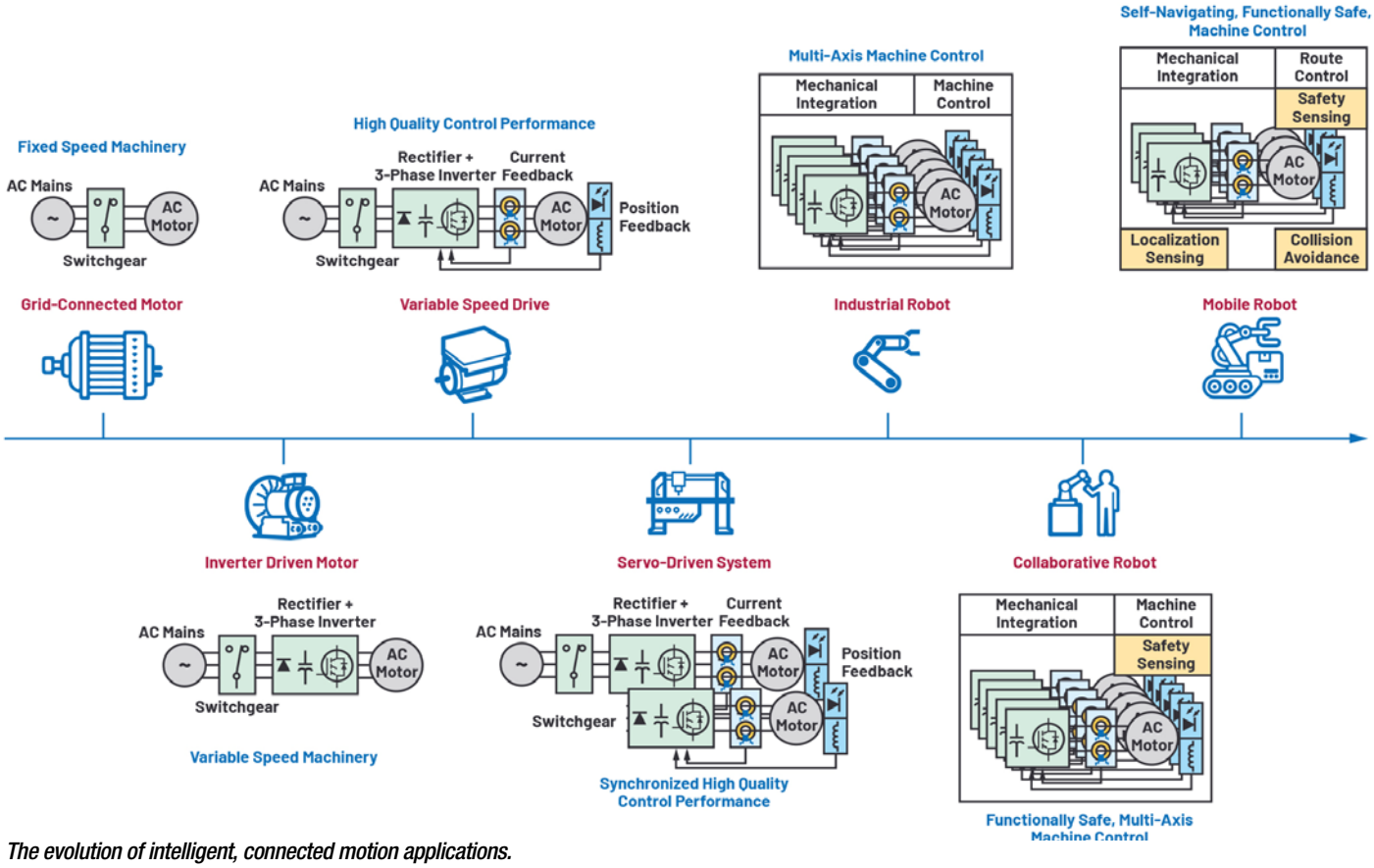
Flexible, productive, sustainable smart manufacturing

Smart manufacturing using intelligent motion control supports more agile and scalable manufacturing, including batch size 1 production. By optimizing the manufacturing flow for higher throughput, less energy is consumed resulting in more sustainable smart manufacturing.



SOURCE: ANALOG DEVICES

The evolution of intelligent, connected motion applications.

INTELLIGENT MOTION CONTROL IS THE CORE building block of smart manufacturing, enabling highly flexible and efficient manufacturing. Intelligent motion control combines precision feedback, advanced sensing, high performance control, and seamless connectivity to deliver deterministic motion solutions.

Seamless connectivity of motion insights to PLCs and manufacturing execution systems (MES) allows advanced analytics to optimize manufacturing flows and identify potential issues before production stops.

Smart manufacturing using intelligent motion control can be reconfigured quickly to support more agile and scalable manufacturing, including batch size 1 production. By reducing the time to complete a manufacturing step and optimizing the manufacturing flow for higher throughput, less energy is consumed resulting in more sustainable smart manufacturing. Intelligent motion applications include: pumps, fans, hoists, VAC, conveyors, winding, printing, extrusion, machining, robotics, pick and place, handling, and many others.

Intelligent motion solutions

Motion control has evolved over time, from simple grid connected motors to complex multi-axis servo drive solutions for machine tools and industrial robots. This evolution has been accelerated by the increasing complexity of automation required to deliver higher levels of productivity, flexibility, and autonomy in smart manufacturing.

Grid-connected motors

The most basic motion solutions are based on a grid-connected or AC-powered, 3-phase fixed speed motor that uses a switchgear to provide on/off control and protection circuitry. These basic motion solutions run at a relatively fixed speed, independent of any load variation. A reduction in output is implemented with mechanical controls—throttles, dampers, gears or valves, pumps, and fans are some typical asset examples.

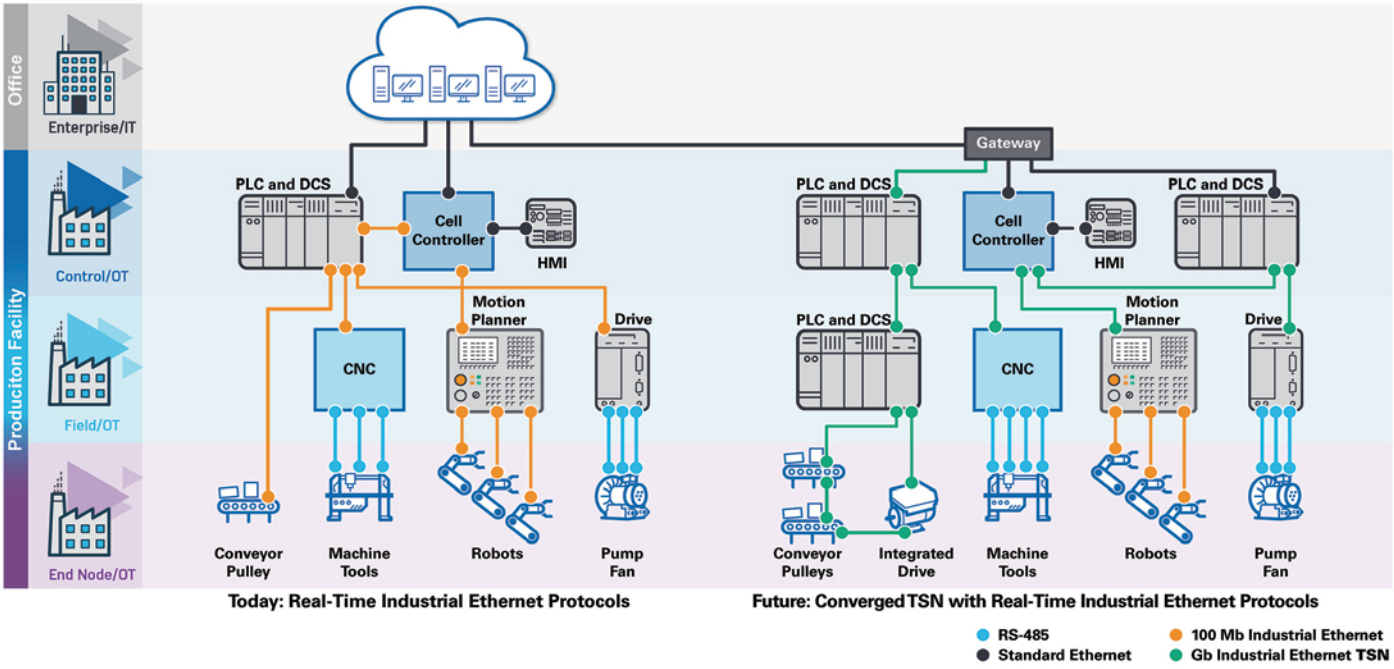
Inverter-driven motors

The addition of a rectifier, DC bus, and a 3-phase inverter stage in effect creates a variable frequency and variable voltage source that is now applied to the motor to enable variable speed control.

This inverter driven motor enables significant reduction in energy consumption by running the motor at the optimum speed for the load and application. Examples include higher efficiency pumps and fans.

Variable speed drives

For higher performance motion control applications, a variable speed drive (VSD) enables accurate torque, velocity, and position control. To achieve this, current and position measurement are added into the



SOURCE: ANALOG DEVICES

Digital transformation is being enabled by seamless Industrial Ethernet connectivity.

basic open-loop inverter drive. More precise control of motor velocity, position, and torque is then possible. Conveyors, winding, printing, and extrusion machinery are typical examples of these applications.

Servo-driven systems

Synchronized, multi-axis servo-driven systems are used in more complex motion applications. Machine tools and CNC machines require synchronization of multiple axes, with extremely accurate position feedback. In CNC machining, 5-axis coordination is common, although there are applications that utilize up to 12 axes in which tools and workpieces are both being moved with respect to each other in space.

Collaborative and mobile robots

Industrial robots require multi-axis servo drives combined with mechanical integration and advanced machine control algorithms to achieve complex 3D spatial positioning. Robots typically have six axes that need to be controlled in a coordinated manner, and sometimes seven if the robot is moving along a rail.

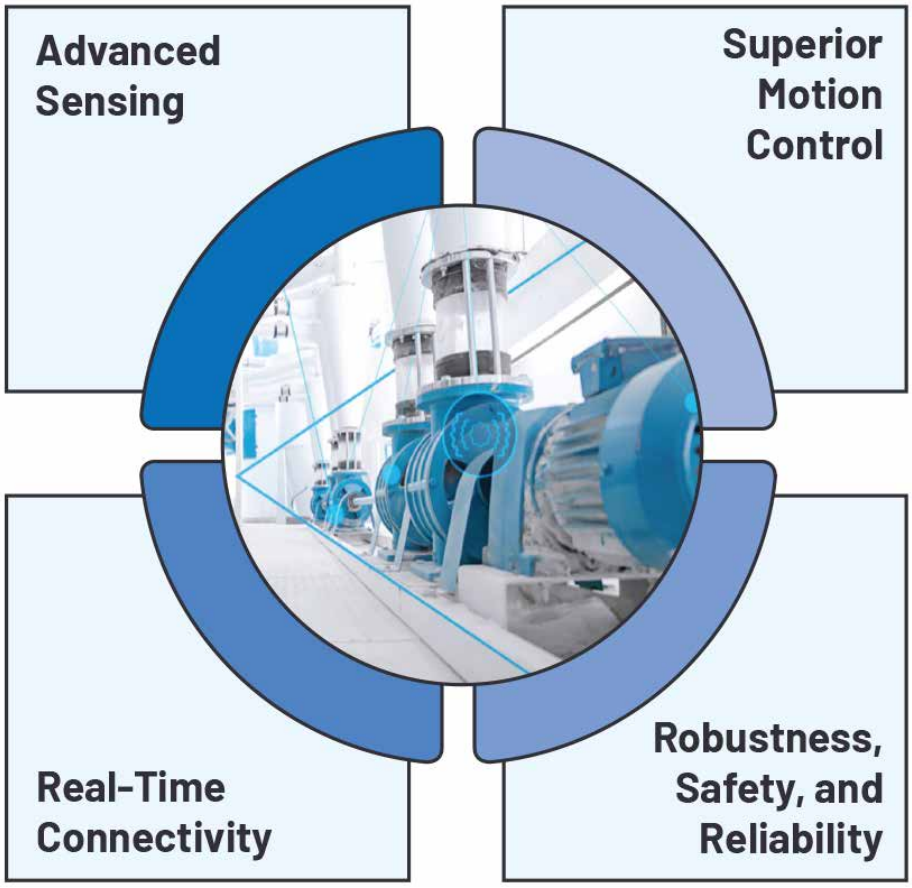
Collaborative robots (cobots) build on industrial robotic solutions by adding power and force limiting (PFL) to deliver functionally safe, multi-axis machine control where an operator can work safely alongside the cobot. Finally, self-navigating, functionally safe machine control is deployed in mobile robots, with localization sensing and collision avoidance.

Intelligent motion growth drivers

Intelligent motion control is being accelerated by four key growth drivers: reduced energy consumption, agile production, digital transformation, and the move toward new service-based business models based on reducing downtime and increasing asset utilization in smart manufacturing. Let's look at each of these four key growth drivers in detail.

Reduced energy consumption

Almost 70% of electricity consumed by industry is used by electric motor systems. Intelligent motion solutions are delivering and will continue to deliver significant reductions in energy consumption by moving more applications from fixed speed motors to high



SOURCE: ANALOG DEVICES

Intelligent motion requirements.

SOURCE: ANALOG DEVICES

Key technologies to accelerate higher value motion solutions with access to system insights.

efficiency motors and variable speed drives, in part driven by energy efficiency regulations. This reduction in energy consumption will enable more sustainable manufacturing. Access to motion insights that optimize a manufacturing flow will further reduce energy consumption in smart manufacturing.

Agile production

As industries are adapting to keep up with consumer demand and changing buyer behaviors, agile production, based on reconfigurable production lines, is required to deliver more customization and faster turn-around times. Consumer demand is driving a shift away from low mix, high volume manufacturing toward high mix, low volume manufacturing, which demands greater flexibility on the factory floor.

Complex, repetitive, and often dangerous tasks can now be performed by industrial robots, leading to higher throughput and increased productivity. Agile production increases resilience in a time of disruption and enables a faster response to changing customer demands.

Digital transformation

Global spending on digital transformation will reach $6.8 trillion globally by 2023.2 Variable speed drives and servo drives use data from voltages, currents, position, temperature, power, energy consumption combined with external sensors for monitoring vibration, and other process variables. With a converged information technology/operating technology (IT/OT) Ethernet network, motion applications are networked together communicating data and insights. Motion data and insights are now more accessible and can be analyzed by powerful cloud computing and AI to optimize manufacturing flows and monitor the current state of health of the assets across the entire installation.

Business models for deployed assets

Asset manufacturers are looking to sell more than just assets—they want to expand their business models to include post-sales services contracts based on productivity and asset utilization. For example, a pump manufacturer wants to use new predictive maintenance service offerings to sell based on volume of liquid (for example, water or fuel) pumped and charge based on per cubic meter (m3) pumped rather than just sell pumps. 50% to 60% of the revenue of pump OEMs is expected to be generated from services-related activities in the next five years.

System integrators want to charge based on the uptime of the manufacturing capability they installed and not just charge based on the initial installation of the assets. New intelligent motion solutions are integrating condition monitoring capabilities to implement real-time monitoring of the assets' health to plan maintenance schedules. This monitoring can eliminate unplanned asset downtime to deliver higher levels of productivity and asset utilization, which are the cornerstones of the new service-based contracts.

Intelligent motion requirements

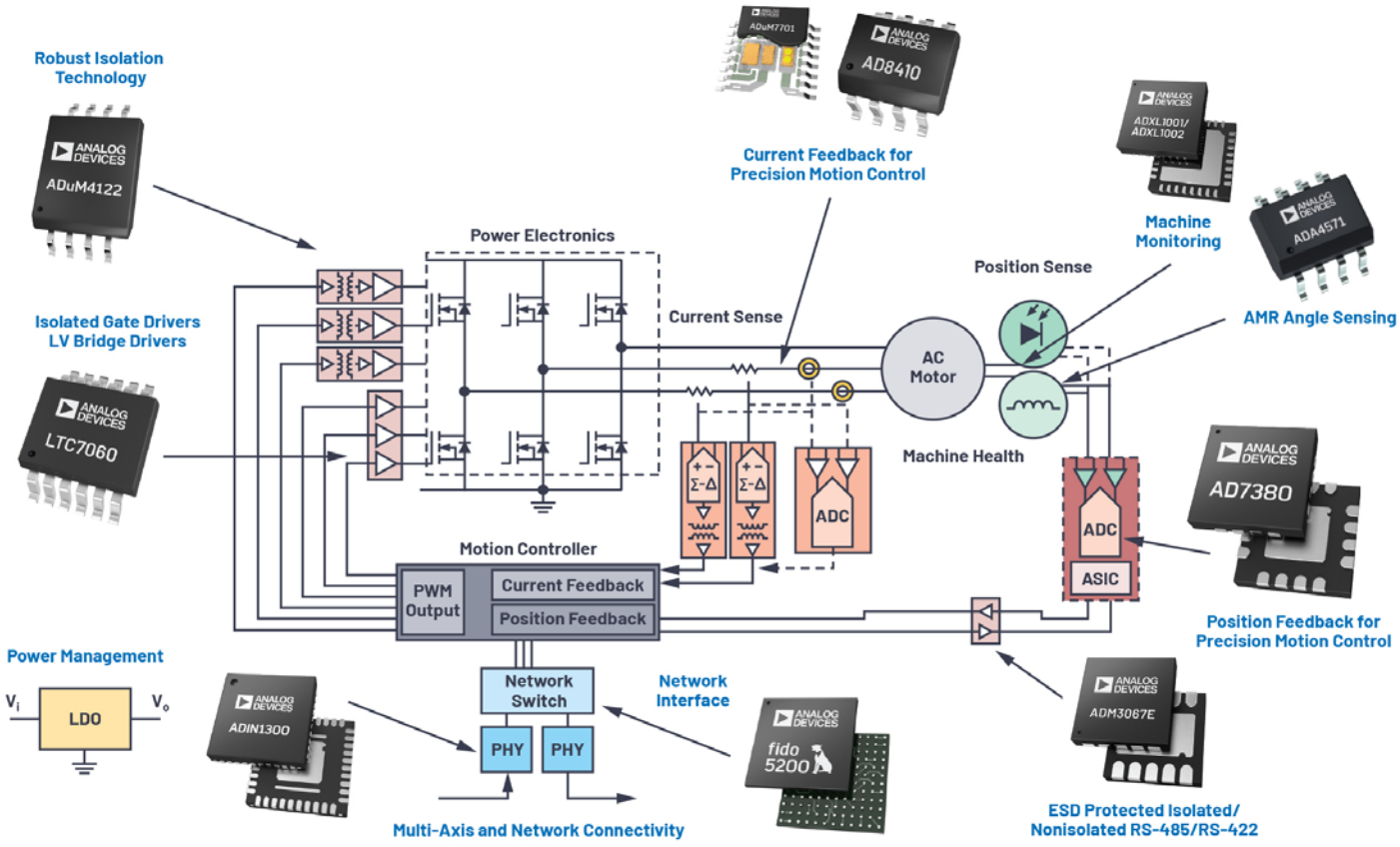
To enable higher levels of productivity and sustainability in smart manufacturing, new advanced motion control solutions are required to deliver the benefits of the four growth drives outlined.

Superior motion control

Superior motion control reduces the time it takes to complete a manufacturing step, thereby increasing throughput and manufacturing productivity while reducing energy consumption. Examples include precise position and torque control for higher quality and faster machining, such as by reducing the number of steps and time to machine a complex component. The key requirements to deliver superior motion control include improved control loop performance, robust solutions for harsh industrial deployments, and high levels of integration to enable high reliability, small form factor solutions. These are in turn enabled by low latency, low drift, multiphase current and position sensing and signal chains with high transient robustness and highly integrated components.

Robustness, safety and reliability

Robust, reliable solutions that extend assets' usable lifetimes are key to more sustainable



SOURCE: ANALOG DEVICES

Analog Devices solutions for intelligent motion applications.

smart manufacturing. By extending asset lifetimes, we significantly reduce the consumption of raw material and energy to build replacement assets.

Power management solutions for both power regulation and power protection are key components to deliver more robust and reliable assets. Power management requirements include high-side power supplies for insulated gate bipolar transistors (IGBTs), high power density solutions for FPGA and processors, digital point of load (PoL) for power management telemetry, EMC robustness, high ambient temperature operation, and data and power isolation to protect users from high voltages.

Reliable use of new wide band gap power switches (made from silicon carbide (SiC) and gallium nitride (GaN)) puts new challenges and requirements to provide fast overcurrent protected systems and robust operation.

Real-time connectivity

In high performance, multi-axis, synchronized motion applications, control timing requirements are precise, deterministic, and time critical, with a requirement to minimize end-to-end latency, especially as control cycle times get shorter and control algorithm complexity increases. These high performance applications require real-time connectivity with sub-ms network cycle time to control complex motion applications.

Smart manufacturing uses vision systems alongside motion applications to monitor manufacturing quality and increase production safety. Industrial Ethernet networks must support the coexistence of both real-time deterministic motion control traffic and best-effort vision traffic on the same network up to Gb bandwidth.

The interoperability of devices and controllers connected to the networks is required to deliver seamless data flow throughout the manufacturing installation and ensures data transparency to the higher-level management systems while making these networks more flexible and scalable by reducing commissioning time. A converged (IT/OT) Ethernet network ensures seamless access of motion insights to the higher-level management software systems, for analysis, to optimize the manufacturing flow and accelerate digital transformation.

Advanced sensing

Advanced sensing solutions create motion insights that can be used to optimize the manufacturing flow and detect early signs of failure. Sensing modalities include position, current, voltage, magnetic field, temperature, vibration, and shock. New business models are being created by using advanced sensing to deploy real-time monitoring of an asset's health to provide predictive maintenance services contracts based on increasing asset uptime. Advanced sensing requirements include robustness in harsh industrial environments (for example, those with a lot of dust), accurate position sensing, contactless high current sensing, high bandwidth current and vibration sensing, reduced calibration to ensure accuracy of the solutions, and small solution sizes for encoder type applications.

Technologies to accelerate higher value motion control solutions

A combination of technologies is required for the next generation of intelligent motion control solutions for smart manufacturing. These technologies when combined deliver robust, precise motion control for harsh industrial deployments with access to system insights from advanced sensing.

Precision measurement

Complex motion control requires precision converter technologies for high quality current feedback utilizing both isolated and non-isolated solutions to provide control loop performance that is both highly accurate and has fast transient response. Current feedback is the fundamental building block to enhancing drive performance and determines the overall control bandwidth and response time. Key requirements for current feedback include synchronized measurement with PWM cycle, isolated or high common-mode measurement, low offset drift to minimize torque ripple, and low latency simultaneous sampling at 14- to 18-bit resolution to measure phase currents. Precision converter technologies are also

required for accurate position measurements in encoders and linear track applications that can deliver greater throughput and increase productivity.

Isolation and interface

Next-generation drives and motors that enable complex motion control require digital isolation technology to provide isolated data and isolated communications interfaces such as RS-485, USB, and LVDS. Isolated gate drivers are also needed to drive high- and low-side power semiconductors to provide robust, safety compliant, and high reliability assets.

Gate drivers convert the logic-level PWM signals to high-side referenced signals that control power transistors. High voltage inverter applications often use IGBTs, with a future trend toward SiC and GaN to increase switching frequency and/or lower switching losses. Low voltage applications typically use MOSFET-based switches.

The key requirements for gate drivers include high speed, low propagation delay, low delay skew, robustness and common-mode transient immunity, switch protection features (DESAT, Miller clamp, soft shutdown, UVLO), and controllable switching (variable slew rate switching).

Standard digital isolators play a role in many drives in transferring signals between high voltage power electronics domains and safety extra low voltage (SELV) domains for PWM and other signaling. Examples include isolated signaling for integrated power modules (IPM). Fully integrated isolated power solutions can also be combined with digital isolators or other isolated functions to provide significant solution size reduction compared to a discrete transformer solution.

Industrial Ethernet

Industrial Ethernet connectivity with sub-ms cycle times network performance is required for deterministic real-time communication in motion control applications (servos and drives). Robust physical layer devices at 100 Mb and Gb speeds combined with layer 2 Industrial Ethernet protocols such as EtherCAT, PROFINET, EtherNET/IP, and IEEE time sensitive networking (TSN) ensure deterministic Ethernet connectivity.

Next-generation designs are moving to Gb TSN on converged networks with multiple traffic types, cyclic communications for control, and acyclic communications for best effort traffic (for example, vision and monitoring traffic). Low latency Industrial Ethernet solutions are required to reduce cycle times in multi-axis applications. These deterministic motion solutions enable more complex motion applications that drive higher levels of manufacturing productivity and flexibility.

Magnetic sensing

Magnetic sensing based on anisotropic magnetoresistance (AMR) position sensor solutions enables robust and accurate position sensing for encoder applications. Position feedback is used for direct position control or for inferring rotational speed and implementing machine speed control in servo drives. Magnetic sensing provides a lower cost solution compared to optical encoders and a more robust solution in industrial applications that are subject to dust and vibration.

Power management

Intelligent motion applications are typically deployed in harsh industrial environments where high ambient temperature operation is required, along with immunity to conducted noise and high voltage transients. In some decentralized applications, drives are located closer to the motor in smaller enclosures and, in other applications, the drive is integrated with the motor. Higher power density power management solutions that operate at high ambient temperatures are required to enable these smaller form factor intelligent motion applications.

Machine health

Machine health uses vibration and shock sensors to enable real-time condition monitoring of an asset's health to eliminate unplanned downtime, extending the asset's useable lifetime while also reducing maintenance costs. By integrating machine health into motion applications, new revenue streams can be generated though digitization strategies that create new service-based business models based on guaranteed uptime to enable higher levels of manufacturing productivity. Asset health data based on vibration, shock, and temperature is transformed into asset health insights by edge AI, which are then communicated via wired or wireless solutions to the management control software where they provide real-time state of health of key assets.

Conclusion

Agile production is required to quickly respond to changing consumer demands and support efficient production, down to a batch size of 1. Agile production is enabled by intelligent, connected assets that can be reconfigured quickly. These connected assets share data in real time; this data is used to improve operational performance by identifying bottle necks in production and by monitoring the health of assets to eliminate unplanned downtime.

Smart manufacturing that is built on intelligent motion solutions consumes less energy and enables more complex motion to drive higher levels of flexibility, productivity, and sustainability.

Intelligent motion control solutions

Analog Devices technologies and system-level solutions for intelligent motion applications are enabling higher levels of performance while reducing energy consumption and downtime. A typical motor drive signal chain is comprised of six key blocks.

Power electronics

Power electronics provide the power conversion in a motor drive system. For high voltage systems (>100 V), an isolated gate driver is used to drive the power semiconductors. ADuM4122 is a single-gate isolated gate driver with 3 A short circuit (<3 Ω). It supports functional or reinforced isolation up to ~800 V DC bus with slew rate control for EMI/power loss optimization.

It also supports high common-mode transient immunity (CMTI) and low propagation delay for use with SiC and GaN power semiconductors.

ADuM160N multichannel digital isolators can be used to isolate PWM signals for use with integrated power modules (IPM) that integrate the gate driver with the power semiconductor. The ADuM6028 isolated power device can be used in conjunction with digital isolators, isolated transceivers, and isolated data converters to provide a very small 8-lead solution that is fully safety certified and ready to use.

For low voltage systems (<100 V), the LTC7060, a 100 V half-bridge driver with floating grounds and programmable dead time or the LTC7000, a 150 V protected high-side NMOS static switch driver with PassThru technology and adaptive shoot-through protection can be used to drive low voltage semiconductors.

LTC7000 also supports programmable dead time for efficiency optimization, enhanced current control, and slew rate control for EMI reduction.

Current Sense

For isolated current sense measurement, the ADuM7701 is a high performance, second-order, sigma-delta modulator that converts an analog input signal into a high speed, single-bit data stream with on-chip digital isolation based on Analog Devices iCoupler® technology.

ADuM7703's low offset drift (0.6 µV/°C max) reduces torque ripple and is packaged in a compact 8-lead package with integrated LDO to simplify power supply design and reduce board area. Its 150 V/ns min CMTI rating enables use with GaN and SiC power electronics.

AD8410 high voltage, current sense amplifiers provide a high gain (20 V/V, 50 V/V, 100 V/V) and low offset drift (~1 µV/°C) with high bandwidth (2 MHz) for optimum current control. AD8410 also includes bidirectional current measurement input up to 100 V

Industrial Ethernet connectivity with sub-ms cycle times is required for deterministic real-time communication in motion control applications.

common-mode input. The LTC6102 precision zero-drift current sense amplifier ensures accuracy across a wide range of operating conditions and can be powered from high-side voltages up to 100 V in shunt-based current sensing applications.

Position sense

Position feedback is used for direct position control or for inferring rotational speed and implementing machine speed control. ADA4570 and ADA4571 integrated AMR angle sensors with integrated signal conditioners enable higher absolute accuracy position sensing for motor drive and servo applications (<0.1° error, <0.5° over life/temperature).

They are robust in magnetically harsh environments, support wide air gap tolerances without degradation of angular error (unlike Hall/GMR/TMR), and simplify system design considerations.

The ADA4570 and ADA4571 are not affected by dust or dirt when compared with optical sensors in industrial applications, and they have very low latency compared to digital output solutions on the market with built-in calibration engines.

ADA4571 produces two single-ended analog outputs (sine and cosine) that indicate the angular position of the surrounding magnetic field, while the ADA4570 produces two differential analog output pairs. A dual version of the ADA4571 (ADA4571-2) is also available where full redundancy is needed in safety critical applications.

The AD7380 is a 4 MSPS dual simultaneous sampling, 16-bit SAR ADC that provides precision, throughput, and minimal size for encoder applications. AD7380 is in a small package size (3 mm × 3 mm) for miniaturization of the encoder with 4 MSPS throughput for minimal latency and fast control loop transient response. The AD7380 oversampling engine allows higher accuracy for slower operating conditions.

Machine health

Vibration and shock sensors are being integrated into the encoder or the motor to provide asset health insights. The ADXL1002 ultralow noise (25 µg/√Hz in ±50 g range), high frequency, ±50 g MEMS accelerometer provides high data bandwidth vibration sensing up to 11 kHz (3 dB point) with a resonant frequency of 21 kHz. ADXL1002 provides a lower cost and lower power alternative to piezoelectric sensors.

ADXL1002 enables monitoring of slow rotating equipment down to DC while also reducing calibration requirements when compared to piezo sensors. ADXL354 is a low noise, low power, 3-axis MEMS accelerometer in a small (3 mm × 5 mm) package with a digital interface, SPI (3- and 4-wire), and I2C to provide a compact solution for vibration sensing integration in encoders.

The ADI OtoSense Smart Motor Sensor is an AI-based, full turnkey hardware and software solution for condition monitoring of electric motors, combining best-in-class sensing technologies with leading-edge data analysis. Agnostic of motor type, ADI OtoSense SMS covers the most critical diagnostics, translating data into actionable insight that enables you to forecast maintenance cycles and avoid unplanned downtime.

Network interface

Smart manufacturing is based on a network of intelligent motion applications sharing data between the assets and the higher-level control and management network. ADI's robust, low power, and low latency PHYs include the ADIN1200 (10/100) PHY and the ADIN1300 (10/100/1000) PHY. Both these Industrial Ethernet PHYs were developed for industrial applications that require operating ambient temperature up to 105°C and have been extensively tested to EMC and robustness standards to operate in harsh industrial applications.

Low latency PHYs enable a lower cycle time network that can support more devices connected to the network and meet the timing requirements for complex, high performance deterministic motion applications. For deterministic Industrial Ethernet connectivity, ADI's layer 2 Industrial Ethernet embedded 2-port switches. fido5100 and fido5200 support PROFINET, Ethernet/IP, EtherCAT, Modbus TCP, and Ethernet POWERLINK Industrial Ethernet protocols with any processor, any protocol, any stack.

Motion controller

The motion controller provides the processing engine to generates the PWM signals to drive the power semiconductors and receives the current and position feedback signals to control the motors speed and torque. Robust, high ambient, high power density power management solutions are required to power the controller, which is often an FPGA or a processor with optional power supply sequencing and power telemetry capabilities. Analog Devices' Power by Linear power management ICs and power modules provide the foundation for powering today's and tomorrow's intelligent motion applications.

The motion controller is often located in a central rack that needs to communicate over a large distance to the encoder. This is where ADI's isolated and non-isolated RS-485 transceivers are used for serial communication of the encoder position feedback information to the motion controller. The ADM3066E, a ±12 kV IEC ESD protected, full-duplex 50 Mbps RS-485 transceiver, provides a high bandwidth, high ambient (125°C), robust communications solution in a small 3 mm × 3 mm package size for encoder applications.

Maurice O'Brien, Strategic Marketing Manager, ***Analog Devices.***

Visit Website

IIoT network trends and the role of Single Pair Ethernet

Looking at industry and the need for fully Ethernet-based networks, Single Pair Ethernet (SPE) offers a promising solution. SPE only requires two wires to transfer data and power and is designed in a way that, over an entire network, all machines can talk in the same language.

SOURCE: TE CONNECTIVITY

The new Single Pair Ethernet standard easily integrates with existing Ethernet infrastructures to provide real-time data.

WE ARE IN THE MIDDLE OF THE FOURTH revolution. Or, otherwise known as the Industrial Internet of Things (IIoT). Following the first three waves of rapid changes in technology — first the steam engine, then electricity, then the computer — IIoT is now the primary driver for change.

Because of IIoT, factories are getting smarter, machines are more connected, and productivity is increasing. As companies look to further optimize IIoT systems, they must be able to effectively gather data from each part of the IIoT network. This requires interconnecting each data source with secure, reliable connections so each data point is stored in a larger database for further analysis.

IIoT network trends

As IIoT networks become more common, they become more complex. More complex networks mean the number of devices per network increases. At the same time, networks have become decentralized due to increased amounts of connectivity locally and on the factory floor. This movement underscores the need for more dustproof and waterproof solutions in order to withstand the harsh environment. IP20 regulations won't hold up and instead IP67-compliant products need to be used.

Another industry trend that impacts IIoT networks is the rise of miniaturization. The cost of nodes is decreasing and they're getting smaller. Plus, the connectivity per device is increasing. In order to fit the expectations of increased connectivity while making products smaller, a new style of industrial connector is necessary to realize the interconnect.

Lastly, today's automation networks are built out of different communication protocols, ranging from serial to BUS to Ethernet communication. With increased complexity, decentralization and miniaturization, streamlining communication protocols will help increase overall productivity and establish a free flow of data from the network to the database. In addition, combining an Ethernet-based network with an IP will give you an IP addressable network. This means the entire network is easier to access and add additional devices to.

Ethernet network architecture

In order to build a productive and effective Ethernet-based IIoT network, there are multiple levels and stages to consider. The first is the servo and motor drive portion of the network, which is created by various OEMs.

The OEM chooses which connectivity types to use, which then impacts the larger system in which it will eventually be used — the second level of our network architecture. For example, robotics applications or control cabinets utilize servo and motor drives, so the machine will need to be constructed in a manner that will connect securely to the OEMs original connector type. This is where it's important to select the right cable connectors and field installable connectors.

SOURCE: TE CONNECTIVITY

While SPE has been in use in the automotive industry, SPE is relatively new to the industrial space.

The last level of the network is handled by installers, where multiple pieces of equipment are interconnected as part of a larger build. In these situations, cordsets and field installable connectors are used to create a cohesive network on all levels.

IIoT networks of tomorrow

Looking at where the industry is headed and the need for fully Ethernet-based networks, Single Pair Ethernet (SPE) offers a promising solution. SPE only requires two wires (rather than eight) to transfer data and power.

SPE technology is designed in a way that, over an entire network, all machines can talk in the same language. The need for translation between the various communication standards is eliminated compared to older network styles. SPE provides one network with one language in communication that all machines can understand and use.

Besides improved efficiency, the benefits of SPE include reduced complexity and costs, increased flexibility in designs, and a scalable foundation to go beyond previous limited speed and interoperability.

While SPE has been in use in the high-volume environment of the automotive industry, where space saving, high performance and shared weight solutions are especially valuable, SPE is relatively new to the industrial space.

However, its benefits are quickly proving obvious in the industrial automation sector and in the industrial internet of things (IIoT). Both require increasingly complex systems yet are built on an outdated legacy of multiple communication standards. At TE Connectivity, we believe SPE is essential to helping IIoT drive industrial automation forward.

As an enabler of IIoT, SPE allows barrier-free communication from the sensor to the cloud. It also provides movement freedom to applications and supports the rise of miniaturization.

SPE enables cross-network real-time communication without any loss in information, which helps industrial engineers build a more streamlined, unified automation ecosystem that are more cost-effective than the traditional ethernet solutions of the past.

The industry is at a tipping point, with an exponential increase in innovation and technology just around the corner. The "smart tech" trends that have overtaken everything from watches and cars to mobile phones and thermostats are coming for industrial automation and IIoT.

These types of smart solutions will come to the industrial market and Single Pair Ethernet will help in accelerating this trend, because it enables the underlying communication to take place seamlessly throughout an expanding IIoT network infrastructure.

Ruud van den Brink, product manager for industrial communications, ***TE Connectivity.***

Visit Website

New IEC 63171-7 connectivity standard for IIoT implementations

TE Connectivity has been a leader in developing a new Single Pair Ethernet (SPE) standard enabling companies to simply and cost-effectively connect devices on the network edge to make data-driven decisions in real-time. The International Electrotechnical Commission (IEC) 63171-7 standard creates industry consensus on a power-and-data hybrid format that easily integrates machines into a network and improves power distribution.

"Manufacturers often struggle to realize the advantages of IIoT because their networks can't communicate from the cloud all the way down to an individual sensor on a machine," said Eric Leijtens, global product management and managing director for TE. "This is why the new '-7' standard is so critical. It helps us overcome that gap in data at the network edge by creating an industry-standard approach for connecting to physical assets in a production environment."

An industry consortium recommended that M12 hybrid interfaces be specified under the new IEC 63171-7 standard. The standard now has the support of multiple trade groups and more than 80 companies. As one of the most common connector sizes in field-level applications, the M12 format easily connects to existing Ethernet infrastructure, replacing traditional fieldbus and analog solutions. With SPE implemented at the device level, manufacturers can realize transparent, IP-based communication replacing the current solutions that are expensive or have reduced transparency.

The hybrid configuration in "-7" cables also provides increased flexibility to distribute power across the network, instead of the point-to-point connections required in power-over-data lines.

Ethernet APL offers continuous access to process data

Ethernet-APL brings real-time communication to the field in process systems. End-to-end Ethernet technology yields a wide range of benefits in terms of efficiency and simplicity. Users benefit from an integrated web server that simplifies remote access to field instruments.

WITH NEW ETHERNET-APL COMMUNICATION technology, users in the process industries have gained a strong partner at their side in their quest for higher efficiency and increasing quality. This new form of data transmission will give digitalization a boost in process engineering production environments. Data from all areas of a process system will be connected in a secure and practical manner and made available from a central point. This helps users derive valuable information from vast amounts of data points.

For years now, process control field instruments have been able not only to fulfill their measuring tasks but to supply additional information as well. In theory, this makes the installed base transparent and provides detailed instrument diagnostic information, which can be used for such things as preventive maintenance of the instruments.

However, this added value can only be partially realized with the current technology. The 4–20mA analog technology, to cite one example, is suitable for process control tasks but not for further data access. The additional HART protocol, which today is used primarily for configuration of the instruments, is simply too slow for comprehensive data access. Fieldbus technology, known for many years, has improved this aspect, but is also still considerably slow. Furthermore, fieldbus technology has proven too complex for many users over the years and has consequently failed to fully establish itself.

SOURCE: ENDRESS & HAUSER

Ready for use at the field level. With Ethernet-APL, digitalization will receive a boost in process engineering production environments.

Worlds growing together

A glance at other industries shows that Ethernet has not only become a standard in office environments but is also being utilized in industrial applications. The main advantage is the high speed and seamless integration into IT systems.

"Only in the process industry have Ethernet specifications failed to meet the expectations of the operators up to this point," says Benedikt Spielmann, Marketing Manager Industrial Communication at Endress+Hauser. "While Ethernet is a fast way to transmit data, all the components require a separate power source. That translates into extensive cabling effort and the associated higher costs. Furthermore, Ethernet has so far been restricted to 100-meter cable distances while process systems often extend up to 1,000 meters. Another issue is that the RJ-45 plugs are not designed for harsh field environments. And so far the best argument against the use of Ethernet in the process industry has been the lack of suitability for ex-zones because of the absence of intrinsic safety."

Leading manufacturers and user organizations joined forces several years ago to eliminate these disadvantages. The APL Group established the goal of being able to utilize the basic advantages of Ethernet technology in process systems as well and to get Ethernet in shape for use at the field level in the process industry: power and data transmission via the same two-wire cable, suitability for ex-zones, high bandwidth and long cable distances.

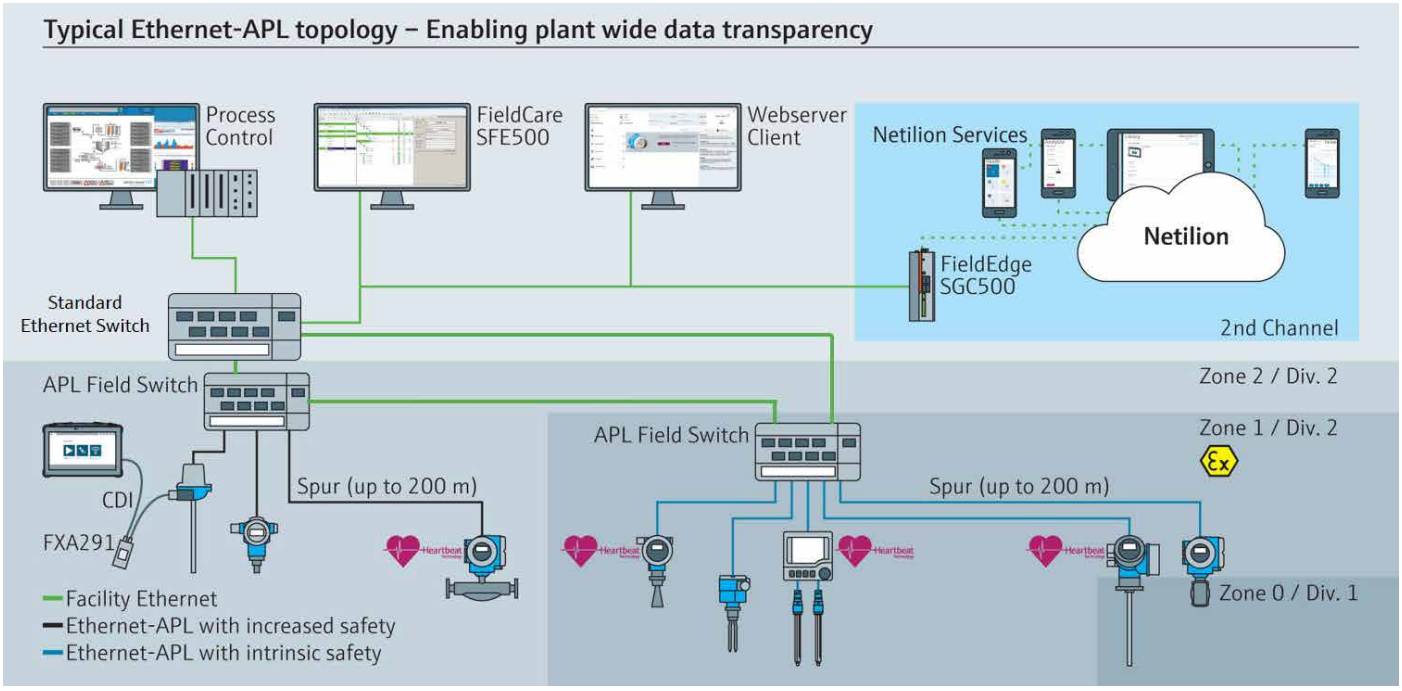
Work on the specification has now been completed. The technology was made public during the virtual Achema 2021 conference. "The launch of Ethernet-APL technology during Achema Pulse was an important milestone," according to Benedikt Spielmann. "All the specifications and guidelines were completed on schedule. The presentation of the first Ethernet-APL instruments on the multi-vendor APL exhibit wall was a striking illustration that all the participating manufacturers are working on their APL portfolios. There were also insights into which customer applications would benefit from the new technology."

APL project work packages

One of the primary tasks of the working group was to guarantee intrinsic safety, which first required limiting the power transmission. This requirement initially contradicted the desire for higher bandwidth, long cable distances and robustness against electromagnetic interference. Questions related to the cable and plug or type of connection had to be answered as well. All of the challenges were successfully addressed. The solution is reflected in various working papers, standards and documents:

10BASE-T1L: The IEEE802.3cg-2019 specification defines the full duplex 10 MB data transmission via two-wire cable at distances of up to 1,000 meters. This is also the basis for the production of physical layer components (microchips for coding and decoding in Ethernet-APL devices).

2-WISE: This concept for two-wire intrinsically safe Ethernet (2-WISE) is based on the fieldbus intrinsically safe concept (FISCO). Migration to existing fieldbus installations is simplified through compatible ex-i parameters, and simple installation without extensive validation in ex-zones is ensured.



SOURCE: ENDRESS & HAUSER

Port Profiles: Functional and electrical requirements with multiple energy concepts are defined in the APL port profile specification. This enables different topologies such as the common trunk-and-spur concept, with up to 1,000 meters on the trunk and 200 meters on the spur line. The specification furthermore contains installation guidelines, such as approved cables, shielding and grounding, as well as the definition of clamp connections and M8/M12 plug connectors.

Engineering Guideline: This guideline provides detailed information for planning, installing and commissioning APL networks.

Conformance Test Specification: To ensure the conformity of an Ethernet-APL device with the stated specifications, a corresponding test specification is created. These tests form the basis for the certification of Ethernet-APL devices by accredited test labs run by the user organizations, ensuring interoperability of Ethernet-APL devices for the end user.

Real-world experience

Even before the official introduction of the norms and specifications and the correspondingly designed devices, APL technology was successfully implemented in real environments. BASF installed APL prototypes from various manufacturers at its Ludwigshafen, Germany, location in 2019. The tests ranged from installation and commissioning to exporting data parallel to the process control system. Automation providers in the process industry were already discussing the promising results at the 2019 NAMUR general meeting. In a nutshell, Ethernet-APL offers the following benefits:

- Plug connectors and different topologies enable simple and flexible installation.
- Remote access and fast data transmission simplify and speed up system commissioning.
- Ethernet via two-wire fieldbus cable provides stable communication.
- Data from smart instruments can be routed around the process control system via the "second channel" in accordance with the NAMUR open architecture

These are all experiences that Endress+Hauser can confirm. "Ten years ago, we brought a flowmeter featuring Ethernet connectivity to the market and since then have gradually expanded the portfolio," says Spielmann in looking back at the development. The response was extremely positive, especially from the food and beverage industry. "More process data and more diagnostic information create transparency and help to optimize workflows. This additional functionality, in terms of digitalization, was very well received by the users," reports Spielmann.

End-to-end Ethernet technology yields a wide range of benefits in terms of efficiency and simplicity, particularly with instrument maintenance. Users benefit from an integrated web server that simplifies remote access to field instruments for parameter configuration or error detection. Firmware updates are possible via remote access, including high bandwidth. Ethernet's performance also promotes the use of standard applications such as the creation of measurement point reports or uploading/downloading parameter sets.

In the future, access to data in the field will be possible without interpretation issues since the information will be available to digital services such as the Netilion ecosystem from Endress+Hauser. Theoretically speaking, this connection also functions with other protocols such as PROFIBUS or HART. However, Ethernet-APL makes more data available – and faster. A typical example is predictive maintenance, which is controlled with real-time data from the field instruments. "Although the algorithms reside in the field instruments, they have to be processed in the cloud as well. With Ethernet-APL, the data highway is in place to make the data available. If all of this was done via HART, the network would be constantly overloaded and the data transfer unbearably long," explains Spielmann.

Another aspect is that Ethernet-APL also supports the modular approach currently employed at many plants in the chemical industry. Any number of APL segments can be added with the same design already used in other segments. The topology is set up first; everything else, such as the name assignment or the start-up parameters in the example of PROFINET as Ethernet protocol, is automatically transmitted to the instruments. "With the current two-wire Ethernet approach, we're also attracting users in the chemical, oil & gas, minerals and mining segments where they have the same requirements in terms of digitalization. We're now providing the portfolio they need," says Spielmann.

With the completion of the APL specification and the availability of the PHY chips, the necessary pieces of the puzzle are in place. Ethernet-APL instruments for flow, level, pressure and temperature will be introduced to the market in the first half of 2022. "We are thus offering a broad portfolio of Ethernet connectivity products, in addition to the existing four-wire Ethernet instruments for flow and liquid analysis," says Spielmann.

Frank Jablonski, freelance journalist, mylk+honey for ***Endress+Hauser.***

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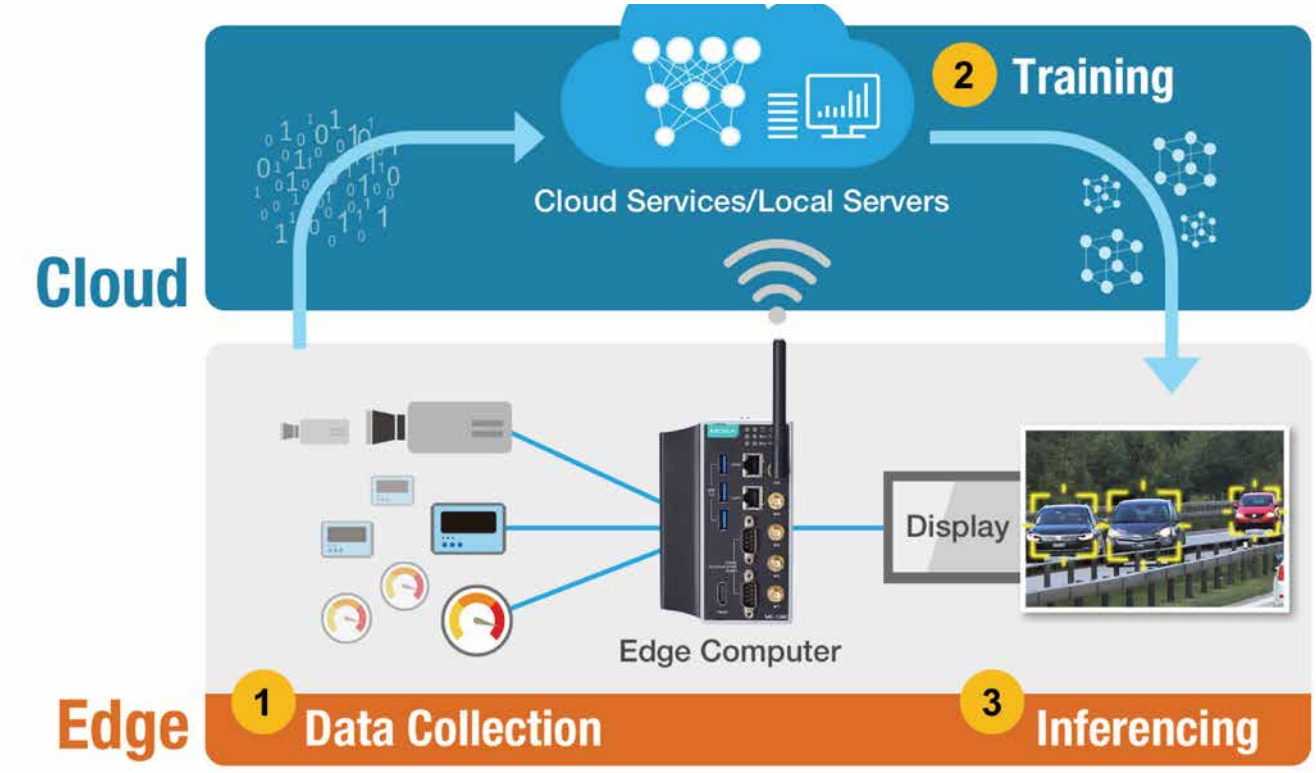
Artificial intelligence at the edge enables new IIoT applications

Enabling AI capabilities at the edge can improve operational efficiency and reduce risks and costs for industrial applications. Choose the right computing platform for your industrial AIoT application by addressing specific processing requirements during implementation.



SOURCE: MOXA

There are three phases in building "Artificial Intelligence of Things" applications.

IIOT APPLICATIONS ARE GENERATING MORE data than ever before. In many industrial applications, especially highly distributed systems located in remote areas, constantly sending large amounts of raw data to a central server might not be possible.

To reduce latency, reduce data communication and storage costs, and increase network availability, businesses are moving AI and machine learning to the edge for real-time decision-making and actions in the field.

These cutting-edge applications that deploy AI capabilities on IoT infrastructures are called the "AIoT." Although users still need to train AI models in the cloud, data collection and inferencing can be performed in the field by deploying trained AI models on edge computers.

This article discusses how to choose the right edge computer for industrial AIoT applications and provides several case studies to help get started.

Bringing AI to the IIoT

The advent of the Industrial Internet of Things (IIoT) has allowed a wide range of industrial manufacturing businesses to collect massive amounts of data from previously untapped sources and explore new avenues for improving productivity.

By obtaining performance and environmental data from field equipment and machinery, manufacturing and production organizations now have even more detailed information at their disposal to make informed business decisions.

Unfortunately, there is far too much IIoT data for humans to process alone so most of this pontentially important information goes unanalyzed and unused.

Consequently, it is no wonder that businesses and industry experts are turning to artificial intelligence and machine learning solutions for IIoT applications to gain a holistic view and make smarter decisions more quickly.

IIoT data goes unanalyzed

The staggering number of industrial devices being connected to the Internet continues to grow year after year and is expected to reach 41.6 billion endpoints in 2025. What's even more mind-boggling is how much data each device produces.

In fact, manually analyzing the information generated by all the sensors on a manufacturing assembly line could take a lifetime. It's no wonder that "less than half of an organization's structured data is actively used in making decisions, and less than 1% of its unstructured data is analyzed or used at all".

In the case of IP cameras, only 10% of the nearly 1.6 exabytes of video data generated each day gets analyzed. These figures indicate a staggering oversight in data analysis despite our ability to collect more and more information. This inability for humans to analyze all of the data we produce is precisely why businesses are looking for ways to

The AIoT offers the ability to reduce labor costs, human error and optimize preventive maintenance.

incorporate artificial intelligence and machine learning into their IIoT applications.

Imagine if we relied solely on human vision to manually inspect tiny defects on golf balls on a manufacturing assembly line for 8 hours each day, 5 days a week. Even if companies could afford a whole army of inspectors, each person is still naturally susceptible to fatigue and human error.

Similarly, manual visual inspection of railway track fasteners, which can only be performed in the middle of the night after trains have stopped running, is not only time-consuming but also difficult to do. Likewise, manual inspection of high-voltage power lines and substation equipment also exposes human personnel to additional risks.

Combining AI with IIoT

In each of the previously discussed industrial applications, the AIoT offers the ability to reduce labor costs, reduce human error, and optimize preventive maintenance.

The "Artificial Intelligence of Things" (AIoT) refers to the adoption of AI technologies in Internet of Things (IoT) applications for the purposes of improving operational efficiency, human-machine interactions, and data analytics and management. But what exactly do we mean by AI and how does it fit into the IIoT?

Artificial intelligence (AI) is the general field of science that studies how to construct intelligent programs and machines to solve problems that are traditionally performed through human intelligence. Artificial intelligence also includes machine learning (ML), which is a specific subset of AI that enables systems to automatically learn and improve through experience without being programmed to do so, such as through various algorithms and neural networks. Another related term is "deep learning" (DL), which is a subset of machine learning in which multilayered neural networks learn from vast amounts of data.

Since AI is such a broad discipline, the following discussion focuses on how computer vision or AI-powered video analytics, other subfields of AI often used in conjunction with ML, are used for classification and recognition in industrial applications.

From data reading in remote monitoring and preventive maintenance, to identifying vehicles for controlling traffic signals in intelligent transportation systems, to agricultural drones and outdoor patrol robots, to automatic optical inspection (AOI) of tiny defects in golf balls and other products, computer vision and video analytics are unleashing greater productivity and efficiency for industrial applications.

Moving AI to the IIoT edge

As previously mentioned, the proliferation of IIoT systems is generating massive amounts of data. For example, the multitude of sensors and devices in a large oil refinery generates one TB of raw data per day.

Immediately sending all this raw data back to a public cloud or private server for storage or processing would require considerable bandwidth, availability, and power consumption. In many industrial applications, especially highly distributed systems located in remote areas, constantly sending large amounts of data to a central server is not possible.

Even if a system had the bandwidth and sufficient infrastructure, which would be incredibly costly to deploy and maintain, there would still be substantial latency in data transmission and analysis. Mission-critical industrial applications must be able to analyze raw data as quickly as possible.

In order to reduce latency, reduce data communication and storage costs, and increase network availability, IIoT applications are moving AI and machine learning capabilities to the edge of the network to enable more powerful preprocessing capabilities directly in the field. More specifically, advances in edge computing processing power have enabled IIoT applications to take advantage of AI decision-making capabilities in remote locations.

Indeed, by connecting field devices to edge computers equipped with powerful local processors and AI, users no longer need to send all of the data to the cloud for analysis. In fact, the data created and processed at the far-edge and near-edge sites is expected to increase from 10% to 75% by 2025, and the overall edge AI hardware market is expected to see a CAGR of 20.64% from 2019 to 2024.

Edge computers for Industrial AIoT

When it comes to bringing artificial intelligence to industrial IoT applications, there are several key issues to consider. Even though most of the work involved with training AI models still takes place in the cloud, eventually there will be a need to deploy trained inferencing models in the field.

AIoT edge computing essentially enables AI inferencing in the field rather than sending raw data to the cloud for processing and analysis. In order to effectively run AI models and algorithms, industrial AIoT applications require a reliable hardware platform at the edge. To choose the right hardware platform for an AIoT application, consider the following factors.

1. Processing Requirements for Different Phases of AI Implementation
2. Edge Computing Levels
3. Development Tools
4. Environmental Concerns

AI processing requirements

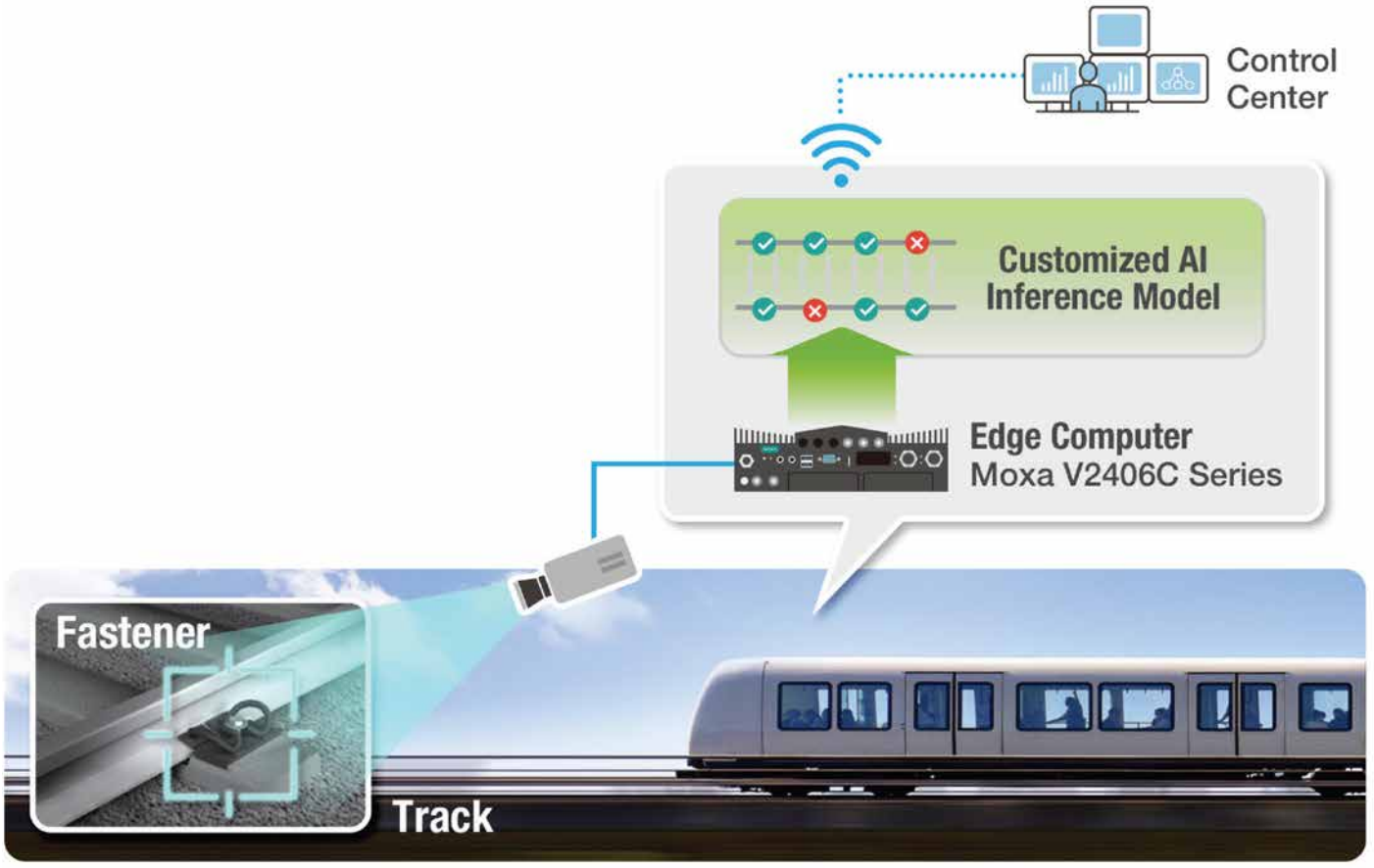
Generally speaking, processing requirements for AIoT computing are concerned with how much computing power is needed along with a CPU or accelerator. Since each of the following three phases in building an AI edge computing application uses different algorithms to perform different tasks, each phase has its own set of processing requirements.

Data collection

The goal of this phase is to acquire large amounts of information to train the AI model. Raw, unprocessed data alone is not helpful because the information could contain duplications, errors, and outliers. Preprocessing collected data at the initial phase to identify patterns, outliers, and missing information also allows users to correct errors and biases.

Depending on the complexity of the

SOURCE: MOXA



AIoT Track Fastener Inspection System. *Because visual inspection during non-operating hours is time-consuming and human fatigue may lead to data omission, the transit system decided to deploy an AI edge computing solution to accelerate track fastener inspection with computer vision.*

application data that is collected, the computing platforms typically used in data collection are usually based on Arm Cortex or Intel Atom/Core processors. In general, I/O and CPU specifications (rather than the GPU) are more important for performing data collection tasks.

Training

AI models need to be trained on advanced neural networks and resource-hungry machine learning or deep learning algorithms that demand more powerful processing capabilities, such as powerful GPUs, to support parallel computing in order to analyze large amounts of collected and preprocessed training data. Training an AI model involves selecting a machine learning model and training it on collected and preprocessed data.

During this process, there is also a need to evaluate and tune the parameters to ensure accuracy. Many training models and tools are available to choose from, including off-the-shelf deep learning design frameworks such as PyTorch, TensorFlow, and Caffe.

Training is usually performed on designated AI training machines or cloud computing services, such as AWS Deep Learning AMIs, Amazon SageMaker Autopilot, Google Cloud AI, or Azure Machine Learning, instead of in the field.

Inferencing

The final phase involves deploying the trained AI model on the edge computer so that it can make inferences and predictions based on newly collected and preprocessed data quickly and efficiently. Since the inferencing stage generally consumes fewer computing resources than training, a CPU or lightweight accelerator may be sufficient for the AIoT application.

Nonetheless, users will need a conversion tool to convert the trained model to run on specialized edge processors/accelerators, such as Intel OpenVINO or NVIDIA CUDA. Inferencing also includes several different edge computing levels and requirements.

Edge computing levels

Although AI training is still mainly performed in the cloud or on local servers, data collection and inferencing necessarily take place at the edge of the network. Moreover, since inferencing is where trained AI model does most of the work to accomplish the application objectives (i.e., make decisions or perform actions based on newly collected field data), users need to determine which of the following levels of edge computing are needed in order to choose the appropriate processor.

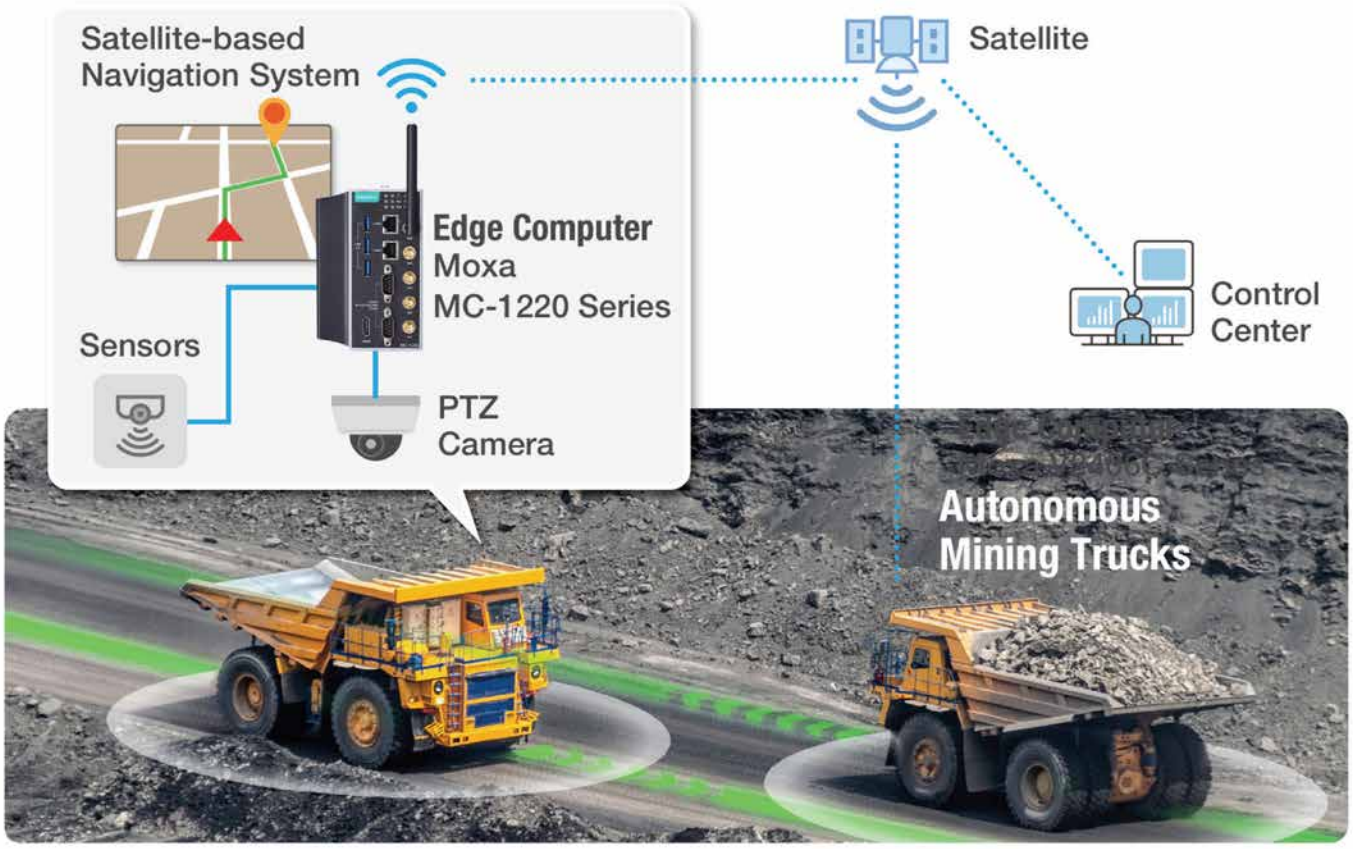
Low edge computing level

Transferring data between the edge and the cloud is not only expensive, but also time-consuming and results in latency. With low edge computing, applications only send a small amount of useful data to the cloud, which reduces lag time, bandwidth, data transmission fees, power consumption, and hardware costs. An Arm-based platform without accelerators can be used on IIoT devices to collect and analyze data to make quick inferences or decisions.

Medium edge computing level

This level of inference can handle various IP camera streams for computer vision or video analytics with sufficient processing frame rates. Medium edge computing includes a wide range of data complexity based on the AI model and performance requirements of the use case, such as facial recognition applications for an office entry system versus a large-scale public surveillance network. Most industrial edge computing applications also need to factor in a limited power budget or fanless design for heat dissipation.

It may be possible to use a high-performance CPU, entry-level GPU, or VPU at this level. For instance, the Intel Core i7 Series CPUs offer an efficient computer vision solution with the OpenVINO toolkit and software based AI/ML accelerators that can perform inference at the edge.



SOURCE: MOXA

Autonomous Haulage Systems (AHS). *Systems involve training and deploying AI models to safely traverse rugged terrain and move rocks.*

High edge computing level

High edge computing involves processing heavier loads of data for AI expert systems that use more complex pattern recognition, such as behavior analysis for automated video surveillance in public security systems to detect security incidents or potentially threatening events. High Edge Compute Level inferencing generally uses accelerators, including a high-end GPU, VPU, TPU, or FPGA, which consumes more power (200 W or more) and generates excess heat.

Since the necessary power consumption and heat generated may exceed the limits at the far edge of the network, such as aboard a moving train, high edge computing systems are often deployed in near-edge sites, such as in a railway station, to perform tasks.

Several tools are available for various hardware platforms to help speed up the application development process or improve overall performance for AI algorithms and machine learning.

Deep learning frameworks

Consider using a deep learning framework, which is an interface, library, or tool that allows users to build deep learning models more easily and quickly, without getting into the details of the underlying algorithms. Deep learning frameworks provide a clear and concise way for defining models using a collection of pre-built and optimized components.

The three most popular include the following technologies:

- *PyTorch*: Primarily developed by Facebook's AI Research Lab, PyTorch is an open source machine learning library based on the Torch library. It is used for applications such as computer vision and natural language processing, and is a free and open-source software released under the Modified BSD license.
- *TensorFlow*: Enable fast prototyping, research, and production with TensorFlow's user-friendly Keras- based APIs, which are used to define and train neural networks.
- *Caffe*: Caffe provides an expressive architecture that allows users to define and configure models and optimizations without hard-coding. Users can set a single flag to train the model on a GPU machine, and then deploy to commodity clusters or mobile devices.

Hardware-based accelerator toolkits

AI accelerator toolkits are available from hardware vendors and are specially designed to accelerate artificial intelligence applications, such as machine learning and computer vision, on their platforms.

- *Intel OpenVINO*: The Open Visual Inference and Neural Network Optimization (OpenVINO) toolkit from Intel is designed to help developers build robust computer vision applications on Intel platforms. OpenVINO also enables faster inference for deep learning models.
- *NVIDIA CUDA*: The CUDA Toolkit enables high-performance parallel computing for GPU-accelerated applications on embedded systems, data centers, cloud platforms, and supercomputers built on the Compute Unified Device Architecture (CUDA) from NVIDIA.

Environmental considerations

Last but not least, also consider the physical location of where the application will be implemented. Industrial applications deployed outdoors or in harsh environments such as smart city, oil and gas, mining, power, or outdoor patrol robot applications should have a wide operating temperature range and appropriate heat dissipation mechanisms to ensure reliability in blistering hot or freezing cold weather conditions.

Certain applications also require industry-specific certifications or approvals, such as fanless design, explosion proof construction, and vibration resistance. And since many real-world applications are deployed in space-limited cabinets and subject to size limitations, small form factor edge computers are preferred.

Moreover, highly distributed industrial applications in remote sites may also require communications over a reliable cellular or Wi-Fi connection. For instance, an industrial

edge computer with integrated cellular LTE connectivity eliminates the need for an additional cellular gateway and saves valuable cabinet space and deployment costs. Another consideration is that redundant wireless connectivity with dual SIM support may also be needed to ensure that data can be transferred if one cellular network signal is weak or goes down.

To see how real-world industrial applications enable and benefit from AIoT edge computing, let's examine the following two examples.

Keeping mass transit on track

All trains, whether in an inter-city railway line or municipal mass transit system, run on metal tracks that need to remain upright and properly spaced according to a standard gauge at all times. If the tracks become uneven, trains could derail.

That's why users always see some sort of support, known as railroad ties or ballasts, laid perpendicularly beneath the tracks. To ensure a smooth ride, railroad tracks need to be securely fastened to the ties by spikes, screws, or bolts. Due to constant friction and vibration between fast-moving train wheels and the tracks, as well as damage from the natural environment, track fasteners degrade and break over time. Consequently, timely detection and repair of track fasteners is crucial to ensuring the safety of any railway line.

A large metropolitan railway in East Asia needed a more efficient way to inspect the vast number of fasteners used to stabilize thousands of miles of tracks throughout its entire mass transit system. Located in the Ring of Fire where many earthquakes occur, the transit system cannot take any chances on the safety of its infrastructure since constant tremors compound the regular wear and tear from rolling stock and high passenger traffic.

Usually, after train service ends on one of the lines, the railway operator dispatches human maintenance engineers to perform manual visual inspection of the tracks and check for loose fasteners. If a loose or damaged track fastener is detected, the fastener must be repaired before train service recommences on the railway line.

Since visual inspection of railway tracks during non-operating hours is time-consuming and human fatigue may lead to data omission, the transit system decided to deploy an AI edge computing solution that could accelerate track fastener inspection with computer vision.

More specifically, the transit operator wanted a customized AI inference model with object recognition for track fastening systems that could detect track fastener defects while the trains are moving and perform maintenance between journeys.

AI inferencing for track fastener inspection also requires the edge computer to have powerful computing performance and storage expansion for video data, compact size and fanless design for installation in small cabinets, wide operating temperature range, and EN 50155 compliance for use on rolling stock.

The first step was to install high-resolution cameras underneath the train carriages, which enabled the system operator to capture real-time video of track fasteners as trains run on the tracks during service hours. Video data is then transmitted to an onboard edge computer for image processing and object recognition of track fastener defects.

The train operator selected Moxa's V2406C Series rail computer for its compact-size with an Intel Core i7 processor that provides ample computing power for running the trained AI inferencing model. The V2406C also runs on low power consumption and has a wide operating temperature range of -40 to 70°C.

Last but not least, the V2406C supports the Intel OpenVINO toolkit and features two mPCIe slots for Intel Movidius VPU modules to accelerate image recognition computations and edge AI inferencing. By replacing manual visual inspection with real-time AI visual inspection during operating hours, the transit system was able to improve efficiency and reduce maintenance expenses.

Autonomous mining trucks

The growing popularity of autonomous haul trucks in open-pit mining, an application which is expected to triple by 2023, is mainly driven by the ability of autonomous hauling systems to reduce accidents, fuel consumption, and operating costs, while also increasing machine life and overall productivity.

Automating the trucks not only enables mining companies to move human workers to a control room, where they can oversee operations from a safe distance, but also optimizes overall production by shortening truck exchanges and eliminating shift changes.

Surface mining operations depend on heavy-duty dump trucks, called haul trucks, to transport rocks and debris from excavation sites. Due to the heavy weight and large volume of rocks and other materials that need to be moved in mining operations, haul trucks are often massive vehicles in their own right.

For example, some of the largest haul trucks used in open-pit mining are designed to carry payloads of 400 tons or more. Traditionally, these giant vehicles are operated by human drivers in quarries located in dangerous, extreme outdoor environments, such as deserts or mountains, where explosives are used to excavate mineral resources and ore from the Earth's surface.

Besides the inherent dangers involved with open-pit mining, human truck drivers often need to work 12-hour shifts or longer, which results in fatigue and a greater risk of human error. In recent years, leading mining companies around the world have been increasingly looking towards autonomous technology and AI to help improve occupational safety and productivity.

As with self-driving commercial vehicles, autonomous hauling systems involve training and deploying AI models to enable haul trucks to safely traverse rugged terrain and move rocks across the excavation site. These autonomous haulage systems (AHS) also rely on computer vision and navigation technology to enable autonomous haul trucks to identify obstacles and move into the proper position to collect excavated rocks from excavators and dump the debris in designated locations.

By installing a high-performance edge computer such as the Moxa MC-1220 series to connect PTZ cameras and sensors on each autonomous haul truck in the fleet, mining companies can obtain real-time video data from the excavation site as well as the exact position of each truck.

The MC-1220 provides high-performance Intel Core i7 processors for video analysis and self-driving systems, as well as Wi-Fi and cellular connectivity to transmit preprocessed field data to the control center.

Since mining trucks need to traverse rugged terrain, solid metal casing and high shock and vibration tolerance are also required. What's more, extreme outdoor quarry environments also necessitate a wide operating temperature range. The MC-1220 is not only Class 1, Div. 2 certified for safe, explosion-proof operation in hazardous mining locations, but also ensures reliable performance from -40 to 70°C.

Conclusion

As the case studies illustrate, enabling AI capabilities at the edge allows users to effectively improve operational efficiency and reduce risks and costs for industrial applications.

Choosing the right computing platform for an industrial AIoT application should also address the specific processing requirements at the three phases of implementation: (1) data collection, (2) training, and (3) inference. For the inference phase, users also need to determine the edge computing level (low, medium, or high) so they can select the most suitable type of processor.

By carefully evaluating the specific requirements of an AIoT application at each phase, users can choose the best-suited edge computer to sufficiently and reliably perform industrial AI inferencing tasks in the field.

Ethan Chen, Product Manager, Alicia Wang, Product Manager and Angie Lee, Product Marketing Manager, ***Moxa Corporation.***

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TwinCAT software solutions for networked machine control

New automation and machine control networking solutions include direct integration of OPC UA Pub/Sub for real-time communication, a server inference engine for increasing machine learning requirements and a TwinCAT/BSD Hypervisor that increases availability through integrated virtual machine environments.

SOFTWARE AND HARDWARE INNOVATIONS ARE the heart of advances and new capabilities for automation and control applications.

New TwinCAT solutions from Beckhoff including direct integration of OPC UA Pub/Sub, a server inference engine for increasing machine learning requirements and TwinCAT/BSD Hypervisor as a new system feature that increases availability through integrated virtual machine environments.

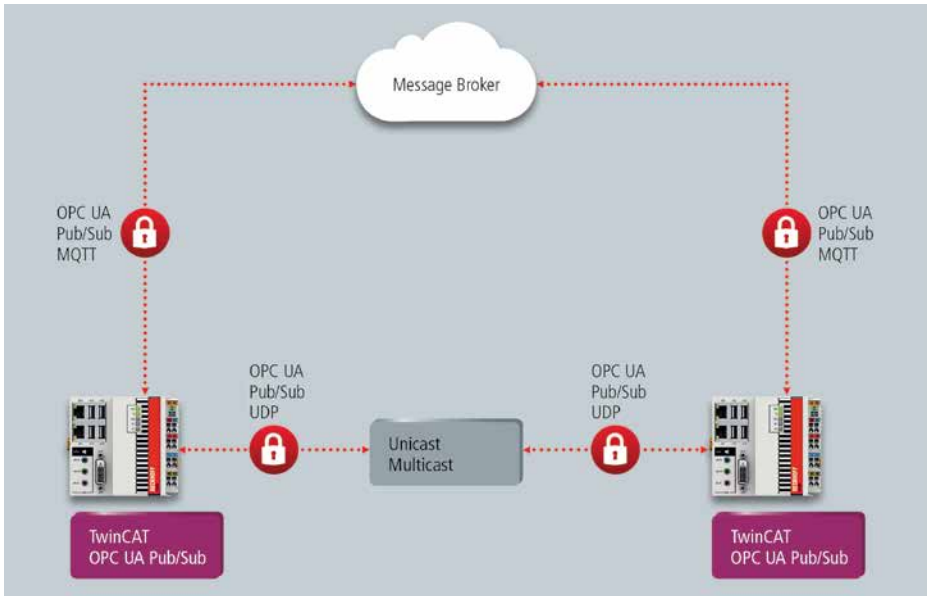
OPC UA Pub/Sub

Direct integration of OPC UA Pub/Sub communication into the TwinCAT 3 runtime paves the way for straightforward realization of machine-to-machine (M2M) and device-to-cloud (D2C) scenarios based on the OPC UA Pub/Sub specification.

With a new extension of the OPC UA specification, which Beckhoff played a prominent role in helping develop, the publisher/subscriber principle is being introduced into the established and standardized OPC UA communication protocol. Two different transport paths can be defined for data transmission: UDP and MQTT.

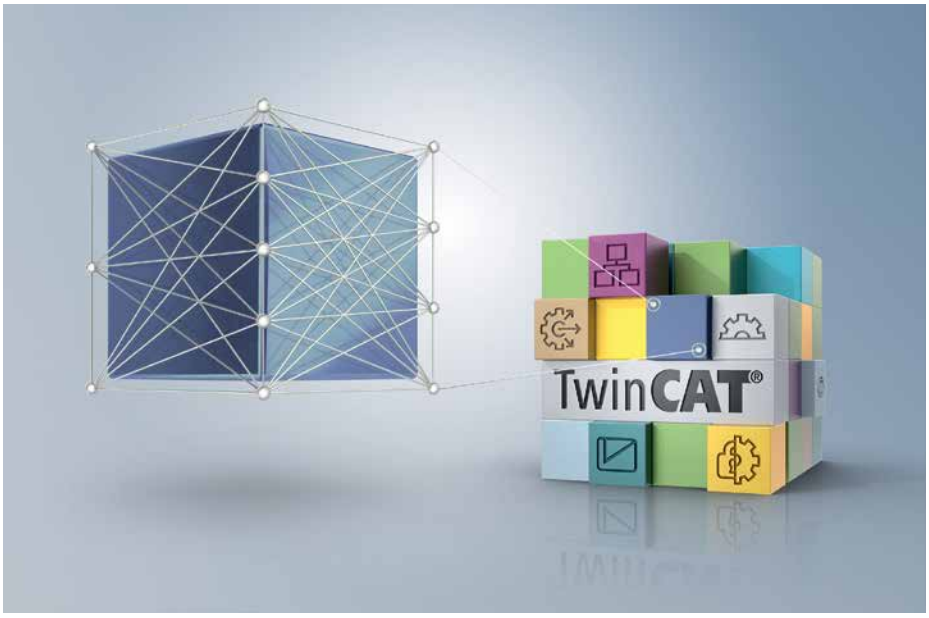
UDP enables efficient and real-time-capable data exchange in a local network between machines or machine components, whereas transport via an MQTT message broker primarily, but not exclusively, supports cloud scenarios. As an early adopter, Beckhoff implemented an initial prototype implementation of the UDP transport path back in 2016.

Now, the implementation of MQTT adds a second transport path. With the new TwinCAT 3 function OPC UA Pub/Sub (TF6105), Beckhoff provides a package that can be used to configure and use both OPC UA Pub/Sub UDP and MQTT Publisher and Subscriber directly in TwinCAT 3.



SOURCE: BECKHOFF

With PC-based control and TwinCAT 3, Beckhoff supports the extension of OPC UA to include publisher/subscriber communication.



SOURCE: BECKHOFF

TwinCAT Machine Learning Server is a high-performance execution module (inference engine) for trained machine and deep learning models.

TwinCAT Machine Learning

With TwinCAT Machine Learning Server as an additional inference engine, TwinCAT Machine Learning also meets the increasingly growing requirements of machine learning (ML) or deep learning for industrial applications. This is because ML models are becoming more and more complex, the execution speed is expected to increase, and greater flexibility of inference engines is demanded with respect to ML models.

TwinCAT Machine Learning Server is a standard TwinCAT PLC library and a so-called near-real-time inference engine, i.e., in contrast to the two previous engines, it is not executed in hard real time, but in a separate process on the IPC. In return, basically all AI models can be executed in the server engine and this with full support of the standardized exchange format Open Neural Network Exchange (ONNX). Furthermore, there are AI-optimized hardware options for this TwinCAT product that enable scalable

performance.

The TwinCAT Machine Learning Server can operate in classic parallelization on CPU kernels, either using the integrated GPU of the Beckhoff Industrial PCs or accessing dedicated GPUs, e.g., from NVIDIA. This provides an inference engine with maximum flexibility in terms of models and high performance in terms of hardware. Applications can be found in predictive and prescriptive models as well as in machine vision and robotics. Examples include image-based methods for sorting or evaluating products, for defect classification as well as defect or product localization, and for calculating gripping positions.

SOURCE: BECKHOFF

With PC-based control and TwinCAT 3, Beckhoff supports the extension of OPC UA to include publisher/subscriber communication.

Increased availability using integrated virtual machine

TwinCAT/BSD Hypervisor is new technology implemented in the TwinCAT/BSD operating system that enables the simultaneous execution of virtual machines (VM) and TwinCAT real-time applications on an Industrial PC. Optimized hypervisor integration in TwinCAT/BSD and matching configurations of Beckhoff software and hardware enable maximum performance of virtual machines while maintaining TwinCAT real-time properties.

The high-performance execution of virtual machines enables the strengths of different operating systems to be utilized on one Industrial PC and the security properties of the overall system to be improved by operating user environments in a modular and isolated manner.For example, TwinCAT real-time applications can be operated separately from a Windows desktop environment for machine operation on an Industrial PC. In this context, the Windows operating system is run in a virtual machine environment. Windows restarts, e.g., due to software updates, will therefore not interrupt machine control execution. This ensures machine availability since Windows is only restarted within the virtual machine environment and TwinCAT continues to run in the real-time context supported by the TwinCAT/BSD host.

Through the device passthrough feature of TwinCAT/BSD Hypervisor, hardware resources such as GPU, USB and/or network interfaces can be explicitly assigned to a virtual machine. In this way, access to the TwinCAT/BSD system by user and/or network interfaces can be limited, and the security of the control system can be improved. With TwinCAT/BSD Hypervisor, Linux distributions can be operated on the controller in addition to Windows, e.g., for running Linux containers. In this case, data communication between Linux containers and machine controller can be supported by host-only networks. This ensures that unencrypted network communication will take place exclusively locally between TwinCAT/BSD and the Linux container host, and confidential machine data will not leave the Industrial PC.

SOURCE: BECKHOFF

With the new No Cable Technology (NCT), XTS movers can become mobile handling or processing stations, thus expanding XTS into a highly flexible multi-robot system.

Contactless power and data transmission for movers

Contactless power supply and synchronous real-time data communication is now enabling individual XTS movers to be expanded into mobile handling and processing stations.

The modular XTS system has been expanded with NCT to include a special motor module as well as electronics that can be mounted on the movers. The hardware required for the transmission technology is fully integrated into the motor module, so that the existing functionalities and compact set-up are retained. No additional connections or supply lines are needed. The control of the hardware on the mover is fully implemented in TwinCAT. All known TwinCAT functionalities are available for simple project implementation.

For the first time, NCT makes it possible to process and check the quality of products on the mover while the process is running. Sufficient power and fast communication with the TwinCAT control system enable easy connection of sensors and actuators. The data communication is real-time capable and can synchronize system-wide events with µs accuracy in connection with EtherCAT. This opens up new solution options for the user, especially in the areas of product handling, machining and measuring in parallel with product transport, as well as adapting production machines for rapidly changing production lots.

Technology update, ***Beckhoff Automation.***

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UA Cloud Library and Field Level Communications Updates

The OPC Foundation continues to forge ahead with technology advancements. Recent highlights include the launch of the UA Cloud Library developed in conjunction with CESMII and completion of the second release candidate for the OPC UA FX (Field eXchange) specifications that is part of the FLC initiative.

THE UA CLOUD LIBRARY MAKES IT EASIER than ever to find, share, explore, and use OPC UA Information Models by applications, end-users, and standards bodies.

The globally available UA Cloud Library was co-developed with the Clean Energy and Smart Manufacturing Innovation Institute (CESMII). With its multi-cloud architecture, the UA Cloud Library saw contributions from all major cloud vendors leveraging open interfaces and is available for sharing, finding, and collaborating on OPC UA Information Models. Today, the UA Cloud Library already contains over 65 OPC UA Information Models created by individual companies as well as international standards organizations like AutoID, DEXPI, MDIS, MTConnect, and over 30 VDMA working groups as part of their OPC UA Companion Specification work.

The UA Cloud Library offers two standout benefits:

- OPC UA information model access for applications
- Ease of use of the entire OPC UA Companion Specification collection for end-users in general

While shop floor (OT) components routinely discover and use data structures and services of other OPC UA components, direct access to such semantic information has not been readily available to cloud-based applications due to security considerations. The UA Cloud Library eliminates this gap by providing IT and cloud-based applications access to semantic information directly from the cloud instead of manually getting it from the OT systems.

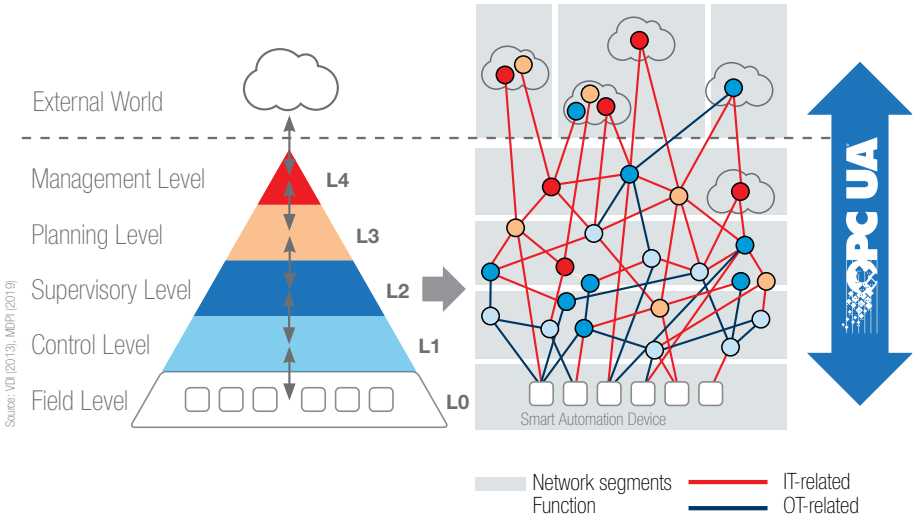
"The UA Cloud Library is the missing link that makes OPC UA information models available in the cloud on a global scale without requiring a connection to physical machines," said Erich Barnstedt, Chief Architect Standards & Consortia, Microsoft Corporation, and chair of the UA Cloud Library working group. "It enables OPC UA Information Models – used as blueprints for industrial digital twins – to be looked up and matched against time-series machine telemetry data provided by cloud-based analytics software, which is a common requirement in Industrial IoT projects."

"It was an honor to partner with the OPC Foundation in this strategic initiative," said John Dyck, CEO of CESMII. "The UA Cloud Library is truly an important step on the journey to Smart Manufacturing Interoperability and will pave the way for dramatic simplification and cost savings for manufacturing systems!"

Stefan Hoppe, President and Executive Director of the OPC Foundation, said that "the value of what the OPC Foundation and CESMII joint working group created cannot be overstated because it equips us with the mechanism needed to facilitate access to all known OPC UA information models via an open, global, single-source of truth."

"Beyond the value the UA Cloud Library brings to applications, it will help with global OPC UA information model coordination and harmonization efforts by making it easy to search and cross-reference the latest OPC UA companion specifications in real-time. Finally, the UA Cloud Library will serve a crucial infrastructure role in Smart Manufacturing initiatives that depend on interoperability."

Semantic interoperability with OPC UA from the sensor to the cloud



SOURCE: OPC FOUNDATION

The UA Cloud Library makes is easy to find, share, explore, and use OPC UA Information Models by applications, end-users, and standards bodies.

FLC Initiative reaches milestone

Three years after its launch, the OPC Foundation's Field Level Communications (FLC) initiative has completed the second release candidate of the OPC UA FX (Field eXchange) specifications and has started the review and release process for them. In addition, a multi-vendor demo with controllers and network infrastructure components of 20 companies – among them the world's largest automation suppliers – has been realized to showcase the cross-vendor interoperability of automation components for the most diverse use cases in Factory and Process Automation.

OPC Foundation (OPCF) announced that its Field Level Communications Initiative has accomplished a significant milestone in the ongoing project by completing and publishing the second OPC UA FX specification release candidate that will become the first public available specification after conducting OPCF-wide membership review.

The release candidate of the Field Level Communications Initiative consists of four specification parts (Parts 80-83) and focuses on communication between automation components to exchange process data and configuration data using OPC UA Client/Server and PubSub extensions in combination with peer-to-peer connections and basic diagnostics:

Part 80 (OPC 10000-80) provides an overview and introduces the basic concepts of using OPC UA for field level communications.

Part 81 (OPC 10000-81) specifies the base information model and the communication concepts to meet the various use cases and requirements of Factory and Process

Automation.

Part 82 (OPC 10000-82) describes networking services, such as topology discovery and time synchronization.

Part 83 (OPC 10000-83) describes the data structures for sharing information required for Offline Engineering using descriptors and descriptor packages.

A multi-vendor interoperability demo has been implemented, combining components from a total of 20 manufacturers, among them the world's largest automation suppliers, to enable cross-vendor data exchange via OPC UA and the extensions for the field level, OPC UA FX (Field eXchange).

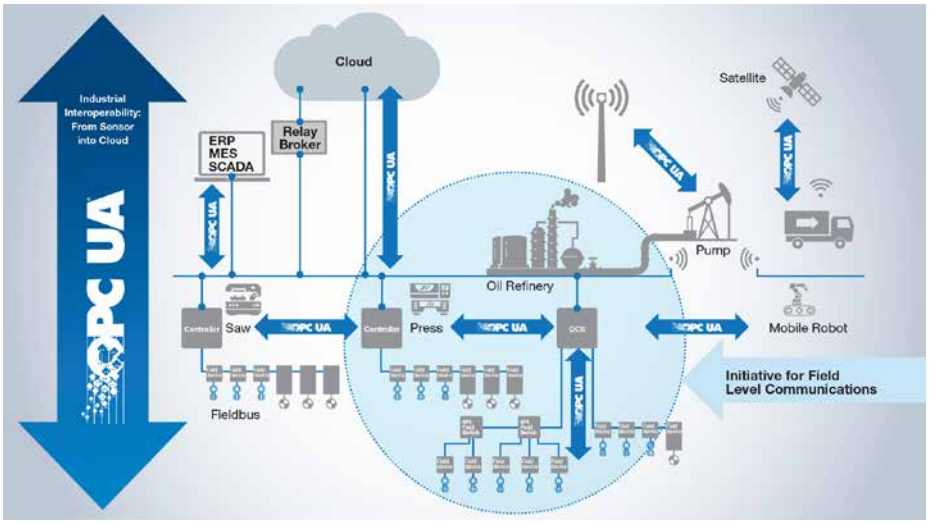
The focus of the interoperability demo is on horizontal communication between automation components, i.e. controller-to-controller (C2C(communication. With the UAFX extensions, the controllers are able to exchange process data with other controllers using UAFX Connections and PubSub mechanisms. In the demo itself, process data is exchanged via UDP/IP using wired Ethernet or Ethernet TSN, as well as in combination with a 5G wireless connection.

In the demo, the controllers act as UAFX Publisher and/or UAFX Subscriber, which exchange data via UAFX Connections. The controllers are configured and interconnected via so-called UAFX Connection Managers, which are either integrated into the controller or implemented as an external software component. The Connection Managers used were implemented by Siemens and Unified Automation. All controllers are monitored in real time via a central dashboard which visualizes the respective status, selected process data and other information from the UAFX asset information model of the automation components.

Participants in the demo are the manufacturers: ABB, Beckhoff, Bosch Rexroth, B&R, Emerson, Festo, Honeywell, Hirschmann/Belden, Huawei, Kuka, Mitsubishi, Moxa, Omron, Phoenix Contact, Rockwell Automation, Schneider Electric, Siemens, Unified Automation, Wago and Yokogawa.

Two additional demos were implemented to highlight two highly relevant aspects for field level communications: Firstly, a multi-vendor demo demonstrating deterministic transport in a converged network based on OPC UA over TSN using the UAFX extensions with a direct Layer 2 mapping to optimize the efficiency for high-performance real-time applications. Secondly, the prototype of a Safety Testing Tool which will be used for development-accompanying testing and certification of OPC UA Safety devices based on the new OPC UA Safety Specification which is now also supporting PubSub and UAFX.

Peter Lutz, Director Field Level Communications of the OPC Foundation said: "The completion of the second release candidate and an impressive multi-vendor live demo is a major achievement because the specifications are now mature so that the member review process could be started."



SOURCE: OPC FOUNDATION

OPC UA ecosystem.

Since the start of the Field Level Communications Initiative in November 2018 more than 320 experts from over 65 OPC Foundation member companies have contributed to generate the technical concepts and elaborate the specification contents for extending the OPC UA framework for field level communications, including Determinism, Motion, Instruments and Functional Safety.

Thomas Brandl from Bosch Rexroth, who is chairman of the Field Level Communications Initiative's Steering Committee, commented: "It is remarkable how many companies – including all major automation suppliers and key technology providers from all over the world – have been contributing to our initiative and how constructively all the experts have been working together to advance the common goal of bringing OPC UA to the field level."

Progress has also been made by two working groups of the Field Level Communications Initiative, contributing to a harmonized solution for motion and safety applications:

The *Safety Working Group* has finalized Version 2.0 of the OPC UA Safety specification (OPC 10000-15) that includes extensions for OPC UA PubSub and support for OPC UA FX (Field eXchange).

The *Motion Working Group* has started work in May 2020 to develop an architecture and common information model for motion devices which has resulted in requirements specifications and technical concept creation.

MDIS Sub-Sea Standard

As an OPC Foundation specification, MDIS is now freely available for market adoption and the MDIS working group is open to all interested OPC Foundation members.

OPC consolidated and took over the MCS-DCS Interface Standardisation (MDIS) specification ownership. Effective immediately, as with all OPCF Companion Specifications, MDIS is freely available for adoption by all interested parties at no additional cost. The OPCF MDIS working group, co-chaired by Markus Koenig from SubSea, Tim Fortin from Honeywell, and Paul Hunkar from DS Interoperability, now oversees the ongoing maintenance and expansion of the standard. Original MDIS network group members will continue working in the OPCF working group.

MDIS was formed with a vision to optimize and standardize communications between subsea Master Control Stations (MCSs) and topside Distributed Control Systems (DCSs). A standardized MCS-DCS interface simplifies the implementation of data communications and increases data quality. Companies that adopt the MDIS standard, whether they are the operators or automation vendors, benefit from simplified integration and commissioning of the MCS–DCS interface, reduced maintenance efforts, and minimized risk of interface failures that lead to downtime and expensive subsea equipment repairs.

Shreekant Mehta, Senior Vice President, Energy at Sagentia Innovation (which incorporated OTM Consulting) commented, "MDIS was started as an OTM network in 2009 with support from operators and vendors. The collaboration seen within MDIS is unique, and we have seen some great technology development leading to three interoperability testing meetings where interfaces were proven. We are delighted to see the MDIS specification reach maturity and have a new home with OPC who will maintain and update this specification as needed. We'd like to thank the operators, integrators, vendors and OPC who have worked together to create this industry standard."

*Technology update by **OPC Foundation.***

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Bringing geolocation services to the supply chain

IoT-connected sensors with cloud-based geolocation capabilities allow organizations to monitor assets over large geographic regions. With this technology in place, retailers can work directly with their manufacturers and logistics partners to mitigate potential delays in the supply chain while managing customer expectations.

THE INTERNET OF THINGS (IoT) CONNECTS billions of smart devices and sensors all over the world, enabling real-time monitoring and tracking of events. However, IoT is typically discussed in land-based activities; applications in the world's oceans are limited.

The World Shipping Council estimates that there are, on average, 1,382 containers lost at sea each year. With wireless sensors using Semtech's LoRa devices and the LoRaWAN standard, companies can monitor many variables while vessels are at sea to conduct preventive maintenance. This includes the status of shipping containers, the condition of machinery, fuel efficiency, environmental metrics, and cargo.

Monitoring assets is even more challenging in today's supply chain shortage; it's increasingly important to know where packages are within the journey from the factory to the customer. IoT-connected sensors with Cloud-based geolocation capabilities allow organizations to monitor assets over large geographic regions. With this technology in place, retailers can work directly with their manufacturers and logistics partners to mitigate potential delays in the supply chain while managing customer expectations.

Smarter asset management

Asset management technology can be expensive or impractical to implement because of the vast distance the asset needs to travel. By combining cost-efficient, low power and secure wireless connectivity with a standardized infrastructure, asset management becomes much more cost-effective and reliable.

With long range, low power technology, IoT solutions are scalable and easy to implement. It also fills the technology gap left by high bandwidth, high power technology. For example, cellular and Wi-Fi/BLE-based networks require either high bandwidth or high power and have a limited range or an inability to connect to land networks.

Long range, low power sensors can be embedded into assets, such as pallets, packages and containers, to provide better visibility into the supply chain. With sensors and location data, track and trace applications can be used for data transmission frequency ranging from hours to less than a few minutes.

SOURCE: SEMTECH

Long range, low power sensors can be embedded into supply chain assets (pallets and containers).

The main difficulty with asset tracking solutions is linking remote sensors wirelessly to the internet across a variety of sites in a seamless manner.

Benefits of geolocation

Geolocation-equipped devices bring better asset management to further optimize supply chain operational processes. Geolocation in every device can significantly lower the Total Cost of Ownership (TCO) for deploying sensors and trackers.

Access to reliable location data is increasingly valuable to production managers, reducing the potential for assets to be misplaced or lost entirely during their journey. To help companies navigate the supply chain crisis, access to real-time data allows enterprise operations to better manage operations through the supply chain process.

The real-time visibility into supplier activity accelerates time-to-market, reduces operational design complexity, and decreases costs of over purchasing since retailers are aware of when their shipments are coming in.

Sensors leveraging LoRa can help supply chain professionals significantly lower the cost and reduce the design complexity of their IoT asset tracking and monitoring solutions. A transceiver can utilize Global Navigation Satellite System (GNSS) tracking for outdoor applications and Wi-Fi passive scanning for tracking indoor assets, enabling continuous indoor-outdoor tracking on a single chip.

When GNSS technology is combined with LoRa devices, the combination of these two technologies offers:

Increased productivity: Implementing IoT solutions to monitor assets provides workers with the ability to quickly locate and deploy assets, saving time, fuel, equipment and resources.

Efficient operations: With geolocation technologies, logistics managers can streamline the workforce needed to track down vehicles, product movements and statistics. With two-way communication, fleet managers can communicate with their team in real time.

Location tracking: Implementing a low power, long range solution into the supply chain can simply inform managers of the whereabouts of goods and prevent theft and other losses.

Looking forward

By leveraging connected solutions, companies can replace inefficient and costly processes with IoT-enabled asset management solutions. This holiday season and beyond, implementing smart sensors with long range and low power capabilities will better position companies to help mitigate potential errors and streamline the supply chain process.

Marc Pégulu, Vice President, IoT Strategy and Products, ***Semtech.***

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Special Report

IT-OT Convergence in Focus

Solutions bridging the gap between Information and Operations Technology for smart manufacturing.

industrial ethernet book

Industrial Networking & IIoT

IT-OT Convergence Special Report

Industry experts weigh in and provide their perspective on the state of IT-OT Convergence in the modern manufacturing plant. This special progress report takes a look at cybersecurity, enterprise data connectivity and how common network diagnostic and management tools can increase IT-OT effectiveness.

Visionary operations leaders recognize that reams of operational data used to support real-time decision making could create additional value for companies.

INFORMATION TECHNOLOGY AND OPERATIONAL technology departments within industrial manufacturing plants have traditionally functioned independently. The goal of OT was to keep the plant running smoothly, and to support IT-managed business applications within the enterprise. But the world of manufacturing is changing. And to keep up, IT/OT relationships and deployment of technology must change as well.

In this special report, IEB reached out to industry experts to get their insights into the latest insights into IT-OT convergence, cybersecurity concerns, and all of the technical megatrends that are providing new management and diagnotic tools for helping to meet this challenge.

Together, IT and operations teams must go beyond responding to problems. Instead, they are key players in their companies' transformations, helping to seize new business opportunities that make companies more competitive, more efficient, and more secure.

Focus on Security

Forging stronger partnerships.

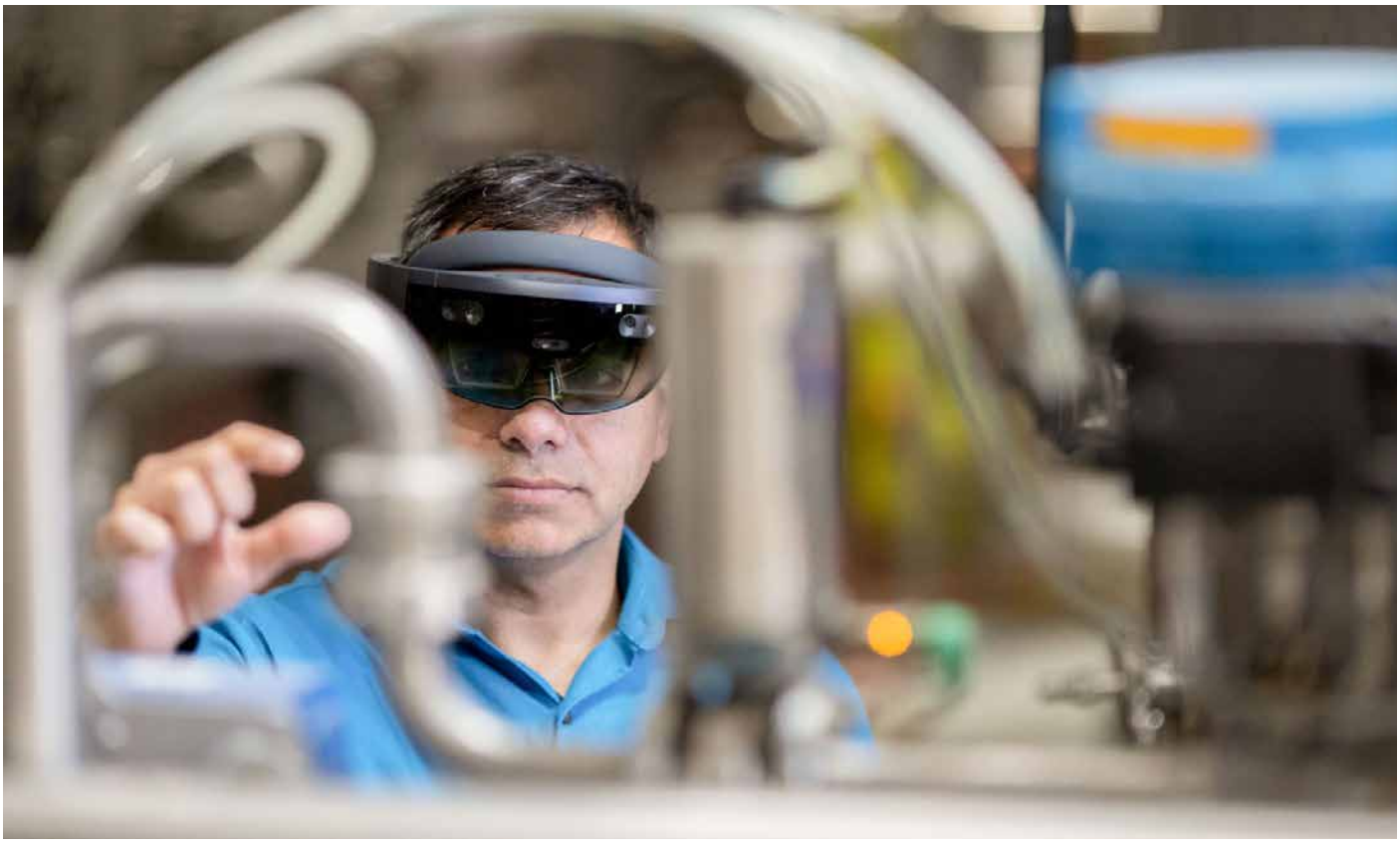
According to Barry Turner, Technical Business Development Manager at Red Lion, cybersecurity is a primary issue for strengthening the IT-OT, and the ability to implement a defense-in-depth strategy. Information Technology (IT) and Operations Technology (OT) personnel within a manufacturing environment often have different priorities, but generally IT departments have experience in this specific area. Education and communication enables them to work together more effectively, and especially to build the future the industrial networks that 5G and Web3 will require."

IT-OT solutions

"Traditionally the IT and the OT have misaligned priorities when it comes to security. The OT is responsible for making it work as quickly and efficiently as possible, which in many cases is in direct conflict with the IT department's highest responsibility, security," Turner told IEB recently. "For that reason, it will be important that OT understand and implement key concepts the IT department has been using for quite some time. For example, defense in depth is a concept that increases the security of a network or application by adding multiple layers of protection from attacks. These layers often come in the form of VLANs, firewalls, and strict user access control."

Technology benefits

Turner stated that increasing the network and application security by implementing a defense-in-depth strategy will help align both IT and OT and create a more robust application in general. A great way to get started is to build zones and conduits using VLANs, routers, and ideally, monitored access control. So, in terms of hardware, we are talking about routers, layer 2 Ethernet & layer 3 Ethernet



SOURCE: ROCKWELL

There is an acute need for providing enterprise connectivity between systems that create data, and the users that distill data into relevant information.

switches. Using the Ethernet switches to create VLANs to make smaller networks or zones. Then using routers and firewalls to build a path in and out of those zones. It is also important to be able to have access control and some type of monitoring and alerting.

"Many times, access control can be accomplished by using access control lists which would allow access based on IP or MAC address of a network device. Lastly, the network needs to log and alert when unusual activity is detected," Turner said.

He added that Syslog is one of many options here. It's a technology that the IT department is already using and many industrial controls products support including Red Lion's FlexEdge controller or NT24k Ethernet switch. Adding a layer that can detect and alert when bad things happen will ensure a controls engineer has as much time as possible to take action and hopefully mitigate costly downtime.

Convergence challenges

"Getting this very critical piece right is about education and communication. The IT department has been in this cyber security battle for a few more years than the OT. It's a good idea to learn from that experience and build it. The IT department typically does not have unmanaged switches in their network as they do not provide features needed for a defense in depth strategy," Turner said.

"Likewise, controls engineers would be better served to replace unmanaged switches with managed ones that would offer features like VLANs, Access Control Lists, and Syslog. Having managed switches in the network will enable controls engineers to configure their networks in alignment with the IT department. Ensuring they are able to work together, and build the future-state industrial networks that 5G and Web3 will require."

Enterprise data connectivity

Software at the edge can break down barriers.

Arvind Rao, global business leader, Digital Solutions for Rockwell Automation emphasized the need for providing enterprise connectivity between systems that create data, and the users that distill data into relevant information. They key is software for taking operational data, and developing methods to take advantage of it at the enterprise level to drive decision-making.

IT-OT solutions

"Industrial data from plants and equipment is generated in huge volumes, every millisecond, which makes it difficult to capture accurately. When that data is captured, it is often stuck in siloes that make it hard to bring different data sources together," Rao told IEB recently. "Even when you do accurately capture data and bring it together, a lot of work remains. You need to contextualize data from disparate sources, align timestamps, and prepare data models."

Rao said that new software at the edge can help break down these barriers by providing connectivity between the systems that create data and the consumers of that data. Once the data can flow easily, data scientists can create actionable industrial performance insights.

"This is the future of IT/OT convergence – connecting data as it's created to the analytics engines, quality systems, traceability records, and optimization programs that drive industrial efficiency," he added.

Software that collects, organizes and contextualizes OT data and makes it available to higher-level IT applications and databases, such as FactoryTalk Edge Gateway software from Rockwell Automation, can unlock actionable plant and enterprise-level insights to accelerate IIoT digital transformation. It provides the right foundation to drive edge-to-cloud IT/OT convergence at the enterprise level, so everyone from the shop floor to the top floor can use data to make smarter decisions.

Technology benefits

Every industrial facility has numerous data sources and, many times, these data sources use different communication protocols from different vendors. To get data from the control system to the edge, multiple ingress sources are needed. This can be addressed in many

ways, such as native support for the most common industrial communication protocols like EtherNet/IP and OPC-DA, or with multi-protocol solutions like Kepware.

The ingested data will be mapped to data models. More advanced solutions can set up the ingress pathways and create a data model from a controller project file at design time, reducing the need to create data models during commissioning.

Once the data is ingested, it can be processed at the edge or sent to other egress destinations. The more formats and destinations that are supported, the better. Some common destinations include specific applications, like Azure IoT Hub from Microsoft and ThingWorx from PTC and may also include generic protocols to support any destination, like MQTT.

Your priority should be to use one solution that can send data to an on-premises data center and/or the cloud.

Integration challenges

"Using the controller project file allows a more literal translation of the industrial control layer to the data layer, helping OT engineers and IT analysts speak the same language. Instead of ingesting raw, unstructured and uncoordinated data from the control system, using a data model defined in the controller can more accurately and more quickly contextualize information," Rao said. "That means less time spent preparing or grooming data, and more time on generating meaningful results."

The FactoryTalk Edge Gateway software leverages a unique smart object capability. This capability is built directly into the industrial control layer and transforms raw data from tags into a logical data structure that is completely configurable by the OT engineers based on the needs of IT analysts and data scientists.

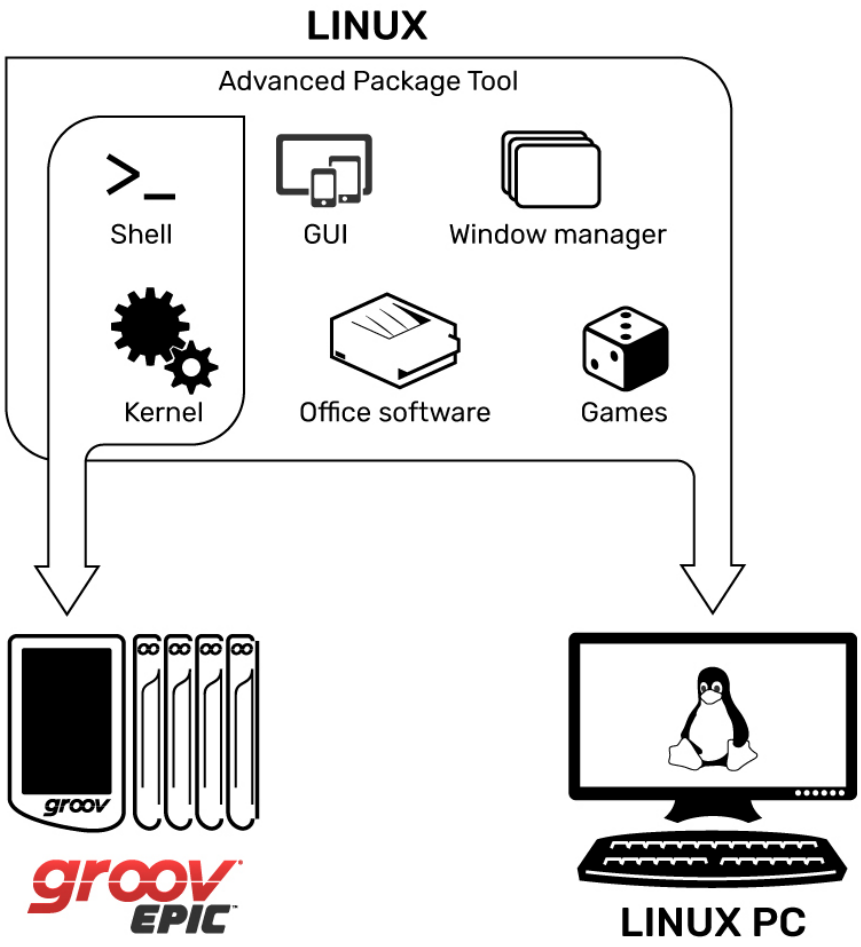
This allows you to automatically build in OT data context at the source, at high speeds of sampling, and maintain that context throughout the IT layer. This increases the data's readiness for ingestion into the next level of analytics, removing up to 70% of the effort from data engineering.

Convergence challenges

"Industrial organizations have a lot of operational data, but they don't know how to take advantage of it at the enterprise level to compete better, such as by improving their organization's resiliency, sustainability and supply chain agility," Rao said. "While digital transformation initiatives are on the rise in manufacturing, CIOs and CTOs are struggling to make OT and IT worlds play well with each other and tap the hidden insights from the vast industrial data sources."

The key reason for these roadblocks is the lack of proper correlating context, such as data source, type or timestamp, while capturing high-speed OT data at the edge. Without this critical OT context, captured industrial data has low data integrity, which translates into significantly higher data preparation efforts while building analytical models. To extract actionable insights from this OT data, it needs to be packaged in an interchangeable and flexible data format that can be easily shared between OT and IT applications.

"As it becomes easier to connect the data across the enterprise, the value of IT-OT convergence becomes greater. Smart connectivity at the edge creates that ease," Rao concluded.



SOURCE: OPTO 22

Opto 22's custom built Linux OS for the groov EPIC includes only the packages required for EPIC's functionality. This makes it easier to keep installations secure, stable, and up to date.

Common tools & procedures

IT-compliant standards & toolchain.

An important aspect of IT-OT Convergence is not only working more effectively together, but also adopting a common set of standards and tools, especially to deal with cybersecurity but also to manage the network infrastructure as well. Examples would be use of industry standard open protocols, and convergence on a toolset and standards that work for both IT and OT.

IT-OT solutions

The Eclipse Foundation, in its 2021 IoT & Edge Developer Survey Report, noted that Linux is the most popular operating system for constrained devices, edge servers, and the cloud. If this kind of adoption were mirrored by OT hardware vendors, many options would become available to foster convergence with IT systems.

Key among these are networking and cybersecurity technologies, which over time have created sharp cultural divides between OT and IT organizations due to a lack of interoperability. Instead of pushing proprietary protocols, OT should embed IT-compliant standards like DNS/DHCP, network firewalls, and SSL/TLS encryption, so that all devices can be managed using the same tools and procedures.

Technology benefits

Linux is an open source operating system with a significant presence throughout IT and communications systems, including much of the internet; a supportive professional and enthusiast community; and a broad range of libraries for every kind of application. These factors represent a significant difference

from the proprietary, closed source operating systems that power many automation devices from the Industry 3.0 generation.

"An IT-compatible toolchain in OT eliminates questions about how to integrate the two organizations, provides greater assurance that they can operate with the same integrity levels, and moves us toward a shared vocabulary and culture about networking and security," said Josh Eastburn, Director of Technical Marketing, Opto 22.

IT-OT integration challenges

Eastburn said that Linux was designed as a modular, open-source implementation of the UNIX operating system. It has a small kernel of essential functions that allow software to communicate with underlying system hardware and a broad library of modules (called packages) supplied by other open source contributors, including enterprises and non-profit foundations, which manage much of the source code.

As such, Linux has been extended, modified, and re-released many times for different purposes and powers everything from small consumer electronics, to websites, to the servers that manage the internet, and even spacecraft. Different flavors of Linux are referred to as distributions. Opto 22 uses tools provided by the Yocto Project to create a minimal, secure OS for our products based on the popular Debian Linux distribution.

Convergence challenges

"Since questions about IT-OT integration come up very often for Opto 22's customers, it's typical for us to meet with IT representatives to address concerns about cybersecurity and network architectures," Eastburn noted. "Our decision to build our edge devices on Linux makes this conversation very straightforward.

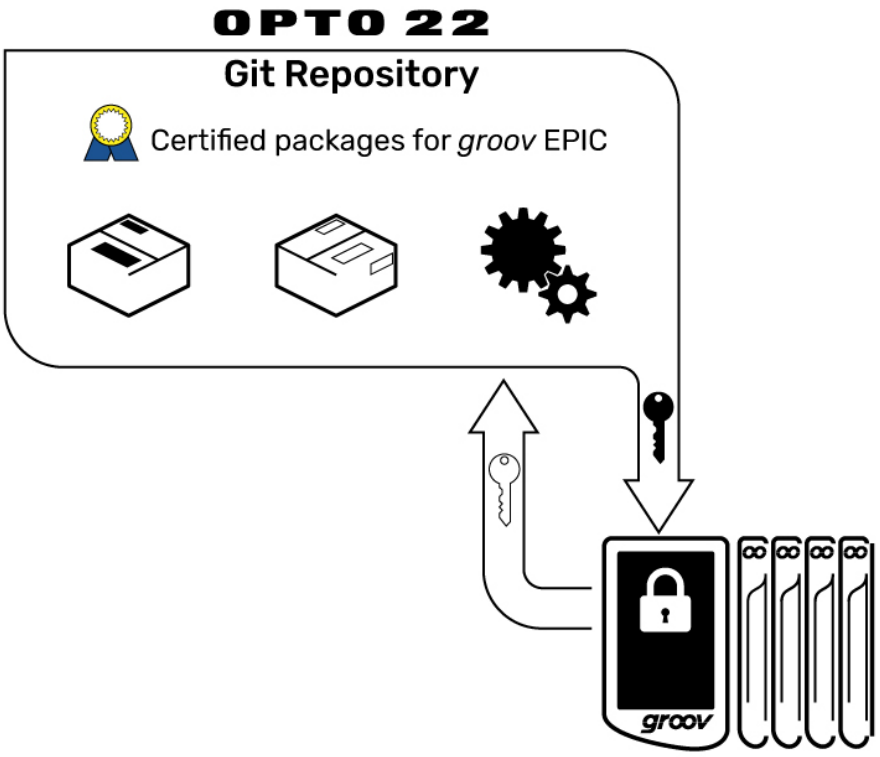
Instead of explaining why IT needs to adapt to special OT protocols and procedures, we simply demonstrate how our devices can be managed in the same way that the rest of the network is managed, including things like centralized user access rights (LDAP) and automatic addressing (DHCP). This puts IT at ease and allows our customers' projects to move forward."

Standard Ethernet Solutions

Network diagnostic and management tools.

Dr. Al Beydoun, President and Executive Director at ODVA said that IT-OT convergence can be enhanced not only by mutual understanding of key technologies, but also a common set of diagnostic tools and capabilities. Consistent content in a common location, from different devices and different vendors, can be shared using IT tools to create greater IT-OT visibility.

Ultimately, a broad set of skills are needed to optimize industrial operations, and manage the effective transfer of valuable data from the plant to MES, ERP, and cloud systems

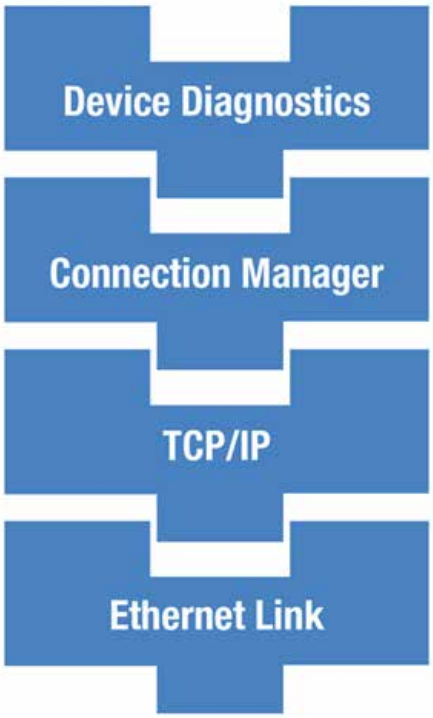


SOURCE: OPTO 22

A Linux repository is where code packages are stored ,so developers can add them to applications. Opto 22 signs all code in with a digital cryptographic key indicating it has been approved for use.

IT-OT solutions

EtherNet/IP has played a critical role in IT-OT convergence by providing industrial operations the information needed by management to continue to drive growth and constrain costs in ever more challenging business environments. EtherNet/IP uses standard IEEE 802.3 Ethernet technology and Internet Protocol suite standards to solve critical industrial automation applications.



SOURCE: ODVA

Standard Network Diagnostic Assembly Concept.

"Reliance on standard Ethernet technology reduces the differences between the plant floor OT network and the broader enterprise IT network making it easier to transport critical information wherever it needs to go," Beydoun said. "Furthermore, the object-oriented design of EtherNet/IP via the underlying Common Industrial Protocol or CIP allows for the services and device profiles needed for real time control in an interoperable environment. The object-oriented nature also makes it easier for those with an IT background to work with and to understand EtherNet/IP."

CIP Security is also a key component of IT-OT convergence as a last layer of defense for EtherNet/IP devices to protect critical infrastructure investments and worker safety. Approaches like permit and deny listing via firewalls along with detection tactics like deep packet inspection are vital components of network security that can be enlisted in the switches that connect OT and IT networks.

However, IT centric approaches alone aren't enough with bad actors constantly searching for weaknesses in OT networks, developing new malware, and finding more and more success with ransomware attacks. A defense in depth approach that includes the EtherNet/IP device level must be a part of a comprehensive security plan.

Security Properties	EtherNet/IP Confidentiality Profile	CIP User Authentication Profile	Resource-Constrained CIP Security Profile
Device Authentication	✔		✔
Trust Domain	Broad – group of devices	Narrow – Users/Roles	Broad; option to be Narrow via Gateway or Proxy
Device Identity		✔ (Identity of User)	✔ (Via PSK)
Device Integrity	✔		✔
Data Confidentiality	✔		✔
User Authentication		✔	Via Gateway or Proxy
Change Detection (Audit)			
Policy Enforcement (Authorization)		Fixed	Via Gateway or Proxy

SOURCE: ODVA

CIP Security Profiles.

Technology benefits

EtherNet/IP has added a Standard Network Diagnostic Assembly to enhance the diagnostic capabilities of EtherNet/IP devices. The Standard Network Diagnostic Assembly creates a scaled architecture concept where network and device diagnostic data that was once spread out in many different locations is now combined together to be more easily accessible. This approach reduces messaging and user programming required to access data. This provides for consistent content in a common location from different devices and different vendors, which can be exposed via IT tools to create greater IT-OT visibility.

Standard Network Diagnostic Assembly Concept

Beydoun said that, with CIP Security, a self-defending device can reject data that has been altered (integrity), reject messages sent by untrusted people or untrusted devices (authenticity), and reject messages that request actions that are not allowed (authorization). CIP Security for EtherNet/IP devices makes use of the IETF-standard Transportation Layer Security (RFC 5246) and Datagram Transport Layer Security (RFC 6347) protocols in order to provide a secure transport for EtherNet/IP traffic.

TLS is used for the TCP-based communications such as diagnostics and commissioning, and DTLS for the UDP-based transport communications such as I/O data. User Authentication is provided via the OpenID Connect standard, with Role-Based Access Control (RBAC) being enforced with the CIP Security capable devices.

IT-OT integration challenges

The EtherNet/IP Standard Network Diagnostic Assembly combines ten different attributes of three different object classes into one location. One message is required instead of 10 messages per device in order to retrieve all of the information.

Making it easier for diagnostic and prognostic analysis tools/systems to utilize data that is already available in EtherNet/IP devices is one way to realize the benefits of IT-OT integration. The reduction in messages minimizes traffic and therefore required bandwidth, which is important for existing OT networks that are seeing the addition of new devices and traffic.

"Reduction in user programming, application development complexity, and changes to devices on the network allows for more valuable data to be transported from devices to the cloud for analysis and action to improve the production process," Beydoun said. "The Standard Network Diagnostic Assembly is the first profile-independent definition of assembly instances in CIP that have data applicable to any device providing a higher level of data standardization."

From a security perspective, CIP Security provides the last mile of security-related requirements and capabilities for EtherNet/IP devices. With the reality that not every EtherNet/IP device requires the same type of security or can support the associated resource requirements, CIP Security defines the notion of a Security Profile. A Security Profile is a set of well-defined capabilities to facilitate device interoperability and end-user selection of devices with the appropriate security capability.

Convergence challenges

Beydoun added that "IT-OT convergence is a requirement to stay competitive in a future where cost pressures and resource constraints will continue grow. Data must securely traverse from the plant floor to the edge and the cloud in order to continuously optimize the business."

He said that the challenges of differing priorities regarding data confidentiality versus network uptime have become a moot point as converging networks have proven that data must remain confidential for security purposes and the production line has to keep going for cost reasons. The merging of expertise ranging from well experienced controls engineers with mechanical and electrical engineering backgrounds to workers graduating today with software training is a requirement for IT-OT convergence.

"Ultimately, all of these skillsets are needed to optimize industrial operations and to transfer valuable data from the plant to MES, ERP, and cloud systems," he added. "EtherNet/IP and CIP Security are key underpinnings to the connection of lower level to upper-level networks to stay globally competitive and to ensure the preservation of both workers and assets."

Barilla implements digital connectivity at sauce plant

Digital connectivity at the Barilla plant provided key solutions including elimination of times of inactivity, real-time analyses of huge amounts of data, more effective way of working thanks to remote control and teleservice, repaid investment and maximum cybersecurity and data protection standards.

SOURCE: SIEMENS

Barilla's production gains advantages from a new OT network.

BARILLA, AN ITALIAN COMPANY FOUNDED in 1877 and based in Parma, is the world leader in the food and pasta goods sector and produces pasta, sauces, and baked products at various production sites both in Italy and abroad. Its newest plant is in Rubbiano (PR) and is the only one used to produce sauces, dressings, and pestos, which includes its flagship product: Pesto alla Genovese with fresh basil and Parmigiano Reggiano cheese. The ingredients, recipes, technology, and "know-how" are 100% Italian, as well as the meat, which is sourced entirely from animals reared in Italy, with full traceability.

Built in 2012, the plant was subject to expansion in 2018, which saw the introduction of an additional two lines, doubling production capacity to 120,000 tons of sauce per year.

The plant comprises three macro departments, one for cooking, one for production, and one for packaging. In cooking, the different ingredients that go into the sauces are blended together and then cooked inside cookers. The prepared sauces are then sent to the packaging department.

Manufacturing challenges

The challenge for the project was clear: automation and state-of-the-art remote control without any downtime.

The expansion of the plant goes along with an ever greater proliferation of networked field devices whose task it is to exchange data with SCADA systems and plant management software. It was therefore necessary to develop a robust and organized industrial communication network to ensure the necessary scalability and flexibility to manage the new technology currently on the market in order to be able to archive, process, and analyze the huge amounts of field data (Big Data) in real time and thus allow companies to generate values using this data. The introduction of new cybersecurity standards in an industrial setting, such as the IEC 62443 standard, also prompted the client to revise its industrial network standards.

The plant also required a remote control and teleservice system for the devices that can guarantee both simultaneous technical interventions by suppliers and security, in terms of access control and monitoring. The aim was to transform an uncontrolled access system consisting of a flat network of communication into a network that, by the end of the project, is segmented and structured using a state-of-the-art access method.

SOURCE: SIEMENS

New systems created more effective way of working thanks to remote control and teleservice.

Another challenge was to avoid downtime situations and hence prevent disruption of production, as Andrea Di Nicola, Automation Manager at the Barilla plant in Rubbiano, explained: "A key issue for this project has been the implementation of Siemens' teleservice infrastructure, based on the Sinema Remote Connect solution combined with the Scalance S firewall. The most difficult part was converting the network architecture while the systems were in operation or in the few times production could be shut down. Thanks to the expertise of Siemens and their competent partner ITCore, we managed to achieve this with zero downtime, thanks to the careful management of the operations and network configurations, which made the transparent and optimally controlled transition phase possible. Both companies helped us throughout all the phases of the project, from the start right up to the final training part, the plant's technical area and maintenance, thus creating a harmonious infrastructure."

Innovative OT network meets high cybersecurity standards

The partnership with Siemens comes along in a natural way; the collaboration between Barilla and Siemens has been producing winning results for years. This is where the strong motivation was born to continue in this way and prefer Siemens over other automation companies. "Our trump card has been the full participation and collaboration in the pre-analysis phase and technical and economic assessment of the investment with Siemens, right from the start," continued Di Nicola. "We tackled this project together. The main idea was to get the worlds of IT (information technology) and OT (operational technology) talking, as before this project the whole automation network in the factory was almost entirely the domain of IT Barilla. The aim of this project was to separate the IT world from the automation world whilst at the same time making them interface in a functional way."

In fact, Siemens recommended to Barilla the most innovative OT networking and cybersecurity technologies currently on the market, ensuring complete compatibility of Siemens' devices with regard to systems and components from other automation suppliers.

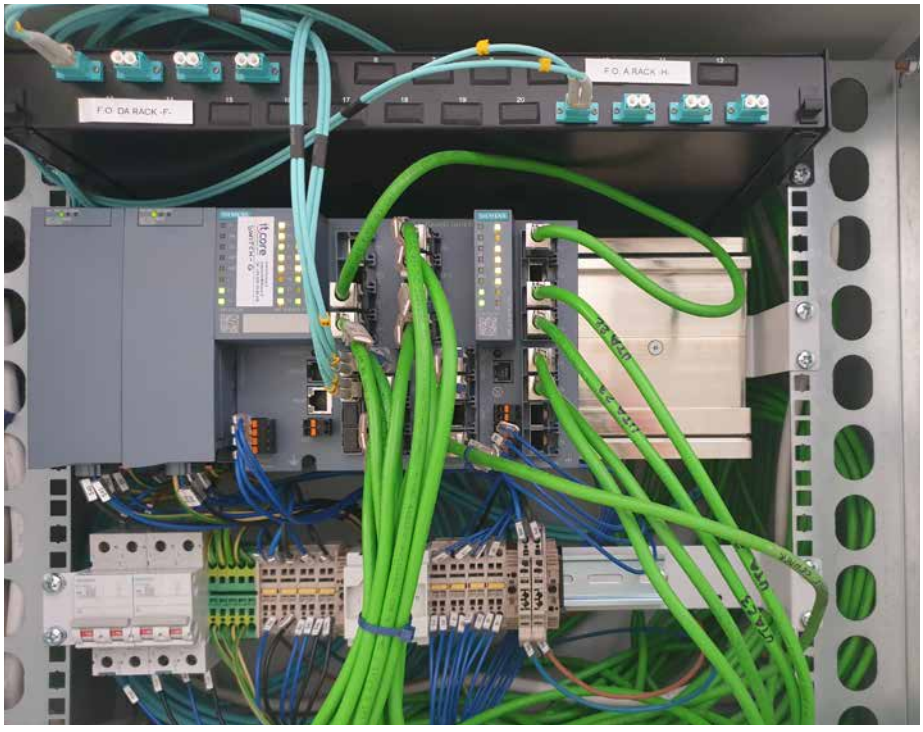
The strength has been the components and competence offered by Siemens, and the possibility of easily managing communications from other vendors, guaranteeing adequate continuity of production.

Marcello Scalfi, Sales Specialist Team Leader Digital Connectivity and Power at Siemens Italia, noted: "Integration work between the information technology and operation technology teams, carried out by Siemens, required a long internal evaluation phase together with Barilla, who considered various solutions presented by us via training workshops targeted at Barilla colleagues in the engineering and OT departments for the purpose of increasing their networking and cybersecurity skills. Knowing the technology available has also enabled them to acquire the right skills to be able to assess the best solution to adopt. For Siemens, it was essential to open up the discussion to the possible scenarios so the client could make a conscious choice. It has been an important transition, a training ground for everyone involved."

New network safeguards production continuity

The whole project was carried out by three parties: Siemens, Barilla, and ITCore.

ITCore, as solution partner of Siemens for the "Industrial Strength Networks", has taken a central role in the planning, realization, and maintenance of the whole network infrastructure and the teleservice systems installed at the Rubbiano plant.



SOURCE: SIEMENS

Scalance XM416-4C: the core of the production backbone that provides high availability and redundancy to the plant network.

SOURCE: SIEMENS

Scalance SC632: the array of industrial firewall enables the right communication path from plant network to IT and vice versa.

The new network, structured with rules and routing plans, now has more than 1,000 interconnected intelligent nodes. The process envisaged the creation of a fiber optic ring backbone network (also called "backbone") managed with MRP (media redundancy protocol) and the segmentation of the automation network in VLAN (Virtual LAN) split into production cells.

Each of these cells is segregated from the others in terms of network and communicates using the following devices from the Scalance product family at Siemens:

Industrial firewalls: a system for network security that allows monitoring of incoming and outgoing traffic using a predefined series of security regulations to allow or block events.

Industrial switches: network devices responsible for switching at datalink level, which is used to manage the data traffic when there are more connected nodes, separating the so-called collision domains connected to its ports.

Routers: electronic devices that route data between the networks, distributing the connection between different terminals.

To complete the solution, a centralized management and control system for remote access to the production network (teleservice) has been integrated according to a defined double jump host model. The implementation of the solution was made possible with the functionality provided by the SCALANCE S equipment from Siemens (industrial firewall) used upstream of the cells and the use of the SINEMA Remote Connect software.

Networking and cybersecurity in the industrial sector are themes that ITCore deals with on a daily basis together with Siemens.

"We believe that in the coming years constant monitoring of all devices connected in the network will be essential because, while we cannot think of stopping the digitalization process, we must do everything possible to safeguard production continuity, both in terms of functional operation and protecting the data generated," stated Federico Tarzia, Chief Technical Officer of ITCore.

Results above expectations

The solution put in place by Siemens has made it possible to achieve higher cybersecurity and data protection standards at a factory networking level feasible to date. This makes the Rubbiano plant a real role model for the brand's other plants.

As well as easy maintenance and thus the plug & play replacement of components, and consequently the reduction/elimination of downtime due to malfunctions, another point that has been gaining ever greater value over time and which has made it possible to repay Barilla's investment in full has been the support.

"With the spread, on the one hand, of the pandemic and the necessity to guarantee plant production on the other, investing in a reliable teleservice infrastructure has allowed us to "be in the factory" even if off-site, when smart working," commented Di Nicola. "At the same time, equipment suppliers, who were not always able to go to the factory to make any changes or interventions due to the pandemic, could use teleservice to be in environments that are segregated from each other, guaranteeing information confidentiality between one supplier and another." The timely control of this access and the possibility to smoothly control and manage external supplier operations has been another successful aspect of this project.

Marcello Scalfi, Product Management Team Leader, and Giorgio Santandrea, Account Manager, ***Siemens.***

Visit Website

Rapid roaming technology for wireless industrial networks

A Rapid Roaming enhanced WIFI client monitors surroundings and prepares new access points (APs) before die-down and drop-off connection processes take place. Protocols are used to seek a new AP when communication is healthy, assuring throughput and faster transitions and switch times.

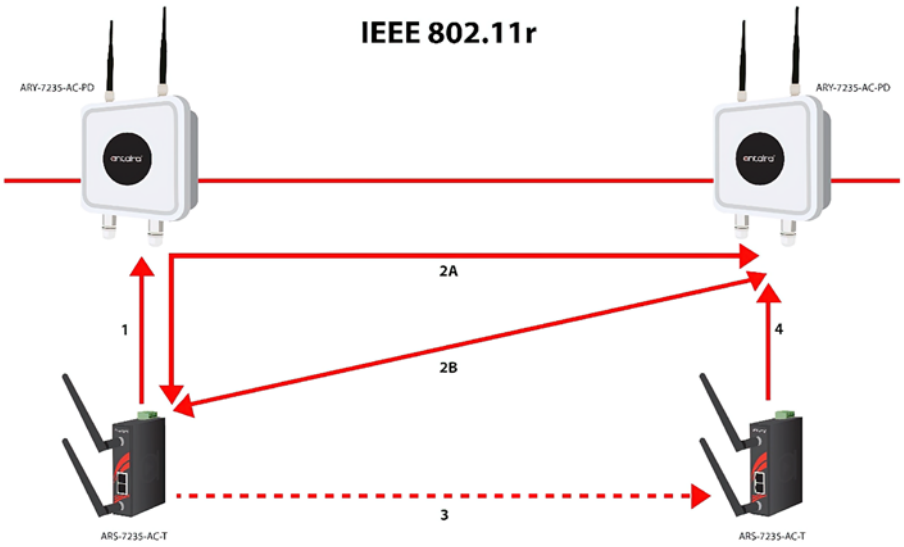
RAPID ROAMING PROVIDES MANY OF THE same advantages of 802.11r wireless at a much lower cost in areas where necessary infrastructure does not exist. An enhanced WIFI client monitors surroundings and prepares new possible access points (APs) connection opportunities before die-down and drop-off connection processes take place.

Modern factories heavily rely on Artificial Intelligence (AI) driven processes in order to optimize every step of production. Often, the sensors used to collect data for AI were connected with slow cable-driven serial protocols with RS-232 cables or twisted pairs for RS-422/485. With the development of newer technologies, however, there has been a transition to Ethernet-based communication.

Two main factors played a key role in this process: one, the price of Ethernet nodes went down with the advent of cheap microcontrollers that included fully integrated Ethernet communication hardware in one chipset, and two, sophisticated new sensors came to market that were not compatible with old serial buses.

Rapid roaming WIFI

To solve these problems, WIFI communication has become a key technology to deliver metrics from sensors, providing freedom from cables and to allow unrestricted 3D movements by a client in motion such as a vehicle or robot.

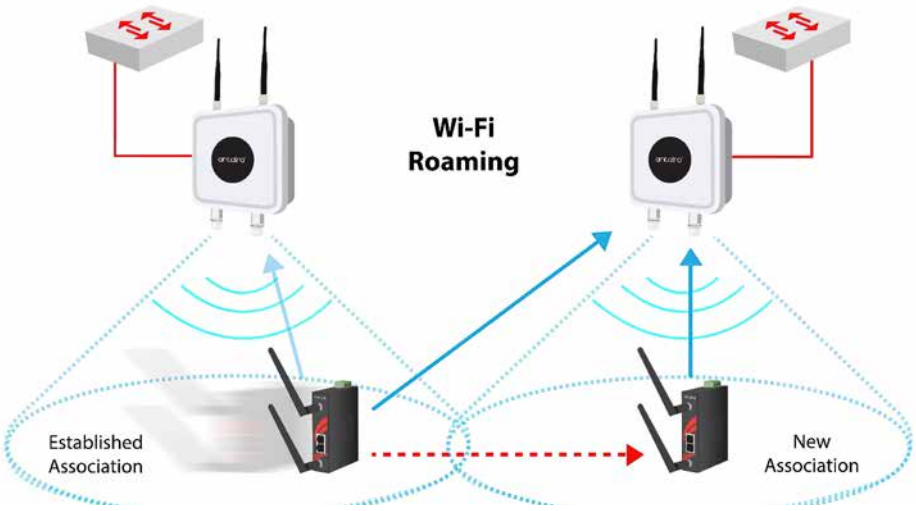


SOURCE: ANTAIRA

IEEE 802.11R wireless roaming system diagram

The trouble is that 802.11ac wireless communication extends only 100 meters, a distance normally not sufficient for reliable service and requiring multiple access points (AP) be installed to cover a large area of operation. A moving vehicle or robot needs to constantly switch over communication to the next strong signal access point.

The best solution is the implementation of 802.11r across the infrastructure that manages the switch-over mechanism with below 50ms transition. However, some areas of a factory or warehouse may not support 802.11r. In this situation, Antaira's new Rapid Roaming enhanced WIFI client is an ideal solution, as it monitors surroundings and prepares new possible access points (APs) connection opportunities before die-down and drop-off connection processes take place. Supported by the new Antaira ARS-7235-AC-T dual-radio industrial WAP, Rapid Roaming protocols seek a new AP when communication is still healthy, assuring superior throughput and faster transitions with below 150ms switch time.



SOURCE: ANTAIRA

Infrastructure requirements for rapid roaming.

IEEE 802.11R wireless roaming

Roaming has been a desired feature in wireless devices for decades. In 2002, the IEEE 802.11r standard was introduced and is still under heavy development with major fundamentals published in IEEE 802.11r-2008. The main goal of 802.11r was to hand over wireless connections between numerous APs along a client travel path without significant delay.

It has been particularly important for Voice over Internet Protocol (VoIP) applications where human conversation requires 50ms or better of transmission time to avoid undesired noticeable interruptions. The 802.11r standard allowed for speed with secure and seamless handoffs where authentication and Quality of Service (QoS) configurations were preconfigured ahead of switching to

the next AP. It made for a stable throughput of data without delays caused by the regular authentication process.

To implement 802.11r, the wireless infrastructure needs to support this standard. This typically will require significant additional investment as most systems that support 802.11r must have a Wireless LAN Controller in addition to the APs that are then controlled by the Wireless LAN Controller.

Applications where necessary infrastructure does not exist and there are cost restrictions, then Antaira Rapid Roaming technology can provide many of the same advantages at a much lower cost.

Steps of fast roaming

Authentication and QoS

In this step, two technologies are properly transitioning. Not just units are connected to one AP, but it has the same privileges in respect to communication priority. It is important in voice-over IP scenarios when delays could affect the human-to-human conversation.

Exchange 802.11r (2a - cable, 2b - radio)

This special protocol allows exchange of all necessary information ahead of travel path of a client, making the transition smooth and fast.

Travel path

This is the way Client travels along the available APs.

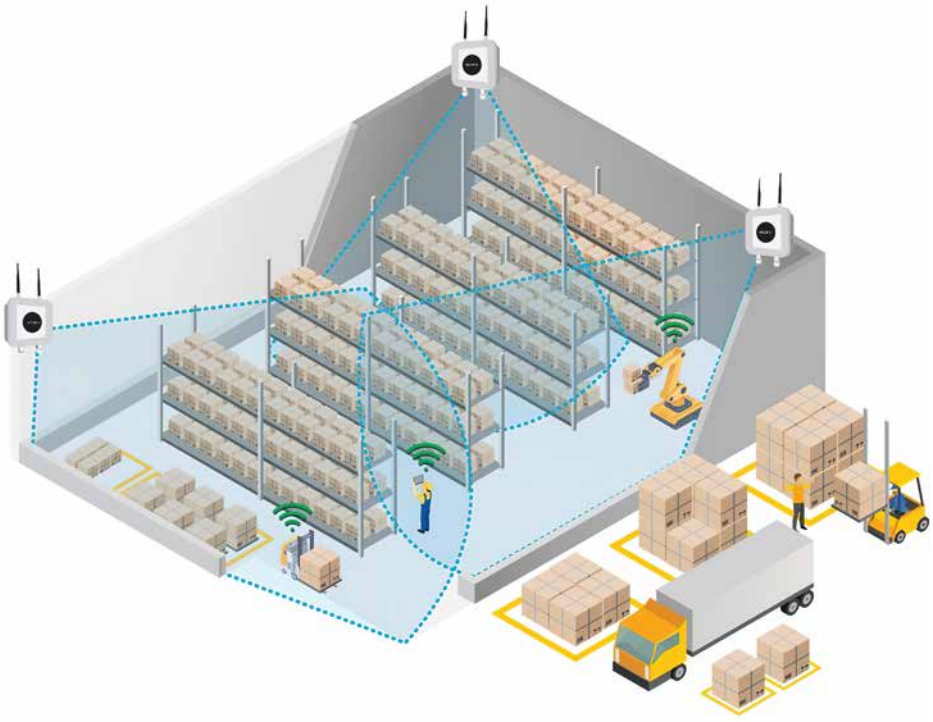
Infrastructure requirements for rapid roaming include:

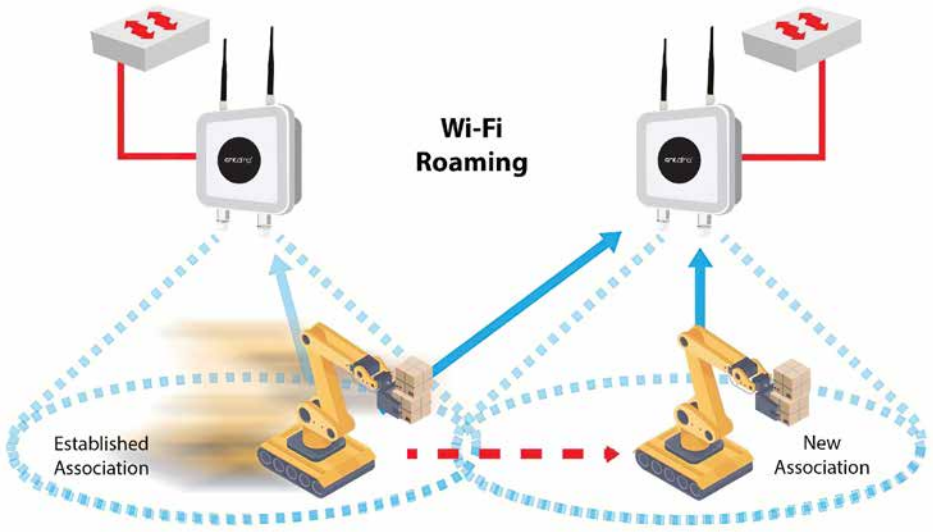
1) Same Service Identifier (SSID)
2) Same Password
3) Same Security Mode
4) Sand Band
5) Same Channel Width

In order for the rapid roaming technology to work correctly, it is necessary to use an AP with the same SSID and security key. When rapid roaming is enabled, the client device will be configured to scan for the surrounding APs. It is necessary to set slow scan time intervals to specify relatively slow scans when Received Signal Strength Indication (RSSI) signal levels are high and the client device can comfortably concentrate on delivering the maximum data throughput.

Next, specify the RSSI threshold level that will indicate an imminent need for a new connection. When this level is reached, the client device will be performing fast scans looking for a new AP. When it is detected it will authenticate and auto-connect to the new AP while simultaneously dropping the current connection. This active process eliminates weak signals deprived of links and prepares a new connection ahead when needed.

SOURCE: ANTAIRA





A warehouse uses autonomous robots that move about stocking shelves and fulfilling orders. A legacy WIFI network to support employees but the network did not have the equipment to support 802.11r.

Additionally, there are two modes of channels for scanning. One mode is "standard" and it works when all the channels are scanned.

The other mode is "intelligent" and it works when a client device for example goes back and forth along the same APs. In this scenario, it can learn those APs channels and look for them auto matically, further speeding up the reconnection process.

Warehouse wireless system

One example of where this scenario plays out is in a warehouse application with autonomous robots that move about the warehouse stocking shelves and fulfilling orders. Here, a legacy WIFI network was already in place to support employees connecting their PCs, tablets and phones, but the network did not have the necessary equipment to support 802.11r.

Antaira was able to provide the solution by fitting each of the robots with an ARS-7235-AC wireless router that could implement Rapid Roaming technology at a fraction of the cost of installing an entirely new wireless network.

*Technology report by **Antaira**.*

Visit Website

AI algorithms simplify complex robot applications

AI-based software facilitates man-machine collaboration using the MI.RA / Dexter software and Racer-5 COBOT to automate and simplify quality control for the infotainment system in the all-electric New Fiat 500. This is usually a lengthy, repetitive and manually executed processes with high costs and error rate.

THANKS TO METALANGUAGE-BASED AI algorithms, MI.RA / Dexter software optimizes the interaction between operators and robot systems. Unlike conventional computer languages, the software can be used without special IT or programming knowledge. By simplifying the programming of robotic applications, it also lowers costs and streamlines deployment.

Software based on AI algorithms

MI.RA / Dexter is a a powerful software program based on AI algorithms that simplifies human-machine interaction and at the same time optimizes industrial processes. In keeping with Comau's commitment to simplified automation, MI.RA / Dexter is a metalanguage that makes robotics easier for companies of all sizes by translating human language syntax into robot syntax. This allows operators to program a robot system using simple and intuitive controls, such as looking at an object, touch a certain point in space, listen to speech recognition processes and reproduce and carry out complex courses of action. The programming interface enables the operator to optimize workflow efficiency.

Since it can be used without any special IT or robotics qualifications, customers can reduce or eliminate dedicated programming costs. It streamlines creation of complex programs required to interact with robotic arms and can be used to program any industrial technology in a smart and straightforward way.

"Thanks to the user-friendly interface and metalinguistic syntax of the software, MI.RA / Dexter makes complex technology more accessible and affordable," said Giovanni Di Stefano, Comau's chief innovation officer. "The intuitive system, which is based on AI algorithms and can be used in practically every industrial sector, also allows real-time adjustment of the process parameters for more operational quality and efficiency."

MI.RA / Dexter was recently used by quality controllers to program a complex robotic cell for the all-electric New Fiat 500. The customer commissioned Comau to automate the testing and control process for the vehicle's infotainment system. These are usually lengthy, repetitive and manually executed processes with high costs and a significant error rate. Comau's solution combined an NJ-220 robot in its safe version with a Racer-5 COBOT, mounted on its wrist, to carry out automated testing processes inside the vehicle, which increases the efficiency, traceability and repeatability of the process. The collaborative system also helps ensure full compliance with the test process by objectively assisting the operator in completing each assigned task. For this purpose, the system has devices that have a "quasi-human" sensitivity, such as a vision system for validating infotainment apps, a microphone and a loudspeaker for recognizing voice commands and a gripper for sensitive contact work. The inherent safety features of the 6-axis articulated arm cobot eliminate the need for protective barriers, reducing both overall floor space and safety costs.

SOURCE: COMAU

Programming interface enables operators to adjust and correct the actions of the robot in real-time.

The MI.RA / Dexter programming language enabled the operators to manage the complex robot system autonomously. Activities included the safety management of the activities that the collaborative robot had to perform in close contact with the operator, as well as the automation and subsequent optimization of the required test tasks. It is part of the Comau MI.RA (Machine Inspection Recognition Archetypes) family, which also includes other digital tools and high-tech vision systems developed for the smart factory.

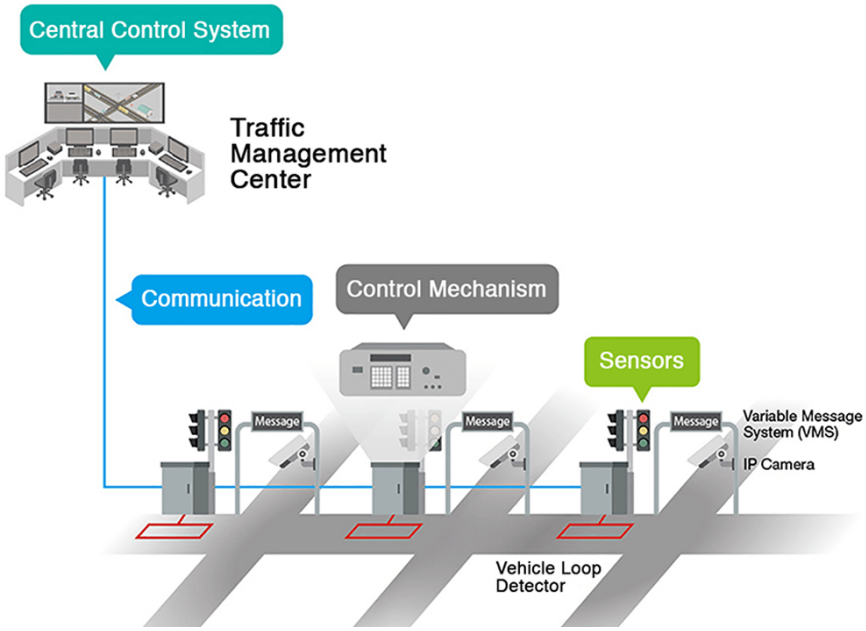
*Technology report by **COMAU**.*

Visit Website

Advanced traffic management using secure data acquisition

Before revamping an existing traffic management systems, ask three questions to guide the design and implementation. Effective traffic management systems leverage cutting-edge analytics, made possible by vast amounts of high-quality data that was collected by various sensors.

AS TRAFFIC CONGESTION CONTINUES TO increase and take a heavy toll on existing infrastructure, commuting times, and the environment, city administrators and traffic engineers are turning to intelligent transportation systems (ITS) for practical and cost-effective solutions to improve road safety and traffic management. At the core of an ITS is its Advanced Traffic Management System (ATMS) that incorporates sensors with communication and control technology to monitor traffic conditions and transmit relevant data to the traffic control center via a citywide network. The control center then consolidates information from other sources to formulate, evaluate and execute traffic control strategies, as well as deliver relevant information to all road users for route planning and safety purposes.



SOURCE: MOXA

Advanced traffic management system diagram.

Components of an ATMS

An ATMS integrates traffic monitoring, analysis and control into a single application via a network. The more real-time traffic data is fed to the central control system, the more robust it becomes. A reliable network is therefore key to enabling operators to make the right traffic management decisions.

An ATMS contains the following components:

Control Mechanism: At each road intersection, the control mechanism analyzes the traffic information coming from various sensors to decide the optimal timing for each traffic signal. This is made possible by multiple subsystems and devices, such as traffic lights, variable message systems (VMS), traffic information from road weather information systems (RWIS), or CCTV systems.

Sensors: Sensor data is important as data forms the basis for recognizing traffic patterns and formulating a traffic control plan. Common sensors in an ATMS include loop detectors and laser or radar sensors for motion detection. Cameras are also widely used in these applications.

Communications: Control mechanisms at each intersection need to be interconnected for communication with the central control system via wired or wireless networks. That way, signal switching at multiple intersections can be coordinated effectively.

Central Control Systems: The Central Control System (CCS) oversees the entire traffic management operation of the ATMS.

Thanks to the increasing adoption of cloud-based traffic management systems and the wider deployment of smart sensors, today's ATMSs are more efficient and robust. However, these advanced sensors and systems also raise several connectivity concerns. Before revamping an existing traffic management systems, Moxa recommends that engineers ask the following three questions.

1. Does the solution make network integration of various sensors easy?

An ATMS relies on multiple sensor data to provide insights for both traffic management input systems and information output devices used to convey messages to road users. The interfaces required may include serial-based or digital/analog data points, so a connectivity solution should offer multiple yet flexible communication interfaces in one compact hardware design to make installation and maintenance efficient. Choose a compact and reliable solution to connect various sensors for clean and robust integration.

2. Does the connectivity solution provide sufficient cybersecurity safeguards for critical infrastructure?

Transportation systems are critical infrastructure important to national security and safety. Networked and cloud-based services can become an easy target of malicious hackers. Proper device configuration and up-to-date installation of firmware and security patches help secure both data and communication within the network. Select a solution that is secure by design and provides essential functions to ramp up device security.

3. How do I manage multiple field devices spread across different networks and sites?

The increasing number of smart sensors that are deployed at different field sites requires more networking devices for data acquisition and communication. Consequently, traffic system networks can become a tremendous undertaking and easily overwhelmed.

Configuring, maintaining and troubleshooting devices and networks can also be labor-intensive. For this reason, an efficient solution is required from the very beginning. For example, a network management tool that visualizes networking device statuses and provides a user-friendly interface for mass conigurations can be a great help.

Alvis Chienming, Global Marketing, Integrated Marketing Project Manager, ***Moxa.***

Visit Website

Digitally integrated net-zero emissions mining solution

ABB has announced it is working with Amazon Web Services (AWS) to accelerate the adoption of new and sustainable technologies in mining. The two companies are now creating solutions for digitally integrated all-electric operations to help meet industry goals on net-zero emissions.

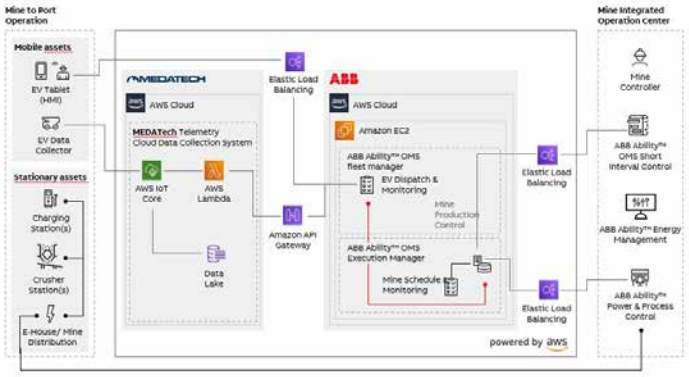
DIGITALLY INTEGRATED ALL-ELECTRIC operations for net-zero emissions mining is the goal of a cooperation between ABB working with Amazon Web Services (AWS).

Together with mining electric vehicle drivetrain developer MEDATech, the two companies have demonstrated secure exchange of operational data for production optimization. The initiative aims to show reliability, effectiveness and scalability as mining operators move towards all-electric and net-zero emissions.

ABB, MEDATech and AWS will keep collecting and analyzing the vehicle data during truck testing, with the ambition to ultimately implement the system in a real mine environment

Delivering operational and sustainability benefits for EV mine operators
Application of ABB Ability™ Operations Management System (OMS) together with MEDATech on AWS

SOURCE: ABB



Effective collection and analysis of vehicle data during truck testing is key to the project success.

Operations management solutions

In a first demonstration, ABB Ability Operations Management System (OMS) has already been integrated with heavy-duty EV drivetrain developer MEDATech's cloud data collection system on AWS. Telemetry data, including battery state and speed of charge, was transmitted in real time from MEDATech's first-ever 100 percent electric haul truck – paired with ABB's fast charging pilot solution, ABB Ability eMine FastCharge – while ensuring data security using AWS's Internet of Things (IoT) services.

Such seamless digital integration of electrical equipment across industrial operations is increasingly important for operational efficiencies through optimized scheduling and planning. Battery electric vehicles (BEVs) and their related charging infrastructure present a challenge and an opportunity as the industry commits to decarbonization and reduced resources and energy consumption.

ABB and AWS are also proving scalability. AWS enables OMS to ingest, store, process, and analyze operational data from stationary and mobile equipment and dynamically scales to meet the operational demands. The new ABB Ability™ eMine approach relies on the reliable and standardized exchange of equipment and process data to effectively integrate electrical and digital systems from mine to port. ABB is simplifying the integration for its mining customers via a collaborative and interoperable approach, leveraging AWS, which removes management and investment responsibilities normally associated with on-premises infrastructure from the customer.

"In the course of the digital transformation and decarbonization in the industrial sector, customers are looking for end-to-end integrated solutions to optimize their operations," said Flemming Kongsberg, Director, Global ISV Alliances, AWS. "Together, ABB, MEDATech and AWS have demonstrated a fully integrated solution for mining operators to combine data from electric vehicles and operations to maximize their efficiency and contribute to their sustainability goals. Through this collaboration, we are excited to help deliver this solution to our customers worldwide, providing flexibility, scalability and security in the cloud."

"We know what data OEMs and mine operators need to ensure a successful transition to electrification," said Darren Mueller, Director of Sales and Marketing, MEDATech Engineering. "The agnostic vehicle-level telematics systems that we have developed work with AWS and ABB's solutions to provide mine operators with the real-time vehicle data they need to make important decisions. Mine operators have full control over the information, including analytics modelling for increased productivity, more machine uptime through predictive maintenance and better power usage. We have worked with ABB over five years on mine electrification processes and solutions, including high powered charging and electric-vehicle mine simulations. AWS represents the last piece of this puzzle as we move forward as partners to help decarbonize operations."

ABB has introduced ABB Ability eMine, which is comprised of a portfolio of electrification technologies that makes the all-electric mine possible from mine to port and is integrated with digital applications and services to monitor and optimize energy usage. It can be used to electrify any piece of mining equipment across hoisting, grinding, hauling and material handling and the entire process area.

ABB's digital applications can continue to draw on advanced AWS services to reduce process complexity and integrate with existing equipment, process installations and operational technology. ABB and AWS will continue to collect and analyze the vehicle data during the truck testing, with the ultimate goal to implement the system in a real mine environment, as part of an eMine™ project. Having proven the feasibility with the MEDATech battery electric vehicle and looking ahead, the focus will be on driving digital interoperability by scaling towards further mining assets, mobile as well as stationary, and addressing their dependencies to optimize the overall process efficiency.

*Application report by **ABB**.*

Visit Website

The days of the control cabinet are numbered

A completely decentralized automation platform brings devices into the field without control cabinets. Vario-X combined with Digital twin technology saves time and money in all phases of an automation and control project: from planning to installation, operation and service.

GROWING DIGITALIZATION AND SHORTER development cycles, increasing customer requirements and a shortage of skilled workers, the world of automation is changing at breakneck speed.

New technology is implementing a modular, highly flexible automation platform that allows all automation functions to be implemented completely decentrally (i.e. without a control cabinet).

Vario-X brings sensors and actuators directly into the control environment and ensures reliable voltage, signal, data management and the seamless integration of decentralized servo drives.

At the heart of Vario-X are robust, IP67 rated waterproof and dustproof modules, which include power supplies, controls, disconnect switches, safety technology and I/O connections. They can be easily assembled side by side on a rugged backplane with integrated mechanical mounting profiles.

Once assembled, the Vario-X solution can be easily attached to all common mounting systems without further protection and, in extreme cases, is rugged enough to be stepped on without damage. Equipped with a multicore CPU, Vario-X can meet all control requirements and be easily integrated into all higher-level Industrial Ethernet networks as an open control platform.

100% cabinet-free automation

The installation and cabling of devices is plug-and-play with standard M12 and MQ15 connectors, eliminating wiring errors and reducing assembly time. This also eliminates expensive and time-consuming installation work in the control cabinet like populating components, stripping and landing wires, labeling and grounding individual components.

To extend the modular concept for your machine control, additional stations can easily be distributed around the machine and connected to each other, like adding an additional power supply to support localized servo motors.

Likewise, remote IO modules can be connected directly to Vario-X to process and control sensors and actuators without a backplane or cabinet I/O. This limits control hardware variants and vastly streamlines the cable architecture.

SOURCE: MURRELEKTRONIK

Vario-X is a modular and highly flexible automation platform where all automation functions can be fully decentralized, and implemented without using a control cabinet architecture for the first time.

Turning off the air in production

Vario-X is driving forward the electrification of manufacturing processes and offers a much more efficient alternative to pneumatics. With an efficiency of only ten to twenty percent, far too much energy is wasted by using compressed air as an energy source due to countless leaks in the system and inefficient actuators.

Replacing pneumatics with electrics, swapping an air cylinder with a servo motor, brings advantages to all those involved. This includes the engineer who can reduce the inefficient, low resolution and relatively expensive pneumatics in his machine, the production planner who can focus on one physical energy source – electricity, the employees who can finally operate in a noticeably quieter work environment and by reducing energy use to help our planet.

Digital twin for planning, installation, operation and service

Vario-X is not only a collection of backplanes, modules, cables and I/O. A system automated with Vario-X has a digital twin right from the start: a portable 1:1 image of the virtual system that contains all the functions and parameters of the physical system – even in the design phase, before even the first mechanical component has been ordered or assembled.

For this purpose, Murrelektronik creates a kinematic of machines and systems in unique software, where movements and processes can be simulated. With the digital twin, the same virtual kinematic is then run to control the real machine. The digital system can also be "placed" directly into the manufacturing process with augmented reality (AR) on a mobile phone or tablet, so that all movement sequences and functions can be viewed virtually while assembling the machine or in production.

"All this reduces the assembly and commissioning time many times over, because many problems that are discovered during assembly do not even occur," Prein summarizes the advantages of the digital twin. In addition, assemblers can use the digital twin as a '3D blueprint', for example via augmented reality app or virtual reality glasses. This often works much faster than understanding a plan drawn in 2D.

"With Vario-X, we are providing the answer to the pressing questions and challenges of production, plant and installation planning in automation technology," concludes Prein. "Vario-X helps to avoid 'silo-driven' planning and to break up static planning processes. In addition to the agile development processes, this consistent focus on customer needs has made a decisive contribution to the development of Vario-X."

*Technology article by **Murrelektronik GmbH.***

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Robotics, AI and automation technology fight COVID-19

The AGAMEDE project is an interdisciplinary project combining robotics, computer science, industrial design, mathematics, biology and chemistry. Thanks to Labomatica's Gene Game software, the system is 'closed loop'. It prepares and reads the data, interprets it and then independently adjusts the test series.

SOURCE: POLISH ACADEMY OF SCIENCES

The AGAMEDE project is an interdisciplinary project that combines the worlds of robotics, computer science, industrial design, mathematics, biology and chemistry. [Source: Institute of Bioorganic Chemistry, Polish Academy of Sciences (IBCH PAS)]

DEVELOPED AT THE INSTITUTE OF BIOORGANIC Chemistry of the Polish Academy of Sciences, alongside Mitsubishi Electric, Labomatica and Perlan Technologies, the AGAMEDE robotic system was designed to significantly speed up the diagnosis of SARS-CoV-2.

Thanks to state-of-the-art automation technology combined with artificial intelligence, the system can test 15,000 individual samples per day. Other applications include researching new drugs, developing individualised cancer therapies or even creating cosmetic formulations.

Agamede is considered the first female scientist in history and therefore a fitting namesake for the laboratory automation system developed at the Institute of Bioorganic Chemistry of the Polish Academy of Sciences (IBCH PAS).

Robotics and AI

While automating laboratory work is a common practice, the AGAMEDE robotic system combines automation and artificial intelligence (AI) to form a unique 'closed loop' setup. Here, the robots prepare experiments, read the results at a specified time and interpret the data using Labomatica's Gene GameTM software to independently prepare the next experimental cycle. This means that operators simply need to define the question, design the experimental system and then monitor the correct sequence and operation of the system. AGAMEDE can then conduct experiments 24 hours a day and deliver results.

The combination of AI and automation in a high-throughput system is considered a breakthrough. Most automated high-throughput systems still require an operator to read the results and plan the next series of experiments after a cycle is completed. AGAMEDE can do this independently.

"Thanks to the AI module, AGAMEDE interprets the experiments without human involvement, based on mathematical models," explained Radosław Pilarski, PhD, the inventor and chief engineer of the system. "The system can be used by central diagnostic laboratories, pharmaceutical companies in drug development, oncology laboratories in search of personalised therapies for patients, but also in R&D departments of chemical and biotechnology companies to optimise bioprocesses."

EPICELL project

Work on AGAMEDE began at the IBCH PAS in 2015. The system was originally developed for the EPICELL project, which was funded by the National Centre for Research and Development (NCBiR) as part of the STRATEGMED programme 'Prevention and Treatment of Civilisation Diseases'. The aim of the project was to develop optimised media for the culture of induced pluripotent stem cell-derived (iPSC) cardiomyocytes.

The EPICELL consortium consists of the IBCH PAS, the Institute of Human Genetics PAS as well as three hospitals from Poznań. Combining expertise in small molecule epigenetic modulators and experience in cell reprogramming, it conducted studies leading to the future development of methods for transforming induced iPSCs for the purposes of regenerative medicine. In particular, they

looked at targeted implantation in the hearts of patients after heart attacks.

The idea was to restore cardiac output to its pre-infarction state. The challenge was the number of experiments required to design a suitable mix of small molecule epigenetic modulators. For example, a recipe with ten components and ten different concentrations requires 10,000,000 experiments.

"AGAMEDE was used to search for the right combination of compounds in a multidimensional system of solutions. From this, the composition of the reprogramming medium 'EPICELL One' was developed," explained Prof. Wojciech T. Markiewicz, head of the EPICELL project.

15,000 tests per day

At the end of March 2020, the situation changed. Since its foundation, the IBCH PAS has been dealing with RNA and DNA nucleic acids, so it had all the facilities to deal with SARS-CoV-2 diagnostics.

"Our institute was the first in Poland to develop a test to detect SARS-CoV-2. We soon decided to combine AGAMEDE's automation capabilities with our tests and developed a high-throughput diagnostic protocol that allows us to test 15,000 samples in one day. At least this is the potential, because IBCH PAS as a scientific entity does not have an accredited diagnostic laboratory. This is an outstanding result, because when analysing samples manually, one person can at most process a few hundred samples a day," said IBCH PAS director Prof. Marek Figlerowicz.

Robots, PLC and software

The AGAMEDE project was created alongside technology partners Mitsubishi Electric, Labomatica and Perlan Technologies. Mitsubishi Electric provided a 6-axis robot, PLC controls and its MELFA Basic software. The industrial robot with its long arm reach is the central component of the system. Using an integrated set of robotic tools, it can perform microscale experiments on 96- and 384-well microassay plates, reproducing the work of a laboratory technician who continuously operates the analytical equipment. It does this according to the experimental protocols entered by the operator into the control software.

The application further includes industrial cell culture incubators, plate and tip feeders, pipetting stations, labellers, barcode scanners, plate sealers, fluorescence readers and spectrophotometers. As a particular highlight, AGAMEDE is equipped with an automated confocal microscope HCA with four fluorescence channels. For the biotechnology community, this instrument is the equivalent of the Hubble telescope brought into the microcosm. Instead of astronomical objects, it photographs and analyses millions of cells and tissue structures with similar quality and efficiency. The device is complemented by an acoustic dispenser that releases quantities of liquid in the nanolitre range (millionths of a millilitre). Rapid dispensing of such small volumes of solution reduces research costs and increases throughput. It allows experiments to be conducted using a collection of over 115,000 chemical compounds available.

SOURCE: MITSUBISHI

Mitsubishi Electric's industrial robot offers a long arm reach as well as an integrated set of robot-controlled tools for micro-scale test series on 96- and 384-well microassay plates.

Working under high pressure

"In implementing the first such advanced system in Poland, combining robotics with laboratory equipment, we benefited from our international experience. The support of Mitsubishi Electric's global organisation dedicated to innovative projects was very helpful," said Roman Janik, coordinator of solutions for the life science industry in Poland. However, he also emphasises the tight deadline of the project. "We all worked under time pressure to develop a solution that would relieve the lab technicians as quickly as possible. We were able to deliver a weekly throughput of 100,000 samples, which is scalable. This is a phenomenal result!"

Bringing many worlds together

Tomasz Scholz, Robotics Engineer at Mitsubishi Electric further recalls: "The task would have been complicated even without the time pressure. The AGAMEDE project is an interdisciplinary project that combines the worlds of robotics, computer science, industrial design, mathematics, biology and chemistry. The solutions we used in it are innovative and unique. As with many projects, the biggest challenge was to define the goal and how we would achieve it. The key to this was to find a common 'technical language' so that people from different areas of expertise could communicate on the same level and make their expectations clear. It was often difficult to bridge the gap between the academic world, which thinks in abstract terms, and the industrial world, which typically follows a fixed pattern."

New approaches for laboratory planning

The result is a system that not only works well, but also looks interesting. "Its design refers to ancient Greece and is a tribute to the beginnings of scientific thinking in our civilisation, especially to women in science," explained Radosław Pilarski, PhD.

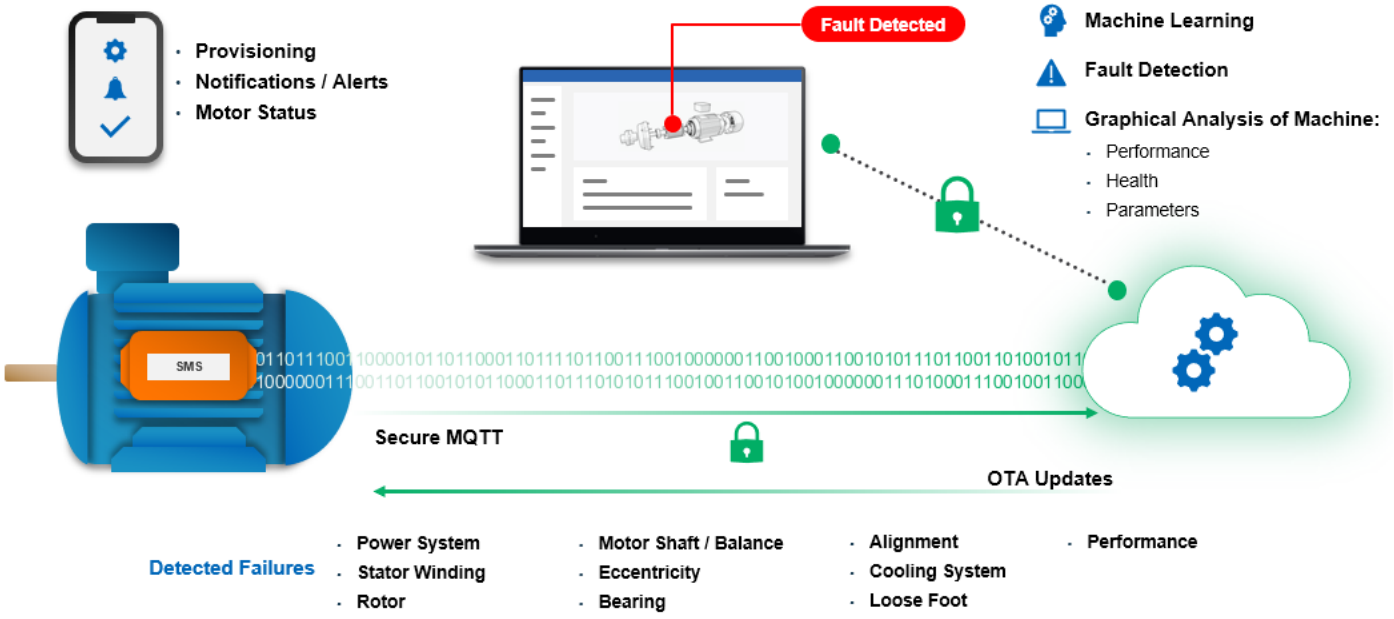
He further emphasises that the planning also paid attention to the laboratory space in which the installation was placed. A clean room for aseptic cell culture, windowless in most labs, was given a completely new look, breaking with previous standards. It is well lit thanks to large, carefully sealed windows. Glass panes were added to allow constant observation and control of the system without having to wear cleanroom suits. The work is facilitated by high-resolution 4K monitors and cameras that allow remote monitoring of AGAMEDE and experiments from anywhere in the world.

*Application report by **Mitsubishi**.*

Visit Website

Predictive maintenance leverages software frameworks

The Otosense SMS technology solution consists of an edge device called Smart Motor Sensor (SMS), Android and iOS mobile applications to provision the device, web dashboards to visualize the data, and AI based analytics and REST API services hosted in the cloud.



SOURCE: ANALOG DEVICES

End to end predictive maintenance solution for electric motors.

IN TODAY'S FACTORIES, 14 MILLION HOURS OF unplanned downtime happen due to system failures in the US alone, resulting in billions of dollars lost to the industry.

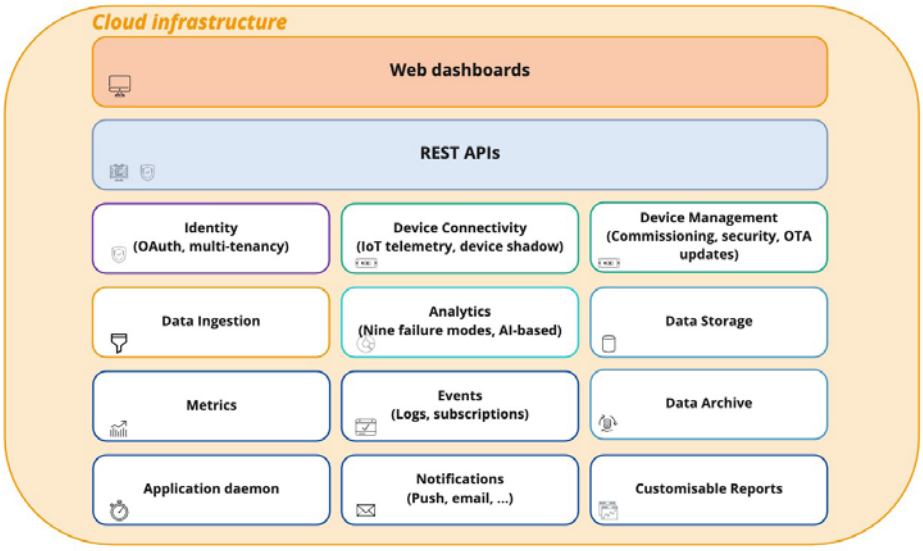
In order to prevent such events, manufacturing operations typically employ an expensive route-based approach where an expert gathers data to assess the health of the equipment or utilize a range of suboptimal sensing solutions that do not reliably detect all potential failures that could occur in these systems.

Why Predictive Maintenance?

Now that Industry 4.0 (also known as the Industrial Internet of Things, IIoT) wave is well under way, industrial customers are more focused on deploying solutions that increase equipment uptime, reduce operational cost, extend equipment lifetime, and improve worker productivity.

Predictive maintenance solutions combine sensing technologies to gather equipment data and employ advanced analytics and algorithms to draw actionable insights into the health of the equipment. As a result, this approach is expected to increase customers' overall productivity by more than 30%.

Customers are asking for a full turnkey wireless solution that combines hardware and software and is easy to install and use. They need a solution that does not require experts to manually gather data and/or install and maintain dedicated networks.



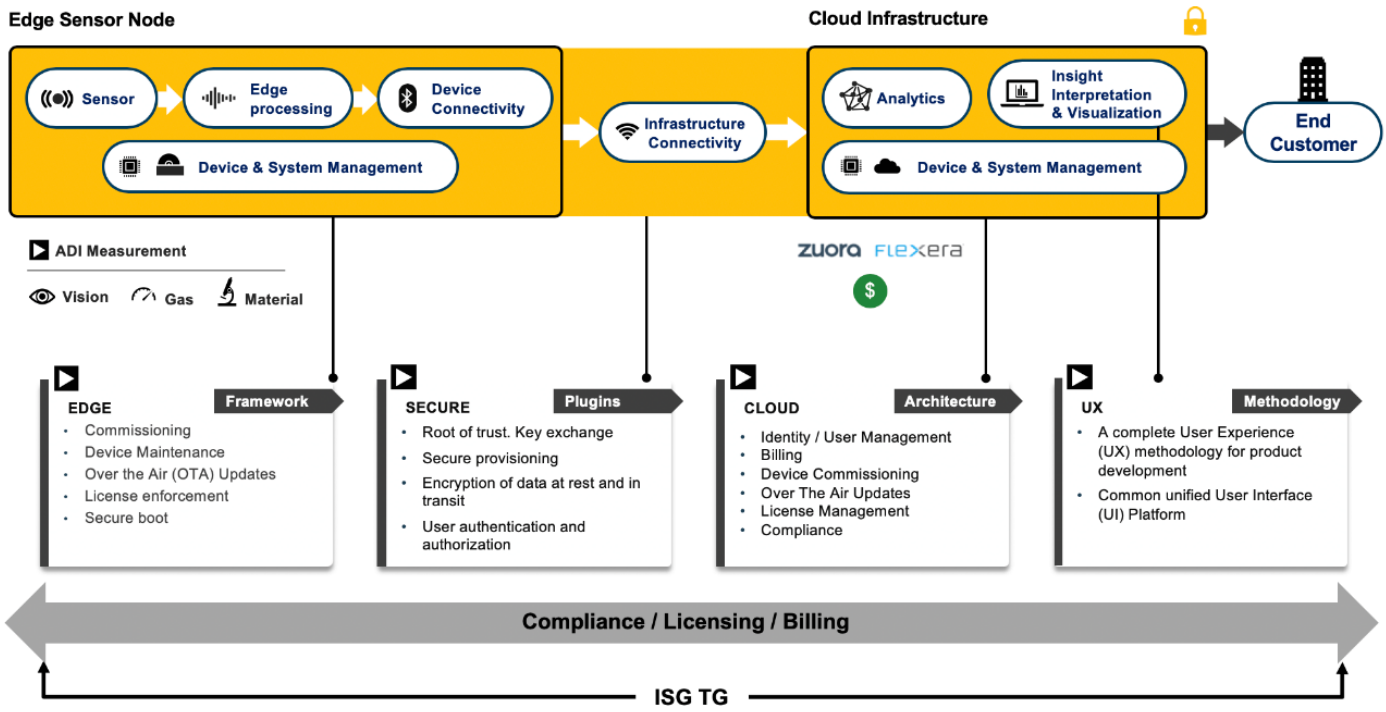
SOURCE: ANALOG DEVICES

SMS Cloud components from Secure Software Framework.

The ADI Solution

ADI has created a flexible, out-of-the-box end-to-end secure, wireless predictive maintenance solution that combines ADI software, hardware, and domain expertise in electric motors to create a secure scalable offering for predictive maintenance of electric motors.

The Otosense SMS solution consists of an edge device called Smart Motor Sensor



SOURCE: ANALOG DEVICES

Sensor to cloud secure software framework.

(SMS), Android and iOS mobile applications to provision the device, web dashboards to visualize the data, and AI based analytics and REST API services hosted in the cloud.

Battery operated, the SMS device combines ADI's MEMS sensors, precision converters and signal chains. Firmware embedded in the SMS device captures various parameters of the motor (vibration, temperature, speed, magnetic flux) and sends this data securely over a Wi-Fi connection to the backend cloud for processing. An Artificial Intelligence (AI) engine which runs on the cloud analyzes the data and monitors the health of the motors.

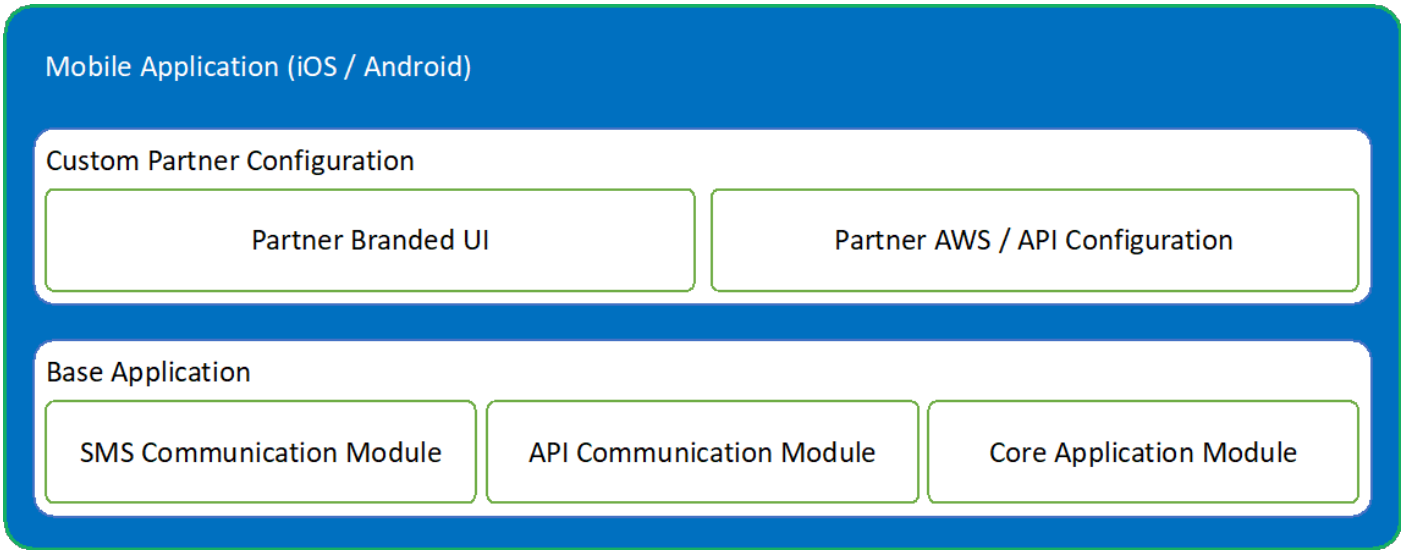
The system can predict nine different electrical and mechanical failures that commonly occur in motors and upon detecting one, sends push notifications and/or emails and informs the customer on the appropriate action to be taken. The Smart Motor Sensor (SMS) product suite is available direct to customers as an end-to-end solution or via a RESTful API.

The combination of ADI's advanced technologies like MEMS sensors, precision converters, signal chains along with analytics, algorithms and domain expertise is a key differentiator that makes ADI the ideal partner for our customers.

Kevin Carlin, Vice President, CbM-OtoSense AI business unit says "The OtoSense SMS predictive maintenance solution has been deployed across multiple industries and geographies and has proven to be the most capable platform available in its field. The individual framework components that the team has developed coupled with ADI's best in class sensors, measurement techniques and domain knowledge are enabling us to solve our customers' most challenging problems."

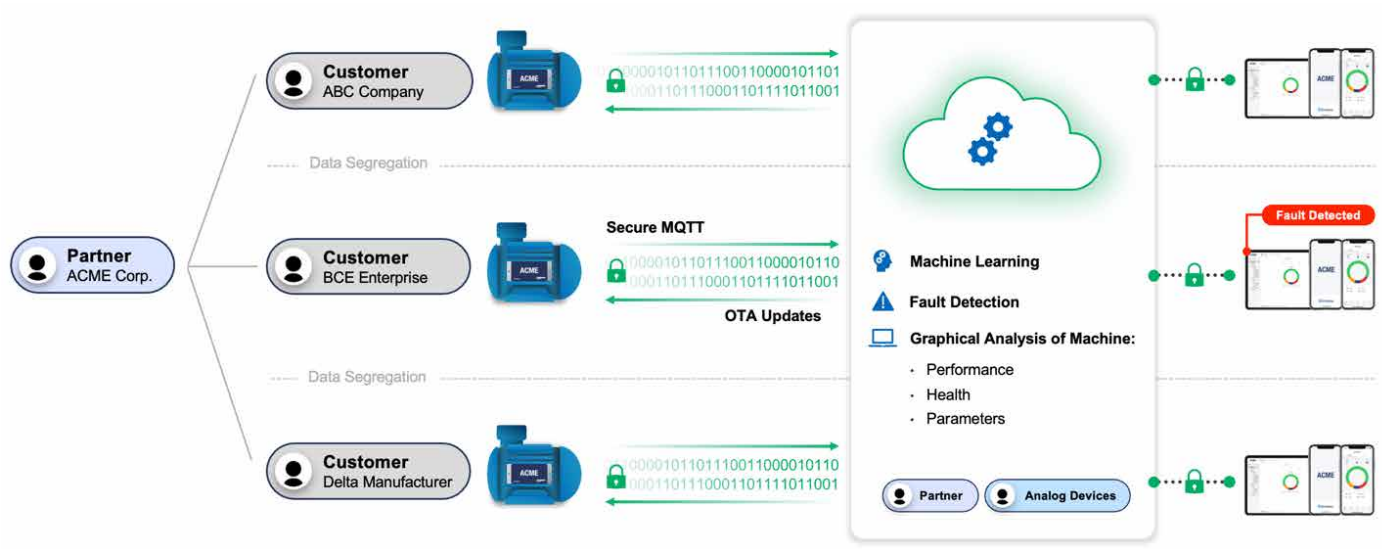
The sensor to cloud secure software framework helped to meet customers desire for complete solutions, without the frustration or the complexity of putting together a full system to capture actionable insight from real-world data.

Greater reusability doesn't just drive faster time to market, but also security and quality goals. Core turnkey, production grade components included in the framework enabled faster time to market, so more of the development schedule was focused on delivering the domain specific solution for any given product. The integration of best-in-class



SOURCE: ANALOG DEVICES

Mobile applications architecture.



SOURCE: ANALOG DEVICES

Multi-tenancy ensuring customer data segregation.

billing and software license infrastructure allows for the realization, and on-going renewal, of software as a service (SaaS) based revenue.

Providing Software as a Service (SaaS) solutions means exposure to the full onslaught of hackers and digital thieves. Security as part of the framework is not only critical for our customers, but for our brand; any early security breach would greatly diminish future success.

Along with functionality and scalability, prescriptive best practices and processes included as part of the framework ensure the most robust and secure solutions are delivered. The Software Framework is an embodiment of recommended best practices and proven processes; from approaching each new customer engagement from a user-centric perspective to automation of DevOps principles to achieve efficiency and compliance.

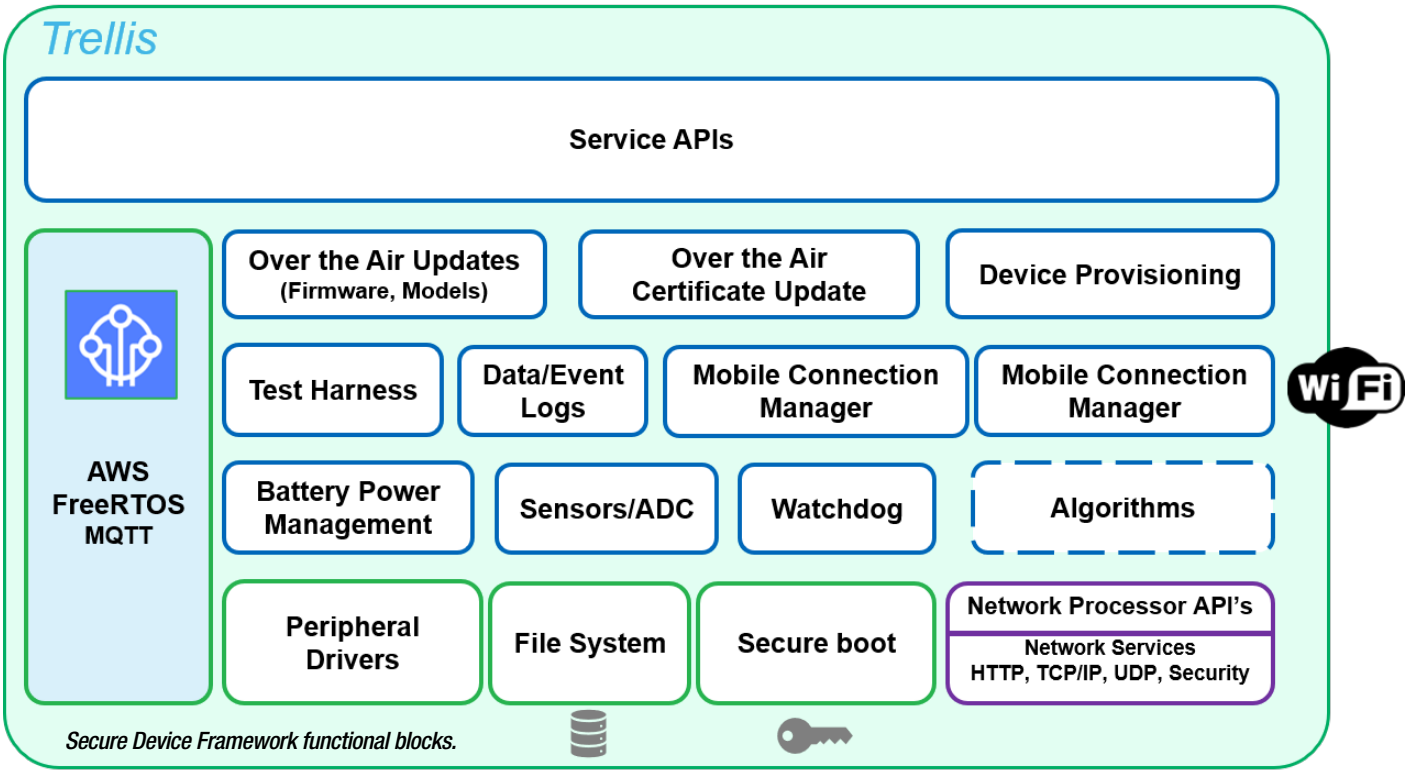
SMS cloud and web

The OtoSense SMS cloud backend is built on and extends the secure software framework. The application is multi-tenanted to support onboarding multiple customers and ensuring data segregation.

We also offer a unique custom label partner version which allows customers such as motor repair workshops, motor distributors and others to easily add their logo and branding and sell SMS directly to their customers. Partners can seamlessly create new customer tenants with just a few clicks and all the necessary architecture is automatically generated and onboarding email invitations sent to the customer.

The OtoSense SMS mobile applications have been architected with code re-use as a priority. The core application consists of several modules, including an SMS Communication Module, API Communication Module and a Core Application Module (views and navigation).

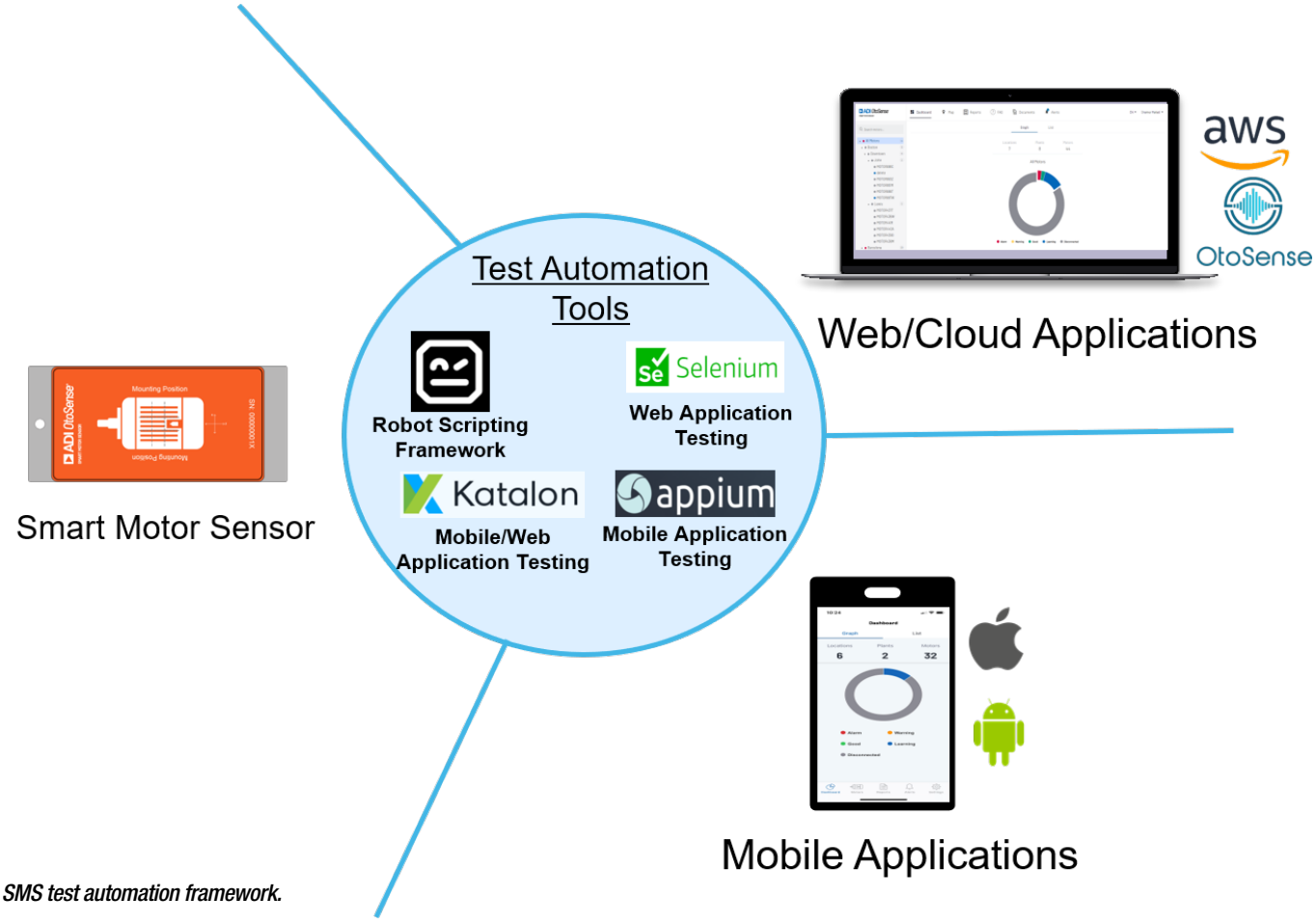
These modules represent everything that can be re-used across all custom label partner applications. For each new custom label application, a new configuration set is created which contains the partners branded UI components and API configuration. This software architecture enables the mobile



SOURCE: ANALOG DEVICES

Secure Device Framework functional blocks.

SOURCE: ANALOG DEVICES



SMS test automation framework.

development team to create new partner applications quickly and easily, as well as release new features and updates to all partner applications efficiently.

SMS AI engine

The ADI-OtoSense AI platform can address any Sensing Interpretation challenge. This platform has been leveraged to implement the machine learning components of the Smart Motor Sensor solution.

ADI's deep domain expertise in electric motors has been used to create a digital blueprint of an electric motor's optimal behavior, across all ranges of loads, rotation speeds and temperatures. However, each motor once sold deviates from this initial model. Its environment, usage and maintenance operations make it unique.

After installation on a motor, OtoSense SMS initially acquires data to learn how this motor differs from the blueprint, creating a unique digital twin for the motor the SMS edge device is attached to. From there, OtoSense SMS compares the data coming from this motor to its digital twin running in the exact same operating conditions.

If there is a substantial difference in behavior between the physical motor and its digital twin, OtoSense SMS analyzes this difference to determine the most probable root cause of this discrepancy, informing the user about the existence of a fault, its origin, and the action to perform to resolve it.

SMS firmware

SMS firmware embedded in the SMS captures various parameters of the motor (vibration, temperature, speed, magnetic flux) that it is attached to and sends this data securely over a Wi-Fi connection to the backend cloud for processing. SMS firmware connects with iOS or Android smartphone via the Wi-Fi interface to enable device installation and provisioning. The firmware provides diagnostics information for troubleshooting the device during and after deployment and can be updated securely Over the Air.

SMS firmware was built leveraging a portable Service Oriented Architecture based framework. This Secure Device Framework (SDF) consists of modular, reusable functional blocks wrapped in application agnostic service API's to enable reuse for other IoT applications with a short Time to Market cycle. It also enables application developers to easily integrate application specific signal processing functions and algorithms along with service APIs into the product.

Sensor to cloud software testing

A comprehensive test plan was set in place to ensure we deliver the highest quality solution to our customers.

In addition to unit tests and integration tests performed by developers as part of the development cycle, a dedicated, independent test team was tasked with performing end-to-end solution testing. The majority of the tests were automated to ensure quick turnaround testing and to perform regression testing as the software evolved over time.

A test set up employs a variety of popular open-source test frameworks integrated into a single cohesive test automation framework. This enabled us to perform all end-to-end functional tests for all the critical functions of that require interaction between the device, mobile application and web application.

Several hours of "golden" data was recorded to test the Analytics engine to ensure robustness in performance with minimal false positives and negatives, and appropriate notifications are sent to users when failure events are detected. Test methodology included both positive and negative cases as well as testing under different network conditions to ensure reliability, robustness, and graceful recovery under severe conditions.

Shankar Malladi: Director, Embedded Software & Product Quality; Jason Griffin: Director, Technology Solutions; and Sebastien Christian: Product Line Director, ***CbM-Otosense.***

Visit Website

Controller: modular control cabinet

Flexible, space-optimized, and intelligent system completely replaces the conventional control cabinet.

The new MX-System is potentially a revolution in control cabinet construction. With the launch of this system, the company now offers a flexible, space-optimized, and intelligent system solution for completely replacing the conventional control cabinet with a bid to revolutionize control cabinet construction and automation.

The MX-System is a uniform modular automation component that can be used to completely replace traditional control cabinets with modules in many applications. The system consists of a robust aluminum baseplate in protection class IP67 with integrated module slots that feature EtherCAT for communication and an integrated power supply (safety extra-low voltages as well as 400 V AC and 600 V DC).

The largest expansion stage can even accommodate a connected load of 400 V AC/63 A. Corresponding modules are available for the mains connection and all other control cabinet functions.

When it comes to connecting the field level, the modules use connection plugs that have been tried and tested for many years in the field of automation technology. A system combination of baseplate and modules has a protection class of IP67 and can be mounted directly on the machine. The system reduces the amount of effort involved for the manufacturer, especially during the planning and installation phases, while the integrated diagnostic functions reduce the complexity for the end user. This all combines to result in a modular control cabinet system with a high protection class that can be mounted on the machine without the need for additional protective housings.

SOURCE: BECKHOFF

MX-System channels knowledge of system and component technology with practical application experience.

Beckhoff

Learn More

EtherCAT to IO-Link gateway solution

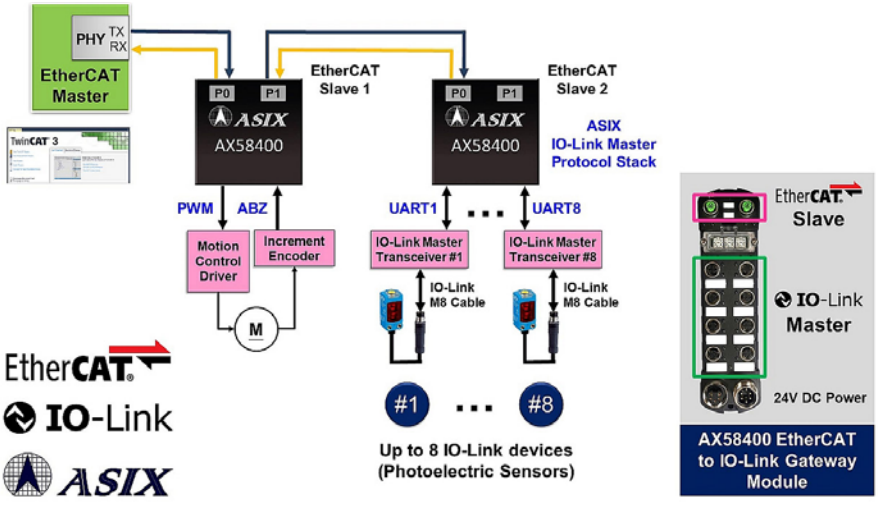
IO-Link gateway solution supports up to eight IO-Link devices, such as smart sensors and actuators.

ASIX Electronics has launched a new AX58400 EtherCAT to IO-Link gateway solution which combines EtherCAT industrial Ethernet fieldbus technology and IO-Link intelligent communication technology.

Th AX58400 EtherCAT to IO-Link gateway solution supports up to 8 IO-Link devices, such as smart sensors and actuators, through AX58400 EtherCAT Slave Controller with Dual-Core MCU and ASIX's own IO-Link Master Protocol Stack. AX58400 is equipped with the highest-performing 480MHz ARM Cortex-M7 core, 240MHz ARM Cortex-M4 core that can operate in parallel, EtherCAT Slave Controller integrated with two embedded Fast Ethernet PHYs, and embedded 2Mbytes dual-bank Flash memory and 1Mbyte SRAM.

This solution uses the highest-performing ARM Cortex-M7 core to process the IO-Link master protocol stack operation for supporting up to 8 IO-Link devices; and uses the ARM Cortex-M4 core to process EtherCAT slave protocol stack operation in parallel. Using AX58400 dual-core MCU architecture can effectively reduce the CPU load of microcontroller and generate a higher-performance EtherCAT slave to IO-Link master gateway solution.

Using IO-Link intelligent communication technology, industrial computers can be easily connected to IO-Link master via industrial Ethernet fieldbus networks to remotely monitor and configure IO-Link smart devices, so manufacturers can easily build up more flexible and effective manufacturing environment in smart factory.



SOURCE: ASIX

ASIX AX58400 EtherCAT to IO-Link gateway solution.

ASIX

Visit Website

Condition monitoring & cloud gateway

New Alfa Laval CM Connect leverages digitalization to optimize hygienic processing.

The new Alfa Laval CM Connect marks the next step in the digitalization journey to drive innovation and growth for customers in the hygienic processing industries. The CM Connect is a subscription-based condition monitor and cloud gateway. It enables plant operators to access data of rotating equipment on processing lines from a remote location.

With data on actual runtime, trend analysis, and time to next service close at hand, plant operators can make informed maintenance decisions using their personal computers and mobile devices. This protects process continuity and critical assets, improves workplace safety, saves time and money, and delivers competitive advantage.

As Industry 4.0 evolves, the CM Connect is a natural next step on the customer digitalization journey, expanding the Alfa Laval range of condition monitoring solutions. With complete visibility of all connected assets, plant operators can detect issues that impact future performance, prevent unplanned downtime, and improve asset management.

Acting as a gateway communicating via Bluetooth, the CM Connect can link up to 10 Alfa Laval CM wireless vibration monitors launched last year. It then transmits the data over a 4G cellular network to the cloud for review and analysis on an intuitive, user-friendly dashboard.

SOURCE: ALFA LAVAL

Plant operators can access data of rotating equipment on processing lines from a remote location.

Advanced vibration analysis enables detection of any deviation from pre-set equipment threshold values. Should deviations occur, an SMS or e-mail notifies users who can take action in real time based on data analysis. Besides linking the CM wireless vibration monitors, the CM Connect can also act as a sensor.

Alfa Laval

Visit Website

M12 managed switches

New managed switches provide an expansion of Antaira's industrial networking infrastructure family

Antaira's LMP-1802G-M12-10G-SFP-67-24 Light Layer 3 managed series switch offers dependability and ease-of-use functionality in harsh industrial environments. The IP67-rated switch was designed specifically for industrial applications that are subject to high vibration and shock, water, and dust.

The switches offer 24 to 55VDC redundant power inputs through a 5-pin M12 K-coded male connector. The total power of 240W is available for supplying up to 16 IEEE 802.3af (PoE) & 802.3at (PoE+) devices. Built-in fault tolerance ensures against PoE system or PD overloads thanks to the PSE management system.

In the cases of complete power failure, the LMP-1802G-M12-10G-SFP-67-24 uses bypass technology to keep data communication flowing even if the switch is offline. Easy to manage, the 16-port 10/100/1000 Mbps LAN M12 ports offer 148,800pps for fast packet switching with store and forward technology. The 8-pin M12 CAT6A sockets with X-coding female connectors feature auto-negotiation speeds, full/half-duplex mode, and auto MDI/MDI-X connections.

SOURCE: ANTAIRA

IP67-rated switch was designed specifically for industrial applications that are subject to high vibration and shock, water, and dust.

Don't need to provide PoE to devices? The LMX-1802G-M12-10G-SFP-67 Series has the same features as the LMP-1802G-M12-10G-SFP-67-24 Series except for the PoE functionality.

For more technical details about Antaira Technologies' lineup of M12 managed switches, visit www.antaira.com.

Antaira

Visit Website

New edgePlug product family

Softing launches edgePlug SINUMERIK CNC, edgePlug FANUC CNC and edgePlug SIMATIC PLC.

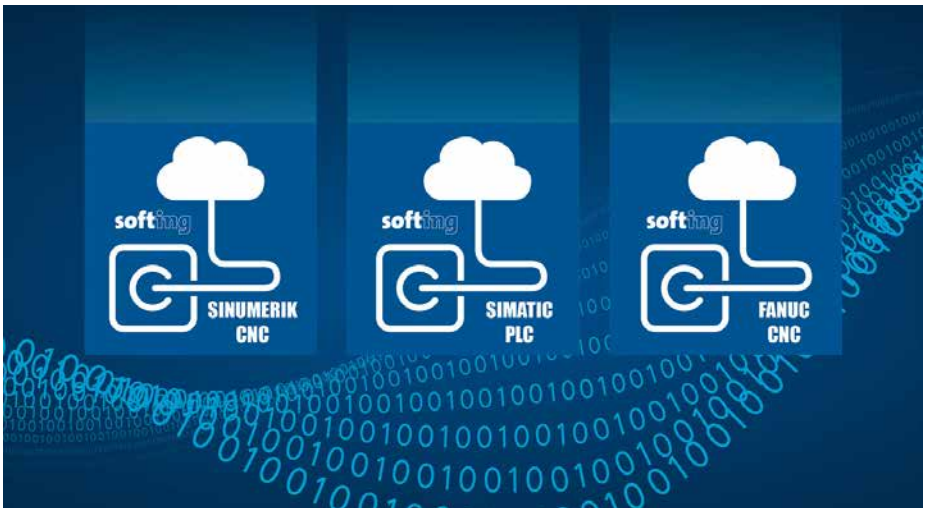
Softing plans to launch its new edgePlug product family for the Siemens Industrial Edge ecosystem in the first quarter of 2022.

Industrial Edge is an open software platform that makes IT and software for the shopfloor simple, scalable, and manageable. The Marketplace makes it easy for users to find products they need for Industrial Edge.

In the first quarter of 2022, Softing will launch the three software products edgePlug SINUMERIK CNC, edgePlug FANUC CNC and edgePlug SIMATIC PLC. edgePlug SINUMERIK CNC provides access to data from Siemens 840D CNC controllers. The software supports access to Solution Line controllers as well as to older Power Line controllers. On the one hand, it provides machine data such as operating data, alarms, and energy data. On the other hand, it provides production data such as the drive current, the position values of the axes and information about the tools used and those located in the magazines.

With the second product - edgePlug FANUC CNC - machine and manufacturing data can be read from the FANUC CNC product series 30i-B, 31i-B, 32i-B, 35i-B and 0i-F.

The third product - edgePlug SIMATIC PLC - allows access to Siemens SIMATIC S7 controllers. The software supports access to data from the older S7-300 and S7-400 PLCs as well as the newer S7-1200 and S7-1500 PLCs. Users can continue working with optimized data blocks on the S7-1200 and S7-1500 PLCs because edgePlug SIMATIC PLC can read the variables of these data blocks.



SOURCE: SOFTING

Three software products edgePlug SINUMERIK CNC, edgePlug FANUC CNC and edgePlug SIMATIC PLC.

All edgePlug products are seamlessly integrated into the Siemens Industrial Edge Device environment and can be configured via the integrated configuration tool.

Softing

Visit Website

ix Industrial PROFINET Interface

The ix Industrial™ connector has been specified as a new PROFINET Interface by PNO.

The ix Industrial connector series has been specified as a new standard interface connector for Ethernet applications by PROFINET (Process Field Network).

The PROFIBUS User Organisation (PNO) released a new PROFINET Cabling and Interconnection Technology - Guideline for PROFINET Version 5.0 which specifies the ix Industrial as a new standard interface connector for Ethernet applications. As a result the guideline provides PROFINET users with definitive universal regulations for industrial cabling in Industrial equipment, systems and plants.

This benefits manufacturers of Industrial applications that comply with PROFINET standards to develop smaller yet higher performing devices. The ix Industrial series reduces functional space by up to 75% and footprint by two-thirds compared to RJ45 solutions. Supporting CAT5e (1Gbps) and CAT6A (10Gbps) cabling, the ix Industrial Series I/O connector features an optimized EMI/ESD shielding design for safe and secure data transmission up to 10Gbps.

The ix Industrial series is compliant with the standard IEC 61076-3-124. The range feature receptacles and plugs with two keying codes, differentiating Ethernet according to IEEE 802.3 from other applications.

There are three receptacle types available within the variations. The upright right angle type can be mounted in parallel with a pitch distance of only 10 mm to save space. The vertical type allows the mating plug to be mated from the top giving design flexibility.

SOURCE: HIROSE

New connectors achieve both a compact size and high reliability.

HIROSE

Visit Website

Compact controller with integrated IOs

Compact Controller 100 with integrated I/Os offers maximum performance in minimum space.

The new WAGO Compact Controller 100 with integrated I/Os offers maximum performance in minimum space using its Compact Controller 100. The new unit provides a smaller controller with integrated I/Os that is perfect for smaller automation solutions. The new controller also allows WAGO to solidify its automation portfolio downstream of the proven PFC200 Series.

Thanks to its design as a DIN-rail built-in installation device per DIN 43880, the new controller can also be mounted in small distribution boards. The I/O unit is housed with the controller in a compact enclosure, so it requires no additional space for additional control components. The wiring interface is removable, providing advantages for installation and facilitating device replacement.

The Compact Controller 100 can be freely programmed according to IEC 61131 with CODESYS V3. Extensive IEC libraries and macros simplify the process of creating applications. WAGO's compact controller uses a real-time Linux operating system and supports standard fieldbus protocols.

With the Compact Controller 100, WAGO now offers a smaller controller with integrated I/O specifically designed for compact control applications. Designed as a DIN-rail mount device, the new controller can also be mounted on small distribution boards.

Benefits include a compact controller and integrated I/O in a DIN-rail mount device enclosure; pluggable connector and a controller with a real-time Linux operating system.

SOURCE: WAGO

With the new WAGO Compact Controller 100, the I/O unit is housed with the controller in a compact enclosure.

WAGO

Visit Website

Y-SPE Single Pair Ethernet

New series of connectors offered for Industrial Single Pair Ethernet (SPE) according to IEC 63171.

The new series initially includes both IP20 sockets and M12 sockets with IP67 protection for PCB mounting in accordance with IEC standards 63171-2 and -6.

Single Pair Ethernet offers the possibility of efficient data transmission from the sensor to the cloud. The increasing need and ability of machines, devices and also components in the production environment to communicate effectively poses challenges to previous versions of Ethernet. Especially for systems with cable distances >100 m, there were only few possibilities in terms of Ethernet technology. Due to the large range and the uniform communication level, single pair Ethernet is therefore generally considered the key in the transition to IIoT and Industry 4.0.

Transmission takes place via only two wires, and no longer via four or eight contacts. Due to this fact, it is possible to build smaller connectors than the previous RJ45 versions. The same applies to the cables.

Instead of two or four pairs, only one pair is needed. This saves space, raw materials, weight and money.

To additionally ensure the supply of power, SPE offers the possibility of using Power over Data Line (PoDL) which is similar to Power over Ethernet (PoE). However, the limit here is approx. 60 W. Only the two existing stranded wires are necessary for use. For components that require more energy, hybrid connectors have been entered as a draft standard, for example in 63171-7 for M12.

SOURCE: YAMAICHI

Single pair Ethernet offers the possibility of efficient data transmission from the sensor to the cloud and especially for systems with cable distances >100 m.

Yamaichi Electronics

Visit Website

Industrial Ethernet connectivity

Reliable "All for Ethernet" solutions are designed for demanding industrial applications.

Ethernet is being deployed in more and more areas of automation and is the connecting element for IT and OT. In order to be able to implement correspondingly robust networks for industrial use, HARTING is constantly developing and refining its range of reliable Industrial Ethernet connectivity.

With regard to Fast Ethernet and Gigabit Ethernet, the Technology Group is highlighting new variants of the robust RJ Industrial Multifeature interface: the industrial RJ45 with "integrated side cutter" for accelerated and simplified cable connection, as well as the new preLink RJ45 in optimised design. Both RJ45 innovations are decidedly convincing in their straight and angled versions.

Catering to demanding Ethernet applications on the field level, where assembly can be subject to massive time pressure, HARTING is now presenting M12 circular connectors according to the new IEC 61076-2-010 standard. This represents the cross-market PushPull locking standard for M12 connectors that users have long been waiting for. On the one hand, this allows access to standing and recessed device sockets, while on the other hand, the interfaces can also be connected

SOURCE: HARTING

A 70% smaller interface is now also specified in the PROFINET Guideline Cabling and Interconnection Technology.

75% faster in the field. Consequently, the long-standing critical issue of second source and interoperability has been overcome.

Users of PROFINET-compatible cabling solutions might take a look at the miniaturised ix Industrial connector. Compared to RJ45 solutions, the 70% smaller interface is now also specified in the PROFINET Guideline Cabling and Interconnection Technology, and offers users a significantly more compact and industry-compatible interface for demanding applications in the PROFINET environment.

HARTING

Learn More

Network gateway solution

Gateways available for building automation protocols including ASCII, BACnet, KNX, M-bus and Modbus.

Intesis gateways solutions enable existing devices and equipment from virtually all manufacturers to be connected no matter what protocol or network technology is used. This means all elements of even the most complex building automation project can be integrated into a single unified system.

It can communicate using open standards or proprietary protocols and includes a range of both protocol translators and AC interfaces. The result is simple design, installation and commissioning coupled with robust and reliable operation.

Intesis is scalable from the simplest domestic requirements to large projects in the commercial, retail, healthcare and education sectors. It shares a pedigree with other HMS technologies used in the control of manufacturing plants, refineries, generating stations, high securities facilities. As well as DALI, HMS makes gateways for all the major building automation protocols, including ASCII, BACnet, KNX, M-bus and Modbus.

Pets at Home has installed energy efficiency control systems for the air conditioning (AC) in all its 450 stores, using a standard

SOURCE: HMS NETWORKS

Networking solutions enable devices and equipment from virtually all manufacturers to be connected.

template based on Intesis gateway. The gateway is powered by the AC unit, allowing straightforward installation. By reading predefined information from the gateways, the systems makes it easy to duplicate the configuration across different units and sites, which saves a lot of time in commissioning. This simplicity enabled the system integrator Consyst to install each system quickly and efficiently.

HMS Networks

Visit Website

High-speed LAN solution

Innodisk releases what is claims is the world's first 10GbE LAN module in M.2 form factor.

Innodisk has announced an all-new EGPL-T101 M.2 2280 10GbE LAN module, a 10GbE LAN designed in M.2 form factor, featuring flexible integration and excellent compatibility with existing network infrastructure for crucial backward compatibility.

Looking into markets ranging from surveillance to gaming, networking, and industrial uses, the demand for high-speed LAN solutions is promising. Interference issues are also occurring more often as the size of the PCIe form factor cannot fit in the smaller design of IPC platforms nowadays. The M.2 10GbE LAN module is designed to meet the demand for increased speed and reduced size, high-speed LAN solutions.

Innodisk's EGPL-T101 is the first M.2 2280-to-single 10GbE Base-T Ethernet module which is also the smallest 10GbE expansion solution available today and ten times faster than standard Ethernet. By supporting PCI Express Gen 3x2, the EGPL-T101 module can provide sufficient bandwidth for one 10GbE LAN port suitable for server and industrial applications' high-speed network demands.

As a high-speed LAN solution, EGPL-T101 boasts flexible integration. Its standard RJ45 LAN port on a tiny daughterboard provides an easy solution for upgrading to a 10GbE network using existing Cat6/6A copper cables. The EGPL-T101 also features excellent compatibility with its six network standards supported in 10/5/2.5/1Gbps and 100/10Mbps, providing excellent backward compatibility with existing network infrastructure. Lastly, the EGPL-T101 features high-performance computing (HPC) which is ten times faster than the widely used Gigabit Ethernet with low power consumption.

SOURCE: INNODISK

Module provides flexible integration and compatibility with existing infrastructure for crucial backward compatibility.

Innodisk

Visit Website

Industrial TSN Ethernet switches

Kontron is expanding its Industrial Ethernet solutions to include managed 8-port TSN switches.

A new industrial switch product line includes high-performance and cost-effective TSN switches. The different versions of the KSwitch D10 MMT will be available at the beginning of Q1/2022 and offer both RJ45 and SFP fiber interfaces up to 2.5 Gb/s with a full TSN feature set and management.

Modern automation solutions for successful Industry 4.0 and IoT applications require powerful real-time communication. The new KSwitch D10 MMT family is suitable for fast and gigabit networks and was specially developed for use in industrial environments. In addition to a compact design, the switches offer the option of connecting machines, controls and other components with one another in a future-oriented manner on the basis of Time Sensitive Network Ethernet (IEEE 802.1 TSN).

All TSN standards such as IEEE 802.1AS, 802.1Qci, 802.1Qav, 802.1Qbv, 802.1Qbu / 3br and 802.1CB, as well as IEEE1588 v2 are supported. The implemented management makes it possible to structure Quality of Service, VLANs and IGMP functions in industrial networks and to program the TSN network. A Netconf implementation for TSN network functions is optionally available.

The system software can be updated using standardized update functions. All variants of the KSwitch family, including the new KSwitch D10 MMT series, can be flexibly combined with one another and make it easier to set up a future-oriented TSN or standard Ethernet automation solution.

SOURCE: KONTRON

Switches offer the option of connecting machines, controls and other components with one another in a future-oriented manner on the basis of Time Sensitive Network Ethernet (IEEE 802.1 TSN).

Kontron

Visit Website

Bluetooth 5 sensor platform

IP67-rated, battery-operated wireless nodes provide robust and secure messaging.

Mouser Electronics is now stocking the Sentrius BT610 I/O sensor from Laird Connectivity.

The new Bluetooth 5 sensor platform turns wired sensors into IP67-rated, battery-operated wireless nodes that provide robust and secure messaging in applications such as cold chain, HVAC monitoring, single/three-phase induction motor AC current sensing, or tank level monitoring.

Laird Connectivity's Sentrius BT610 I/O sensor is powered by the Laird Connectivity BL654 Bluetooth module, enabling the sensor to deliver full Bluetooth 5 capabilities, including LE Coded PHY. At a hardware level, the BT610 supports virtually any industry-standard external sensor through a wide range of interface options, such as general-purpose analog inputs, digital input/output to I²C, SPI, and UART, or in combination with a sensor cable assembly.

The many configuration choices enable users to read and report sensor data up into the cloud and configure alarm events through the associated Android or iOS mobile app. Users can choose to use either the Nordic nRF Connect SDK or Zephyr RTOS to develop custom applications and address their own requirements or use the ready-to-deploy application software that comes onboard the BT610. The BT610 is fully certified for FCC, ISED, EU, RCM, and MIC, and is Bluetooth SIG listed.

With a rugged IP67 enclosure including a pressure vent, a high-gain internal antenna with IPEX locking connector, and long-range Bluetooth 5 connectivity (LE Coded PHY), the BT610 is an ideal sensor solution for harsh Internet of Things (IoT)

SOURCE: LAIRD CONNECTIVITY

The BT610 supports virtually any industry-standard external sensor through a wide range of interface options.

Laird Connectivity

Learn More

19" rackmount network appliance

Appliance offers enhanced network traffic management and virtualized network security.

The Lanner NCA-5530, a 1U 19" rackmount network appliance built with Intel Xeon Processor Scalable Family (Codenamed Ice Lake SP) is a new solution aimed at enhancing networking performance.

The introduction of the NCA-5530 fulfills the demand, from network service providers, for a more agile and flexible method that delivers optimal network computing performance and modest ownership costs.

The NCA-5530, featuring optimized computing power and virtualization capacity, is powered by Intel Xeon Processor Scalable Family and Intel C621A/C627A chipset; this platform delivers networking features that include Intel QuickAssist Technology, new Intel AVX-512 instructions, Intel Hyperscan and Data Plane Development Kit (DPDK).

With support for up to 512GB of DDR4 system memory at 3200 MHz, the NCA-5530 maximizes packet processing efficiency for virtual network functions, cryptography acceleration for deep packet inspection and next-generation firewall and UTM/IPS/IDS applications. For networking tasks, the NCA-5530 comes with 4x or 2x NIC module slots that support 10G/25G/40G/100G fiber/copper/bypass configurations; such versatility and scalability make the NCA-5530 a hardware appliance for enhancing network traffic management and virtualized network security.

Features include 1x GbE RJ45 Ethernet port, 1x RJ45 console port, 2x USB 3.0 ports, 5x or 4x hot-swappable fans, 2x 2.5"HDD/SSD bays, 550W 1+1 ATX redundant PSUs and optional TPM 2.0.

SOURCE: LANNER

NCA-5530: Enhancing Network Traffic Management And Virtualized Network Security .

Lanner

Visit Website

Innovative monitor for data lines

Unit monitors service life of data line at risk of failure in Ethernet-based automation technology networks.

Predictive maintenance is an important tool for avoiding unplanned machine downtimes. LAPP is presenting the new ETHERLINE GUARD, which monitors the service life of a data line at risk of failure in Ethernet-based automation technology networks.

Cables usually last for many years, but in the case of highly dynamic, demanding movements at high speeds and strong torsion, it is advantageous and cost-saving if the connection systems are monitored so that unforeseen downtimes, thus impairing productivity, can be avoided.

The innovative solution from LAPP is the ETHERLINE GUARD. This is a stationary monitoring device that evaluates the current performance of a data line and indicates it as a percentage.

SOURCE: LAPP

Stationary monitoring device evaluates the current performance of a data line and indicates it as a percentage.

The basis for this is data that is determined by sensors from the physical properties of the data transmission. The real-time status display makes it possible to recognize the wear limit of a line and to plan the optimal replacement time in advance. LAPP recommends the ETHERLINE ® GUARD primarily for data lines in accordance with the 100BASE-TX transmission standard (up to 100 Mbit / s) according to IEEE 802.3, but also for EtherCAT, EtherNET / IP and 2-pair PROFINET applications such as the ETHERLINE TORSION Cat. 5 or the ETHERLINE PN Cat. 5 FD. In many industries, these cables are used in the last few meters or at the process level of an application, so they are often part of drag chains or torsion-prone cable guides, such as those found in robot arms. The ETHERLINE GUARD is suitable for top-hat rail mounting and, thanks to its protection class IP 20, can be used in the control cabinet.

Lapp

Visit Website

USB-to-Serial converters

USB-to-Serial converters provide high-performance, industrial-grade connections to legacy devices.

In the age of the IIoT, the time is right for network managers to get more value from legacy serial devices. One way to do this is to connect these older serial devices to a PC via USB, so that untapped information can be extracted for spotting patterns, extracting trends from historical data, and extrapolating potential failures, among other intelligence.

Moxa UPort 1100 USB-to-serial single port converters are the perfect bridge for laptops or PCs lacking a serial port to connect to legacy serial devices or sensors. Capable of delivering 921.6 kbps maximum baudrate for fast data transmission, these cost-effective, simple to use converters empower industrial engineers to connect different serial devices in the field or separate interface converters for devices without a standard COM port or DB9 connector. The 2 kV isolation protects expensive PCs and devices against damage from electrical noise, surges and spikes, while LEDs visually indicate USB and TxD/RxD activity.

Built to rugged specifications, the UPort 1100 Series converts from USB to RS-232/422/485. They are compatible with legacy serial devices, and can be used with

SOURCE: MOXA

UPort 1100 converters now feature Linux drivers for Arm-based platforms.

mobile and instrumentation applications, eliminating the configuration issues associated with high-priced card solutions.

In addition to drivers for Windows, macOS, and WinCE drivers, Moxa now offers Linux drivers for Arm-based platforms. The Mini-DB9-female-to-terminal-block adapter makes wiring fast and easy, and there is no need to set card slots, IRQ jumpers, DMA, or device addresses.

Moxa

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Next generation graphical panel meter

The PM-50 is available as a 3.5-inch or 4.3-inch graphical touchscreen display.

A new graphical panel meter, PM-50, expands Red Lion's existing award-winning panel meter portfolio. The PM-50 is available as a 3.5-inch or 4.3-inch graphical touchscreen display. Using simple "swipe" technology, users can easily switch between relevant screens and receive comprehensive operational data for monitoring equipment and production.

Visual alerts notify the user that immediate action is necessary, either on the unit itself or via PM-50 app, available on Google Play or Apple Store. The PM-50 offers built-in Wi-Fi connectivity for users to remotely access critical workflow and process data from the confines of the plant floor to create a smarter plant floor. Wired connectivity is also an option via Ethernet and Modbus.

Rod Smith, Senior Director, Product Management for Red Lion offered: "Today's manufacturing environment is changing quickly and there is a greater need for data visibility, connectivity, and collection. So, the team at Red Lion challenged themselves to create a product that would help solve these challenges and allow manufacturers to take additional steps in creating a smarter factory floor. The PM-50, with its innovative graphical display, does just that - allowing for more efficient processes, improved uptime, and lower operational costs."

SOURCE: RED LION

Visual alerts notify the user that immediate action is necessary.

The PM-50 is easy to install, program, and expand. The PM-50 can replace a meter with a 1/8 or 1/16 DIN panel cut out. An on-device programming wizard, mobile app, or web browser provides an easy and intuitive setup. Additional capability is available with field-installable modules to provide outputs, communications, and AC power functionality when needed.

Red Lion

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Advanced HMI applications

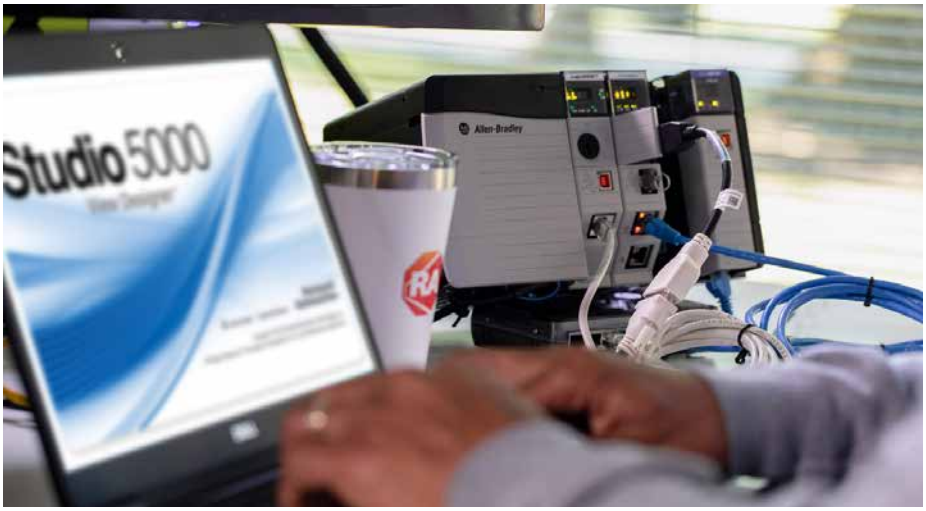
PanelView 5510 terminals now support up to 500 screens, display video and other content.

Machine builders can now create richer, more advanced human-machine interface (HMI) applications on the PanelView 5510 operator terminals from Rockwell Automation.

New versions of the Studio 5000 View Designer software and PanelView firmware expand the amount and types of information that can be provided on PanelView 5510 terminals. Key enhancements include:

A new web-browser functionality allows the PanelView 5510 operator terminals to support a wider range of content. For example, they can now display videos to show operators how to perform certain production tasks. They can show IP camera feeds to give operators visibility into locations like remote or dangerous areas of a facility. And they can display content like hyperlinked help files and online scheduling systems.

Up to 500 screens can now be supported on the PanelView 5510 operator terminals. This can help machine builders create a wide range of screens for setup and operation activities for more complex applications. Users will also see design time and runtime performance improvements, like the ability to switch between screens up to two times faster.



SOURCE: ROCKWELL

New versions of Studio 5000 View Designer and PanelView firmware expand display options.

Automatic diagnostics are now available just by connecting any PanelView 5000 terminal to a Rockwell Automation Logix controller (version 33 or later). Diagnostic information is provided automatically, without any programming required. This can help machine builders provide self-monitoring machines that can alert users of control system issues when they occur.

Rockwell Automation

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Open Industrial Edge ecosystem

Third party app providers can now offer solutions based on the Siemens Industrial Edge Platform.

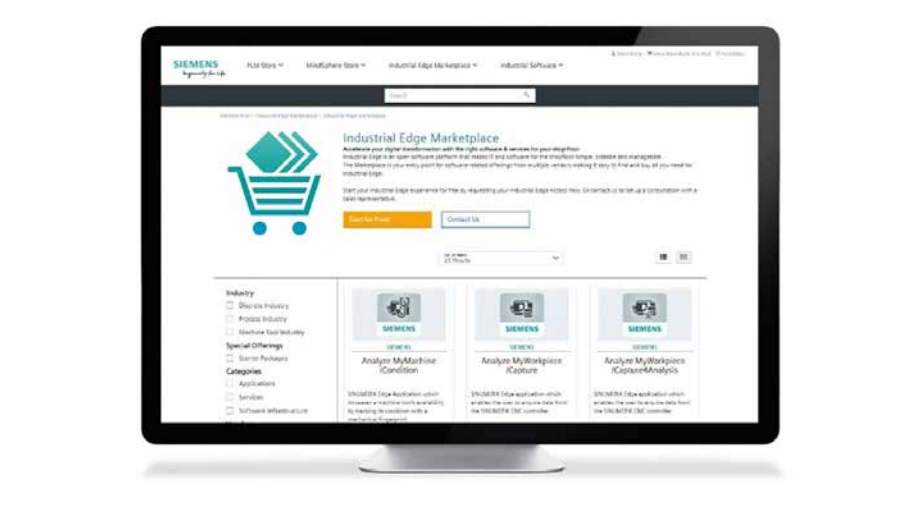
Siemens has launched a digital and vendor independent, cross-manufacturer App Store for industry customers. The marketplace serves as a transaction mechanism specifically for the Siemens Industrial Edge platform: an innovative IT platform which enables the scalable deployment of IT technologies and apps in the production environment.

In addition to the Siemens Edge apps for the discrete and machine tool industries, third-party providers such as Braincube, Cybus, SeioTec and Tosibox have already started to list their products. Customers thus benefit from a broad range of software components, offered by numerous providers and manufacturers, which they can integrate into their manufacturing processes in a standardized manner.

Today, the multifaceted offering already ranges from connectivity, data storage, visualization and analysis right up to machine monitoring, as well as energy and asset management. As an open software platform, Industrial Edge thus constitute an Edge Computing ecosystem.

The new offering makes it possible for B2B customers to purchase and operate multiple software components on an all-in-one platform. In the Industrial Edge Marketplace, customers enjoy an intuitive and consistent user experience when purchasing and using software and services – as customers are used to from B2C app stores.

In just a few steps, they can fill their app shopping cart, place their order, and pay and use their products right away – independent of individual manufacturers. Credit card payment is possible in addition to traditional payment methods.



SOURCE: SIEMENS

Stationary monitoring device evaluates the current performance of a data line and indicates it as a percentage.

Siemens

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More range for wireless operation

SIGMATEK has developed a wireless roaming feature for wireless HMIs.

To enable system operators to move even more freely along the production line, SIGMATEK has developed a wireless roaming feature for wireless HMIs.

The TÜV-certified, wireless operating solution with Safety-to-go from SIGMATEK consists of three main components: a wireless panel from the HGW 1033 series with Safety elements (SIL 3/PL e), the base station BWH 001 as the access point and charging station and an S-DIAS Safety control.

To increase the quality of the wireless transmission in the immediate machine environment, a redundant transmission process is implemented. Safety and payload data are simultaneously transmitted over two WLAN frequencies 2.4 and 5 GHz. Analogous to wired solutions, Safety-relevant data is sent via the Black Channel principle.

When multiple base stations and HMIs are used for complex, very large-scale machines and systems, the wireless roaming feature provides reliable and nearly unlimited coverage. The HGW panel is directly coupled with the selected machine and Safety control. The base station serves as the communications bridge between the wireless and cable-connected networks. Roaming means that an active connection exists over at least one of the two frequencies at all times.

By combining the interfaces of the base stations used, all network participants (HGW, machine/Safety control) are connected to one another over a single subnetwork.

SOURCE: SIGMATEK

Guided by the menu, the operator connects the SIGMATEK wireless panel with the desired system component and the corresponding safety zone.

SIGMATEK

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