November/December 2021 127
ISSN 1470-5745

industrial ethernet book

The Journal of Industrial Networking & IIoT

Factory Automation Connectivity Showcase 6

No more kicking the can.

Here's the cybersecurity guide you've been looking for.

Get the ***groov* EPIC Cybersecurity Technical Guide** to learn more about:

- Creating secure zones and conduits between IT and OT networks (ISA/IEC 62443)
- Protecting legacy automation with device-level firewalls
- Restricting and centralizing user access
- Securing remote access with embedded VPN
- Encrypting communications with SSL/TLS certificates, HTTPS, and MQTT

groov EPIC™

Download your copy at: **op22.co/cybersecurity**

MADE IN THE USA

Made and supported in the U.S.A.
Call us toll-free at 800-321-6786 or visit www.opto22.com

OPTO 22
Your Edge in Automation.™

GET CONNECTED...

Visit our new website at: www.iebmedia.com

Industrial connectivity

Welcome to the November/December 2021 issue of the Industrial Ethernet Book, and our coverage of Industry Connectivity technology and application megatrends.

Factory connectivity solutions make higher levels of automation and machine control networking possible. This ability to interface a wide range of devices is key to manufacturing excellence and has helped to create an ecosystem of solutions aimed at systematic production improvement.

On page 6, you will find our cover story, "Factory automation leverages connectivity solutions". In this special report, industry leaders offer their perspectives on how connectivity technology is shaping the future of the smart factory. Topics range from IO-Link, intelligence at the edge, remote maintenance, wireless Ethernet and how network security is no longer just an IT function.

One common theme from the report is the importance and focus on network security issues. Josh Eastburn at Opto 22 said that "connectivity and security need to be inherent in the design of the network, rather than additional components that need to be licensed, configured, and managed. And as we look at popular concepts like IIoT that many organizations are now dabbling with, it's more feasible to imagine a network where everything is connected to everything. Along with the use of these new software technologies, incorporating security measures has become an absolute must."

On page 12, we highlight how a hand sanitizer packaging plant uses unique automation architecture to run at the pace of modern business. This new connectivity solution puts dynamic manufacturing data at the edge of the production line and into enterprise systems simultaneously in real-time.

Another connectivity feature, starting on page 14, illustrates how real-time locating is enabling flexible production models in electronics manufacturing. Modern technologies are being deployed to digitally connect IT systems and real processes in the factory, increasing productivity and flexibility.

Other connectivity features in this issue address Cloud-based CNC Monitoring of Aerospace Parts Manufacturing (page 17) Smart Pump Monitoring (page 19), Connecting Container Cranes Across the Globe (page 21), New Connectivity for Smart Motors (page 23) and Energy Network Monitoring (page 25).

All of these connectivity examples illustrate how automation and control networks, along with device integration, serve as fundamental building blocks in the transformation of smart manufacturing both now and in the future.

Al Presher

Contents

Industrial Ethernet Book

The next issue of Industrial Ethernet Book will be published in **January/February 2022.**
Deadline for editorial: January 10, 2022 **Advertising deadline:** January 10, 2022
View Industrial Ethernet Book website for latest news and products: www.iebmedia.com.

Editor: Al Presher, editor@iebmedia.com
Advertising: info@iebmedia.com
Tel.: +1 585-598-6627
Free Subscription: iebmedia.com/subscribe

Published by IEB Media, Div. of Stratejus, Inc. Box 1221, Fairport, NY, 14450 USA ISSN 1470-5745

83% will have deployed Wi-Fi 6/6E by end of 2022

Wireless Broadband Alliance (WBA) cross-industry survey of service providers, technology vendors and enterprises demonstrates mass adoption of Wi-Fi 6 technology.

According to a survey by the Wireless Broadband Alliance, eighty-three percent of service providers and equipment manufacturers and enterprises worldwide will have deployed Wi-Fi 6/6E, or plan to do so, before the end of 2022. That is one key finding from the latest cross-industry survey from this global industry body dedicated to improving Wi-Fi standards and services.

The findings, released by the WBA as part of the WBA Annual Industry Report 2022, highlights how 6GHz spectrum will enable Wi-Fi to support even more users and new use cases, such as time-sensitive networking (TSN) for Industry 4.0 applications. Fifty-eight percent of respondents said 6GHz was critical or very important to their strategy.

This outlook reflects the rapid growth in both global harmonization and device selection:

- 41 countries, representing 54% of world GDP, have authorized 6GHz for use
- More than 338 million Wi-Fi 6E devices will enter the market this year
- Nearly 20% of all Wi-Fi 6 device shipments will support 6GHz by 2022

SOURCE: WIRELESS BROADBAND ALLIANCE

Report available for download at https://wballiance.com/resource/wba-annual-industry-report-2022.

Report details

The new report includes updates on a variety of technologies, amendments and initiatives, including 5G convergence and Wi-Fi 7 (802.11be).

Also known as Extremely High Throughput (EHT), Wi-Fi 7 is projected to support up to 30Gbps throughput, about three times faster than Wi-Fi 6. WBA expects Wi-Fi 7 devices to make their market debut in 2025.

The report also quantifies global momentum for WBA OpenRoaming, which enables users to connect automatically and securely to millions of Wi-Fi networks around the world — and without the need for logins, registrations or passwords. Respondents said roaming is the second most-important Wi-Fi capability for commercial success, especially in smart cities.

- 40% of respondents have implemented Passpoint/OpenRoaming, such as Adventist Health hospital campuses in the US, or plan to do so before the end of 2022
- 70% of respondents involved in a city-wide public Wi-Fi network, or who plan to be, will support city-wide roaming, joining several municipalities across Europe that have implemented it

OpenRoaming Release 2 was announced in June and defines important new functionality, including support for SLAs via a QoS tier that guarantees a "silver-tier" HD streaming experience when on OpenRoaming networks. Silver-tier service is already available across 95% of the OpenRoaming ecosystem.

Tiago Rodrigues, WBA CEO said, "Service providers, equipment manufacturers and enterprises worldwide see more value than ever in Wi-Fi."

"Despite all of the uncertainty due to the pandemic, 56% of respondents said they were more confident about investing in Wi-Fi than they were a year ago. This confidence also shows up in the number of WBA members participating in various projects – an increase of 15% compared to 2020 — and the record 20 projects in development or already in progress. One example is their strong interest in the convergence of 5G and Wi-Fi 6, including how mobile operators can leverage Wi-Fi as part of their 5G strategy in terms of maximizing coverage and capacity."

Annual Industry Report

The 60-page 2022 Wi-Fi Market Report is written by Analysts, Maravedis and Rethink, and published by the Wireless Broadband Alliance is available for download at https://wballiance.com/resource/wba-annual-industry-report-2022/. As well as reviewing 2021, the report addresses emerging trends and business models in key vertical markets such as Retail, Aviation, Hospitality, Smart transportation, healthcare and general industry.

In addition, it charts the progress of technology trends and developments including standards evolution, OpenRoaming, Mesh Wi-Fi, and Mobile edge Computing.

WBA undertakes programs and activities to address business and technical issues, as well as opportunities, for member companies. WBA work areas include standards development, industry guidelines, trials, certification and advocacy.

Its key programs include NextGen Wi-Fi, OpenRoaming, 5G, IoT, Testing & Interoperability and Policy & Regulatory Affairs, with member-led Work Groups dedicated to resolving standards and technical issues to promote end-to-end services and accelerate business opportunities.

*News from **Wireless Broadband Alliance.***

Visit Website

[ATI1-19E]

XPlanar®: Levitating, contactless, intelligent!

Free 2D product movement with up to 6 degrees of freedom

- Levitating planar movers
- Scalable payload
- 360° rotation
- Tilting by up to 5°
- Lifting by up to 5 mm
- Velocities up to 2 m/s

XPlanar enables new degrees of freedom in product handling: Levitating planar movers float over individually arranged planar tiles on freely programmable tracks.

- Individual 2D transport at up to 2 m/s
- Processing with up to 6 degrees of freedom
- Transport and processing in one system
- Wear-free, hygienic and easy to clean
- Free arrangement of planar tiles enabling customized machine layout
- Multi-mover control allowing parallel and individual product handling
- Fully integrated into the powerful PC-based Beckhoff control system (TwinCAT, PLC IEC 61131, Motion, Measurement, Machine Learning, Vision, Communication, HMI)
- For use across all industries: assembly, food, pharma, laboratory, entertainment, …

Scan to experience XPlanar in action

New Automation Technology **BECKHOFF**

Factory automation leverages connectivity solutions

Connectivity solutions are at the heart of advances in automation and machine control networking. This special report provides the perspective of industry experts, and how meeting cybersecurity requirements and concerns has come forward as a front and center issue for automation connectivity technologies.

Smart manufacturing systems require sophisticated interfaces with all types of devices that are the component parts in the manufacturing process.

FACTORY CONNECTIVITY SOLUTIONS MAKE higher levels of automation and machine control networking possible. This ability to interface a wide range of devices is key to manufacturing excellence and has helped to create an ecosystem of solutions aimed at systematic production improvement.

In this special report, the Industrial Ethernet Book offers comprehensive coverage and offers the perspective of industry leaders on how connectivity technology is shaping the future of the smart factory.

Intelligence at the edge

IO-Link technology solutions

According to Jonathan Law, Director of Process Control and Factory Automation at Analog Devices, the combination of trends helping to drive higher levels of factory automation device and networked automation connectivity are the needs created by edge computing.

"As Industry 4.0 continues to evolve, there is a drive to deliver more Intelligence to the Edge of the factory floor. This new capability enables a fabric of intelligent sensors and actuators that provide a higher quality of information that allows Productivity software algorithms better data to make better decisions to optimize the productivity of a manufacturing line" Law told Industrial Ethernet Book recently.

"At the heart of this evolution is an exciting new technology called IO-Link, which enables flexible manufacturing to improve factory throughput and operational efficiency."

IO-Link® is a short distance, bi-directional, digital point-to-point, 3-wire industrial communications standard (IEC 61131-9) designed for linking sensors and actuators into control networks. IO-Link applications, the transceiver acts as the physical layer interface to a microcontroller running the data-link layer protocol while supporting up to 24V digital inputs and outputs.

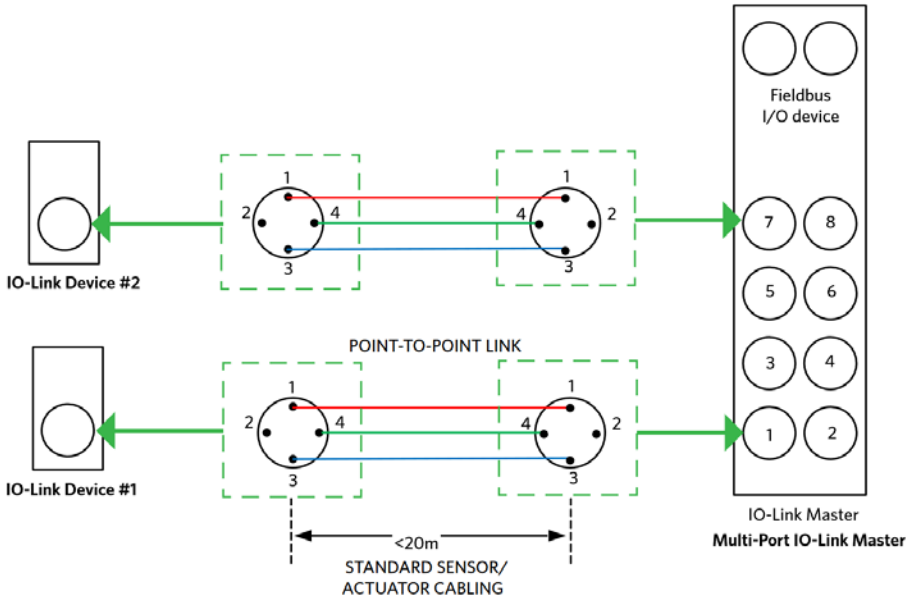
Law said that IO Link technology enables sensors to become interchangeable via a common physical interface that uses software in the form of a protocol stack and a IO Device Description (IODD) file to allow a configurable sensor port.

He added that an IO Link port now becomes the ultimate Universal IO that can support any type of sensor or actuator. It is truly plug & play ready while providing the ability to re-configure its parameters on the fly.

IO-Link benefits

IO-Link offers specific technology and application benefits that are making on impact on the connected factory.

"IO Link provides a new capability to reconfigure a sensor and actuators performance parameters on-the-fly to allow manufacturing lines to accommodate a variety of products at one factory," Law said. This flexibility and ability to provide a higher quality of information to enable productivity algorithms



SOURCE: ADI

IO-Link Master/Device Interface.

to make better optimization decisions differentiates IO Link and sets it apart from traditional binary and analog sensors. This provides the connected factory the ability to react to any changes in the work environment to ensure productivity remains optimized."

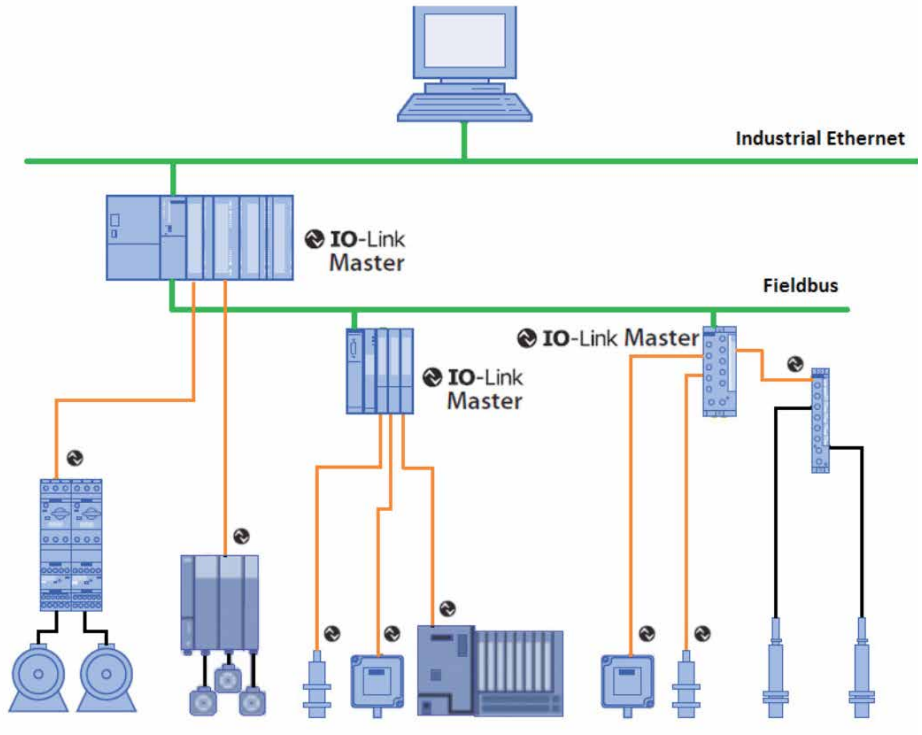
Automation challenges

Automation engineers face many challenges in designing production systems, that IO-Link connectivity is able to address?

Law said that, in the manufacturing environment, all products manufactured require an array of sensors working in unison to help machines figure out distance to an object, detection of an object, colors and composition of an object, as well as monitor the temperature and pressure of an object or liquid.

"Now if we think about the amount of time and cost involved to send a technician down to the factory floor to change a sensor and then re-calibrate it to the correct parameters necessary to manufacture a single product, this impacts the manufacturing flow in a negative way and represents lost productivity," Law said. "If we multiply this same level of maintenance necessary to support many different types of products on a manufacturing line, then the unproductive time spent to shut down production and change or re-configure a sensor is the single most costly expense that all manufacturing lines incur."

"IO Link technology reduces the time it takes to commission sensors and actuators which improves the overall productivity and operating expenses of a factory," he added.



SOURCE: ADI

IO-Link Compatibility with Existing Industry Protocols.

SOURCE: OPTO 22

Performance vs. security

Connectivity requires balancing needs

One connectivity megatrend that Josh Eastburn, Director of Technical Marketing at Opto 22, pointed to is the need to balance use of connectivity solutions while also addressing rising security concerns.

"Right now, there is a lot of tension in factory floor communication. On the one hand, we want more and more connectivity between systems: OT to IT as well as within OT networks. On the other hand, lack of security is a major concern. Improvements on both of these fronts are helping things to move forward," Eastburn said.

For one thing, embedded OPC UA capabilities in edge controllers like Opto 22's groov EPIC, industrial gateways, and even some traditional controllers are making inter-system connectivity much easier. Engineers can use it to stitch together disparate OT networks and devices without the overhead of configuring and maintaining an additional communications server.

"IT technologies, like MQTT, RESTful APIs, Node-RED, Python, and other high-level programming and scripting languages are also becoming more prevalent, which gives designers some really creative options for connecting everything together," Eastburn said. "And fortunately, IT tech brings with it a recognition of modern security requirements, so things like client authentication and encryption are already built-in."

Focus on technology solutions

One key development is that new solutions for automation and control networking are leveraging more sophisticated, open source software technologies.

When something like OPC UA or REST interfaces are distributed throughout automation devices, OT connectivity becomes a lot more flexible. Devices can communicate directly with each other, and automation networks that use different protocols can be unified into a common network without requiring server hardware in the network core to mediate the transactions. That fact also relieves Operations of dependence on IT to manage communication because it already controls the devices.

"Essentially, we are seeing the same shift happening for security as well where it is becoming more distributed and less centralized," Eastburn said. "Newer devices require users and other network clients to login or provide an API key before they are allowed to communicate. They provide their own network firewalls and are able to create encrypted connections, so it's much easier to design automation that can communicate with external networks safely."

The result is that support for high-level IT languages allows data processing to be distributed as well. Field devices can not only generate the raw process data but they can filter it and format it into something like Sparkplug or JSON that can be understood throughout the organization.

Potential impact in manufacturing

According to Eastburn, what this all means is that it's becoming safer and easier to build a common data infrastructure across the enterprise without some of the traditional hurdles. Connectivity and security are inherent in the design of the network, rather than additional components that need to be licensed, configured, and managed. And as we look at popular concepts like IIoT that many organizations are now dabbling with, it's more feasible to imagine a network where everything is connected to everything.

And, along with the use of these new software technologies, incorporating security measures has become an absolute must.

"Cybersecurity is a long-standing concern in automation and consistently appears at the top of the list of obstacles to IIoT adoption. And when something like IIoT or a digital transformation project is undertaken, actually getting OT systems connected to other systems isn't trivial," Eastburn concluded. "Critical data about energy, performance, are not readily available in formats that can be understood and used by backend systems. So on top of addressing the security of data and control systems, engineers struggle to find efficient ways to bridge these systems and to make data usable."

Network security

No longer just an IT function

According to Charles Norz, Automation Product Manager at WAGO Corporation, network security on the plant floor is paramount today and the responsibility for network security is no longer just an IT function. Control engineers also need to help ensure that plant floor networks are secure. A secure network is one way to drive higher levels of connectivity because a breach of the network can result in catastrophe.

"It is a good practice to use defense in depth strategies for network security. Start with zoning you plant into multiple networks. This can be done using separated networks or with VLANs," Norz stated. "Controls engineers should also look to reduce the risk of physical access to their networks. Keep control cabinets locked and be sure that unused Ethernet ports on switches are turned off and only allow approved devices to be used within the network. And in cases where networks cannot be physically secured like between systems or buildings, use encryption to help prevent unwanted access to your systems.

Effective use of network switches

Norz said that unmanaged switches abound in most industrial systems. These devices require no set up, are reliable and cost efficient. However, they are very difficult to secure. In many cases using a fully managed switch can address security issues, but can be cost prohibitive for systems.

"Controls engineers now can use Lean Managed Switches to help them reduce security risks and keep their budget low," he added. "Lean Managed Switches are managed devices that only have features required for the plant floor operations, without the costs associated of a fully managed switch used at the IT level. Lean Managed Switches can be used in lieu of unmanaged switches; providing tools to help secure networks including VLANs along with the ability to turn off unused ports and only allow approved devices."

He added that, in applications where it is not possible to secure the physical cable or connections, users should consider encrypting their communications. This may seem to be an expensive and complex task, but it can be done easily and economically. Engineers can use IEEE 802.1AE Media Access Control security standards (AKA MACsec) for encrypting data. A MACSec network is point to point, using two matched managed switches.

These specialized switches have ports that can manage communications with standard Ethernet devices such as PLCs, Drives or HMIs that are all within a locked control cabinet. There are one or two ports on the device that are used for MACsec encryption for network cables that leave the enclosure. At the other end of the cable there is another MACsec switch that de-encrypts the information and routs the frames to the proper Ethernet device. With this architecture, if a hacker does intercept the encrypted messages, they can't decipher the information or inject frames.

"In the past, automation engineers have been focused on ensuring their control

Switches play a key role in industrial connectivity solutions

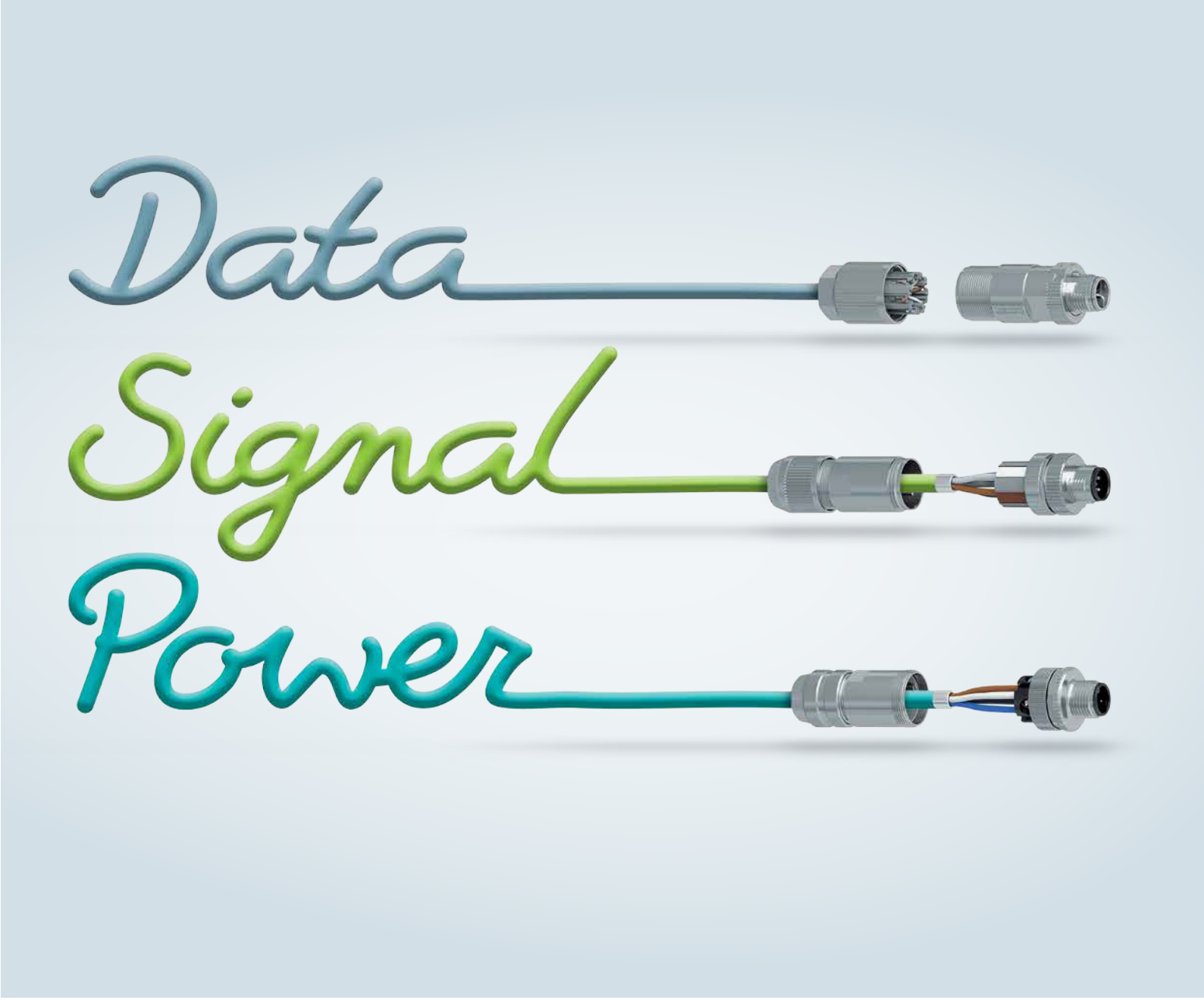
Lean managed switches.

WAGO's line of lean managed switches are a cost effective solution for industrial networking. These switches come with an easy to use dynamic web-based dashboard and topology mapping for instant updates on network status and system health. Features include tools for network performance, security and availability. There are several variants available, all with 1 GB RJ45 ports and a choice of 8 or 16 ports as well as two supplementary fiber optic ports.

WAGO's two Media Access Control Security (MACSec) industrial managed switches offer innovative solutions for network security. They allow users to easily implement network encryption and provide point-to-point network security that protects against numerous threats. Each come with eight RJ45- 1GB ports with six that are not encrypted for local communication. However, the 852-1322 switch comes with two ports for MACSec encrypted for communication throughout the building or plant floor. The 852-1328 switch has two SPF ports for fiber optic MACSec encrypted communication.

MACSec switches.

Visit Website



Always the best connection technology

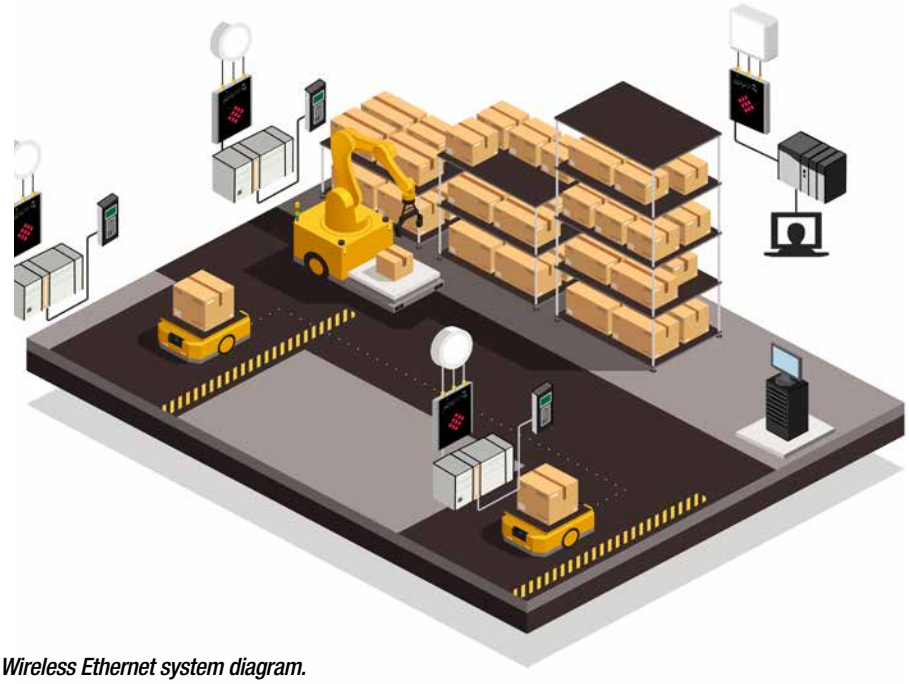
M12 connectors for assembly

With M12 connectors for field-assembly, Phoenix Contact will always provide you with the best connection technology for every application. From our wide product range, select your favorite connection technology for optimum connection of data, signals, and power.

For additional information call +49 52 35 3-00 or visit **phoenixcontact.com**

PHOENIX CONTACT
INSPIRING INNOVATIONS

IC 04-17.000.L1



Wireless Ethernet system diagram.

SOURCE: PROSOFT

networks and operating at peak performance," Norz said. "Now, they also have to help ensure the network is also operating in a secure manner. There is a learning curve to understand methods to help secure their plant floor networks. The investment in learning this methodology is extremely beneficial and far outweighs the consequences of a not understanding or protecting your network."

Automation connectivity

Focus on wireless Ethernet applications

According to Brian Allport, Global Business Development Manager at ProSoft, factory automation has been riding the wave of increased automation connectivity for several years, and it's trends just like this that ProSoft has built their business model around. A continuing focus has been working with customers to modernize and optimize their applications by providing solutions that enable the connectivity between their islands of automation, no matter if they are leveraging legacy or modern equipment.

"It's interesting to see the evolution of what drives this demand for increased connectivity," Allport said. "It could be to collect data and diagnostics for a digital twin to build a model for preventative maintenance. It could be to increase data visibility, allowing management or an algorithm to make smarter and faster decisions. Regardless, what all of these drivers have in common is that they are focused on maximizing the value of their automation equipment. To maximize the value, you need decreased downtime and increased efficiency.

Wireless Ethernet

Allport said that, while wireless Ethernet is not new, what is new are the applications it enables. Increasingly, ProSoft is seeing end users leverage different types of mobile robots. These robots range from intelligent cranes in a material handling environment, to AGVs in a production environment, to ASRS systems in an automated logistics environment. It is critical that these mobile robots reliably and safely maintain connectivity to a main control system.

"As end users are increasing their reliance on mobile robotics, they are essentially building stronger partnerships with third-party suppliers. As more and more specialty OEMs provide innovative solutions to end users, it makes sense that end users begin to lose the expertise required to maintain all of their systems," Allport said.

"The result is that OEMs are increasingly leveraging Secure Remote Access technology to remotely access their equipment so they can provide to their customers an enhanced level of service and support."

Having been a technology that has been around for a while, wireless Ethernet isn't seen as a new technology. He added that what makes the solution unique is that they have enhanced the base technology with proprietary algorithms that better facilitate next-generation applications while decreasing downtime often associated with traditional wireless Ethernet.

For example, in mobile robotics applications, it is critical that the robot maintains connectivity to the main PLC throughout the application. To do this, the wireless technology must be intelligent, it must be fast, and it must not drop packets. This is especially true when leveraging a safety protocol over wireless like CIP safety or PROFIsafe.

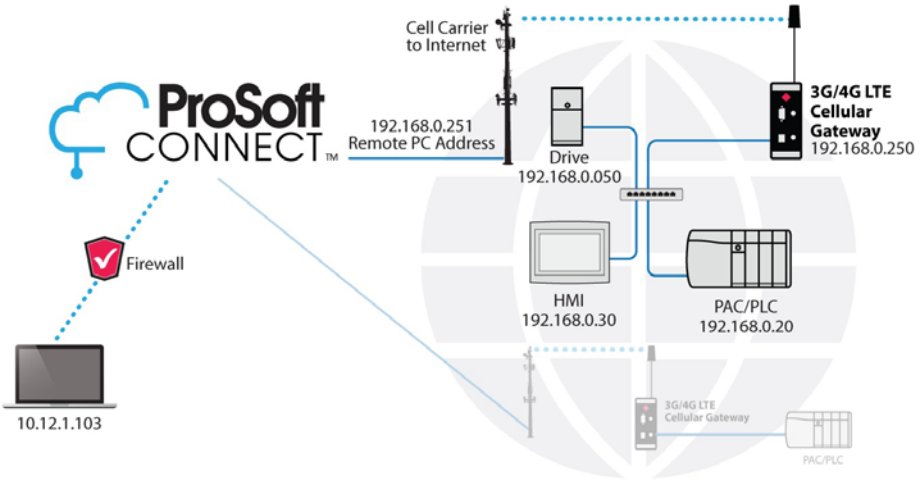
Then, if we look to secure remote access, customers need a solution that is IT-friendly in terms of security, and OT-friendly in terms of ease of use. Secure Remote Access on ProSoft Connect goes above and beyond the industry-leading security practices, and takes the complicated security and networking considerations off of the user so they can focus on bring the most value to their customer.

Addressing automation challenges

Specific to wireless Ethernet on mobile robots, Allport said that the biggest challenges are uptime and safety.

Safety is a critical consideration with mobile robotics, so they often leverage a safety protocol to meet the functional safety requirements of the application. Safety protocols essentially have a heartbeat between the robot and the main PLC, and if that heartbeat is ever missed, the system must shut down to a safe state.

Traditional wireless Ethernet technologies are often unreliable in mobile applications, so these safety heartbeats are often missed resulting in nuisance safety timeouts. ProSoft's proprietary solution was engineered to prevent



SOURCE: PROSOFT

Secure Remote Access technology allows users to remotely access equipment, so they can provide to customers an enhanced level of service and support.

these safety timeouts, by intelligently and autonomously maintaining connectivity between the robot and the main PLC.

"While our wireless Ethernet solution was designed to prevent downtime, there are still cases where other pieces of automation may be having some issues. In these situations, the automation engineer's main focus is on finding a solution as efficiently as possible. This is where the engineer can leverage Secure Remote Access to enable a service provider to efficiently remote into the network of the troubled machine to troubleshoot, service, and ultimately get it back up and running," Allport said.

Remote maintenance

Securely connected remote experts

Jessica Forguites, Technical Platform Lead at Rockwell Automation told IEB that key remote maintenance and use of securely connected remote experts is helping manufacturers leverage connectivity solutions

"One key driver of greater connectivity has been the need to improve maintenance workflows using securely connected remote experts. Being able to troubleshoot and diagnose machine or equipment issues remotely can provide big savings, especially when companies can avoid needing to send an expert on site to resolve an issue. Secure remote connectivity has been a high priority since travel restrictions were put in place during the pandemic," Forguites stated.

"Digital transformation is also driving greater connectivity in many industries. Many companies want to adjust their processes efficiently and securely so they can better respond to customer demands and supply chain dynamics."

Unique technology solutions

ODVA's EtherNet/IP technology is a market-leading solution for automation control for good reason. It's designed with the Connected Enterprise and digital transformation use cases in mind. And it takes advantage of standard unmodified Ethernet at both Layer 2 and 3 of the network, even for applications like safety and motion control that have demanding performance needs.

"Leveraging standard IP (Internet Protocol) makes these communication flows highly portable and flexible to help companies collect and react to their production data," Forguites said. "It also allows companies to take advantage of well-established security technologies to help protect IP-based networks in control applications. For example, CIP Security uses standard and proven IT technology to help protect industrial control devices and their communications from cyber threats."

Application benefits

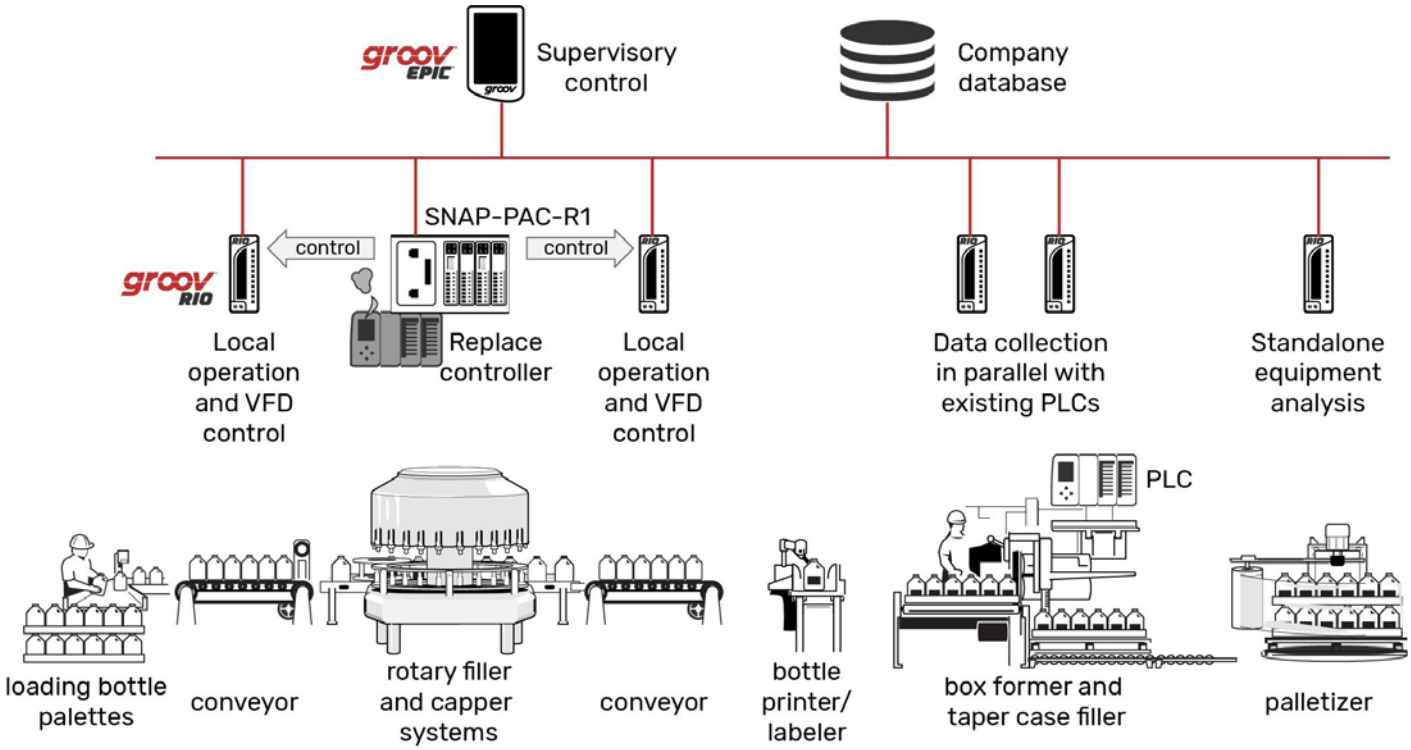
Digital transformation enabled by highly portable and secured data flows between production and enterprise systems can deliver a wide range of outcomes. Some examples include: improved reaction to customer demand, improved reaction to changes in supply chains that would otherwise impact production schedules to meet these demands, and improved collaboration with both on- and off-premises experts.

"Automation engineers are challenged with unpredictable human factors every day," Forguites concluded. For example, they need to secure access and data coming to and from control systems against both intentional and unintentional threats. Cyber threats are increasingly targeting industrial control systems and have caused high-profile security incidents this year in the U.S. Engineers also face challenges in making sure the right information can reach the right people at the right time."

Al Presher, Editor, ***Industrial Ethernet Book.***

From warehouse to enterprise with edge computing

New hand sanitizer packaging plant uses unique automation architecture to run at the pace of modern business. A new connectivity solution puts dynamic manufacturing data at the edge of the production line and into enterprise systems simultaneously in real-time.



SOURCE: OPTO 22

Partial Emerald 66 architecture.

IN RESPONSE TO THE INCREASING DEMAND FOR hand sanitizer in 2020, Emerald 66 Enterprises (E66) set up shop in an empty denim processing plant in Seminole, Oklahoma, U.S.A.

In only three months, with the help of system integrator Northeast Automation Company, Inc. (NACI), E66 had automated packaging lines producing up to 1 million bottles of hand sanitizer a week in a cGMP-compliant facility, and it continues to expand its core capabilities at a rapid clip.

Let's examine the technologies and techniques used to achieve competitive advantage in a challenging market environment.

Getting down to business

When E66 hired NACI to automate its bottling and packaging process, the company understood it was competing against low-paid, high-volume workforces operating manually and believed it could use technology to do more with a smaller, better-paid workforce.

"Each piece of equipment needs to be intelligent … because management is so keen on information," explained Thomas Coombs, principal engineer at NACI. "We're going to make every conveyor and every device smart."

SOURCE: OPTO 22

NACI manufactured VFD control panels for local conveyor control using Opto 22's groov RIO.

To achieve this, Coombs planned to employ edge computing—a design technique that adds general-purpose data processing and connectivity capabilities to traditional real-time control and sensing applications—to build an information management system at the same time that he scaled up production capabilities. He did this using Opto 22's groov family of industrial edge controllers and I/O.

But E66 had also determined that the quickest way to build a new packaging process was by acquiring a variety of equipment at auction. The state of equipment on arrival varied widely, and NACI had to get creative in order to design a cohesive system at the speed that Emerald 66 needed.

Layered distributed control

To address the different circumstances the team faced, NACI employed a unique architecture that enabled separate control systems to function together and also laid a foundation for E66's data acquisition goals.

At the top level, NACI used a groov EPIC

edge programmable industrial controller, which combines PLC control with embedded HMI, OPC UA, and secure gateway functions in a single backplane. The EPIC supervised the process lines and connected disparate devices through REST APIs. Any equipment that arrived with a defunct control system was integrated directly into this network as simple remote I/O.

Functional controllers, on the other hand, were left in place and loosely coupled to the main process using groov RIO edge I/O modules. These modules provide software-configurable, multi-signal I/O channels and are powered over Ethernet (PoE), making them quick to deploy. NACI placed a module in each piece of equipment upon arrival, connected any I/O wires, and identified the types of signals the equipment provided. These I/O signals were then integrated into the groov EPIC network in parallel with the existing PLC I/O connections, which continued to function independently.

Coombs noted, "The ease with which you can do this, you know, you're talking about a half-hour of wiring. Your biggest problem is finding the documentation from the original manufacturer."

NACI also engineered an additional layer of control independent of the groov EPIC by building limited local control into each groov RIO module through Node-RED, an embedded, open-source IoT platform from IBM. Living up to the ambition to make every device smart, NACI added motors, photo eyes, load cells, and other instrumentation to many pieces of semi-automated and dumb equipment, connected these to local groov RIO modules, and added Node-RED logic to make them work together and report process data up to the supervisory level.

E66 COO Robert Bodnar explained, "The top-level process [in the EPIC] is turning on two lines or three lines. If you have a line coming in and you have a line going out, they may not be running at the same speed. … so it's kinda neat to be able to say, okay, what if we use the groov RIOs to control just the lines and the belt and case packers and things like that? … They're kind of little islands of point automation."

This loosely coupled, distributed architecture allowed NACI to assemble their production line without modifying any of the existing control systems that came as part of their purchased equipment. This strategy ultimately saved them development time, and in three months, Coombs and his team had 15 pieces of equipment up and running.

But this wouldn't be their last challenge.

The big pivot

Because it had built its business around packaging and distribution for a single large purchaser, Emerald 66's process was originally designed to maximize throughput. But the situation changed significantly when that customer suffered a financial setback and had to close production. Then, the whole business had to pivot to allow E66 to become a multi-product facility.

SOURCE: OPTO 22

A rotary filler/capper unit at Emerald 66.

Automation grew from processing a high volume of single-formulation, one-gallon containers to working with a variety of sanitizer chemistries in different batch sizes and packaging form factors: from small two-, four-, six-, and eight-ounce containers, hand pumps, and spray bottles, to large jugs in excess of one gallon.

Fortunately, NACI's decision to use a loosely coupled production line made it easy to modify individual segments without interrupting their data collection and process integration. In combination with on-site panel building and 3D printing capabilities, their investment in edge-oriented automation allowed them to retool very quickly and break even on their initial investment within six months.

Data-ready automation

In addition to using Node-RED to cement process control, E66 has started moving data from each groov device into relational and time-series databases, financial software, and other connected systems. And since Node-RED is a free, open-source application, E66 is adding it to their back-end systems as well so they can push data down into the control system.

"You might want to trip a lot number forward on a device or increment something based on a date that's somewhat arbitrary, based on a business event, not necessarily on a machine event," Bodnar explained. "[Node-RED] gives you a very lightweight way to run an operational bus or hub."

For example, Emerald 66 purchased a standalone pallet wrapping machine that used a proprietary circuit board design and offered only a limited operator interface. However, by adding load cells, connecting them to a groov RIO module, and feeding that data to Node-RED, E66 could sanity check the weight based on the known pallet contents and communicate the pallet number, lot number, shipping weight, and date to its central database to create bills of lading automatically.

More to come

As demand grows, Emerald 66 continues to expand its automation and diversify its business. It is adapting to accommodate new functions like on-site container molding, bulk product blending, and additional quality control procedures.

Bodnar says he is defying the industry norm of investing in a multi-million dollar build for an automated facility and instead "putting in just enough automation to double my business, literally, which is going to make the company's year. And then I can grow into that. And I'm not going to have to go back and rip and replace everything …. We'll tweak things, but I'm not going to have to throw away anything that I do because I can scale it."

"The fluidity and dynamics of modern manufacturing requires extremely fast response to changing market demands," added NACI's Coombs. "With groov EPIC and groov RIO, Opto 22 puts dynamic manufacturing data at the edge of the production line and into enterprise systems simultaneously in real-time."

Josh Eastburn, Director of Technical Marketing, ***Opto 22.***

Visit Website

Real-time locating enables flexible production models

To make the same part as often as possible, this old mantra of production planning has been outdated for a long time. Modern technologies to digitally connect IT systems and real processes in the factory aid in increasing productivity and flexibility. An example: the use of real-time locating in electronics manufacturing.

SOURCE: SIEMENS

Black material boxes are the distinguishing feature of new production concepts in electronics manufacturing.

AN UNSPECTACULAR OBJECT SYMBOLIZES THE transition to Industrie 4.0 at the Siemens Electronics Factory in Fürth: black material boxes. Thousands of them are used in the factory for almost all material transport duties. In these boxes, components are brought from the warehouse to the assembly stations and finished goods are transported to the shipping department. The inter-factory transports between Siemens locations also relies on them. Over 2,000 boxes circulate within the factory alone.

Low volume / high mix production

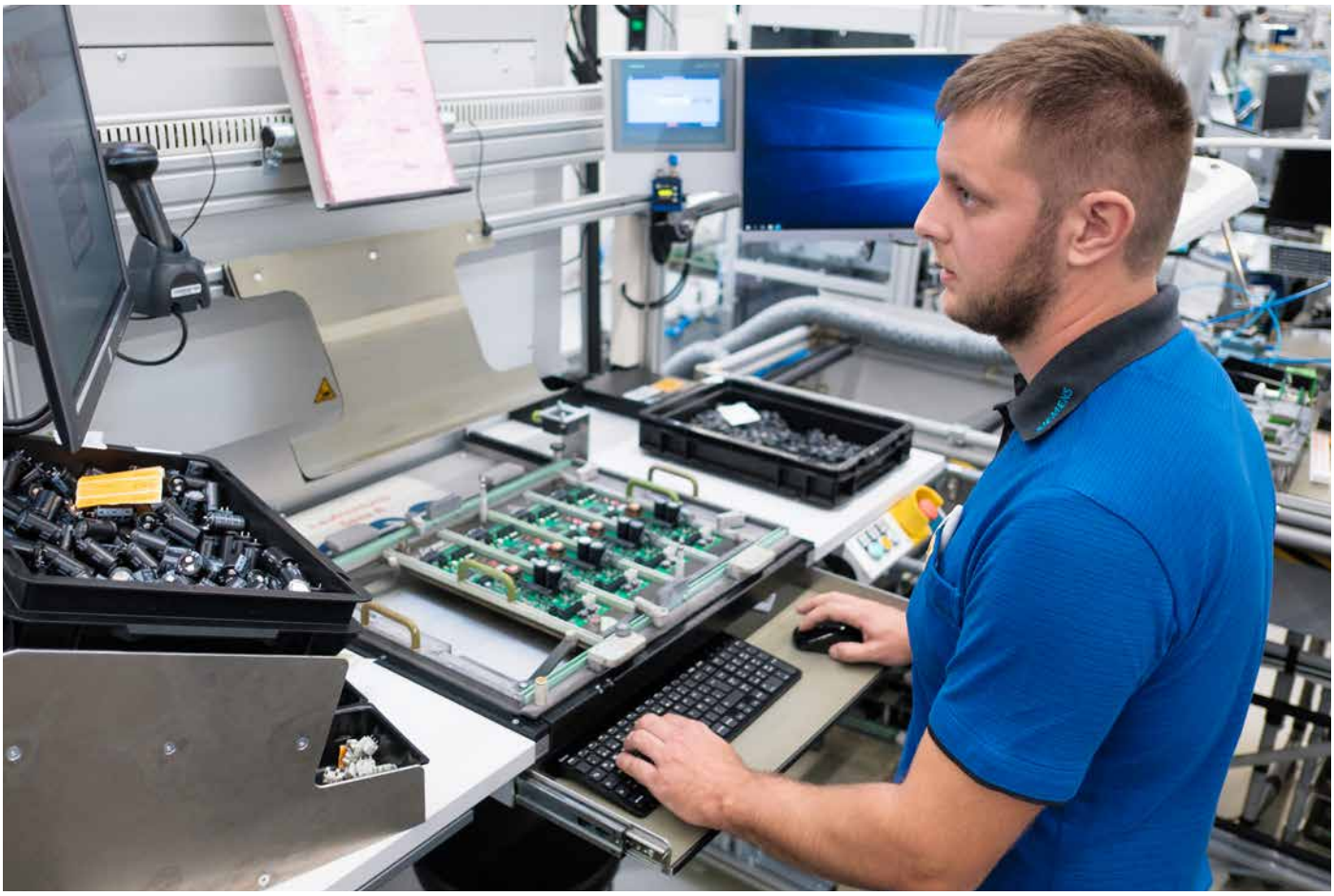
Fürth occupies a special position in the group of factories run by Siemens Digital Industries; factory manager Lorenz Rappl describes the output as a low volume / high mix production. Meaning low quantities per type, but with a high product variety – ranging from high-quality electronic components for industrial use to complex systems with a high degree of engineering. This shifts some aspects compared to mass production. In particular, secondary processes such as material transport or setup times play a much greater role than if the same product would come of the line day after day.

Significantly higher flexibility at comparable costs – that is the formula focused on by the factory. Ultimately, it is about the reversal of the former Industrie 3.0 paradigm, which sought economies of scale through a high output quantity. The motto was to manufacture the same part as often as possible, thereby reducing unit costs.

However, the demands from the markets have changed considerably. The increasing product variety is the result of more and more specific customer requirements. Whereas in the past, a "one for all" product was accepted within certain limits, tailored solutions are needed today, which are also optimized in terms of price for the respective industry or application. Classic mass production cannot answer these requirements.

Industrie 4.0 production in Fürth

Black boxes instead of interlinked conveyor technology, highly qualified professionals instead of inflexible automation, dynamic self-organizing structures instead of pre-planned cycles: all these are characteristics of a modern Industrie 4.0 production like the one



SOURCE: SIEMENS

The low volume / high mix production strategy needs new concepts that are supported by modern technologies.

in Fürth. At the various assembly stations, a multitude of products can be manufactured.

The material flow takes place dynamically with materials getting to the distribution station by tugger train and from there by trolley to the workspace – if need be, all over the hall. In the future, automated guided vehicles (AGVs) will take over this task autonomously. And a full automation can only be found in individual, specific work steps – for example, in the SMD placement of printed circuit boards.

A typical production order begins in the central materials warehouse. There, the components for a production batch are picked and placed in the boxes, which are handed as a stack to the internal shipping. A tugger train transports these stacks of boxes to distribution stations in the factory. The technician of an assembly cell receives the production order on their digital shop floor report and retrieves the stacks of boxes for their workspace. After the order has been completed, the finished goods are picked up again by the tugger train and brought to the shipping department.

Which box belongs to which order?

But, as is often the case, solving a problem leads to another challenge. Handling the black boxes turned out to be difficult and/or prone to errors in practice. For instance, employees have to identify the correct stack of boxes on the basis of the accompanying documents – as the boxes can hardly be distinguished "at a glance." An order can also consist of two stacks, which the employee possibly might overlook. The consequence: a repeated journey to the distribution station, which costs valuable minutes. Add to this that the Fürth factory planners are not even that sure whether the set routes are optimal.

A new technology that Siemens has had in its portfolio since 2018 now helps here: a real-time locating system (RTLS) operating wirelessly. SIMATIC RTLS consists of three system components. Transponders such as the SIMATIC RTLS4030T are attached to the moving objects – such as means of production, goods, transport systems, or the actual products – which are used for position detection and possess a unique identification number. Via a wireless network of RTLS gateways, these transponders are recorded at short intervals and the position determined in the form of two- or three-dimensional coordinates. With SIMATIC RTLS, the omnidirectional characteristic of the integrated antenna requires the gateways to be installed clear of obstructions as much as possible to guarantee an optimal coverage.

The gateways are linked to each other via a separate Industrial Ethernet network, so that the production network, communication network (e.g., email), and RTLS network are completely separate. The gateways are supplied with energy via Power over Ethernet (PoE), so that a single line per gateway suffices. Industrial SCALANCE XM400 switches then forward the data to the locating manager.

Radiolocation in factory applications

In fact, RTLS has been available on the market for many years, but the previous systems were often difficult to install, limited in accuracy, or expensive. The new ultra-wideband (UWB) technology used by SIMATIC RTLS overcomes these limitations: Now a positioning accuracy in the centimeter range and the detection of thousands of transponders in a complex manufacturing environment, e.g., a complete hall, are possible. The lifespan of the transponder batteries has also been extended to ensure operability for years. UWB-RTLS therefore strikes the right balance between freedom from maintenance, precision, and costs to meet the demands of a digital infrastructure.

A sophisticated software, the locating manager, assumes the information from the gateways, calculates the coordinates, and transmits them to the actual target systems – depending on the type of the located object and the actual position. However, in

order to obtain actual, production-relevant information from the coordinates, a further software component is necessary. "Location Intelligence" is the name of a new Siemens offering that connects the locating data from SIMATIC RTLS with the business processes in the production, e.g., the material and order data. The component thus forms the link between the digital twin and the real processes in the factory.

Real-time information

For the Fürth factory, precise location information in real time is worth its weight in gold, because employees can now be guided to the material stacks in a targeted manner, and exactly when the boxes arrive. Mistakes are a thing of the past.

Particularly practical is that Location Intelligence also supports mobile devices such as the SIMATIC ITP1000 – a tablet computer for industrial users. Static processes were once and for all replaced by dynamic and mobile structures.

Another special feature of SIMATIC RTLS proved to be particularly helpful in Fürth. The transponder used (RTLS4083T) cannot only be located, but also features an LED, buttons, and a so-called paper ink display, which is especially energy-efficient.

Via this transponder, an interactive communication between the system and the employees can now take place: The employees are guided to the box searched for via the flashing LED, receive information on content and status of the box via the display, and in the future can also confirm orders via the buttons. The RTLS thus not only helps to eliminate unnecessary search times, but also makes printed accompanying documents unnecessary. In addition, the automatic triggering of certain process steps by reaching a defined position (geo-fencing) will replace manual activities.

SOURCE: SIEMENS

Location Intelligence forms real information from the coordinates for production specialists.

ROI in less than two years

This application – the locating of boxes by employees – already brings such high savings that the return on investment (ROI) will be achieved in less than two years. There are other application ideas, though, that can be implemented with SIMATIC RTLS. Because like a wireless LAN, RTLS is an infrastructure that can be used for a multitude of use cases. In Fürth specifically, two other scenarios are being analyzed.

One application deals with the route planning in the factory. On the one hand, the processes are fixed, but on the other hand, deviations prove extremely useful in practice. In order to include this knowledge into the factory planning, the actual routes as well as the dwell time of the boxes at individual stations are to be analyzed. The knowledge gained is then incorporated into the ongoing optimization of the production processes.

The second application relates to the AGVs. Each of these vehicles is equipped with extensive sensors to avoid collisions. Should the paths of two AGVs cross, both will stop at first and then try to slowly drive past each other. It would be better if the vehicles were controlled by a control center that would stop a crossing AGV until the main path is clear or would specify an alternative route. To do so, the control center must know the routes of all AGVs and constantly synchronize them with their current position – a task perfectly solved by RTLS.

SOURCE: SIEMENS

RTLS gateways are connected to the servers via a separate network using SCALANCE X PoE switches.

Keys to productivity and flexibility

The acceptance among the employees is high, reports Sebastian Dietel, RTLS project manager at the Fürth factory. On the one hand, SIMATIC RTLS and Location Intelligence have become an important tool to avoid unproductive work steps. The assembly staff can now focus on their actual tasks without having to repeatedly search for material boxes. On the other hand, the functions and the visualization were not purchased ready-made, but instead specifically adapted to the requirements in Fürth. The employees on site also have the opportunity to provide feedback and make suggestions for further development. Thanks to the agile approach in the project team, these ideas are then implemented step by step.

Factory manager Lorenz Rappl also confirms the benefit of the system: "With SIMATIC RTLS, we can take our digital transformation to a new level. Because a digital twin is only worth something if it corresponds 100% with the actual processes." Then there are new opportunities for analyzing and optimizing operations. "The real-time locating by SIMATIC RTLS thus represents a key to higher productivity and flexibility," states Rappl.

Markus Weinländer, Head of Production Management SIMATIC NET, ***Siemens.***

Visit Website

Cloud-based CNC monitoring of aerospace parts to shop floor

With a cloud-based monitoring system, Tech Manufacturing was able to minimize upfront costs and deployment effort. Today's cloud-based solutions "can be set up in less than a day, with almost zero additional IT infrastructure or maintenance effort."

SOURCE: MOXA

Key performance metrics are organized on a visual dashboard to view exactly how productive each cell is performing, down to the machine level.

WITH THEIR 5-AXIS CNC MACHINES ALREADY running 24 hours a day up to 7 days a week, Tech Manufacturing, a Pennsylvania-based supplier of machined metal parts for aerospace clients such as Boeing, Lockheed Martin, and Bombardier, looked to Moxa for smarter operation and real-time machine performance data.

The company's goals were to raise production capacity, reduce lead times for their clients' largest and most urgent orders, and expand the useful service life of their existing machines.

"We needed a better understanding of how our machines were actually performing for us in real-time. Live and historical machine performance data would also help us identify technical or process issues that were detrimental to productivity," said Jerry Halley, Chief Engineer of Tech Manufacturing, and one of the company's 70 employees.

Purchasing additional machines would, of course, be one way to achieve this. But Halley was interested in finding a smarter, more efficient approach that did not require a large capital investment. That "smarter way" was a CNC monitoring system that would collect, analyze, and visualize necessary performance metrics. Before taking the next step, however, Halley carefully weighed the productivity gains of such a system against the cost and effort of deployment, especially if it involved a new and unfamiliar server-based IT infrastructure. The ideal system would be easily deployed without specialized IT equipment, knowledge, or effort, and would not require repeated software installation, updates or configuration.

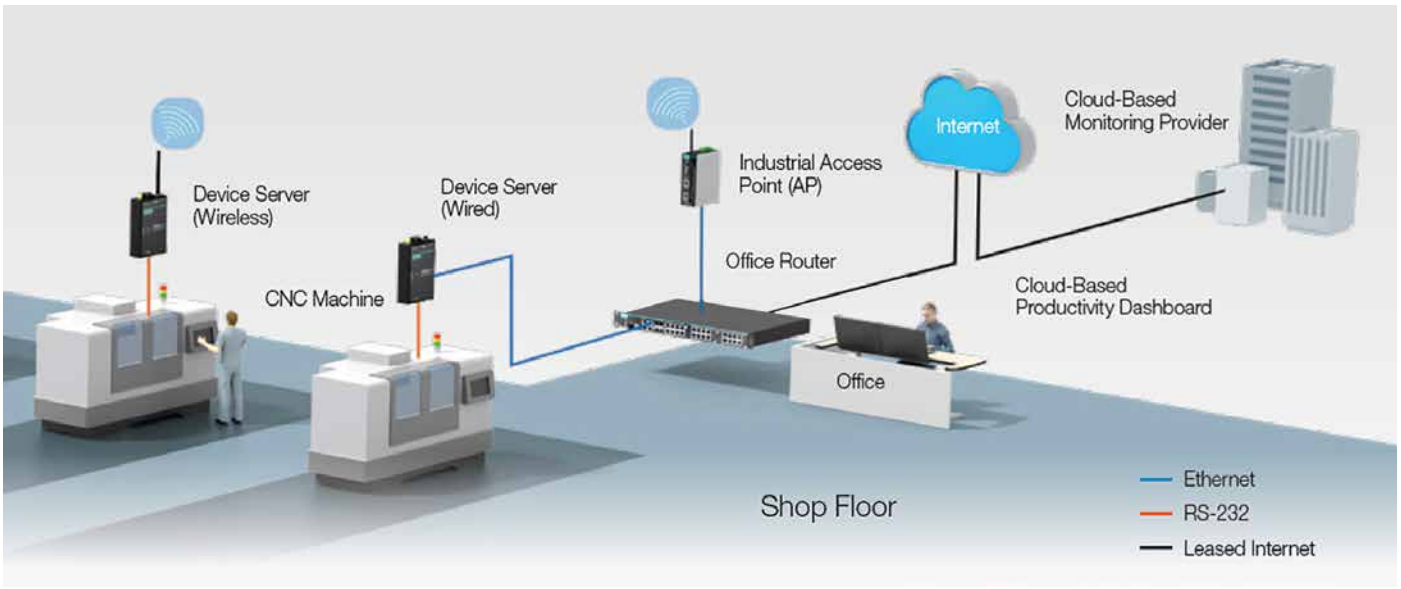
SOURCE: MOXA

NPort® wireless device servers.

New life for older machines

Tech Manufacturing selected Shop Floor Automations, one of the most prominent systems integrators in North America, to assist with a cloud-based CNC monitoring system. Each of Tech Manufacturing's CNC machines were connected to the existing local area network, so no additional IT infrastructure was required.

For legacy machines that did not have a readily available Ethernet port, Shop Floor Automations provided an easy-to-deploy solution that was developed based on Moxa NPort® W2150A and W2250A wireless device servers that permit communications software to access serial and Ethernet devices over



SOURCE: MOXA

With the local network connected to the Internet, CNC machine performance data at Tech Manufacturing can now be easily viewed and analyzed by cloud-based software such as Scytec DataXchange or Predator Machine Data Collection.

the wireless LAN. Being wireless the device servers required far fewer cables and lets users roam between several access points. As such, the servers offered an excellent solution for devices that are frequently moved from place to place, as is the case in many factory settings.

"Getting our CNC machines connected and monitored has made it much easier for us to deliver on our clients' build-to-print orders with maximum efficiency and minimum lead time. It is a lot easier to get connected than a lot of people may realize," said Halley.

With the local network connected to the Internet, CNC machine performance data at Tech Manufacturing can now be easily viewed and analyzed by cloud-based software such as Scytec DataXchange or Predator Machine Data Collection. Key performance metrics are organized on a visual dashboard so the company's owners and machine operators are able to see exactly how productive each cell is performing, down to the machine level.

SOURCE: MOXA

Having comprehensive machine performance data provided an additional benefit: better service.

With a cloud-based monitoring system, Tech Manufacturing was able to minimize their upfront cost and deployment effort, explained a representative from Shop Floor Automations: "Many clients perceive it to be difficult and expensive to set up a CNC monitoring system. However, with today's cloud-based solutions, you can be set up in less than a day, with almost zero additional IT infrastructure or maintenance effort."

With the system now up and running, a live dashboard has made it easy for Tech Manufacturing to identify critical productivity issues. For example, one immediate finding was that set-up times on certain machines were unnecessarily long, leading to hours of lost productivity every day. By rearranging setup sequence and on/off times, Halley quickly achieved significant productivity gains with those machines.

Having comprehensive machine performance data on hand also provided an additional benefit: better service from CNC manufacturers. Service calls are now backed by a rich set of historical data, making it easier to identify and troubleshoot potential hardware issues.

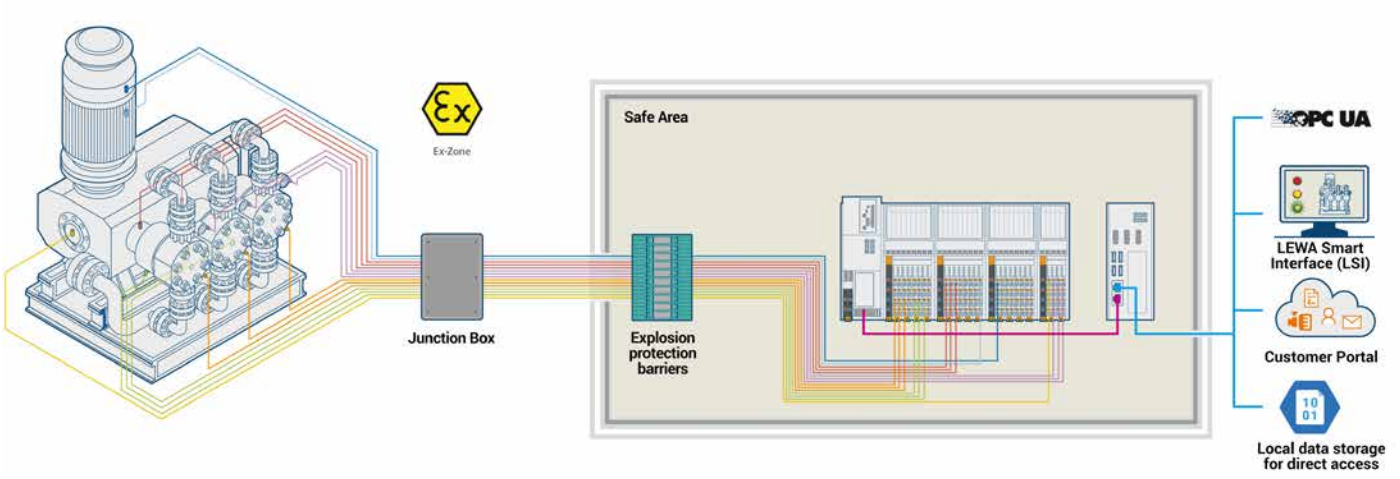
"Manufacturers have became more willing and able to provide support when we need it because we have the data to show abnormal operation," noted Halley.

Application report by ***Moxa.***

Visit Website

Smart monitoring tracks pump operation and analytics

Smart pump monitoring uses a combination of sensors integrated into the pump and software-based evaluation, offering users comprehensive information on the performance and condition of the pumps. Malfunctions and wear development are detected before they lead to unscheduled shutdown.



SOURCE: LEWA

Data is transferred via standardized interfaces such as OPC UA to process control systems for data acquisition and visualization.

A NEW SMART MONITORING SYSTEM LETS operators sleep more soundly and makes pumps smart-factory-ready. In addition to detecting malfunctions and process deviations, smart monitoring also provides important key figures for the economic evaluation of the plant. LEWA provides additional support with operational analyses of the runtime data. Data sovereignty always lies with the operator.

The continuous operation of pump systems in critical applications goes hand-in-hand with high expenditures for monitoring and maintenance. Recording plant operating parameters such as flow rate, temperature or pressure also often requires additional expensive and high-maintenance instrumentation.

For this reason, LEWA GmbH, as a specialist for pump systems, has developed Smart Monitoring for its ecoflow and triplex models. A combination of sensors integrated into the pump and software-based evaluation provides the user with comprehensive information on the performance and condition of the pumps. Malfunctions and wear development are detected before they lead to unscheduled shutdown. This way, the service life of the pumps can be increased and maintenance can be planned more easily. LEWA also offers data analysis as a service. Here, customers not only receive a data-based assessment of the condition and operating efficiency of the pump, but also optimization recommendations for the entire system.

SOURCE: LEWA

The measured values come from a structure-borne sound transmitter located on the pump body, a pressure transmitter connected to a pressure measuring bore, and a rotary encoder adapted either directly via the crank shaft or the engine. Here you can see the pressure transmitter.

More complex production processes

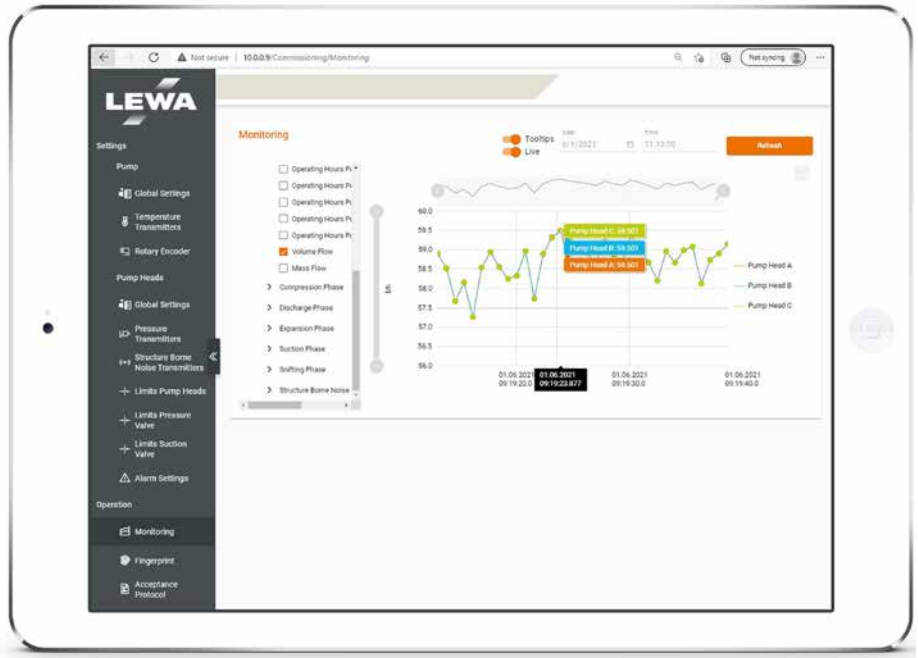
For reliable use of pumps and pump systems in everyday industrial applications, regular inspection of the units is absolutely essential. Wear and malfunctions must be detected before costly unplanned shutdowns occur. Time-consuming inspection rounds are thus the basis for repairs and maintenance work, but do not always capture all functional deviations. Because the requirements are increasing due to ever more complex production processes, the specific pump know-how of the operator is continuously decreasing. For these reasons, companies are turning to digital assistance systems to control and monitor the entire production line. But only if the plant components can also be integrated into these

systems by means of interface integration and characteristic value transmission, the step towards the smart factory – the digitized production facility – can be taken.

Smart monitoring: networked pumps

To meet these challenges, LEWA GmbH, as a pump specialist with experience in critical applications, has developed a product for complete and networked pump monitoring: "Smart monitoring provides information about the performance and condition of the ecoflow and triplex metering and process diaphragm pumps based on up to 13,000 sensor signals processed per second," explained Sebastian Gatzhammer, Development Engineer at LEWA. "In the process, data on structure-borne noise, hydraulic pressure, temperature and angle of rotation is collected by multiple sensors and processed by our software to come up with meaningful key figures."

This system largely serves as a replacement for inspection rounds, since digital monitoring immediately detects wear and malfunctions on both the fluid and hydraulic sides and reports them to a process control system at the operator via the interface. "This means that around 90 percent of malfunctions can be detected at an early stage: for example, overpressure in the hydraulics, worn plunger rings or incorrect closing behavior of valves," says Gatzhammer. Faults in the entire system beyond the LEWA unit are also measured indirectly. "We can use the pump data to interpret changes in the condition of the pumped fluid, possibly due to contamination," Gatzhammer added.



SOURCE: LEWA

Thanks to the structure-borne sound characteristics, wear and tear on valves can even be detected before it becomes measurable in the flow rate of the system.

30 different diagnoses of volume flow measurement

However, detailed monitoring also results in other advantages such as better planning of maintenance intervals. The plant control center learns of any functional deviation in real time so that maintenance can be planned in advance and carried out in a controlled manner. In potentially explosive working areas, this also means a significant increase in safety: "Possible accidents are prevented and overall plant availability increases significantly," reported Gatzhammer. "By monitoring up to 30 different diagnoses, the technical management always has an overview." This was possible because the Smart Monitoring System is the product of more than 60 years of LEWA's pump expertise. "With the interaction of sensors and hardware, we can detect as little as a one percent drop in flow rate in each pump head," Gatzhammer said. "But thanks to the structure-borne sound characteristics, we even detect signs of wear on valves at a very early stage, before they even become measurable in the flow rate of the system."

SOURCE: LEWA

The measured values come from a structure-borne sound transmitter located on the pump body, a pressure transmitter connected to a pressure measuring bore, and a rotary encoder adapted either directly via the crank shaft or the engine. Here you can see the pressure transmitter.

Added value through data analyses, data sovereignty with operator

LEWA offers data analysis for the smart monitoring systems. "We analyze and evaluate the operational data that a system has collected over a period of time. This allows us to do more than just provide the customer with data-based recommendations for maintenance planning based on wear patterns. The overall plant efficiency can also be optimized in this way," explained Gatzhammer. The data is transferred via standardized interfaces such as OPC UA to process control systems for data acquisition and visualization. In addition, the Smart Monitoring System is already cloud-ready and can be networked with other systems via the Microsoft Azure cloud. However, this decision, and also the data sovereignty, always lies with the operator.

*Application report by **LEWA GmbH.***

Visit Website

Connecting container cranes across the globe

Conductix-Wampfler has equipped a number of E-RTG crane battery containers with remote monitoring technology developed in collaboration with Schildknecht. Preliminary test results show that they have succeeded in securing dependable and stable data transfer in a harsh environment.

CONDUCTIX-WAMPFLER MAKES FERRIS WHEELS turn, cranes move and steel mill conductor systems run. Since 1902 the company has built energy and data transmission systems for any mobile equipment and machinery imaginable, across a wide range of industries.

It requires a strong focus on innovation to stay in business successfully for over a 100 years and on top of that, continuously being a world leader in its field. Now Conductix-Wampfler is pushing the envelope once again, integrating sensor based wireless remote monitoring technologies into its products. To achieve this, Conductix-Wampfler collaborates closely with long-term partner Schildknecht. At the moment the two partners are testing new technology for remote monitoring of batteries powering electric container cranes.

The Electric Rubber Tired Gantry Crane (E-RTG) is a highly sophisticated machine, operating in container terminals around the world. Instead of being restricted to moving on a track the E-RTG crane is able to straddle multiple lanes on its rubber wheels, securing maximum mobility and speed. However, the crane's flexibility has a downside: how do you provide stable power supply? As long as it moves along container corridors the crane can be powered via conductor lines and motorized cable reels. But outside the corridors it has to rely on "onboard" power. So far diesel generators have done the job, but now container terminal operators are looking for more environmentally friendly and cost-effective alternatives.

To meet this demand, Conductix-Wampfler has designed battery containers mounted directly on the crane. These battery containers are sophisticated devices packed with hi-tech components that need to be monitored by sensors to secure flawless operation and maximum uptime.

Sensors transmit voltage, temperature, pressure, and humidity measurements to an industrial cloud for visualization and evaluation. And as the cranes are situated in different locations around the world, it is crucial that data can flow freely all the way from source to destination.

Challenges: metal and distance

Some of the problems to be solved came from the cranes themselves: they are continuously in motion, and on top of that, the gateways in the battery containers are surrounded by metal. Therefore high performance radio communication technology is required to secure dependable and stable data transfer.

Another challenge was posed by the fact that E-RTG cranes powered by Conductix-Wampfler power solutions are scattered in container terminals around the world. So, if you want to roll out your remote monitoring solution on a global scale, you need to design a global connectivity infrastructure, the cranes being on the edge of the network and a web portal in its centre, located with the operator monitoring the equipment.

SOURCE: SCHILDKNECHT AG

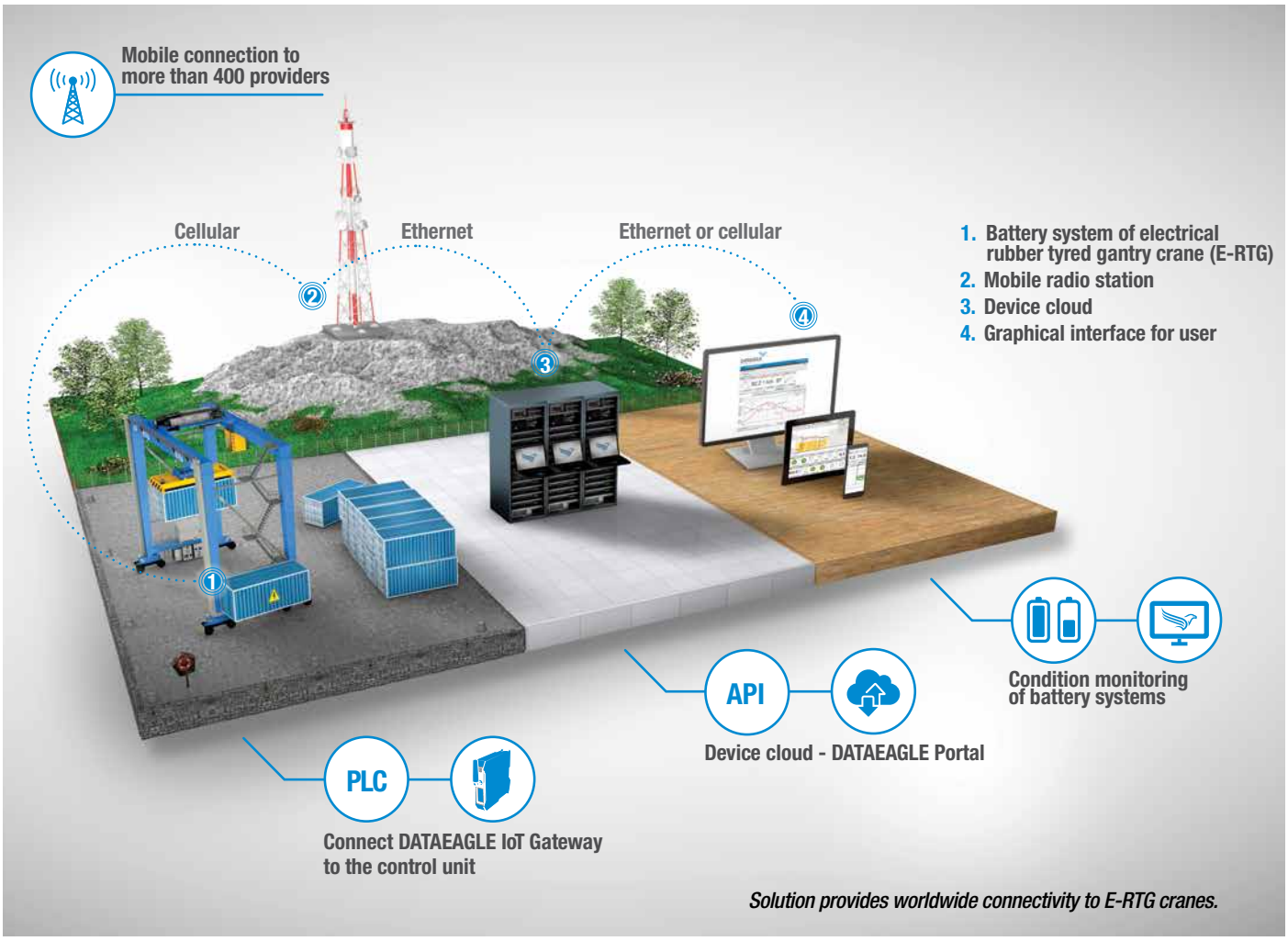
Battery-Container ensures the onboard power supply can freely move electric cranes. IoT Edge Gateway connects the battery management system to the DATAEAGLE cloud to monitor the values 24/7.

Solution: tried & tested equipment

Building on the long-time collaboration between the two companies, Conductix-Wampfler was able to define the requirements for this demanding remote monitoring solution clearly and quickly. And Schildknecht managed to successfully implement the solution using the DATAEAGLE 7050, a product already tried-and-tested many times in similar settings.

On the input side, the gateway receives up to eight sensor signals via Bluetooth Low Energy interface and additionally via fieldbus such as PROFINET and is connected to the battery management a Siemens S7. It also connects via mobile radio (2G-4G) to the DATAEAGLE industrial cloud portal.

After a trial period Conductix-Wampfler is deploying a number of DATAEAGLE 7050 gateways with varying configurations in a number of locations worldwide. These gateways collect mission critical application data about voltage, temperature, pressure, humidity, etc. from each battery container. After pre-processing, the gateways send this data via radio communication to the cloud portal for visualization and further analysis.



SOURCE: SCHILDKNECHT AG

Solution provides worldwide connectivity to E-RTG cranes.

Dependable measurements

Conductix-Wampfler has equipped a number of E-RTG crane battery containers with remote monitoring technology developed in collaboration with Schildknecht. Evaluating the preliminary test results both partners are confident that they are on the right track. They have succeeded in securing dependable and stable data transfer in a harsh environment. And on top of that the portal presents measurement data in an accessible way, giving monitoring personnel a quick and intuitive overview of the condition of the equipment.

SOURCE: SCHILDKNECHT AG

The heart of the Power Packs are lithium-ion batteries of the latest technology in combination with a special battery management system.

Remote monitoring of sophisticated and expensive, globally deployed machinery has evolved into a promising Industry 4.0 business model.

Schildknecht AG is a successful pioneer in this area by linking its powerful DATAEAGLE line of industrial wireless devices with the global connectivity offered by mobile communication networks. Conductix-Wampfler, a world leader in power and data transmission, has recognized this potential, according to Michael Eckle, CTO, Conductix-Wampfler:

"To us, this Industry 4.0 solution is a crucial element of our future business development. We have a global presence and our customers expect our systems to be operational 24/7. That is exactly what we want to achieve with this project, and we are confident that with Schildknecht AG we have found a highly capable partner for Industry 4.0 applications."

Elena Eberhardt, Business Development Manager, ***Schildknecht AG.***

Visit Website

IIoT solution moves beyond the boundaries of drive technology

New holistic technology covers all aspects of advancing the use and connectivity of smart motors. These offerings propvide a solution from the field level to the cloud, using a single source, it aids the rapid development of decentralized control programming and IIoT solutions.

SOURCE: DUNKERMOTOREN

Thousands of applications are running today using the MotionCode program. From simple sensor input profiles to complete autonomous machine control without the need for a PLC.

A NEW HOLISTIC TECHNOLOGY COVERS ALL aspects advancing the use and connectivity of smart motors. Offering a solution from the field level to the cloud, using a single source, it aids the rapid development of decentralized control programming and IIoT solutions.

The Dunkermotoren team has been working on intelligent drive solutions for many years. Even before the boom around Industrial Internet of Things and Industry 4.0, Dunkermotoren provided forward-looking software solutions such as the control functionality integrated in the motor or even condition monitoring.

The Industrial Internet of Things is now creating completely new possibilities in the areas of remote connectivity and decentralized control topologies. In order to fully exploit the opportunities that arise and to create a holistic solution offering for its customers, Dunkermotoren is bundling its expertise in the development of decentralized control programming and IIoT solutions under the new nexofox brand.

For nexofox, holistic means, on the one hand, from the initial consultation and joint concept development to project implementation in partnership. On the other hand, holistic also means from the field level to the cloud from a single source, i.e. from the realization of the control logic with MotionCode to condition monitoring & predictive maintenance using cloud services.

In the IIoT area, nexofox naturally also offers solutions for the automation systems of Dunkermotoren subsidiary EGS. The following article is dedicated to the innovative solution approaches, used and further advanced by nexofox technology.

Technology solutions

Nexofox starts where the pure Dunkermotoren or EGS automation system leaves off. On the one hand, nexofox enables free MotionCode programming of the BG series of Dunkermotoren in order to map PLC logic directly to the motor. This offers several interesting use cases, which are realized for customers or for which customers are supported. For smaller systems such as AGVs or AGVs, for example, the entire logic of the vehicle can be implemented on the motors without the additional installation of a PLC.

The necessary sensors are then connected directly via the digital and analog IOs of the motors. The motor can receive the position commands from the navigation control system via the integrated CANopen or Industrial Ethernet interfaces and can be addressed by the safety via the integrated Safe Torque Off interface. The advantages of this solution are obvious: space and cost savings due to the elimination of a separate PLC.

This approach is not only interesting for small plants. More complex machines can also be built up modularly by coupling all axes belonging to one function to one module. The sensors are again connected directly to the motor. The associated control logic can be implemented directly on the motors, as in the above example. This not only creates mechatronic modules that are addressed from a central PLC, but they also act fully autonomously and contain all the information they need.

SOURCE: DUNKERMOTOREN

A suite of hardware and software tools are needed to create a holistic solution for integrating smart motors into factory automation applications.

The advantages of a decentralized approach are obvious. For one thing, wiring is much simpler and faster because it is done much more locally. On the other hand, this approach also offers further advantages in terms of scalability. All information and tasks are encapsulated in functional modules and can be combined as if from a Lego construction kit. This eliminates the need for central adaptation of the software. Data is exchanged between the modules and other system components, such as an HMI, via standardized interfaces programmed on the motor.

But as already indicated at the beginning, nexofox does not stop there. The entire integration of the smart BG series of Dunkermotoren as well as EGS automation systems into the IIoT and the development and provision of digital services also falls within the range of solutions offered by nexofox.

The basis of the technology are software solutions via which drives and systems that can be connected to the EDGE and provide their data there. Alternatively, the data can also be transferred directly to the cloud and thus be viewed and evaluated from the desktop worldwide.

This solution is implemented at nexofox via specially developed Docker containers, which can read out the motors and systems via the fieldbus and thus provide the acquired data, such as the electronic nameplate via MQTT or OPC UA. nexofox has already demonstrated in a demonstrator that the data can be received and evaluated in the cloud.

Looking to the future

But what are the benefits for the customers of Dunkermotoren and EGS? In the future, Dunkermotoren sees itself even more strongly as a service provider for customers with nexofox. As a service, the data supplied by the intelligent motor or automation system will be analyzed and transferred directly to the customer's application via plug-in apps or web services. This means that users no longer have to worry about interpreting the device data and can concentrate fully on their application.

The roadmap for IIoT is already clearly defined. Remote monitoring to display and provide device data is at the top of the list. Various tools, such as the remote oscilloscope for real-time analysis, can be used to analyze device data in detail. Alarm and status messages can also be called up at any time.

In the area of remote control nexofox sees the firmware and software distribution to single motors and plants or whole fleets as well as the motor tuning by remote. This is also the basis for the machine analysis of device data and the prediction of failure probabilities. This enables just-in-time spare parts deliveries. Ad-hoc maintenance calls will then be a thing of the past and can be replaced by planned, prepared maintenance. Conclusions can be drawn about defects or malfunctions in the mechanics connected to motors by means of sudden deviations in the data. This makes it possible to avoid consequential damage to motors.

The service technician is also not forgotten with nexofox. A smartphone app enables him to retrieve the electronic nameplate and accompanying information via 2D code. Live data such as temperature, messages or operating hours can also be displayed via the app. In this way, service technicians can access the device data at any time - smart factory - smart working.

When data transmission/data monitoring is mentioned, the topic of IT security naturally comes into play. Here, too, Dunkermotoren has an integration solution in mind using nexofox.

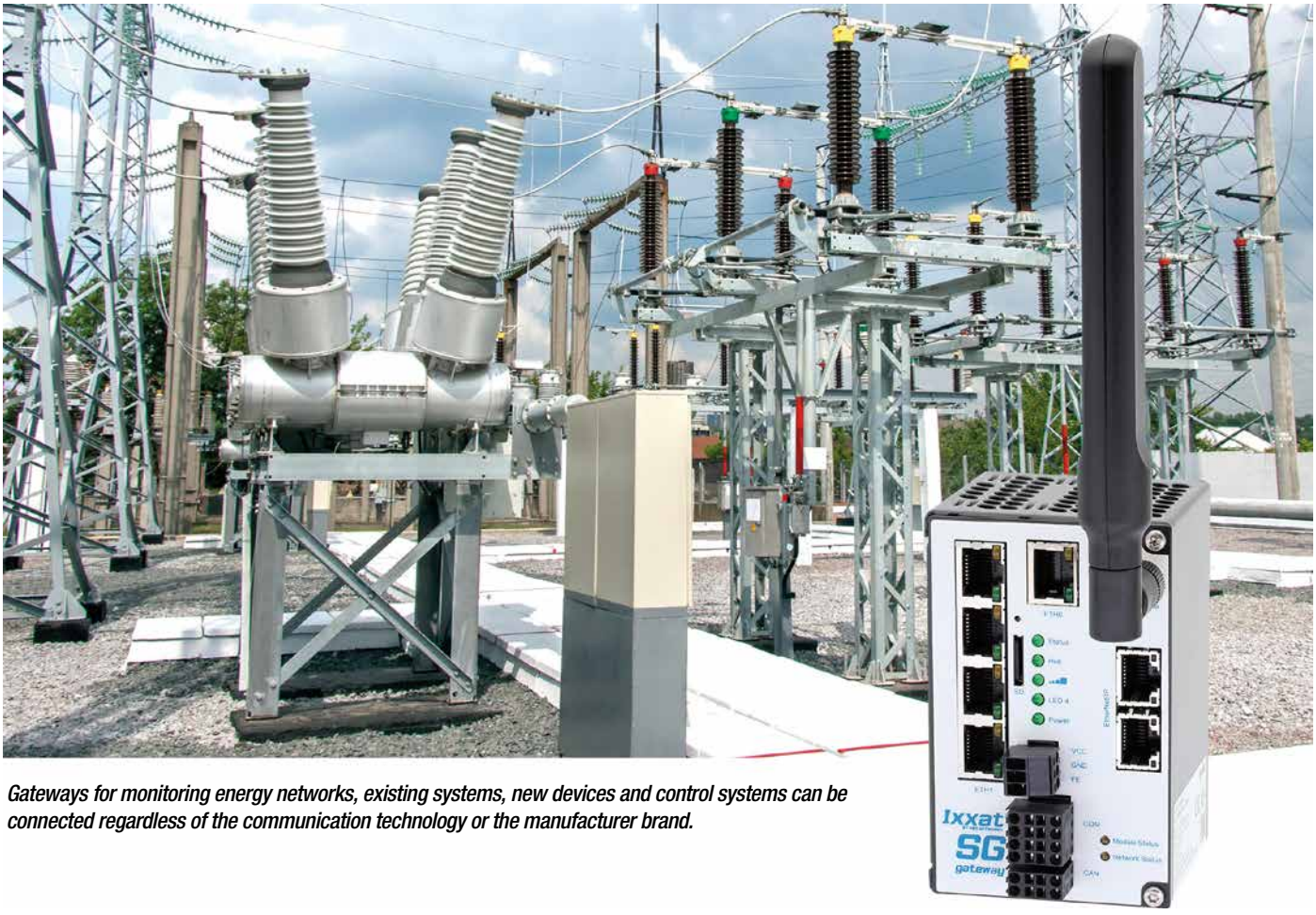
To fully exploit the potential of IIoT, Dunkermotoren believes that open and generally recognized standards must be relied upon. This goes hand in hand with the need to think in terms of ecosystems rather than individual solutions. For this reason, since 2019 the company has been a member of the Open Industry 4.0 Alliance and MindSphere World e. V. There, the drive technology manufacturer is working together with other market leaders on joint solutions.

Markus Weishaar, Head of Systems & Services, ***Dunkermotoren GmbH.***

Visit Website

Monitoring energy networks – how to make it easy and secure

A solution with a high level of cybersecurity protection can guarantee that critical control data will be strictly separated from monitoring data. The solution should also be easy to use and have a compact form factor to ensure that it is suitable for retrofitting, and that it fits into existing cabinets.



SOURCE: HMS NETWORKS

Gateways for monitoring energy networks, existing systems, new devices and control systems can be connected regardless of the communication technology or the manufacturer brand.

CLOUD AND CYBER SECURITY IN CRITICAL energy applications, along withdigitalization and the IoT, is a clear trend within power plants and substations, just as it is in industrial automation. The Smart Grid is certainly a driving factor, but there are also other reasons for this change. Operators often find that only having data available in the control room is insufficient. Instead, they want to monitor transformers remotely, implement new maintenance concepts from anywhere, optimize utilization and commissioning, or retrieve environmental data online.

This requires a solution with a high level of cybersecurity that guarantee critical control data to be strictly separated from monitoring data. The solution should also be easy to use and have a compact form factor to ensure that it is suitable for retrofitting and that it fits into existing cabinets.

By using Smart Grid gateways for monitoring energy networks, existing systems, new devices and control systems can be connected regardless of the communication technology or the manufacturer brand

Cybersecurity of utmost importance

Substations which convert high transmission voltage into consumer voltage are an important part of the electrical grid, not only for municipalities but also for the railways and industrial companies to name but a few. They usually consist of power transformers, switchgear and a lot of equipment for measurement and control.

Substations are usually managed from a control room, or remotely from control centres. This control path is subject to strict security regulations as a successful hacker attack could have catastrophic consequences. There is also a need for cloud-based monitoring. But how can this be achieved without neglecting the required cybersecurity?

Two separate data streams

In principle, there are two different data streams in substations: the first is the control data with which the control room communicates with the substation or individual devices. Control data means sending commands such as “Turn switch on”, “Measure now” or “Send measured value”. This critical communication runs in real time according to the protocols used in the energy sector such as IEC61850 or IEC60870-5-104. The security requirements are high and unauthorized data must be excluded.

The second data stream delivers monitoring data from sensors and devices to the control room. Real-time communication is not required

here but the data packages are usually more extensive for this IoT data. Of course, the data must not be compromised here either, which is why communication is usually handled via TLS or VPN, for example.

There are also event-based alarm notifications that can be transmitted via independent data channels such as MQTT or SMS. Since the data only flows one way towards the control room or the cloud, this data stream and the transmitting device are well protected against attacks.

Typical data that is monitored

The data typically transmitted along the monitoring path includes, for instance, temperatures of transformers, high-voltage lines and motors, or oil pressure in transformers.

If we take SF6-insulated circuit breakers as an example, it is possible to monitor gas pressure, temperature and gas humidity, and transformers, cables or battery back-up systems can provide voltage data. Data from building management can also be made available via the monitoring path. For example, door sensors of the access control system, air conditioning values or even a robot lawn mower can be monitored.

The data involved can come from various sources. Some data comes directly from the "heart" of the substation – values of the IEDs (Intelligent Electronic Devices), i.e. the control computer for the switchgear or measuring devices in the station. Other data is provided by additional sensors that are commonplace in the industrial environment or in building management.

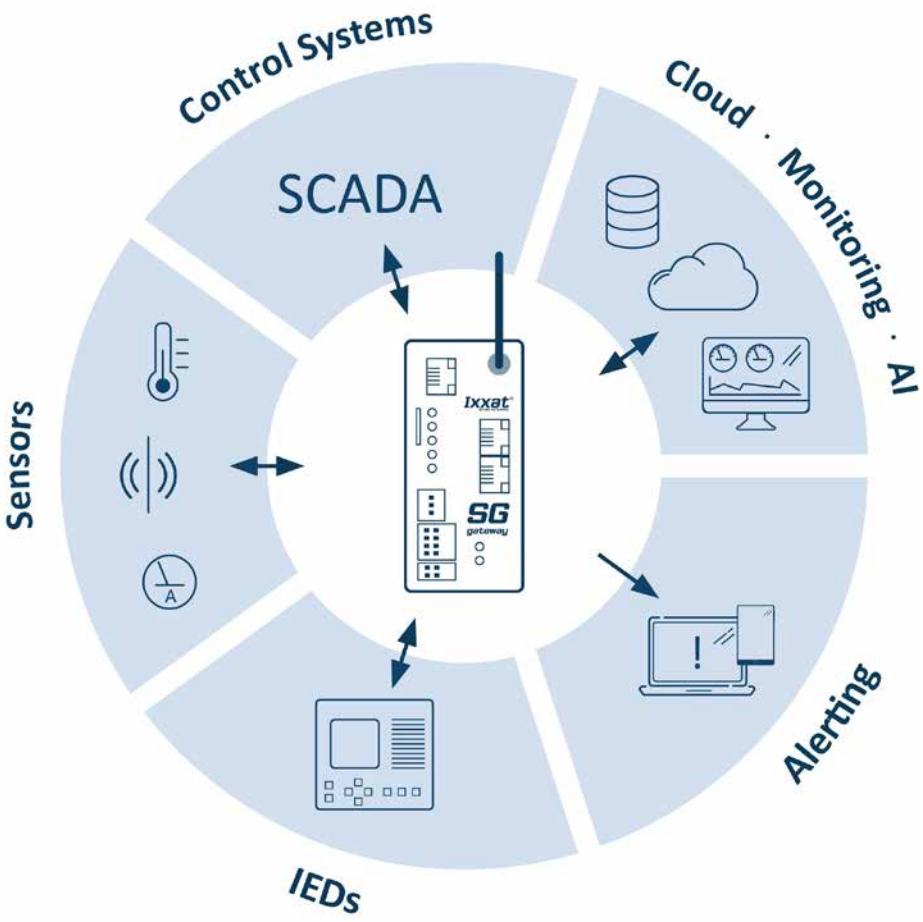
How to gather and forward data?

So how is it possible to gather the various data and how is it transmitted to ensure the required level of cybersecurity?

There are readily available gateways for this task such as the Ixxat SG gateway from HMS Networks. These gateways combine the functionality of RTUs (Remote Terminal Units), controllers and gateways; opening up possibilities to digitize substations and distribution networks.

Existing systems, new devices and control systems can be connected quickly – regardless of the communication technology or manufacturer.

Here is an example to demonstrate how the monitoring works in practice. A gateway collects the data from the various sources via the relevant ports. A gateway collects the data from various sources via the relevant ports (graphic above). It supports the communication protocols used in the energy sector, including IEC61850 and IEC60870-5-104, and can simultaneously feed in the data from IoT sensors connected via Modbus and analogue interfaces (for example).



SOURCE: HMS NETWORKS

A gateway can collect data from various sources via the relevant ports. Support for communication protocols used in the energy sector, including IEC61850 and IEC60870-5-104, can simultaneously feed in the data from IoT sensors connected via Modbus and analogue interfaces.

Monitoring and adding value

Protocol conversion and, where applicable, media disruption, mean that such a cloud connection is very secure. In addition, the data is only transmitted in one direction; access options are initially not provided but can be defined as exceptions if necessary. Configuration of these types of gateways is usually graphical and does not require any programming knowledge or additional software.

There are many use case scenarios. For example, a sensor manufacturer can use a Smart Grid gateway as a platform for communication with its private cloud, for remote monitoring, surveillance and maintenance planning. Substations can digitize the energy supply in an easy way; the gateway feeds the measured data either from IEDs or sensors into the control system and can forward it directly to the cloud (MQTT) via an integrated LTE modem where it remains available for continual status monitoring.

The control unit of the UPS communicates with the gateway via Modbus and is connected to the control room via an IEC61850-based gateway. The status data of the individual battery cells is sent in parallel via MQTT to the manufacturer's private cloud.

Another example of an application can be found in battery back-up systems for local control networks, for example in converter stations in a railway power supply system. The control unit of the Uninterruptable Power Supply (UPS) communicates with the gateway via Modbus and is connected to the control room via IEC61850.

The status data of the individual battery cells is sent in parallel via MQTT to the manufacturer's private cloud. This guarantees functional reliability through continuous monitoring and prompt, plannable maintenance.

It can even lead to new business models, for example, including renting a UPS system according to usage. And the best part, thanks to the ability to retrofit, older existing facilities can also benefit from the new possibilities of digitalization.

Freddy Dahlberg, Business Development Manager, ***Ixxat at HMS Networks.***

Visit Website

Private LTE networks (pLTE) for industrial applications

The potential usage and benefits of pLTE is truly a paradigm shift for industrial customers with challenging wireless needs. Businesses requiring a more secure network with higher reliability, more mobility, and broader coverage areas should seriously consider pLTE technology.

SOURCE: INS

pLTE technology enables organizations to customize their networks for mission-critical applications, optimize the network for low latency and support specific SLA – all without interference from the often-congested public wireless spectrum.

WIRELESS ETHERNET TECHNOLOGIES SUCH AS Wi-Fi or low bandwidth 900 MHz networks are often challenging and cost-prohibitive to use in industrial applications In many cases, these wireless applications required numerous access points to cover the necessary geographic coverage area did not handle mobile assets well, were expensive to install and, worse, were often-times unreliable when installed.

As a result, bandwidth is often "turned down" to ensure higher reliability while using these network technologies in industrial plants, making expandability difficult. In the last couple of years, Private Long-Term Evolution (Private LTE or pLTE for short) network technology has emerged to solve the weaknesses of Wi-Fi and 900 MHz networks described above.

pLTE leverages localized micro towers and small cells, conceptually like Wi-Fi access points, to provide coverage and connectivity. Thus, it functions like a scaled-down version of a public cellular network, and it can be based on licensed, unlicensed, or shared spectrum.

SOURCE: INS

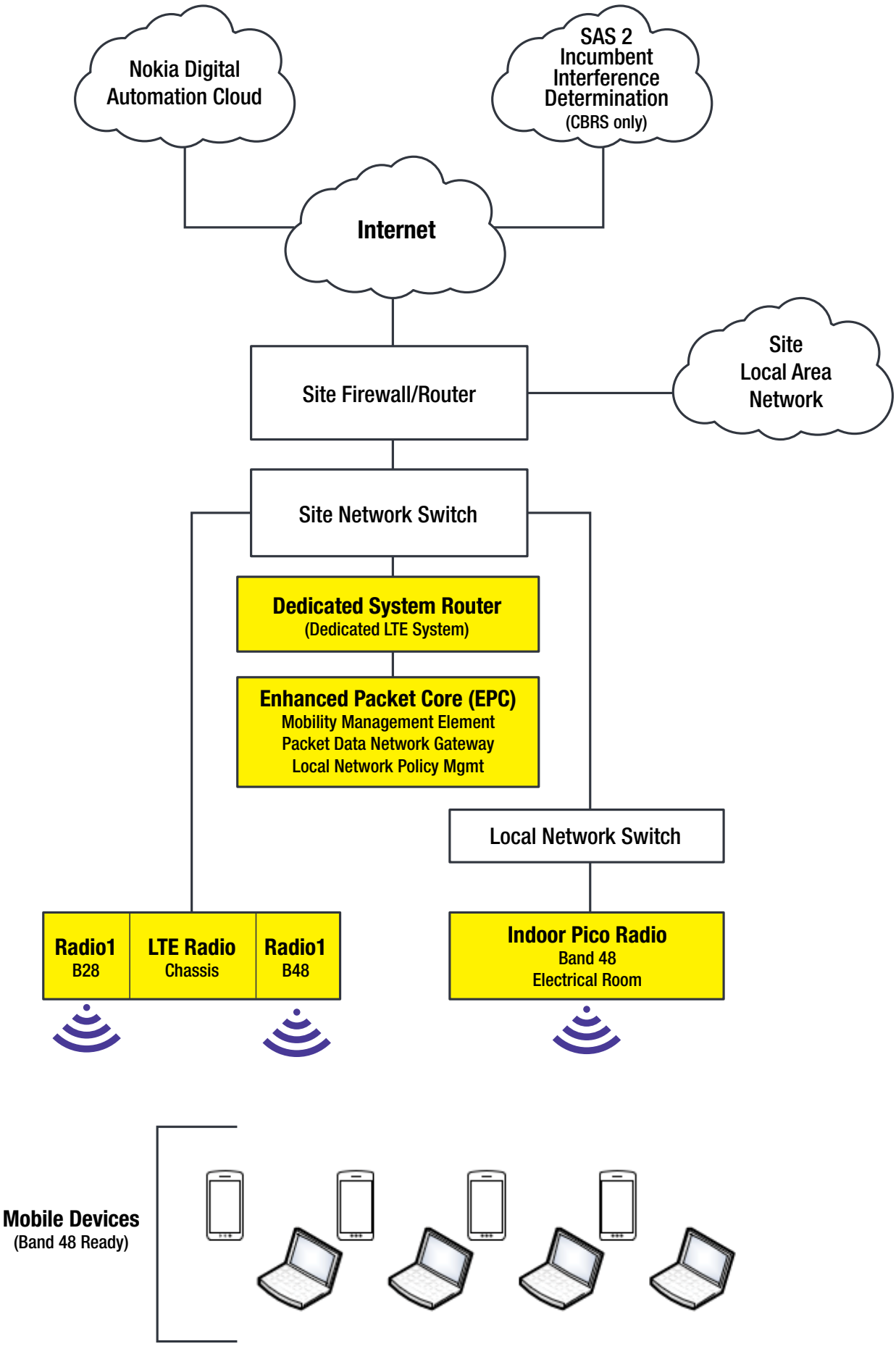
Private LTE is a local and private cellular network.

This technology breaks many legacy barriers associated with wireless technologies and allows a broader range, more mobility, better security, and fewer infrastructure components.

What is Private LTE?

Private LTE is a local and private cellular network that includes cell sites and core network servers dedicated to supporting the connectivity of a specific organization's requirements, independent of the cellular networks of service providers. It enables organizations to customize their networks for mission-critical applications, optimize the network for low latency and support specific SLA – all without interference from the often-congested public wireless spectrum.

Citizens Broadband Radio Service (CBRS) is a band of the radio-frequency spectrum from 3.5GHz to 3.7GHz that the Federal Communications Commission has



SOURCE: INS

Essential components of a pLTE architecture.

Snapshot of CBRS in the LTE Spectrum

SOURCE: INS

46	TDD	5200	U-NII-1-4		5150 - 5925	N/A	10, 20	LAA
47	TDD	5900	U-NII-4		5855 - 5925	N/A	10, 20	V2X
48	TDD	3500	CBRS (US)		3550 - 3700	N/A	5, 10, 15, 20	
49	TDD	3500	C-Band	48	3550 - 3700	N/A	10, 20	
50	TDD	1500	L-Band (EU)		1432 - 1517	N/A	3, 5, 10, 15, 20	

designated for sharing among three tiers of users: incumbent, priority licensees and generally authorized, which is unlicensed. CBRS enables enterprises to build private 4G/5G networks, which results in improved 4G/5G offerings from service providers.

Components and Architecture

Often when we hear "LTE," it's easy to get a little nervous as some may assume is any "cellular" application is complicated, expensive and must involve a major cellular carrier. To that end, there's quite a bit of debate in the industry about removing the term "LTE," as it brings confusion to potential users; therefore, some industry stakeholders refer to this technology as "private wireless." To be clear, a pLTE network is not a complicated architecture. The technology does not involve a public carrier network, and anyone who has deployed industrial Wi-Fi and 900 MHz wireless networks can quickly pick up on pLTE technologies.

Since 2011, when Nokia deployed the world's first pLTE networks, the solutions have evolved to fit many applications that do not involve a major Telco, Communications Service Provider or Managed Network Offering.

In the architecture diagram on page 28, we can see the essential components of a pLTE architecture.

- Cloud Management: a cloud-hosted service for device management
- SAS: System integration to a Spectrum Access System (SAS)
- System Router: A dedicated router for network management
- EPC: Enhanced Packet Core (EPC) for wireless management
- CBRS B48 Radios – Physical radios that are the wireless access points (APs)
- Edge Devices – Cellular devices such as cellular routers, mobile phones and tablets that are Band 48 enabled

What is Band 48?

Recent changes in the allocation of the public wireless spectrum have made it possible for organizations to install a private wireless LTE network, controlled by the user, and free of any recurring data charges paid to a carrier. Introduced by the FCC in 2020, Band 48 CBRS (Citizens Broadband Radio Service) is often referred to as private LTE. It is the frequency band of 3.5GHz, operating in the LTE spectrum in the United States.

The 3.5 GHz CBRS band provides a shared spectrum that allows industrial users to accelerate their Industry 4.0 transformation. It uses the CBRS band to deploy industrial-grade private wireless networks connecting critical assets and supporting mission- or business-critical operations. Long Term Evolution (LTE) telecommunications networks use several frequency bands with associated bandwidths.

Choosing pLTE over Wi-Fi?

Wireless Ethernet (Wi-Fi) provides many benefits, including easy-to-use, open standards and generally reliable use for mobile devices. However, the question most frequently asked is, "when should pLTE be preferred over Wi-Fi?" You should consider pLTE if you need the following.

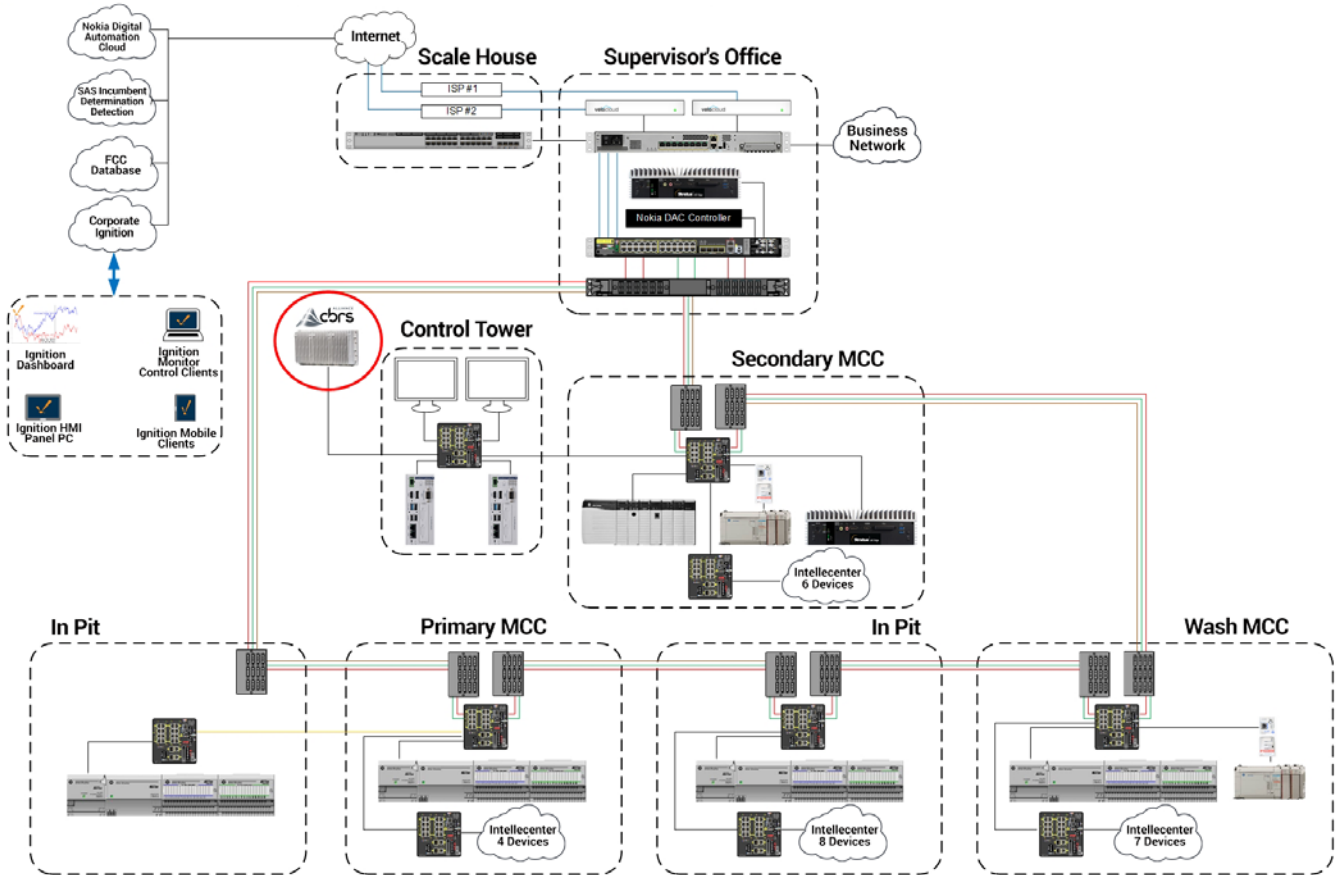
Broader Coverage: Choose pLTE if you need seamless wireless coverage over a large campus or facility. Whether it's outdoor, indoor or some mix thereof, pLTE has far greater range and better signal penetration into buildings and areas with significant outdoor metal infrastructure than Wi-fi. A single pLTE radio/access point can provide as much as 10-20X as a traditional Wi-Fi access point for a typical deployment.

Predictable Performance: pLTE is highly predictable in terms of wireless data rates and latency.

SOURCE: INS

Quarries often encompass large areas with rolling terrain, mobile vehicles and workers, and distribution of industrial systems that require network integration.

pLTE Example Architecture



SOURCE: INS

Numerous Endpoints: Private LTE can connect many devices and mobile workers to a wireless LAN with fewer antennas than Wi-Fi. LTE technology is designed to provide hundreds of concurrent endpoints with high bandwidth and low latency connectivity per "micro tower" antenna. At the same time, Wi-Fi can only reliably handle a few dozen clients per access point.

Mobile Endpoints: If you have mobile assets and people "on the move," private LTE will outperform Wi-Fi significantly. It seamlessly processes the hand-over of multiple fast-moving clients between "micro tower" antennas without data loss or a hike in latency.

Security: Are you concerned about hacking or eavesdropping on a Wi-Fi network? With Private LTE, you provision and distribute private SIM cards for end devices connecting to your network. No SIM card? No connection.

Example application

An excellent example where pLTE performs very well is outdoor mines and quarries. Quarries often encompass large areas with rolling terrain, mobile vehicles and workers, and broad distribution of industrial systems that require network integration.

Usually, quarries have a combination of single-mode fiber optics, wireless Ethernet bridged networks, and local wireless access points for coverage over a small area of the quarry. Unfortunately, over the years, legacy wireless networks make it difficult for the quarry to add new intelligent edge devices, provide business system integration to mobile workers, get real-time information, and collect or historize data. Below is a snapshot of the area of coverage for this quarry example. As seen below, the quarry has dimensions of 1 mile by ½ mile with elevation changes of approximately 150'.

For this application, Industrial Networking Solutions (INS) installed and updated the industrial control network with the architecture below. Is there anything that stands out?

Notice for this entire quarry; a single pLTE radio was utilized. That's not a misprint. A single pLTE radio provided mobile worker and loader coverage for the entire one x one and ½ mile quarry campus. The photos below show the installation for the pLTE radio and a CBRS enabled cellular router on a loader.

NOKIA pLTE solution

INS is a strategic value-added reseller (VAR) for the Nokia Digital Automation Cloud (NDAC) private LTE solution. Nokia's Private LTE Network infrastructure includes a dedicated LTE core server installed at the customer facility (Nokia Digital Automation Cloud) with associated micro-towers to provide the wireless coverage of the site. End devices are supplied with private SIM cards to allow access to the Private LTE network. For customer devices and area networks with an Ethernet or serial port, SIM-enabled LTE gateways can provide the LTE network connection. In addition, a cloud-based management system allows the customer to monitor and manage their Private LTE system from anywhere and create links between distinct enterprise Private LTE networks.

INS has teamed with Nokia to provide their market-leading private LTE network infrastructure and endpoint connectivity to the industrial marketplace. Nokia certified INS engineers perform site surveys to determine the suitability and scope of a Private LTE system. Once an architecture is approved, INS engineers install the network and train customer personnel to manage their new system. Plus, we continue to provide ongoing technical support after the installation.

Summary

pLTE is truly a paradigm shift for industrial customers with challenging wireless needs. Businesses requiring a more secure network with higher reliability, more mobility, and broader coverage areas should seriously consider pLTE technology.

*Technology report by **Industrial Networking Solutions (INS).***

Visit Website

Blend of networks to achieve production scale for IoT projects

Longevity is crucial for the success of an IoT deployment. It's clear that LoRaWAN in particular is on a growth trajectory that will provide that longevity. And the eventual maturity of 5G will also become another option for IoT projects, with much more efficiency in terms of capability to connect millions of sensors.

SOURCE: COMMS365

In recent years we've witnessed the growing expansion and evolution of one dominant IoT Network type, the Low Power Wide Area Network (LPWAN).

NEW IOT PRODUCTION DEPLOYMENTS ARE underpinned by a carefully orchestrated connectivity layer, but there is an ongoing debate about which network types and protocols are better suited for supporting mass sensor deployments. The decision regarding which network is to be used is an early consideration for IoT deployments, but how do you determine availability and which network will give you the best solution and project outcomes?

This article outlines the key considerations and questions that must be asked ahead of an IoT production rollout, and describes why there is a necessity to use a blended strategy for network connectivity, rather than to look for a 'one size fits all' connectivity approach.

Different IoT networks & protocols

The short answer can be captured in two words, evolution and innovation. Over time, IoT sensor technology has evolved in capability, potential for scale and reduction in cost per module. This has created a demand for new wireless network protocols and methods to support the new sensor types, many of which rely on battery power and infrequent messaging at long range, and over a wide area.

Doubt, uncertainty and fragmentation in the IoT market, combined with increasing sensor hardware and software innovation, have led to the creation and fielding of several network connectivity options, each with their own attributes. We are very much still in the early adopter stage as multiple standards coexist and compete in a land-grab operation until certain standards take hold.

In recent years we've witnessed the growing expansion and evolution of one dominant IoT Network type, the Low Power Wide Area Network (LPWAN). The early entrants to this market, LoRaWAN and Sigfox, use free-to-air radio spectrum, and have had time to establish themselves across the world. LoRaWAN in particular has been a runaway success as an IoT Network connectivity option, dominating the market with over 40% market share of new connections, which is projected to continue adding market share through 2025. Both LoRaWAN and Sigfox are now acknowledged as global network and protocol standards for IoT through establishing trust with users who are confident in the usability, scale and reliability of such networks.

On the cellular side, for new IoT network protocols NB-IoT and LTE-M (evolutions of the 4G spectrum that have now been adopted under the 5G standard), there is still an element of catchup in progress. The GSMA was late in ratifying the standards for these IoT protocols and ultimately their deployment by Tier 1 carriers came sometime after the initial rollouts of the first LPWAN network connectivity protocols.

Despite initial predictions claiming that the cellular IoT Network variants would dominate the IoT connectivity market and squeeze LoRaWAN and Sigfox to the margins, there has been a lack of intensity in UK rollout of the cellular IoT network programmes (at the time of writing, LTE-M has been enabled in the Eastern half of the UK, and NB-IoT has 'holes' in its' coverage, particularly in the Eastern side of the UK). This means that IoT

SOURCE: COMMS365

Working with a partner offering all types of IoT connectivity in a blended solution provides benefits.

cellular LPWAN work has been largely limited to testing in the UK, while production rollouts are dominated by Private Council LoRaWAN installations and innovation programmes on public network variants of both LoRaWAN and Sigfox.

Globally, analysts project that there will be a 50:50 split in LPWAN network deployments between the free-to-air (unlicensed spectrum) and cellular variants (licensed spectrum) – the competition between these network standards will continue for some time to come. In particular, once 5G is fully rolled out and there are radio modules at a workable cost point for IoT, 5G protocols will also have an IoT element for the cellular side that will bring increased scale and efficiency in terms of its capability to connect millions of sensors per square kilometer.

Network type or protocol to use?

As with most projects, cost of delivery for data is a primary concern that must be addressed. LoRaWAN and Sigfox are now at a level of maturity where the devices are cost-effective. Initially, cellular was a much higher cost, but is now starting to achieve cost-effectiveness. But in terms of usage costs, for NB-IoT and LTE-M, users are still paying for data usage on the network (paying by the byte), whereas LoRaWAN leverages the free-to-air spectrum facility and charges are based on device licensing, and in the case of Sigfox, per message.

Even though there appears to be a clear differential in terms of cost models, the choice of network and protocol isn't straightforward. As IoT rollouts become more commonplace, there are elements within a LoRaWAN environment that create cause for concern. With multiple devices sharing the LoRaWAN spectrum, this can cause potential collisions on the network and lost messages.

In order to ensure each message arrives at its destination, the LoRaWAN protocol and software controlling the network has been adapted further to mitigate against this happening by spreading messages across multiple channels, monitoring message counters, and other techniques.

Identifying the parameters of the use case and the nature of the deployment is very important. If a message with telemetry data such as bin fill levels or parking events only needs to be sent when there is a status change, this won't necessarily create network congestion on a LoRaWAN Network, as the messages aren't sent at the same time.

Regular 15 minute monitoring of environmental conditions from multiple sensors in an area may however require additional gateway capacity to ensure spreading the sensor message load. But if your use case requires guaranteed delivery of traffic within a specific time period, or a constant stream of messages cellular protocols such as NB-IoT and LTE-M may need to be used.

Use cases

Another consideration is the protocols certain sectors are already using to gain traction. We're seeing a tremendous uptake and interest in LoRaWAN for local governments that see it as a mechanism they can use to scale multiple use cases at once.

In the utility monitoring sector, NB-IoT appears to be the protocol gaining the advantage. No gateways are required as signal towers are the enablement point and it has deep penetration under the ground with good signal strength to reach its destination.

But when it comes to monitoring elements deep within buildings, LoRaWAN can be more effective compared to what NB-IoT can do from the outside in. Refrigeration and temperature monitoring is one such example with the rollout of the Covid-19 vaccine which must be stored at precise chilled temperatures. LoRaWAN can provide an effective protocol in this instance, measuring the temperature deep inside the building, all the way down to the probe. Intensive monitoring and data collection will become critical.

For a use case such as measuring readings intermittently, on an alert basis or once an hour, you need to conserve battery power so the sensors last a long time and will likely be leading towards the unlicensed spectrum. Whereas within a healthcare monitoring scenario, such as in someone's home or in an ambulance on the move, readings will need to be sent through immediately, so will need to rely on the licensed spectrum, such as LTE-M.

Blended connectivity

At this point in time, there is no one protocol that is optimised for every use case or can cover an entire estate. The solution is, therefore, to deploy a hybrid model, one which blends different connectivity protocols together, from the unlicensed and licenced spectrums, to achieve total estate and use case coverage. A blended approach is inherently flexible, cost-effective and scalable – ideal for those that are looking to reap the benefits of mass-scale IoT but are uncertain as to how and where to proceed.

Futureproof

Longevity is crucial for the success of an IoT deployment. No business wants to rip and replace the technology after ten years. It's clear that LoRaWAN in particular is on a growth trajectory that will provide that longevity. And the eventual maturity of 5G will also become another option for IoT projects, with much more efficiency in terms of capability to connect millions of sensors. 5G may be a way off yet, but it's likely that many estates of devices and networks will eventually have parts of them consumed by 5G.

With a blended model of different protocols covering each estate, to make it efficient and streamlined, it's important for a single platform to be used that can bring it all together and be received, read and analysed in one place. NB-IoT, LoRaWAN, LTE-M, Sigfox are all becoming industry-standard protocols that are each received in a different format. But they can be streamlined into one hub that intercepts the traffic and converts it into a protocol that the receiving application requires.

By working with a partner offering all types of IoT connectivity in a blended solution, projects can be rolled out in the confidence that each protocol has been considered and is supported, to maximise the functionality, practicality and cost-efficiency of an entire IoT project.

Nick Sacke, head of IoT and products, ***Comms365.***

Visit Website

Digitalisation of production: the right interfaces for late adopters

Longevity is crucial for the success of an IoT deployment. It's clear that LoRaWAN in particular is on a growth trajectory that will provide that longevity. And the eventual maturity of 5G will also become another option for IoT projects, with much more efficiency in terms of capability to connect millions of sensors.

SOURCE: HARTING

Digitalisation of production can only be successfully mastered in many individual steps.

THE FACT THAT DIGITALISATION OF production systems is progressing has become an established consensus among manufacturers, operators and service providers in the mechanical engineering sector.

At the same time, however, statements such as the following from T-Systems often cause uncertainty among OEMs in the mechanical engineering sector: "digitization is disrupting existing business models, and global markets become increasingly volatile". The correlation, as well as the resulting transformations of business models and the associated risks, must be viewed in a highly differentiated manner. The mechanical engineering sector in particular, featuring its typical structure of SMEs and "hidden champions", is in a very good position worldwide to perceive digitalisation not as a threat but as an opportunity to expand existing business models and, over the long term, to open up new markets by leveraging new automation technologies. In the final instance, it is clear to all business players that digitalisation will secure long-term competitiveness of OEMs in the mechanical and plant engineering sector.

Which arguments support this view?

Digitalisation can only be successfully mastered in many individual steps. For those involved, this cannot be about all-encompassing umbrella functionalities, as described under the terms IIoT, Industry 4.0, Digital Engineering and the like.

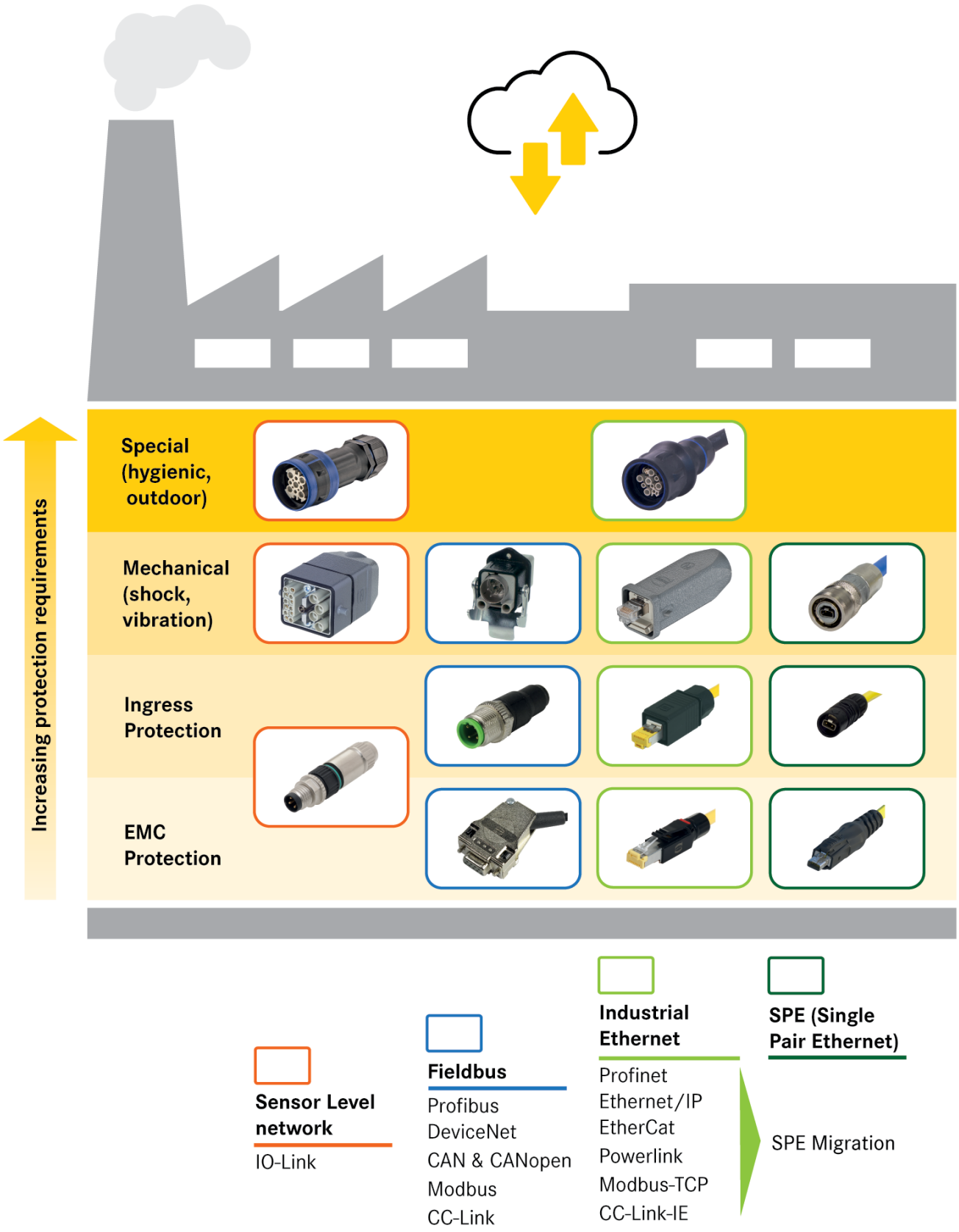
Far more, it is about concrete approaches that can be used to advance the efficiency and cost-effectiveness of machines along the entire "life cycle" with as little input and effort as possible. And because automation in mechanical engineering has been driven principally by digitalisation for decades, it is primarily the OEMs that can successfully implement these approaches based on their core competencies. Only OEMs are able to implement specific measures that combine existing functionalities and systems with the most promising new control and data transmission technologies!

Digitalisation in industry is often mentioned along with the the keyword "Industry 4.0", a term which stands for the 4th industrial revolution: consequently, the disruptive potential of current technical developments is equated with the effects of the industrial use of steam engines, electricity and computers. Successful players such as Amazon, Microsoft and Google are often cited as prominent examples of the forces of change. In the case of the medium-sized mechanical and plant engineering industry, on the other hand, these developments appear at least partly as a threat. The protagonists of digitalisation are endeavouring to take the edge off this.

Hans Beckhoff, the founder and CEO of Beckhoff Automation, very aptly explained during an IHK event in 2017 that these changes and shifts represent opportunities for industrial manufacturing and that the speed of the upheaval is slower than initially assumed: "From today's perspective, the introduction of the steam engine seems like a revolution. However, at the time, it took more than half a century for its use in industry to result in substantial changes."

In a similar manner, he stated, one should regard the impact of digitalisation for industrial production today, which is triggering an evolutionary development at all levels and in all processes. At the same time, Beckhoff also emphasises that this realisation by no means guarantees that one should sit back and do nothing! According to Beckhoff, it is precisely the courageous protagonists who will be rewarded if they creatively develop new business models for production systems.

HARTING has analysed the implementation strategies of its customers and can decidedly confirm Beckhoff's theses. Accordingly, in order to achieve sustainable success with digitalisation projects, it is above all



SOURCE: HARTING

advisable not to want to achieve everything immediately.

Whether the development is revolutionary or evolutionary: All parties involved agree that data forms the basis of more rational processes, and indeed all types of data. The catch phrase "Data is the new oil!" originally referred to "Big Data" or the storage and availability of consumer data. But this characterisation can certainly also be applied to data in the industrial arena. However, to stay with the metaphor, this "new oil" still requires functioning "pipelines" and other structural elements. Consequently, "Data is the new oil" not least describes the current situation of many machine and plant manufacturers who are in the process of revising the generation, processing and transmission of data.

The OEM's "data view" of production systems today can be summarised as follows:

OEMs are experts for many existing technological, machine-related data, as well as for the use of this data in intrinsic machine functions, and for advanced automation

functions. The increased use of the "internal intelligence" of automation components such as drives, smart sensors, actuators or HMI systems with all the associated data transitions is also part of an OEM's standard toolkit today.

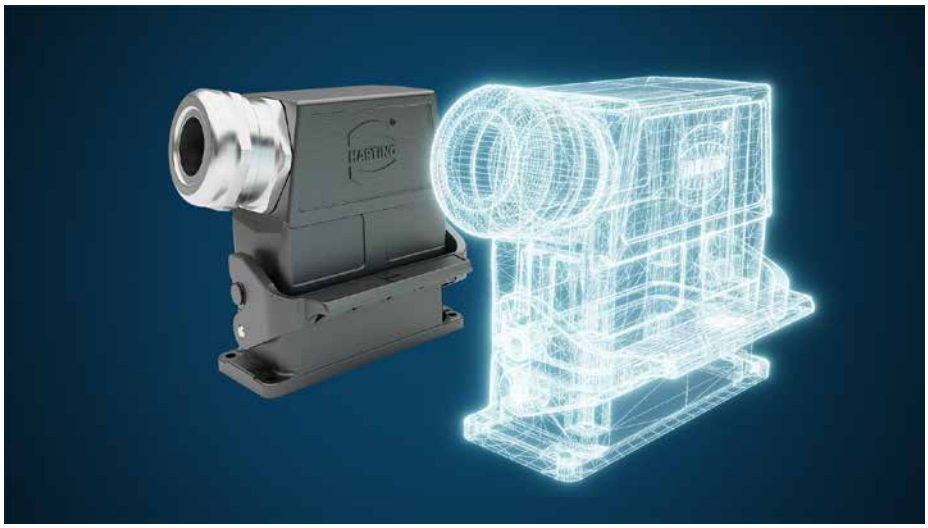
In addition, this comprises all possible data transfer layers on the level of interlinked machine or production lines that use known data origin, machine, user and process models, which are also considered proprietary know-how.

In terms of digitalisation, not all of the aforementioned data structures and transmission layers that are part of the control and automation systems should simply be "discarded" and replaced by new ones. This is due to the fact that almost the entire functionality of modern production systems is based on software and suitable specific interfaces. These functionalities have been developed with an enormous amount of material and engineering effort.

Consequently, an initial conclusion is as follows. In order to drive digitalisation forward with as little effort and input as possible and to cope with the associated rising data volumes, machine and plant manufacturers must be able to continue to use existing data structures and interfaces.

In the sense of 'the data is the new oil' analogy, proven and sufficiently functional "pipeline structures" must continue to be used and extended to include new "pipelines". In this way, companies will succeed in enhancing their competitiveness and gaining new market shares in their own business segment or in other fields of production technology. To put it in terms of control technology for industrial systems: An OEM active in mechanical engineering needs its proven fieldbuses and interfaces for evolutionary digitalisation. At the same time, suitable physical interfaces are advantageous for the expansion of new systems and services in the edge areas, as well as for the most seamless connection possible to the world of "Big Data". Players mastering both disciplines will be best equipped to meet the growing and, in some cases, still unknown future requirements of machine users.

The trend-setting requirements for developments related to digitalisation outlined in the following section are based on the experience of the HARTING Technology Group. The company provides solutions for all types of data interfaces of modern drive, control, HMI and communication technology in mechanical engineering production systems. HARTING is also a pioneer in many ground-breaking developments for power and signal transmission in the industrial arena. In the field of Industrial Ethernet, HARTING is playing a key role in shaping and designing various standards on the physical layer: for example, the company is actively involved in solutions Single Pair Ethernet technology.



SOURCE: HARTING

Increased use of the "internal intelligence" of automation components provides new tools for the OEM.

Decades of experience in the field of interfaces for factory automation, combined with the expertise of a trendsetter in the latest data transmission technologies (including the "Big Data" world), make it possible from HARTING's viewpoint to always find optimal solutions on the physical layer for each and every specific interface design. With the help of the right interfaces, OEMs can decisively drive the migration to digitalisation forward that is so vital for them. In each solution here, the respective application with its mechanical, environmental and EMC conditions and other requirements must remain leading.

"What is the simplest and most effective way to design data transmission interfaces in production systems - at all conceivable levels of the factory and all the way into the cloud?" This question often causes headaches in the R&D and engineering departments of machine building companies that want to gradually shape and design individual actual digitalisation aspects in their projects. The requirements that need to be met follows:

All types of data interfaces should be implementable, both well-proven but also current innovations;

The range of interfaces must be scalable, i.e. the same interface type can be designed in the required normative version, IP protection class or for the required environmental conditions (EMC, resistance to dirt, UV radiation, mechanical stresses such as shock & vibration or the hygiene requirements).

With regard to the transitions between sites or sections, it must be possible to use interfaces that function reliably and conform to standards.

Product variants must be available that are designed for different manufacturing and assembly processes at the OEM, e.g. for tool-free assembly if flexibility is required, or for automatic assembly in the case that higher quantities are to be manufactured in connection with a high level of process reliability.

Data interfaces must be combinable with each other, and must be placeable with other signal and power interfaces in one enclosure or even together in one insulator in order to save space and costs and to simplify processes.

The approach outlined above allows developers and project managers to concentrate on the central tasks for their respective application during the design phase - without having to spend time on the "less important criteria" of interfaces.

At the same time, they can be certain that there is a suitable interface available for every expansion stage of a machine module or a data transmission link. The corresponding solutions are both cost- and function-optimised and scalable. The cost-efficient, technically straight forward expansion of services and system extensions at all levels of factory automation and beyond can be implemented at any time, even retroactively, at the respective machine user.

The diagram on page 34 presents the approach in an exemplary way. It provides an overview of the best-known network systems for industrial data transmission and describes selected actual HARTING solutions, which are shown as product families. It is apparent exactly how great the freedom in the design of the data interfaces actually is: for practically every type of field bus or Industrial Ethernet there are several options available for designing the physical layer. This means that it is (almost) always possible to find a solution that is optimally suited to the application - even for requirements that are still unknown today and/or for digitalisation requirements that are growing along with the application.

Jakob Dück, Global Industry Segment Manager, ***HARTING.***

Visit Website

Single Pair Ethernet: two wires into the future

Single-pair Ethernet (SPE) is a megatrend in automation technology. But it also offers the potential for use with already installed bus cables to modernize and upgrade existing plants and machines by integrating functions like condition monitoring and predictive maintenance.

SOURCE: TERZ

Single Pair Ethernet Evaluation Board with RJ45 jacks.

ETHERNET NETWORKING OF AUTOMATION systems with all its advantages has long been established in factory automation, robotics and also in commercial vehicles. Single-pair Ethernet now adds further decisive advantages that significantly reduce investment costs, installation effort, space requirements and weight.

Completely digital IP-based and transparent network communications from the sensor to the cloud is now possible. But is it really that simple?

Single-pair Ethernet (SPE) is one of the trends in automation technology in the coming years. The advantages of using a simple twisted-pair cable as the communication medium offer considerable potential for cost reduction and space savings.

Also the possibility to continue using already installed bus cables offers the chance to modernize and upgrade existing plant facilities and machines to integrate functions like condition monitoring and predictive maintenance.

The standard

Originally developed for the automotive sector to bring Ethernet into vehicles as an on-board network, SPE or T1 Ethernet is now considered the revolution for networking sensors and actuators in industrial and building automation. In addition to reducing cabling, SPE technology offers the ability to build a fully IP-based transparent communication link from the sensor to the cloud.

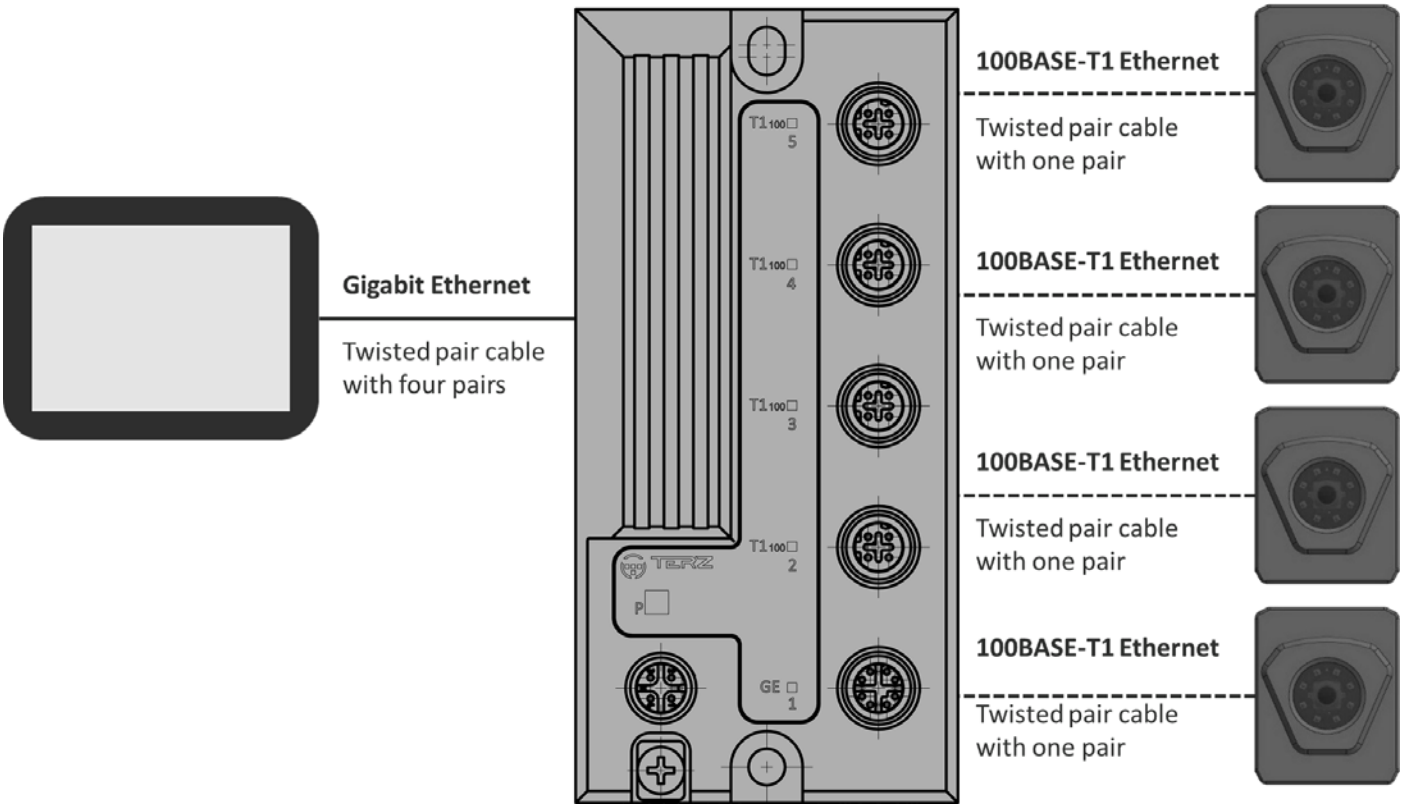
Proprietary bus systems and transmission technologies and the gateways they require are thus obsolete in future IIoT 4.0 applications. Thanks to full compatibility with classic Ethernet at the protocol level, hardly anything changes for the user except for the reduced cabling.

The IEEE specifies different single pair Ethernet variants. For the user, these differ mainly in the available data transmission rate and the maximum cable length. A decisive advantage that is often listed is that an unshielded 1-pair twisted pair cable is sufficient for data transmission, with which data can be transmitted over a distance of at least 15m at 100 Mbit/s (IEEE 802.3bw 100Base-T1). A simple cable offers the great advantages that it is cheaper and can be laid easily due to the smaller diameter and bending radius.

Interference on the network

In industrial applications, however, interference factors naturally occur that can negatively affect the network and communication and have a significant impact on reliability, transmission quality and security. Especially at the connection points where connectors, cables and devices meet, the risk of interference from vibrations, dirt, moisture as well as external electromagnetic influences is high.

It is precisely at this point that the applications in industry differ from those in the automotive sector. While the use of SPE as an on-board network is based on a clearly defined encapsulated system in which all components are matched to one another and



SOURCE: TERZ

Camera application using Single Pair Ethernet.

electromagnetic interference plays hardly any role, the situation in industry is completely different.

With unshielded cables, external EMC influences in particular pose a potential problem. Radiated or conducted interference can cause data loss or, in the worst case, damage or destruction of components. In classic Industrial Ethernet applications, these interferences are dissipated via the shield of the 4-pair twisted pair cable.

When using SPE, it is therefore important to check in each case whether and which interferences can occur in the respective application and whether these can lead to problems. Especially when changing technology and migrating from Industrial Ethernet to Industrial Single Pair Ethernet, it is more important than ever to use robust and reliable components. SPE switches represent an integral part of every modern communication link and also with new installations the topic of decentralization and the associated requirement for a high degree of protection will play a major role.

Robust in the field

TERZ is the first manufacturer worldwide to offer the T1-XS, an unmanaged SPE/T1 Industrial Ethernet switch with IP65/67 protection. With this switch, networking without a control cabinet is possible directly in the field with only one wire pair.

The new T1-XS with vibration-proof M12 connection technology on 5 ports, was specially designed and developed for use in harsh industrial environments outside the control cabinet with an extended temperature range of -40°C to +70°C. The rugged IP65/67 metal housing is dust-tight and protects against water ingress.

The IEC 63171 standard defines the connectors for SPE cables and devices. It defines both the variants for the control cabinet with a low degree of protection (IP20) and field devices with a high degree of protection (IP65/67). In contrast to the standard, standardized M12 D-coded connectors, which have established themselves in the market for Ethernet communication and are widely available, are used in current TERZ switches. This has no disadvantages for the physical data transmission.

SOURCE: TERZ

SPE switch for installation outside control cabinet..

Only two of the four existing contacts are used for data transmission. In the future, there will be solutions tailored to the target markets with additional connection technologies. The data is forwarded via an X-coded M12 uplink connection at gigabit speed. The high bandwidth on the uplink port provides sufficient reserve for modern cameras and sensors of the next generation. All ports also offer the option of connecting a fully shielded cable to meet industrial EMC requirements.

Good prospects

SPE undoubtedly offers great potential for shaping the communication landscape in automation technology in the coming years. The aspect of replacing existing standard Industrial Ethernet applications is much less decisive than opening up completely new fields of application, such as conquering the field level. Which requirements outside the IEEE will come to fruition will be decided in the coming months. However, the first applications can already be realized with the components available on the market today.

*Technology report by **TERZ**.*

Visit Website

Long distance positioning system leverages sensor technology

New technology provides reliable, intelligent and adaptable position measurement over several hundred meters in harsh environmental conditions. An absolute measuring displacement encoder can determine positions over distances of several hundred meters with a repeat accuracy of 0.5 mm.

SOURCE: BALLUFF

System is designed for applications such as overhead traveling cranes, loading bridges, gantry cranes, reversing controls, and for crane and trolley travel.

LONG DISTANCES ARE NO LONGER AN OBSTACLE for the intelligent BTL magnetostrictive position measuring system. Where the highest precision in position and speed measurement is required, a new absolute measuring displacement encoder can determine positions over distances of several hundred meters with a repeat accuracy of 0.5 mm. This makes the system suited for applications on overhead traveling cranes, loading bridges, gantry cranes, reversing controls, and for crane and trolley travel, which turns process cranes into large-scale robots.

Intelligent sensor technology

Intelligent sensor technology drives you along The Long Distance Positioning System (LDPS) consists of a magnetostrictive position measuring system, with a Profinet interface, and several position encoders installed along the travel path of a crane, whose position is read by the magnetostrictive sensor mounted on the crane. This information is transmitted to the controller, which calculates the absolute coordinates of the crane position with high accuracy. In addition, you receive a software function block for easy integration into your control system. The S.C.A.D.A. visualization software is also included in the system.

The measuring system is also available with a fail-safe operating option with redundant markings along the travel path, which further increases the efficiency, reliability and quality of your application. The system is wear- and maintenance-free and is insensitive to shock, vibration and contamination.

Long distance positioning

Crane systems are used worldwide and across industries for transporting goods in intralogistics, in warehouse management or in various production processes. The loads here are often very high and the environment also places enormous demands on the sensor technology. In addition, the operator must always be aware of the absolute position of the crane or the control system.

SOURCE: BALLUFF

Complete hardware and software solution.

This applies all the more if there are two or more cranes on one runway. For correct positioning and to avoid collisions of cranes, laser sensors are usually used, which meet common performance requirements under normal ambient conditions. However, if the level of contamination in a hall is high or if the cranes are operated outdoors, laser-based systems reach their limits.

Bang Kransysteme has put Balluff's Long Distance Positioning System through its paces. "The distance measuring system, which travels with the crane and is approx. four meters long, detects the position sensors which are mounted along the travel path according to a predefined scheme and calculates the absolute crane position from this. If knowledge of this position is indispensable even under adverse conditions, the system is ideally suited," said David Böttiger, Head of Automation.

Advantages at a glance

The absolute linear position measuring system offers a measuring range of up to several hundred meters. The measuring section also does not require a continuous rail, thus guaranteeing highest flexibility. It also includes software function blocks for use with a Siemens PLC (required).

*Technology report by **Balluff.***

Visit Website

High fidelity vibration acquisition platform for condition monitoring

Recent advancements in MEMS technology have pushed accelerometer sensors to the forefront, rivaling piezoelectric sensors in condition-based monitoring applications. This article will also discuss how to use the new development platform that makes this all possible.

SOURCE: ANALOG DEVICES

Elements of the CbM development platform.

CONDITION-BASED MONITORING (CBM) involves monitoring machines or assets using sensors to measure the current state of health. Predictive maintenance (PdM) involves a combination of techniques such as CbM, machine learning, and analytics to predict upcoming asset maintenance cycles or failures. With significant growth projected in machine health monitoring globally, it is imperative to know and understand the key trends.

More and more CbM companies are turning to PdM to differentiate their product offerings. Maintenance and facilities managers now have new options when it comes to CbM, such as wireless installations and lower cost, high performance installations.

While most CbM system infrastructure remains unchanged, new MEMS technology can now be directly integrated into systems traditionally dominated by piezoelectric sensors or those not previously monitored due to cost barriers.

Condition monitoring—engineering challenges and design decisions

In a typical CbM signal chain design, there are many different engineering disciplines required and technologies to consider, which are constantly improving and increasing in complexity. Various customer types now exist with expertise in specific areas such as algorithm development (software only) or hardware design (hardware only) but not always both.

Developers looking to focus on their algorithm development require data lakes of information to accurately predict asset failures and downtime. They don't want to design hardware or troubleshoot the integrity of the data; they just want to use data that is known to be high fidelity.

Similarly, hardware engineers looking to increase system reliability or reduce cost need a solution that can easily connect into existing infrastructure, to benchmark against existing solutions. They need access to the data in readable format that is easy to use and export, so they don't waste time evaluating performance.

Many of the system-level challenges can be solved with a platform approach—from the sensor all the way to algorithmic development—enabling all customer types.

CbM Development Platform

The CN0549 condition-based monitoring platform is a high performance, off-the-shelf hardware and software solution that will allow high fidelity streaming of vibration data from an asset into the algorithm/machine learning development environment. The platform benefits hardware experts as it is a tested and verified system solution providing high precision data acquisition, proven mechanical coupling to the asset, and a high performance wideband vibration sensor.

All hardware design files are provided, allowing for easy integration into the product you design. CN0549 is also attractive to SW experts, as it abstracts the challenges of the condition monitoring signal chain hardware and allows for software teams and data scientists to jump right into developing machine learning algorithms. Key features and benefits include:

- Easy mounting to assets while maintaining mechanical coupling signal integrity
- Wide bandwidth MEMS accelerometer sensor with IEPE data output format
- IEPE, high fidelity data acquisition (DAQ) solution with analog input bandwidth from DC to 54 kHz
- Embedded gateway captures and stores the raw data for local or networked processing
- Visualize frequency domain data in real time using ADI's IIO Oscilloscope application
- Stream sensor data directly into popular data analysis tools such as Python and MATLAB

High fidelity data capture and processing

Wider bandwidth and lower noise sensors enable earlier detection of faults such as bearing issues, cavitation, and gear meshing. It is imperative that any data acquisition electronics maintain the fidelity of the measured vibration data; otherwise critical fault information may be lost. Maintaining the fidelity of vibration data makes it possible to see trends sooner, and, with a high degree of confidence, we can recommend preventative

Accelerometer Comparison	Piezoelectric	MEMS
DC Response		✔
Shock Tolerance		✔
Integration Opportunities (3-Axis, ADC, Alarms, FFT)		✔
Performance Variation over Time and Temperature		✔
Power Consumption		✔
Physical Size (Smaller Is better)		✔
Self-Test		✔
Cost for Similar Performance		✔
Noise	✔	✔
Bandwidth	✔	✔
Mechanical Attach	✔	✔
Industry-Standard Interface	✔	✔
g-Range	✔	✔

SOURCE: ANALOG DEVICES

maintenance, thus reducing unnecessary wear and tear on mechanical elements, and inevitably extending the lifetime of assets.

Cost-effective methods

Piezo accelerometers are the highest performance vibration sensor used on the most critical assets where performance requirements outweigh cost. CbM of lower criticality assets has traditionally been prohibited by the high cost of piezo installations. MEMS vibration sensors, now comparable to piezo in noise, bandwidth, and g-range, are enabling deeper insights for maintenance and facilities managers on lower criticality assets that previously have been covered by a run-to-failure or reactive maintenance schedule. This is primarily due to MEMS' high performance and low cost.

Medium to low criticality assets can now be continuously monitored in a cost-effective manner. Unnecessary wear and tear on assets can be easily identified and remedied, helping to extend the lifetime of assets through advanced vibration sensing. This can also contribute to overall equipment effectiveness and reduction of machine or process downtime.

Monitoring assets

There are many different types of sensing modalities when it comes to CbM and PdM. Current sensing, magnetic sensing, flow monitoring, and several others make up most of the applications. Vibration sensing is the most common modality used in CbM, and piezo accelerometers are the most used vibration sensor. In this section, we will review how the vibration sensor landscape is expanding due to advancements in technology, and how that impacts the application decision making.

MEMS vs. Piezoelectric

Piezo accelerometers are very high performing sensors, but all that performance requires many design trade-offs. For instance, piezo accelerometers are typically limited to use in wired installations because they can consume excess power, they can be physically large (especially triaxial sensors), and they are expensive. When all these factors are combined, it's not practical to outfit your entire factory with piezo sensors, which is why they are predominantly used only on critical assets.

Until recently, MEMS accelerometers did not have wide enough bandwidths, their noise was too high, and g-ranges were limited for use in monitoring less critical assets. Recent advancements in MEMS technologies have overcome these limitations, enabling MEMS vibration monitoring of both low end and even high criticality assets. Table 1 shows the most important characteristics required of piezo and MEMS sensors for CbM applications. Being physically small, capable of running for years on batteries, and being low cost with comparable performance to piezo, MEMS accelerometers are fast becoming the sensor of choice for many CbM applications.

The CN0549 CbM development platform is compatible with MEMS and IEPE piezo accelerometers, to enable a path for benchmark comparison between the sensor types.

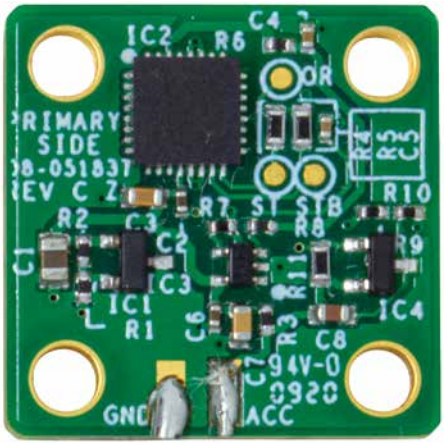
Using MEMS Accelerometers

As outlined in the table, MEMS accelerometers can now provide competitive specifications and performance when compared with piezo sensors, but can they replace an existing piezo sensor? For designers to easily evaluate and replace piezo accelerometers with MEMS accelerometers, Analog Devices designed an interface that is compatible with IEPE, the de facto standard piezo sensor interface in CbM applications.

Sensor interfacing and mounting

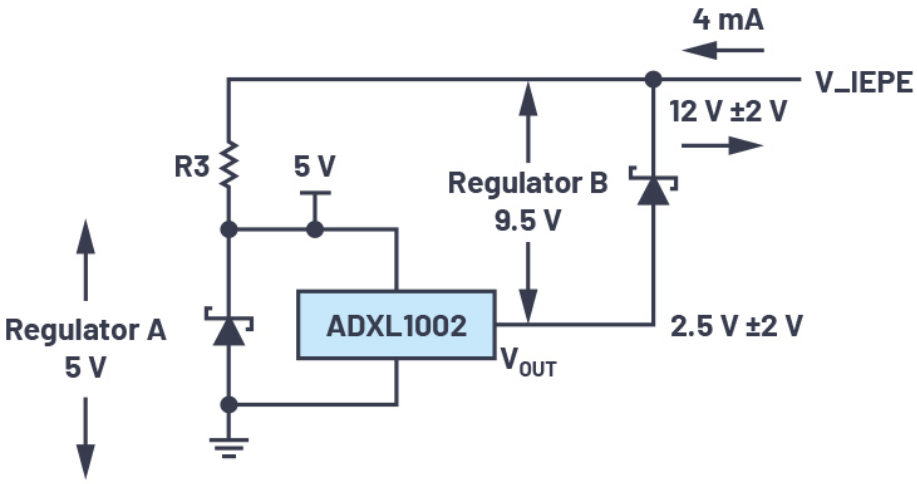
The CN0532, shown, is an IEPE conversion circuit that allows a MEMS accelerometer to interface directly to IEPE infrastructure as seamlessly as any existing IEPE sensor.

Typically, a single-axis MEMS sensor would have three output lines: power, ground, and acceleration out. IEPE infrastructure only requires two: ground on one line and power/signal on the other line. Current is delivered



SOURCE: ANALOG DEVICES

CN0532 MEMS IEPE conversion circuit.



SOURCE: ANALOG DEVICES

A simplified schematic showing how a MEMS sensor can be interfaced to existing IEPE infrastructure (power and data).

to the sensor, and when the sensor measures vibrations a voltage is output on the same line.

The CN0532 PCB was designed with a thickness of 90 mils to maintain the data sheet frequency response performance of the MEMS accelerometer. A stud mountable cube allows immediate testing out of the box. The mounting cube, along with PCB, solder paste, etc., have been extensively characterized to ensure a full bandwidth mechanical transfer function, maximizing visibility of a wide range

SOURCE: ANALOG DEVICES

Vibration measurement test setup: the EVAL-CN0532-EBZ board attached to a shaker table using an aluminium mounting block.

of faults within the sensor bandwidth, and thus extending asset lifetime by having the ability to capture these faults. These solutions make it very easy for CbM designers to attach MEMS accelerometers to their assets as well as seamlessly interfacing with existing piezo infrastructure.

For any high frequency vibration tests, mechanical signal path integrity is very important. In other words, from the source to the sensor, there must be no attenuation (due to damping) nor amplification (due to resonance) of the vibration signal. An aluminium mounting block (EVAL-XLMOUNT1), four screw mounts, and a thick PCB guarantees a flat mechanical response for the frequency range of interest. The IEPE reference design makes it very easy for designers to implement a MEMS sensor in place of a piezo sensor.

Data conversion integrity

We now know that MEMS sensors can be used in place of IEPE piezo sensors. We have also seen how they can be easily mounted to assets while maintaining their data sheet performance. An important part of a CbM development platform is being able to gather high quality vibration data, whether it be MEMS based or piezo based, into the correct environment.

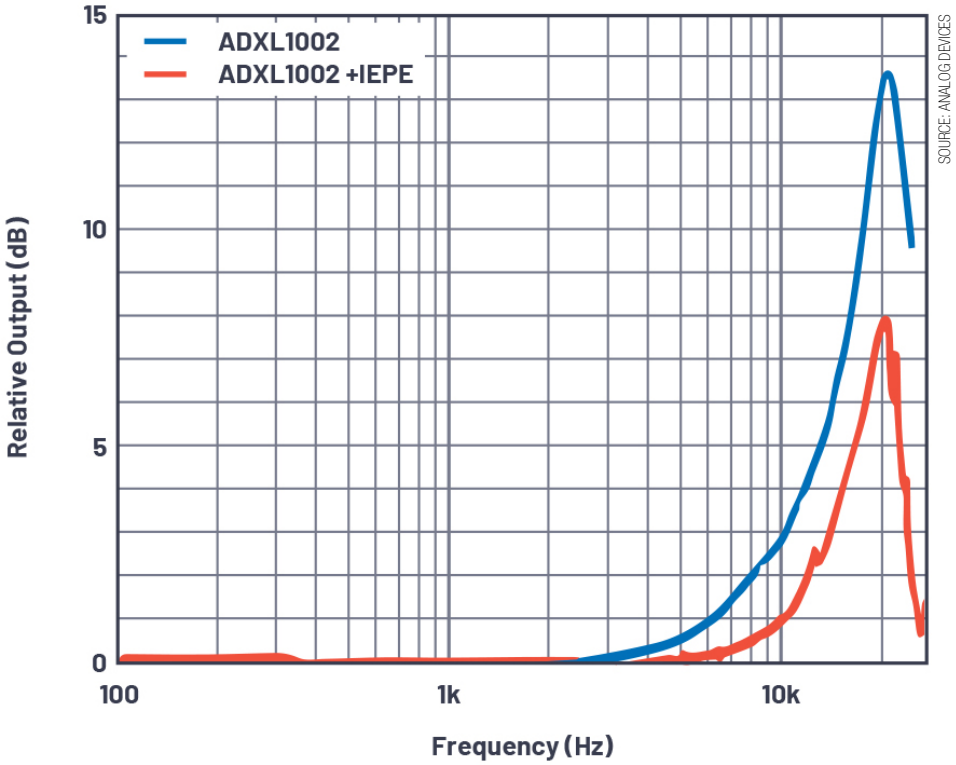
Next, we will look at acquiring IEPE sensor data and maintaining the highest fidelity data to develop the best CbM algorithms or machine learning algorithms possible. This is enabled by another of our CbM reference designs, the CN0540.

Data acquisition system

A lab tested and verified IEPE DAQ signal chain and reference design provides the optimal analog signal chain for use with both MEMS and piezo accelerometers. Analog Devices does not just focus on MEMS accelerometer-based solutions. It is important to remember piezo accelerometers offer the highest performance and are the most widely used vibration sensor; therefore, piezo accelerometers are a focus sensor for precision signal chain offerings.

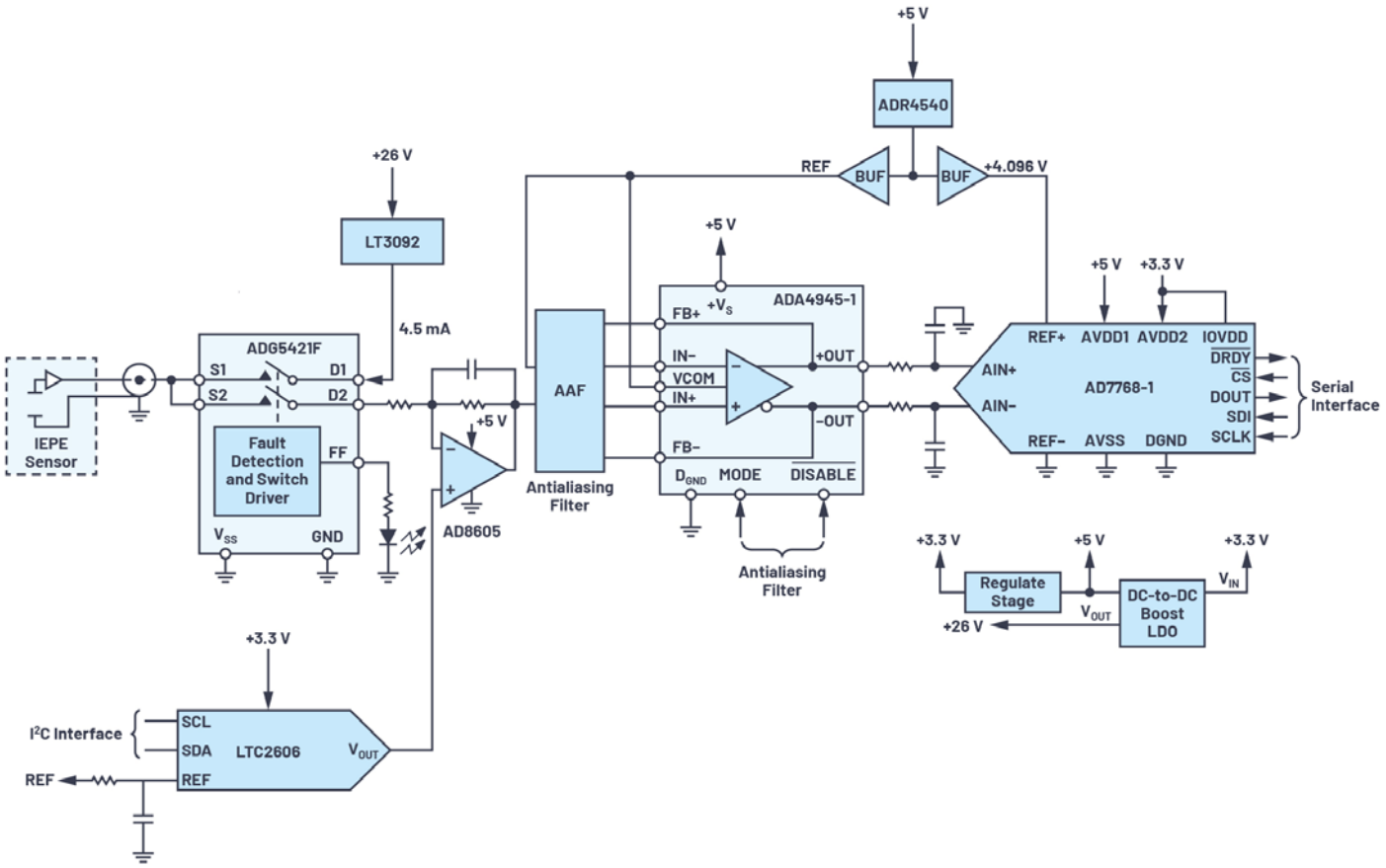
The circuit is a sensor-to-bits (data acquisition) signal chain for an IEPE sensor consisting of a current source, input protection, level shifting and attenuation stage, a third-order antialiasing filter, an analog-to digital converter (ADC) driver, and a fully differential Σ-Δ ADC. CbM system designers using piezo accelerometers require a high performance analog signal chain to maintain the fidelity of the vibration data. Designers can evaluate the signal chain performance out of the box simply by attaching their IEPE sensor or the CN0532 IEPE sensor directly to the CN0540 DAQ reference design. Analog Devices has extensively tested this design and provides open-source design files (schematic, layout files, bill of material, etc.) allowing for easier design into end solutions.

The CN0540 IEPE data acquisition board is a tested and verified analog signal chain



SOURCE: ANALOG DEVICES

Frequency response of the EVAL-CN0532 compared to the ADXL1002 data sheet frequency response.



SOURCE: ANALOG DEVICES

CN0540: high performance, wide bandwidth, precision data acquisition for IEPE sensors.

designed to acquire IEPE sensor vibration data, with better than 100 dB signal-to-noise ratio (SNR). Most solutions that interface with piezoelectric sensors in the market are AC-coupled, lacking DC and sub-Hertz measurement capabilities. CN0540 is suitable for DC-coupled application scenarios, where the DC component of the signal must be preserved or where the response of the system must be maintained down to frequencies of 1 Hz or lower.

The precision data acquisition reference design was tested with two MEMS sensors and three piezo sensors, as shown in Table 2. We can see the g-range, noise density, and bandwidth of each sensor is quite different, as is the price. It should be noted that piezo sensors still have the best noise performance and bandwidths for vibration.

In the case of CN0540, the system bandwidth is set to 54 kHz, and the signal chain noise performance is aimed at sensors that can achieve >100 dB dynamic range over that bandwidth—for example, Piezotronics PCB Model 621B40 accelerometer, which achieves 105 dB at 30 kHz. CN0540 was designed to have extra bandwidth and precision capabilities beyond current vibration sensor performance to ensure it will not be a bottleneck to collecting high performance vibration data. It is very easy to compare and benchmark MEMS vs. piezoelectric on the same system. Whether working with MEMS, piezo, or both, the CN0540 provides the best signal chain solution for data acquisition and processing, which inevitably can be designed into an embedded solution.

When we say that MEMS offer comparable performance at a much lower cost, we can see 83 dB SNR for the ADXL1002 but over 10 times lower cost compared to piezo sensors. MEMS have now established themselves as a viable alternative to all but the highest performance piezo sensors at a fraction of the cost.

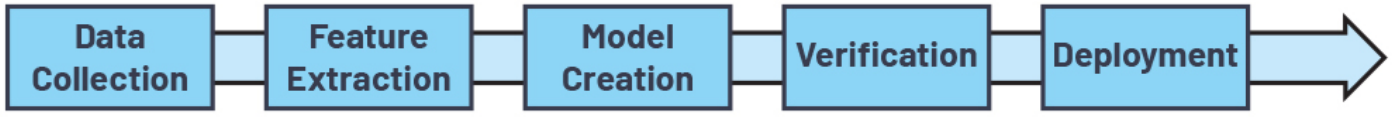
Embedded gateway

Once the high fidelity vibration data has been acquired by the DAQ signal chain, it is important to process it and view in real time and/or transmit it to the machine learning or cloud environment—this is the job of the embedded gateway.

Process vibration data in real time

Two embedded platforms are supported from Intel® (DE10-Nano) and Xilinx® (Cora Z7-07S), which include support provided for all associated HDL, device drivers, software packages, and applications. Each platform runs the embedded ADI Kuiper Linux®, which enables you to display time and frequency domain data in real time, provides access to the real-time captured data over Ethernet, interfaces with popular data analysis tools such MATLAB or Python, and even connects with various cloud computing instances like AWS and Azure. The embedded gateway can transfer 6.15 Mbps (256 kSPS × 24 bits) via Ethernet to your chosen algorithm development tool. Some of the key features of the embedded gateways include:

- **Intel Terasic DE10-Nano:** Dual-core Arm® Cortex®-A9 MP Core processor at 800 MHz neon™ framework media-processing engine with double-precision floating point unit (FPU); and 1 gigabit Ethernet PHY with RJ45 connector
- **Digilent Cora Z7-07S (Xilinx)**

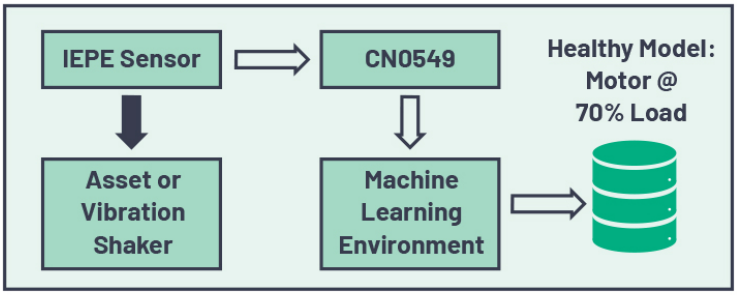


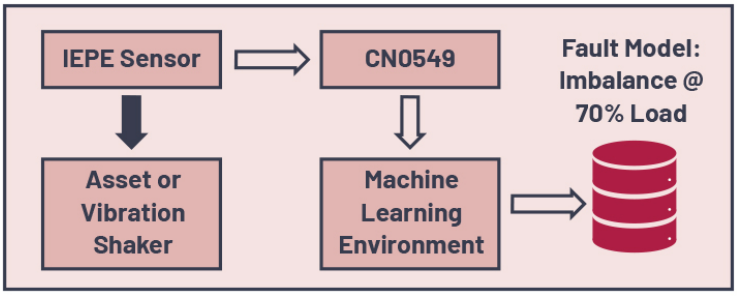
SOURCE: ANALOG DEVICES

Elements of the CbM development platform.

CN0549 Example Use Case

1. **Connect and Power CN0549 Hardware, Then Attach Sensor to Asset or Vibration Shaker**
2. **Perform Resonance Test by Viewing Data in Real Time (Linux IIO Scope)**
3. **Stream Data for Use Case (For Example, 70% Load) to the ML Environment**
4. **Analyze Data in MATLAB, TensorFlow, Caffe, etc. to Identify Signatures of Asset Under Normal Operating Conditions at 70% Load—RMS, Peak, FFT, etc.**
5. **Seed or Simulate a Fault (Loose Footing, Load Imbalance, Bearing Issue) and Repeat Step 4 to Identify Unique Fault Signatures**





SOURCE: ANALOG DEVICES

667 MHz Cortex-A9 processor with tightly integrated Xilinx FPGA; 512 MB DDR3 memory; and USB and Ethernet connectivity

IIO Oscilloscope is a free open-source application that is installed with ADI Kuiper Linux, helping you quickly visualize your time domain and frequency domain data. Built on top of the Linux IIO framework, it interfaces directly with the Analog Devices Linux device drivers, allowing for device configuration, reading device data, and visual displays all in one tool.

Industry-standard tools, such as MATLAB and Python, are also supported on the ADI Kuiper Linux Image. Using interfacing layers that work with the IIO framework, IIO bindings have been developed for streaming data directly into these typical data analysis tools.

Designers can display and analyze data, develop algorithms, as well as perform hardware in the loop testing and other data manipulation techniques using these powerful tools in combination with the IIO integration frameworks. Full examples that enable you to stream high quality vibration data to either MATLAB or Python tools are available.

Predictive maintenance

There are five typical steps in developing machine learning (ML) algorithms for PdM applications, as shown in figure on bottom of page 42. For predictive maintenance, regression models are typically used to predict upcoming failures over classification models.

They perform better when they have more training data to input into the predictive model. Ten minutes of vibration data will likely not detect all the operating characteristics, whereas 10 hours has a much better chance of doing so—and collecting 10 days of data will guarantee a much stronger model.

CN0549 provides the data collection step in one easy to use system where we can stream high performance vibration data to the ML environment of choice.

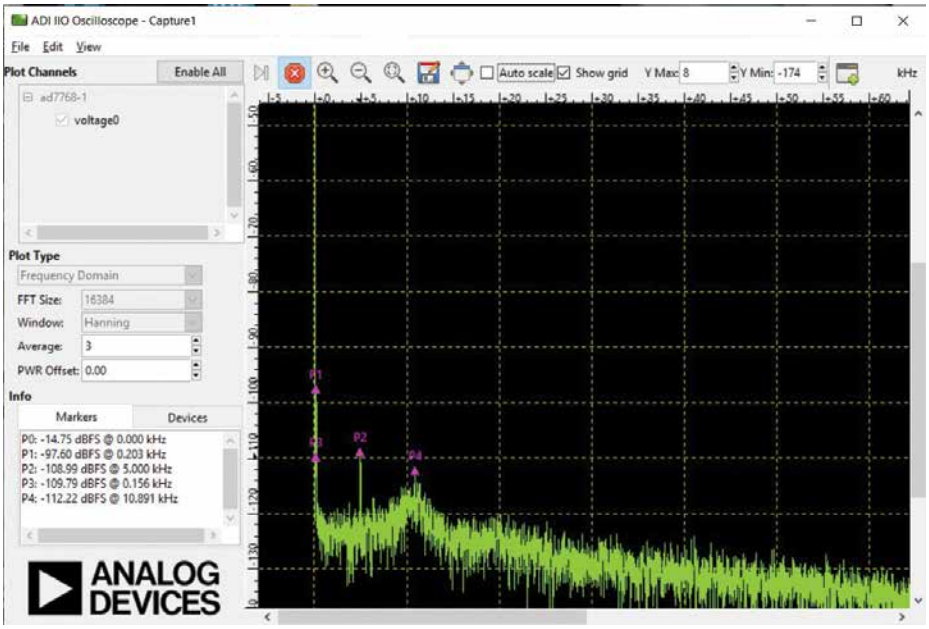
The MEMS IEPE sensor is provided with a mechanical mounting block, allowing seamless mounting of a MEMS sensor to an asset or shaker. Keep in mind IEPE piezo sensors can also be used with this system and attached to assets, shakers, etc. with ease. Before streaming data to the data analysis tools, the sensor attachment should be verified to ensure there are no unwanted resonances. This can very easily be checked in real time using the IIO Oscilloscope. Once the system is ready to go, a use case can be defined, as shown in the figure above—for example, healthy operation of a motor at 70% load capability. High quality vibration data can then be streamed to MATLAB or Python-based data analysis tools such as TensorFlow or PyTorch (and many others).

Analysis can be carried out to identify key signatures and characteristics that define the healthiness of that asset. Once there is a model that defines healthy operation, faults can either be seeded or simulated. Step 4 is repeated to identify key signatures that define the fault, and a model is derived. Fault data can be compared to the healthy motor data, and prediction models can be developed.

This is a simplified overview of the ML process enabled by the CbM development platform. The key thing to remember is this platform ensures the highest quality vibration data is delivered to the ML environment.

Chris Murphy, Applications Engineer, ***Analog Devices.***

Visit Website



SOURCE: ANALOG DEVICES

IIO Oscilloscope showing an FFT of a 5 kHz pure tone.

Ways smart maintenance can reduce unplanned downtime

Smart devices and other digital technologies can help technicians get in front of downtime events or avoid them altogether. These new device-level solutions are creating an opportunity to rethink maintenance strategies and to create a more connected, knowledge-driven workforce.

SOURCE: ROCKWELL AUTOMATION

Smart maintenance can be customized and right sized to the specific needs of an individual business.

UNPLANNED DOWNTIME IS BECOMING increasingly difficult for manufacturers to manage during a global industrial skills shortage.

According to recent research, U.S. manufacturers say finding the right talent is 36% harder now than it was in 2018. And this is happening at a time when manufacturing is trying to meet higher demand. Earlier this year, the Institute for Supply Management reported that its index of national factory activity reached its highest level since 1983.

If unplanned downtime is threatening your business goals, it may be time to think about how you can improve your maintenance strategy using smart technologies. Some companies have been hesitant to adopt a "smart maintenance" approach because they don't want to invest in new technology, or they don't understand the ROI of such investments. But with the right approach, you can realize fast ROI and protect uptime in your operations.

Five opportunities

Smart maintenance can be customized and right sized to the specific needs of your business. It could be an overhaul of your current approach to adopt a predictive or condition-based maintenance strategy. Or it could mean simply adopting a new technology to reduce burdens on your maintenance staff.

To understand what approach might work best for you, consider the opportunities that different technologies present:

1. Smart sensors

It's difficult to protect uptime when you can't see what's happening in production. Smart sensors are now available to monitor every possible parameter in your operations. This can help you create a comprehensive, real-time view of your assets, processes, or entire production operation.

What's more, smart sensors can deliver insights about their health and communication status. For instance, they can tell you if they're detecting dust build-up before the issue causes the sensor to fail. Smart sensors can also alert you to specific problems like a cable break, misalignment, reduced signal strength, or component failure. This can help technicians either take timely preventative action or quickly resolve issues to protect uptime.

You can also store multiple smart sensor profiles in a control system. Then, when you need to make a product changeover, you can simultaneously download all the relevant profiles needed for the next product run. This can significantly reduce changeover-related downtime.

2. Intelligent motor control devices

A motor failure can cause a major disruption and cost you anywhere from thousands to even hundreds of thousands of dollars per hour in lost production.

This is why it's crucial that your production staff have visibility into how motors are

SOURCE: ROCKWELL AUTOMATION

A cloud-based CMMS can analyze work orders and give technicians a short-list of work orders that are causing equipment failures and production delays.

performing and if they're trending toward failure.

Smart motor control devices can give you valuable insights into motor health and performance trends to help you protect uptime.

For example, smart electronic overload relays can provide real-time motor diagnostics and insights like time to trip. This can help technicians monitor a motor and proactively identify if it's having an issue to help avoid costly failures.

Some smart motor control devices can even act on their own to help reduce maintenance demands. Smart servo drives with "load observer" and adaptive-tuning technologies allow for tuning-less startups. This can help you simplify and speed up commissioning and reduce your reliance on tuning experts.

The drives can also use built-in predictive models to calculate the remaining lifespan of components. This can help technicians get ahead of failures and prevent unplanned downtime.

3. Smart safety devices

You can improve both safety compliance and productivity when you use the data and connectivity available from smart safety devices.

Series connection of safety input devices is common in safety-related control systems to reduce installation cost. But a lack of diagnostic information can make it difficult to find a fault when the system trips.

An integrated smart safety system can capture and communicate both standard and safety data over EtherNet/IP and provide the ease of installation from series connection. This allows staff to monitor production and quickly identify what specific safety device has an issue.

Incorporating safety data into your EHS systems can also help you identify discrepancies between your defined policies and your actual operating procedures. This improved insight into worker behavior and compliance can help you identify if specific workers, shifts, or processes are causing unnecessary downtime.

4. Cloud-based CMMS

A cloud-based computerized maintenance system (CMMS) can give your technicians easier access to data and allow them to spend more time on high-value maintenance activities and less time on administrative tasks.

If your maintenance teams are short staffed, they may already be playing catch-up with machine or equipment issues. You don't want to further burden them with outdated maintenance systems that can be inefficient and cause them to miss red flags in your facilities.

A cloud-based CMMS can analyze work orders and give technicians a short-list of work orders that are causing equipment failures, production delays and other issues. This can help the technicians prioritize their work to focus on the most critical needs and hopefully fix problems before they happen.

The CMMS can also reduce administrative work, such as by allowing technicians to submit and respond to service requests digitally in seconds.

5. Augmented reality

Digital technologies allow you to rethink how maintenance teams work. A prime example of this is augmented reality (AR) technology.

For example, you can replace paper-based maintenance manuals with digital work instructions that are accessed in an AR experience. This instant access to step-by-step instructions for specific repair or servicing tasks can accelerate maintenance tasks.

AR technology can also transform how you leverage remote experts. Instead of trying to troubleshoot and resolve issues over the phone, remote experts can now join on-site technicians in an AR experience to get a real-time view of equipment experiencing issues. The remote expert can give on-site technicians detailed directions for servicing the equipment and even make 3D notations in the AR environment, such as to identify which components need to be serviced or replaced.

AR-based remote support can save significant downtime costs in situations where you otherwise would need to fly in a remote expert to provide support.

Improve your resiliency

When it comes to combatting downtime, it may feel like the tide has turned against you in the wake of the pandemic and amid the ongoing global skills shortage. But this moment isn't just a challenge. It's an opportunity to rethink your maintenance strategy and to create a more connected, knowledge-driven workforce.

And by capitalizing on this opportunity now, you can improve your resiliency today and into the future.

Brian Taylor, business director, Safety, Sensing and Connectivity, ***Rockwell Automation.***

Visit Website

Avnu launches advanced global TSN certification program

New program expands scope of testing to make TSN and Milan device certification more accessible worldwide. The program includes globally-scaled testing capabilities and a comprehensive update of certification testing procedures at newly authorized, commercial test houses around the world.

AN ADVANCED GLOBAL CERTIFICATION PROGRAM will streamline certification testing of devices with Time Sensitive Networking (TSN) capabilities, including devices implementing the Milan™ network protocol (using TSN) for professional media, making testing easier and more convenient for Avnu members around the world.

Global locations

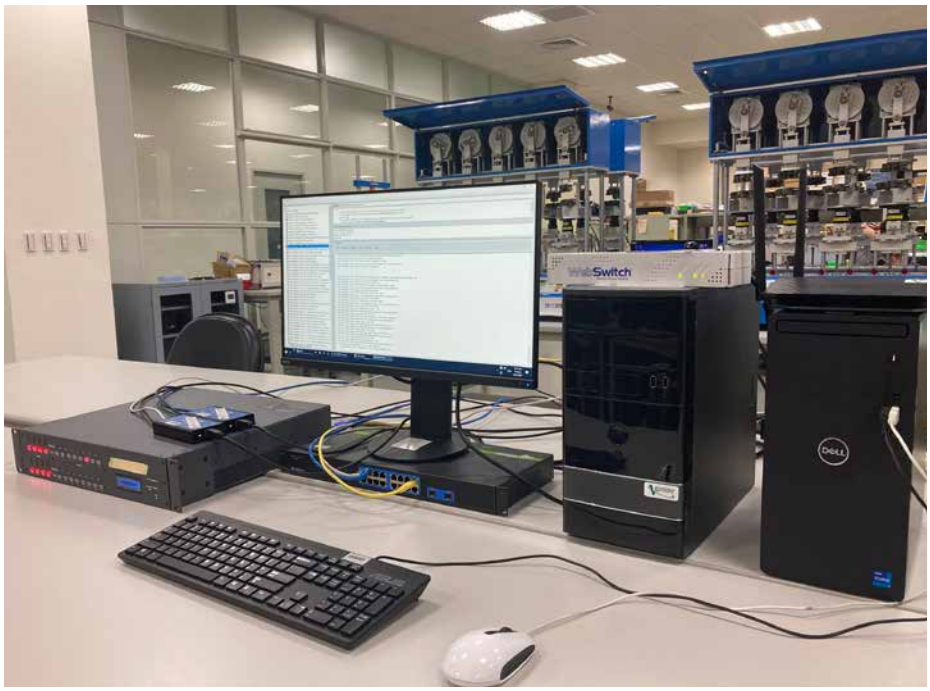
Avnu announced expanded testing at new Registered Test Facilities (RTF) around the world: Allion in Taipei City, Taiwan; Excelfore in Tokyo, Japan; and Granite River Labs in both Santa Clara, CA, USA and Karlsruhe, Germany.

These well-recognized, globally dispersed test labs will lower shipping times, offer competitive pricing models, and streamline the process for members seeking to certify products and make communications between testing sites and vendors seamless. These additional test sites and locations give Avnu Alliance greater ability to scale testing capacity to meet demand, while also allowing device manufacturers to enter products into testing with less lead time prior to release.

"As a part of standard networking technology, TSN is built and deployed around the world," says Greg Schlechter, president of the Avnu Alliance. "Avnu recognized that, for device certification to keep pace with innovation, we needed to expand our testing capabilities and global footprint to increase accessibilty, enable the growth of both test programs and manufacturers, and in general support the diversity of the growing TSN ecosystem."

Avnu's goal is to enable an ecosystem of interoperable, secure, low-latency, and highly reliable networked devices using TSN as part of the open IEEE 802.1 Ethernet standards. Avnu has a variety of test plans and programs to help manufacturers implementing TSN ensure interoperability and demonstrate that to their markets through certification programs.

Avnu's membership brings together experts in automotive, industrial, and networked media as well as all perspectives from across the value chain, including infrastructure providers, silicon and component vendors, and end-device manufacturers. These members collaborate on the current and future requirements for an interoperable TSN ecosystem and define and create conformance test procedures, plans, scripts, and tools for devices and products that leverage Milan and TSN. Those test scripts and procedures are licensed to designated, third-party testing laboratories, where the tests are independently conducted to validate compliance with the specifications.



SOURCE: AVNU

The goal is to streamline certification testing of devices with Time Sensitive Networking capabilities.

Certification management system and product registry

To streamline the new program, Avnu has launched a new testing portal and comprehensive Certification Management System (CMS) with simplified and intelligent certification workflows for seamless, transparent communication. Designed and maintained by experienced certification management professionals, the new CMS provides members with real-time visibility into the testing process and the ability to track device progress and timelines.

In this web-based portal, Avnu members can submit products for testing, view results, respond to nonconformance issues, and manage the public listing of newly Certified products. All certification and testing documents are easily managed in a single, centralized location. Intelligent workflows feed data and visibility back to Avnu's Certification Work Group to track the number of products in certification at each lab, enabling Avnu to scale the capabilities as needed to support testing demand.

In addition, Avnu's certification website will launch a new product registry with a robust database showing all products currently Certified by Avnu. Advanced filtering capabilities make it easy for members' customers and end-users to search for products to specify and design into systems.

"With this new certification platform, Avnu continues to innovate in making pre-certification and certification testing easier, faster, and more convenient for member companies, test equipment manufacturers, and test facilities around the world," added Ed Agis, Certification Work Group co-chair. "Interoperability ultimately accelerates a broader ecosystem of devices, which is the long-term advantage of this advanced global certification platform."

*Technology report by **Avnu Alliance.***

Visit Website

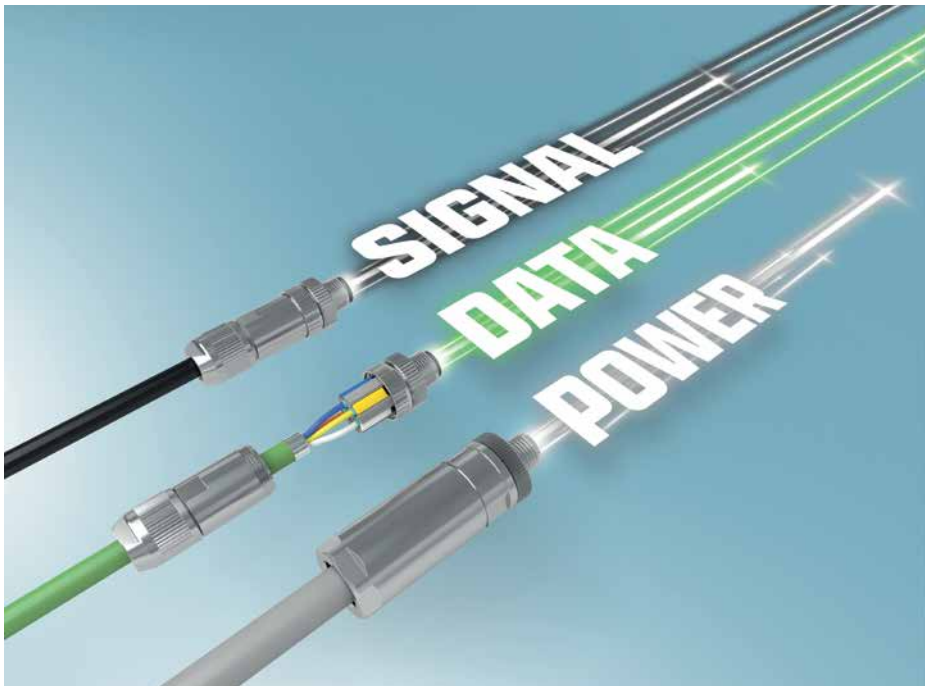
Assemble circular connectors with M12 Push-Lock technology

Push-Lock connection technology provides new possibilities for M12 connectors. With its convenient handling, the connection reduces sources of errors and installation times significantly. Now, this type of connection is more than equal to screw connections whether for signals, data or power.

AS A PART OF THE DIGITAL TRANSFORMATION, the requirements on networking industrial devices and systems are increasing. Standardized and tailored solutions are needed to be able to plan and realize reliable and future-proof cabling. Circular connectors designed for assembly with fast-connection technology and an M12 design have huge potential.

In addition to flexibility and time savings, the simplified conductor connection as well as contacts that remain stable over the long term also play a role in increasing cost effectiveness. Because by selecting the right connector, users are setting a decisive course for the future-proof cabling of their devices and systems.

In the field of M12 connectors designed for assembly, there are several connection technologies available. Here, insulation displacement and spring-cage connections have undergone massive further development in recent years, and are now the standard for M12 connectors designed for assembly. High sales figures and growth rates confirm this development. Sales of Piercecon and the popular screw connection technology are also increasing constantly. And last but not least, crimp connection technology is irreplaceable; it underpins the high proportion of connectors designed for assembly on industrial M12 cabling.



SOURCE: PHOENIX CONTACT

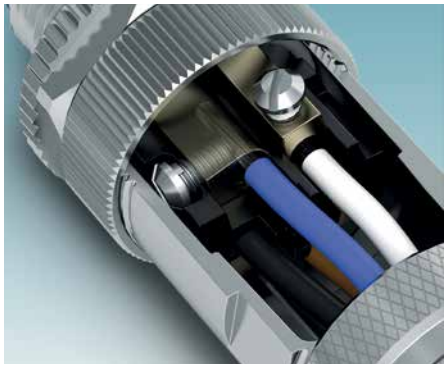
With the M12 Push-Lock connection, users are now equipped for the future, whether for signal, data, or power transmission.

Connection technology depends on the application

The application is always the focus when answering the question of the right connection technology with copper-based cabling for signals, data, and power more precisely. Even if the connectors appear to be very similar on the inside at first glance, it is worth taking a closer look. Further information is available online, but samples can also be procured immediately.

Regardless of the insulation material of the conductors to be connected, the M12 connector with screw connection works; it is widely known in almost all markets around the world and is used almost universally. However, it cannot always be guaranteed that the screw is tightened with the correct torque. If it is too low, the conductor is only partially contacted, which can lead to the contact resistances increasing. If the torque is too high and there is no conductor protection, there is a danger that the conductor will be damaged under the screw, the conductor cross-section will be reduced, and the terminal point will heat up excessively. Because the correct torque is essential for a long-term reliable connection, manufacturers document it and can also be contacted for this information.

M12 connection with spring-cage



SOURCE: PHOENIX CONTACT

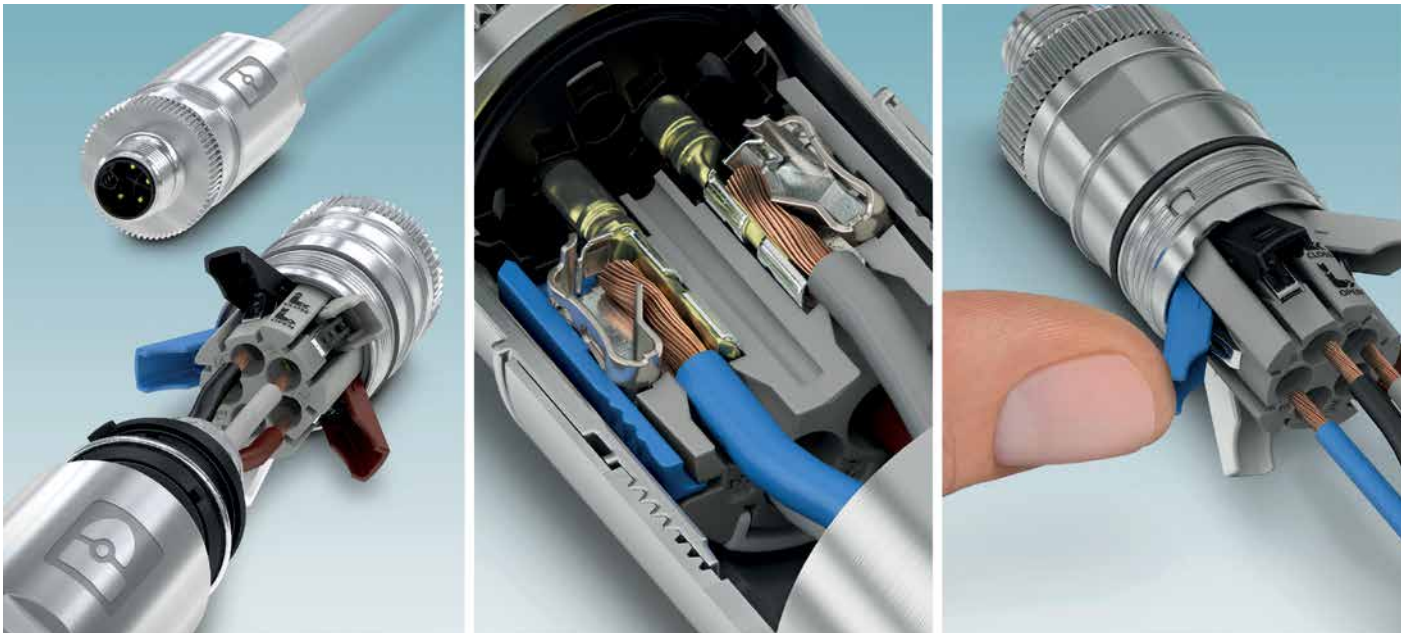
With the right torque used on the screw, the conductor connection is secure.

Connection technology using springs, the most widely known of the fast-connection technologies, appears similar at first glance, but is completely different. This technology allows the convenient connection of terminal blocks, circular connectors, and PCB connectors.

The spring-cage connection is a fast wiring option for rigid and flexible conductors, both with and without ferrules. Here, the clamping space has to be opened using a screwdriver, and then the conductor is fed in. Push-in connections go one step further – Push-in technology has gained significant importance over the past few years.

With this type of spring connection, the tool for opening is, in a manner of speaking, "included". A lever, also known as a pusher, is pressed to open the terminal point. Once open, flexible conductors without ferrules can be fed in easily.

The lever is then released and the terminal point closes automatically. At the same time, the conductor is contacted with a defined contact force, creating a long-term safe and reliable connection. When using rigid



SOURCE: PHOENIX CONTACT

The M12 connector with Push-Lock connection combines Push-in technology and actuation lever for a simple and long-term stable conductor connection.

conductors or flexible conductors with ferrules, actuating the pusher is not necessary, because the conductor can be plugged in directly. Both connection technologies ensure a robust and maintenance-free conductor connection.

Spring-cage connection with M12

While the terminal is fixed in PCB or DIN rail mounting, M12 connectors designed for assembly must be held by hand when connecting. To resolve the challenge of the "third hand", Push-in connection technology for M12 connectors has been continually developed over the past few years. The "Push-Lock" principle has come about as a result. As with the Push-in connection, the Push-Lock connection also uses a leg spring for contacting the conductor. The function of plugging the conductor in directly, like in Push-in connections, has also been carried over.

Now, the Push-Lock connection has an even more decisive advantage when assembling M12 connectors. A lever is positioned on the clamping chamber that can be operated by hand, allowing the clamping chamber to be opened and closed. The lever features another advantage: The clamping chamber remains open and the user has both hands free to feed the conductor in.

SOURCE: PHOENIX CONTACT

M12 connectors in shielded applications must contact the conductor shield across a large area and with long-term stability.

Every installer will appreciate this feature, not just when connecting thin signal lines and data cables, but also when connecting power cables with conductor cross-sections of 1.5 mm² or 2.5 mm². The Push-Lock connection makes the work considerably easier, because it also turns the spring-cage connection into a true fast-connection technology for the M12 field.

PE connection already integrated

To design the connection to be even more intuitive, a colored marking is included in addition to the numerical marking. The levers are available in the standard colors for signal, data, and power cables to suit the application. This means it is much easier for the installer to assign the conductors, and the number of errors is significantly reduced. Moreover, commissioning the system is faster and the availability increased.

The PE connection and shielding deserve further attention. A PE connection is required for power distribution with high voltages, for example. It has to dissipate power in the event of an error and protect the user against life-threatening voltages. This function is already integrated into the Push-Lock connection. The terminal point of the PE conductor is connected internally to the metallic housing so that in the event of an error, the power is safely dissipated via the PE connection. Moreover, the lever for the PE terminal point is marked in green-yellow, which further simplifies assignment for the user.

The shield connection has long been an issue for data transmission, and field cabling must also meet the growing requirements on communication within devices and systems. Because the length of the cables installed also has an effect on data transmission, the shortest possible cable lengths are used.

To this end, assembled data cables are ordered to size or the data cable is cut to length during installation and fitted with connectors designed for assembly. Here, the M12 connectors with Push-Lock connection offer a spring-based solution that can contact a wide range of cable shielding diameters. With 360° contacting, the contact covers a large area and satisfies the demands for a low contact resistance.

Summary

With its innovative functions, the Push-Lock connection provides new possibilities for M12 connectors designed for assembly during the installation and commissioning of devices and systems. With its convenient handling, the Push-Lock connection reduces sources of errors and installation times significantly. Now, in terms of handling, this type of connection is more than equal to screw connections – whether for signals, data, or power. As a result, more and more users are taking advantage of the numerous technical and economic benefits of the M12 plug connector with Push-Lock connection.

Dipl.-Ing. (FH) Jörg Hohmeier, Product Marketing Industrial Field Connectivity, ***Phoenix Contact.***

Visit Website

sps

smart production solutions

31st international exhibition
for industrial automation

Nuremberg, Germany
23 – 25 November 2021
sps-exhibition.com

Extended
lecture program on the
digital event platform
SPS on air

Bringing Automation to Life

Hands-on. Visionary. Personal.

Find answers to current issues as well as possible solutions for the challenges of tomorrow. Our comprehensive hygiene concept enables you to engage in a face-to-face professional exchange and to experience the products while maintaining the highest safety standards.

Register now! **sps-exhibition.com/tickets**
Save 50% on any ticket with the promotion code: **SPS21AZNT2**

mesago
Messe Frankfurt Group

Benefits and potential of edge computing

Industrial edge computing can mean data are processed locally and never leave the site, or data can be forwarded for processing to a central platform. Hybrid systems with a mix of local and centralized data processing are the most common model used in practice but the key is potential advantages and benefits.

THE WORD "EDGE" IS BOUND TO COME UP IN any discussion about the Industrial Internet of Things (IIoT) and implementing an IIoT solution. But what does "edge" really mean in this context – and how is edge computing different to the more general principle of "local" or "on-site" data processing? What are the benefits and advantages users can enjoy from working with an industrial edge? And what are the key technical issues users should know about?

Edge vs. local

Edge computing describes a decentralized approach to data processing, managed and operated via a central platform. These management and operation activities also involve deployment and software component updates, as well as their configuration or the handling of security certificates.

However, the term "edge" does not cover any plant equipment or software components that are operated autonomously and independently of a centralized platform. This is essentially the definition given in the recent white paper "Edge Computing in the Context of Open Manufacturing" by the Open Manufacturing Platform (OMP)[1].

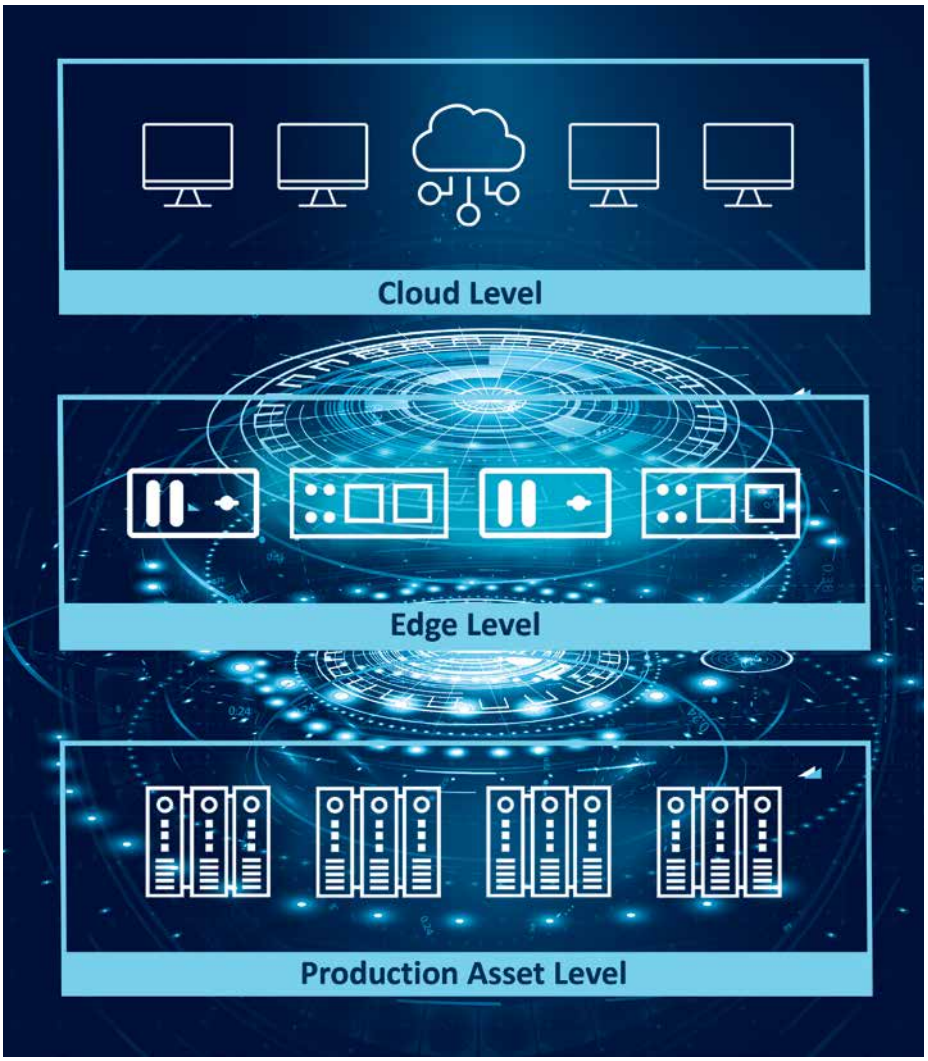
This means that "edge" is applicable only in the context of a centralized platform, unlike the more general use of software "local" to field devices. So the question is one of management and operations: centrally controlled or autonomous/site-specific? Where the data generated are processed is not critical, however: industrial edge computing can mean data are processed locally and never leave the site or, equally, the data can be forwarded for processing to a central platform. In fact, hybrid systems with a mix of local and centralized data processing are the most common model used in practice.

So the question becomes how does the industrial edge benefit users and what are the key advantages?

Efficient management & operations

Typically, a company's production facilities will differ both in terms of the installed machine pool as well as the personnel and available local skills and expertise. In this situation, the centralized management of IIoT solution components deployed to each facility will reduce dependencies on local circumstances while reducing the need for per-site capacity building in terms of IT competencies. So, in many cases, deploying an industrial edge platform holds out the promise of improving the efficiency of solution operations.

Edge deployment may even be a precondition for the multi-site rollout of an industrial IoT solution. The magnitude of potential efficiency improvements also stems from the fact that IIoT solutions evolve dynamically over their lifetime – meaning adjustments and configuration changes at the edge are to be expected.



SOURCE: SOFTING

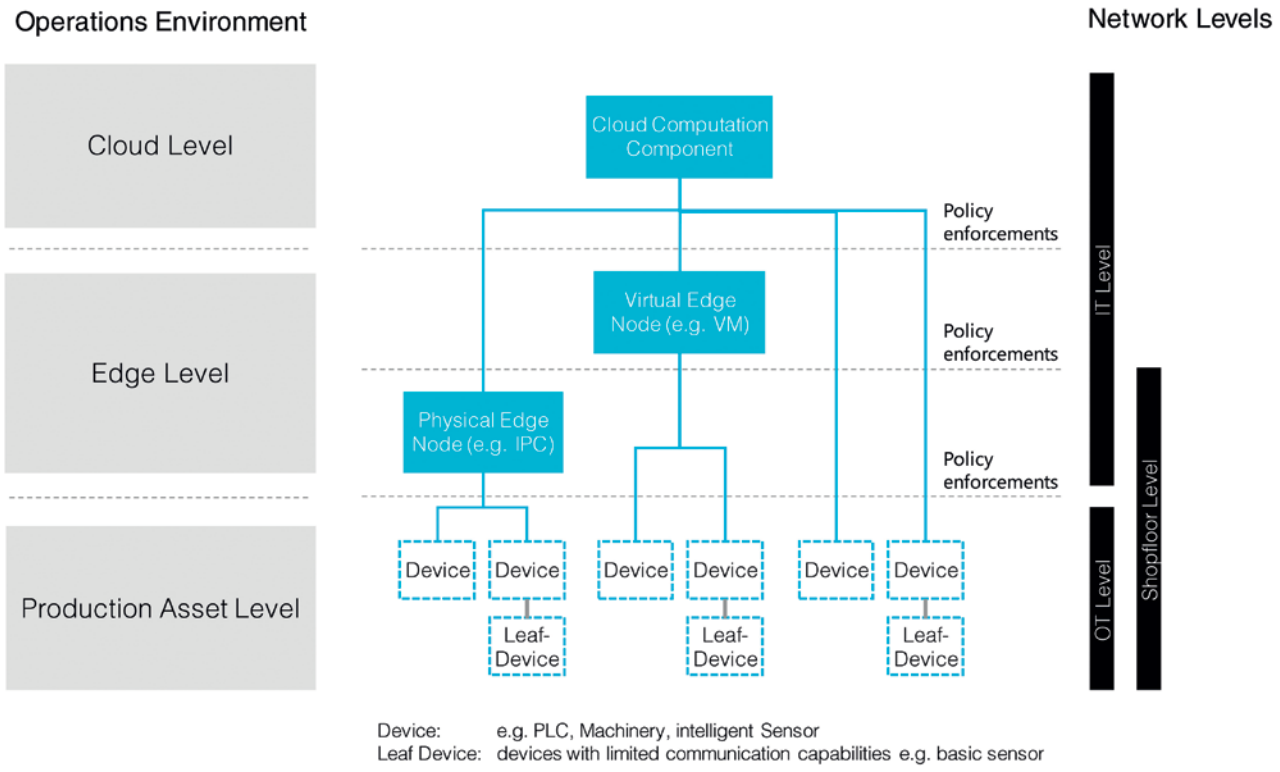
Centralized management of edge computing across sites delivers substantial efficiency gains.

Use of standard hardware & tools

Software virtualization technologies – especially those using containerization – are an important part of edge computing. Docker containers at the edge are one example and are now supported by standard services from most of the major cloud services providers. Independently of cloud service provider tools, there are also many software systems available for the orchestration of these container-based solutions – such as Kubernetes.

In particular, an industrial edge architecture means that connectivity can be implemented as a software component and operated,

SOURCE: SOFTING



Cloud Level, Edge Level and Production Asset Level as defined by the Open Manufacturing Platform.

like any other industrial edge component, on standard hardware. This reduces or even removes the need to deploy specialized, hardware-based connectivity solutions. Taken together, these two benefits of the industrial edge – leveraging standard IT technologies plus centralized management – help to ensure that users can complete an efficient multi-site rollout while simultaneously reducing their operating costs for this solution.

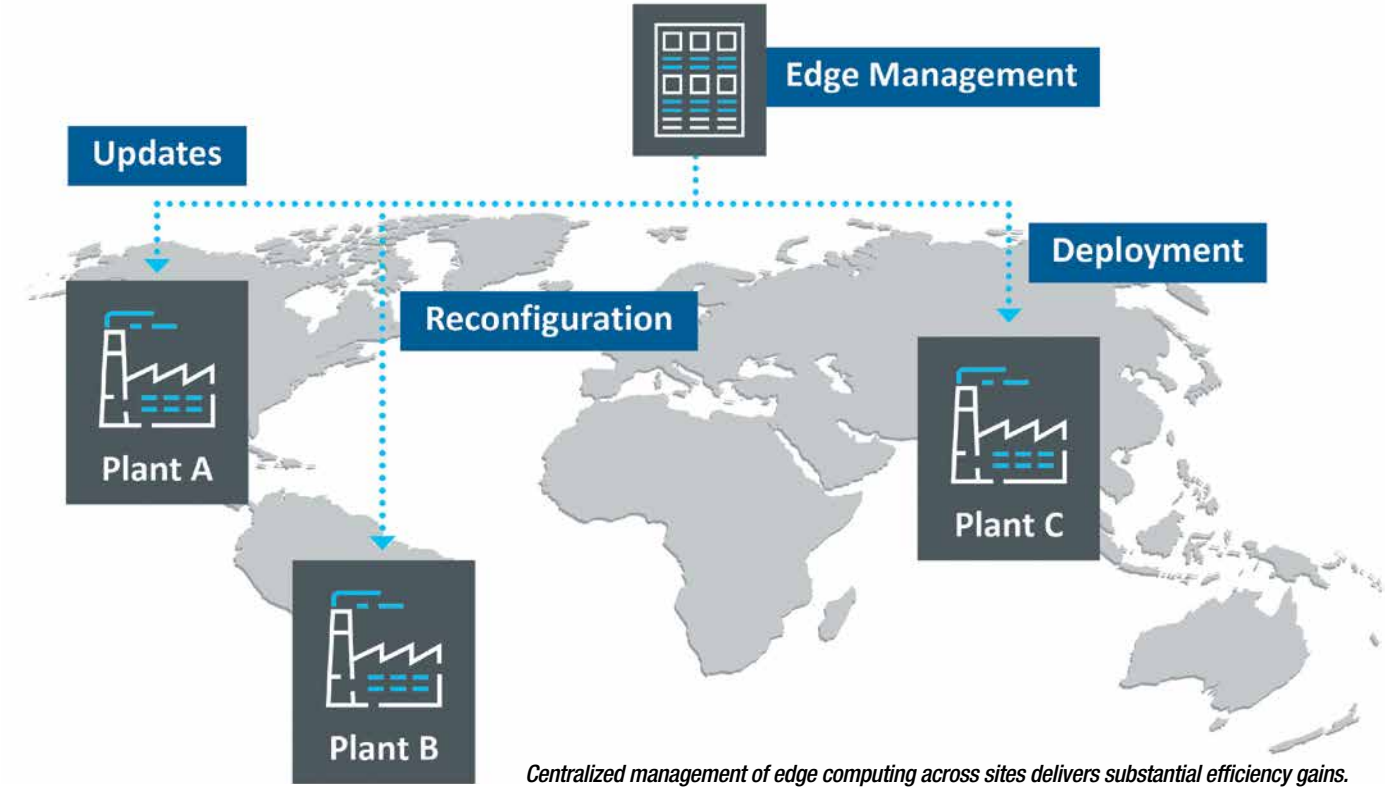
What does the industrial edge look like from a technical perspective and which architecture issues do users need to be aware of?

Functional components industrial edge

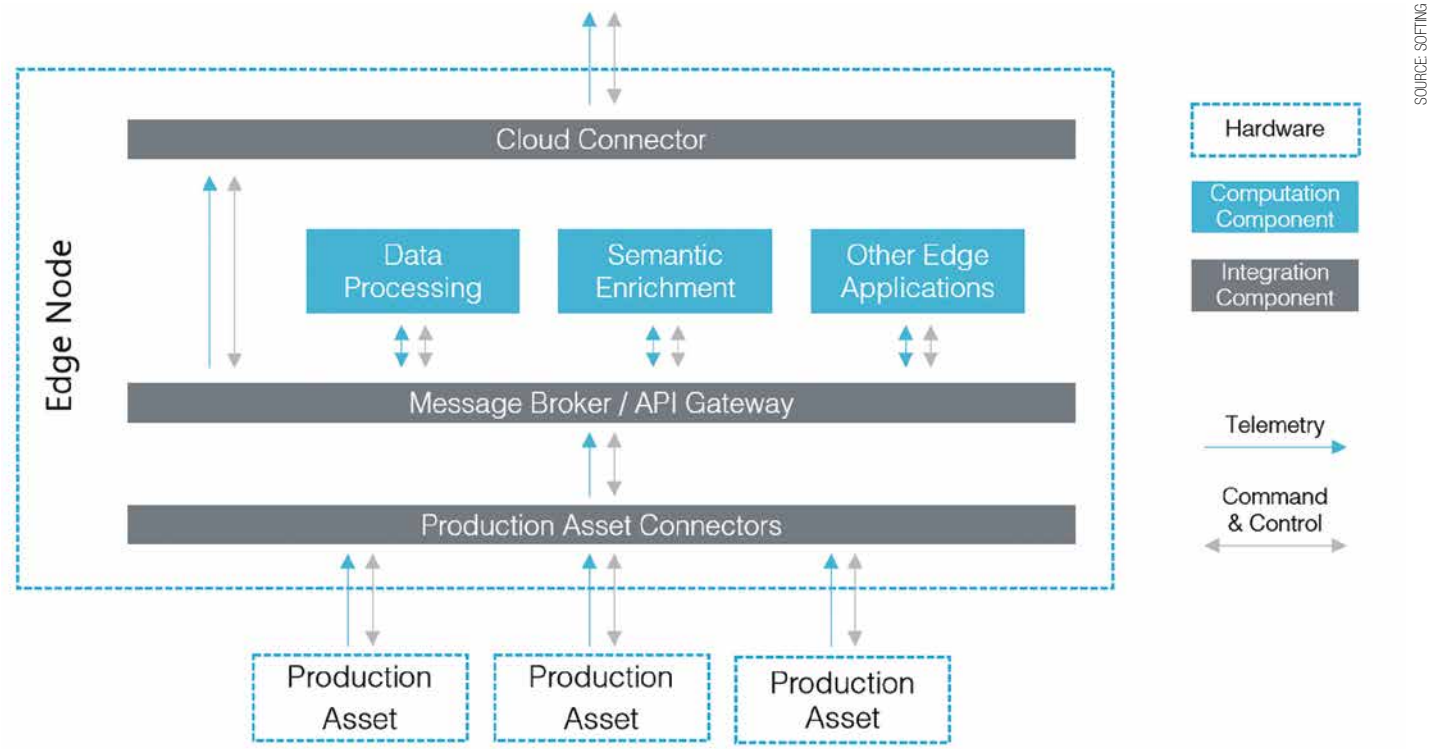
For some IIoT applications, which simply need to collect and analyze their data on a central platform, the industrial edge deployment will be focused only on connectivity. This connectivity architecture can be extended, however, to enrich the OT interface and include semantic information – by using OPC UA information models, for example.

Many IIoT applications will also require machine-level data processing: either because the volume of data generated is simply too large to be transferred in bulk to a central

SOURCE: SOFTING



Centralized management of edge computing across sites delivers substantial efficiency gains.



SOURCE: SOFTING

Application view of an industrial edge as defined by the Open Manufacturing Platform.

(cloud) platform or because latency times have to be kept short for a particular application.

This more advanced industrial edge platform will include functionality for connectivity and semantic data provisioning, as well as application-related functions. The individual components located at the edge will typically communicate via a bus system. Alongside these application components, an industrial edge platform also provides a set of functions – including monitoring, logging, and IT security services – that ensure the efficient operation of the solution throughout its lifetime.

Open architecture and standards

From a user perspective, an IIoT solution should be flexible, should make it as easy as possible to integrate components from several manufacturers, and should be extensible during its entire service life. Even in cases where users have decided to utilize one of the major cloud platform providers, they are often still interested in maintaining their independence from this provider wherever possible.

Accordingly, software architectures for the industrial edge should be open and based on available standards. Examples of such standards include OPC UA, MQTT (i.e. an MQTT broker at the edge), and Kafka for streaming between edge and cloud. Many open-source initiatives support these kinds of setups, with some also providing ready-to-use software components.

Information models and semantics

One key issue that has yet to be properly addressed by commercially available products and standardized models is the question of how the semantic information provided at the edge or production asset level (typically from OPC UA) can be effectively used within the cloud to drive AI and machine learning. This topic is now being addressed by current R&D activities, with successful solutions looking to offer significant simplification and efficiency gains for the implementation of AI-based IIoT solutions.

One example worth noting this context is an initiative targeting the simple deployment of OPC UA information models via a cloud-based database. The OPC Foundation and CESMII are currently part of a joint working group developing specifications for an "OPC UA Cloud Library".

The information models will be deployable within the cloud or at the edge, and the aim is to simplify the integration of components from multiple manufacturers in a single IIoT solution while exploiting the full potential of the OPC UA standard.

IIoT solutions between store floor, edge and cloud

Addressing these technology and market trends, Softing developed and introduced the new edgeConnector family of container applications enabling customers to integrate their production into a comprehensive Industry 4.0 environment. The individual products each access the data of the controllers from different manufacturers via Ethernet or proprietary PLC protocols, using OPC UA (Open Platform Communications Unified Architecture) and MQTT (Message Queuing Telemetry Transport) as the main communication protocols for data transfer and integration.

The product family includes EdgeConnector Siemens, a software module that can read process and machine data via proprietary interfaces from Siemens controllers and make it available to IT via standardized interfaces. As a Docker container, it can be easily managed from a central platform. Two more Docker containers have also become available: edgeConnector 840D and edgeConnector Modbus.

All edgeConnector products feature a built-in web interface for configuration, and an API for configuration via third-party applications. Additional container products are currently being developed, including an OPC UA aggregation server and modules for collecting device data for asset management and asset monitoring applications.

As part of a set of customized solutions, Softing also offers its own Multi Factory Device Management System tailored to shop floor requirements. This enables Softing to independently design and implement architectures and IIoT solutions between shop floor, edge and cloud based on individual customer requirements.

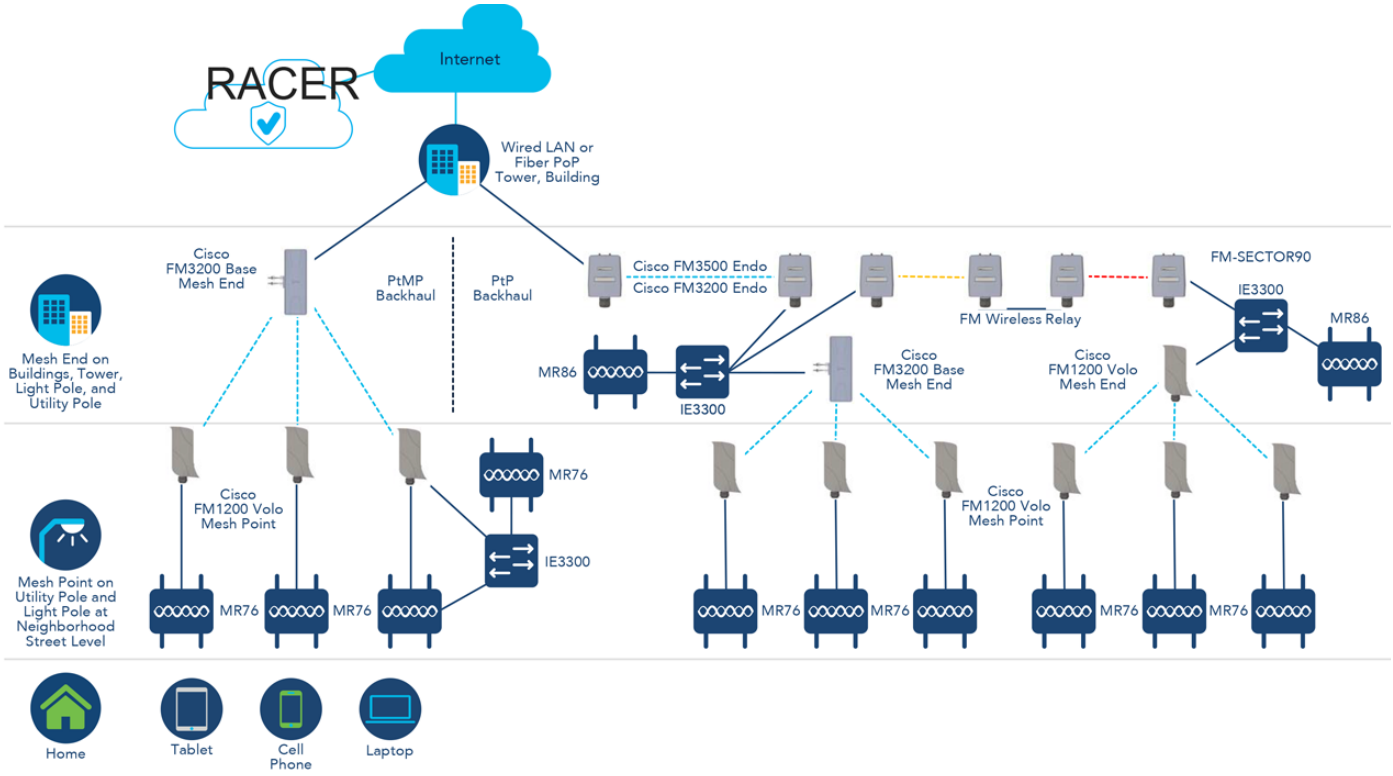
[1]https://open-manufacturing.org/wp-content/uploads/sites/101/2021/07/OMP-IIoT-Connectivity-Edge-Computing-20210701.pdf

Dr. Christopher Anhalt, VP Product Marketing, ***Softing Industrial Automation GmbH.***

Visit Website

The journey to provisioning & maintenance with RACER

In today's world where network manageability plays an increasingly critical role in a network's ability to efficiently scale, having a platform is significantly vital. With the conveniences that RACER provides, it's almost effortless to securely configure, document, and manage Cisco URWB devices on a network of any size.



SOURCE: CISCO

Once devices have a connection to the internet through the core network, configuration changes relative to a device's Mesh ID can be made on RACER and automatically pushed to devices in the field. The most recent firmware updates for these devices are also included in the configurations pulled down from RACER once new versions are available, which keeps devices consistent across the board.

DATA NETWORKS HAVE ALWAYS DEMANDED a means of configuration manageability in one way or another, especially when so much emphasis is placed on its ability to scale while maintaining coherent device management.

In general terms, the more devices added to a Data Network, the more challenging and time-consuming it becomes for the Network Administrator to distribute, manage, and modify configurations for each of these devices on the network.

Device management tools have been around for decades and come in many forms – from terminal emulators utilizing the Secure Shell protocol to Graphical User Interface applications. These tools all had one goal in common – to efficiently distribute, apply, and modify device configurations on networks small to large in size.

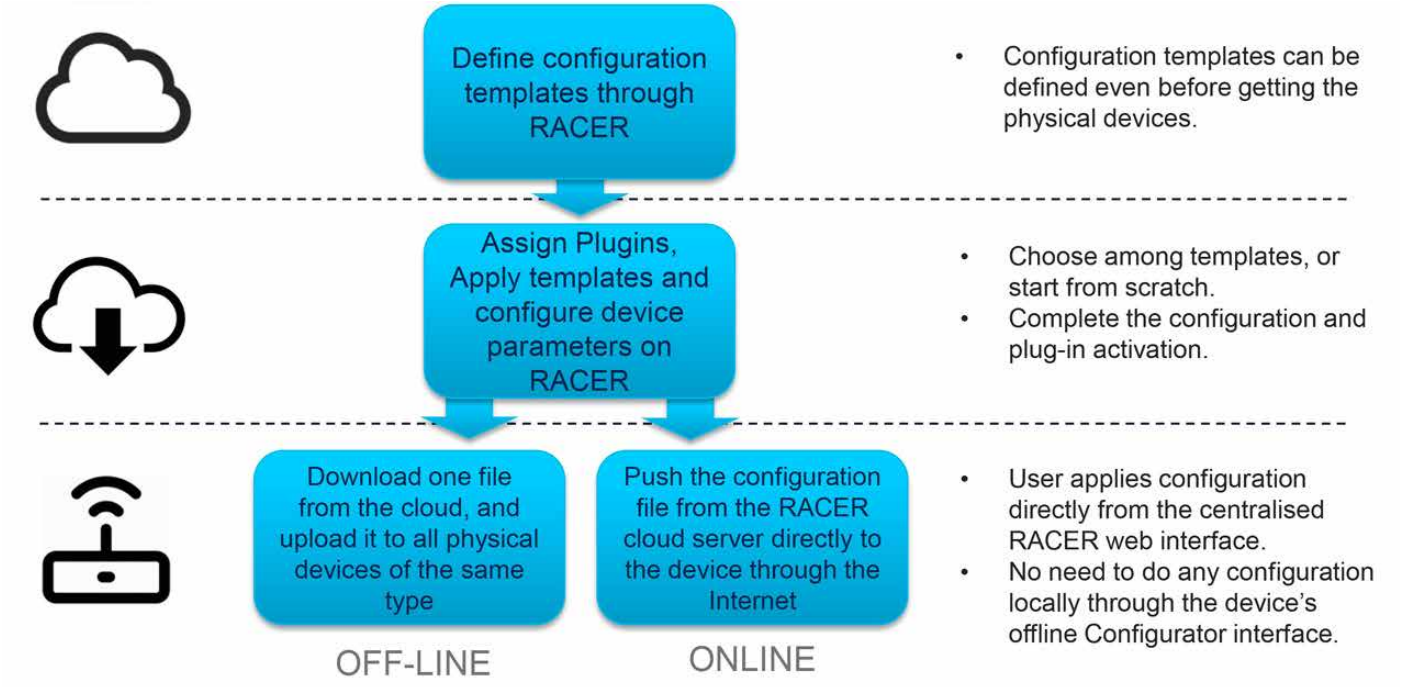
The Cisco Ultra Reliable Wireless Backhaul (Cisco URWB) RACER (Radio Configuration Environment) platform allows just that, by providing an intuitive, secure, and efficient platform which allows devices to be configured from a centralized cloud platform. This by no means removes the conventional step of creating a document for each project, which captures all the pertinent configuration details needed per device, and usually in the form of a spreadsheet.

With this documentation method, it is an efficient way to use these details for the creation of configuration mappings on the RACER platform online. The RACER platform uses Transport Layer Security (TLS), and can be accessed via the link https://partners.fluidmesh.com/.

With RACER, End-Users are able to easily identify radios categorized based on specific projects within their organization. Once a user profile is created on the portal, a database of Cisco URWB devices and licenses associated with the user profile or organization are accessible on the RACER cloud portal. With this centralized convenience, it's now easy for users to:

- Apply and Remove plugin and support licenses to device profiles.
- Create and apply configuration templates for devices based on network roles.
- Directly sync cloud configuration settings to the Cisco URWB devices using the online configuration feature.
- A single configuration file can be downloaded from the RACER portal and uploaded to each device locally using the offline configuration feature, which in turn allows the respective radio to pull the requisite configuration.

One of the key benefits of RACER is the plug and play ability. For new device implementations, Cisco URWB devices can be synchronized with the configurations



defined on the RACER platform once they are plugged into a network source that has internet access and DHCP services. The devices are able to connect with the RACER platform and automatically download and apply configurations that have been mapped to the specific devices Mesh ID. The Mesh ID is a unique, four octet number that each Cisco URWB device has. Think of it being similar to a serial number.

With the ability to have configurations applied to devices in such a seamless manner, it is easy to manage medium to large network deployments. This is also very beneficial post deployment.

As seen in the image on page 53, for networks that are already deployed, once these devices have a connection to the internet through the core network, configuration changes relative to a device's Mesh ID can be made on RACER and automatically pushed to devices in the field. The most recent firmware updates for these devices are also included in the configurations pulled down from RACER once new versions are available, which keeps devices consistent across the board.

The caveat to this is, radios have two modes of configuration depending on the method that is most convenient or practicable based on the network environment. For networks without a direct internet connection to the Cisco URWB devices, the device configuration mode can be set to offline configuration. With this mode selected, network administrators are able to download a single file from RACER that has all the configuration settings previously mapped.

A user can determine which devices they want to be part of the configuration file by selecting checkboxes that correspond to the respective device Mesh ID's, or as an option all devices can be selected.

Once the file is downloaded, the file can be uploaded to each respective device. The devices will intuitively pull configurations and licensing information as necessary based on configuration mapping made to the Mesh ID's on RACER.

In today's world where network manageability plays an increasingly critical role in a network's ability to efficiently scale, having a platform such as RACER is significantly vital. With the conveniences that RACER provides, it's almost effortless to securely configure, document, and manage Cisco URWB devices on a network of any size.

Technology report by ***Cisco Systems.***

Visit Website

The RACER platform uses Transport Layer Security (TLS), and can be accessed via the link:

https://partners.fluidmesh.com

AriZona's new plant connects SCADA/MES with ERP

The AriZona Beverages plant will produce more than 60 million cases per year. The connection to ERP is just one of the SCADA system's many benefits, which also include greater access to data, better mobility, improved efficiency, and lower costs.

SOURCE: INDUCTIVE AUTOMATION

AriZona wanted a comprehensive solution for HMI, SCADA and MES that would connect to its enterprise resource planning (ERP) system.

ARIZONA BEVERAGES IS FAMOUS FOR ITS WIDE variety of teas, juices, and energy drinks. The company is based in Woodbury, New York, and its newest plant is in Keasbey, New Jersey. The plant opened in November 2019, is 621,000 square feet, and will produce 60 million cases of drinks per year on its six lines.

For the new state-of-the-art plant, AriZona wanted a comprehensive solution for human-machine interface (HMI), supervisory control and data acquisition (SCADA), and a manufacturing execution system (MES) that would connect to its enterprise resource planning (ERP) system, which is SAP. Working with system integrator Vertech, AriZona implemented a system based on Ignition by Inductive Automation and Sepasoft.

Ignition is an industrial application platform with tools for building solutions in HMI, SCADA, and the Industrial Internet of Things (IIoT). Sepasoft MES provides control, traceability, and documentation of the transformation of raw materials into finished goods in real time.

Vertech has offices in California, Arizona, Texas, and Tennessee, and has extensive experience in food & beverage and other industries. Vertech had a tall order for the AriZona project: provide the SCADA platform, the MES solution, an ISA-88-compliant batch control system within SCADA, and a strong connection to SAP — while also improving access to data for better production efficiency and lower costs. Vertech provided all this and more.

"We've improved efficiencies and processes throughout the plant," said Shami Usmani, vice president of engineering and manufacturing for AriZona Beverages. He said the SCADA system's ease of use and flexibility were a big part of the project's success. "Getting analytics out of a manufacturing facility has always been difficult," said Usmani. "We wanted best-in-class software to help us analyze the data received from the plant."

Paul Warning, solutions architect with Vertech, said Ignition fit the bill. "It's an extremely flexible platform," said Warning.

"It has a lot of features that modern manufacturing facilities require. Adapting to the things that changed throughout the course of the project was easy to do with this platform."

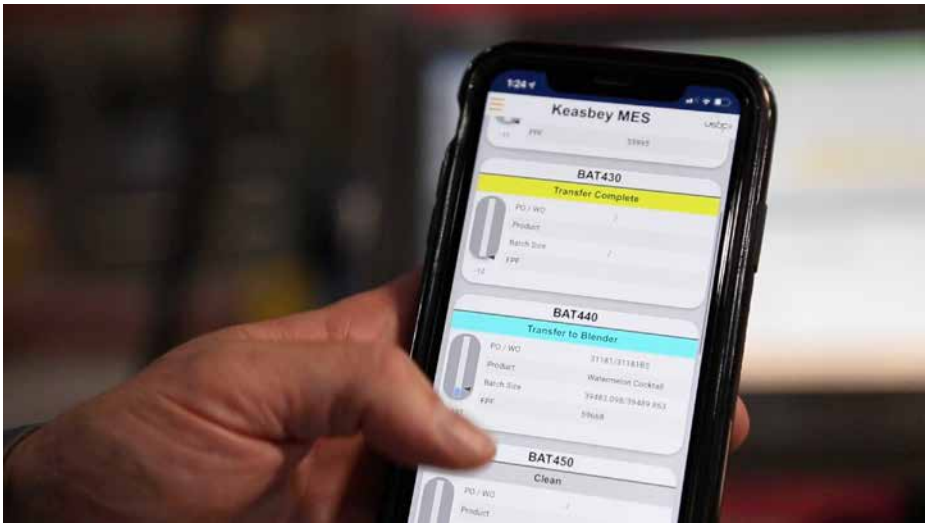
Connecting to SAP

"One of the key features that we implemented is the communication between SAP and our SCADA landscape," said Kimon Stergakos, chief solutions architect for business applications and technology for AriZona.

"We can perform a detailed schedule within MES and then transfer that detailed schedule along with all the required process and order information and bring it right into SAP with no intervention from either party. That was a big step for us. The other benefit of course is getting real-time information back from MES on our production counts. So we get real-time inventory information, and we get real-time

SOURCE: INDUCTIVE AUTOMATION

Adding new recipes into the system was much easier than expected.



The Perspective application for phones and tablets shows a summary of current work orders, sugar tank inventories and syrup tank inventories.

change information in the system for detailed scheduling. A lot of benefit there for us."

Alex Hunt, quality manager for AriZona, agreed with Stergakos on the value of connecting the systems. "It's very important for us to be able to integrate MES with SAP for two reasons," said Hunt. "The first one is to ensure that all the material that gets purchased and used to make a batch is accounted for in SAP. And the second one, from a quality point of view, is for traceability, to know what ingredients went into every batch."

The SCADA system also improved data access and ease of use. "Ignition allowed us to integrate a lot of the controls into the batching, communicating with all the different systems in the plant," said Hunt. "It really smoothed out our process." He added that this SCADA system has been easier to use than other systems he's used in the past.

He was also impressed by the flexibility, which was especially helpful during the plant's first year of operation. "We were always adding new recipes into the system, and we found that it was much easier than we'd expected," said Hunt. "And it's also very easy to change current recipes. And to have real-time data is absolutely essential. As soon as a product is made, it needs to be shipped to another facility. But before we make each product, we have to create a batch. So we're basically doing just-in-time batching, and that would not be possible without a system like this, that can manage inventory and also manage packaging goods."

More data, more access

Vertech's Warning said the SCADA system gave AriZona benefits on several levels. "The flexibility and database integration made it an ideal platform to build a custom batch solution from the ground up that followed the core principles of ISA-88 — while also providing some freedoms to adapt the system to AriZona's business needs," he said.

Defining those business needs involved AriZona's core teams getting together to take a good look at their workflows. "We saw there were a lot of manual handoffs, where people were just exchanging information via emails and phone calls," said Stergakos. "So we designed a solution that removed those manual handoffs. We identified seven areas where we had those, and now we feel we're getting a lot out of the fact that we automated that."

The automated system with SCADA and MES helps AriZona convert manufacturing data into actionable analytics. It includes a best-in-class batch control system that interacts with every level of automation, from device control to SAP.

The system delivers data for overall equipment effectiveness (OEE), downtime tracking, scheduling, and finished goods reporting. And software licensing costs were lowered due to Ignition's unlimited licensing model, which brings no additional costs when adding more tags, clients, devices, or projects.

"The value of unlimited licensing was further enhanced as AriZona's IT group made SCADA clients accessible through their corporate business network," said Warning. "This gave management, quality, maintenance, and production planners access to SCADA and MES systems through their corporate laptops without additional licensing costs." With all the connections within the new plant, and the links to SAP, AriZona has more data to work with than it ever had before.

Going mobile

A key aspect of the solution is Ignition Perspective, which leverages the power of mobile devices. "The Perspective application for phones and tablets shows a summary of current work orders, sugar tank inventories, syrup tank inventories, and more," said Warning. "You can see what's been batched, and where the products are. You can see production packaging counts for OEE and downtime, and key performance indicators over the last seven days."

Usmani said Perspective has been very helpful for AriZona. "Being able to see data on tablets, on phones, and on screens around the plant is the key to success," said Usmani. "That has helped us tremendously to keep the costs down and look at our KPIs."

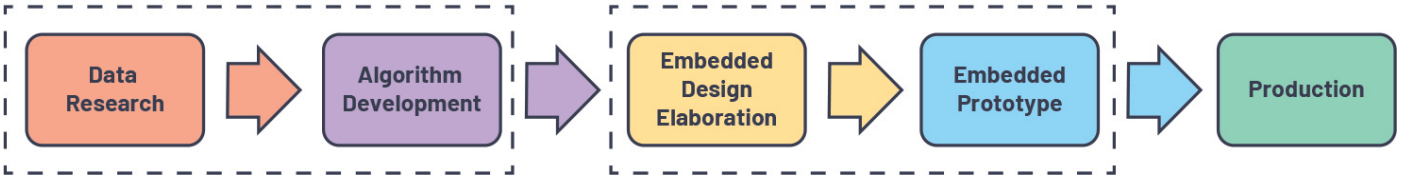
AriZona also appreciated all the help from its system integrator for this very ambitious project. "Vertech has been a great partner to AriZona," said Usmani. Stergakos agreed. "Our experience with Vertech has been outstanding," he said. "Our IT and operations teams have developed good relationships with the Vertech team. Their skills and knowledge are superior to other vendors we've worked with in the past."

*Application article by **Inductive Automation.***

Visit Website

Software enables algorithms for condition-based monitoring

In this introduction to the Condition-Based Monitoring Platform (CN0549), the focus is on the software ecosystem, data analysis tools, and software integrations available for the different components, and how engineers and data scientists can leverage them for application development.



SOURCE: ADI

Embedded system development flow.

WHEN CONDITION MONITORING SOLUTIONS are built, they must contain sensors, local processing, connectivity, and some form of software or firmware to make it all function. The CN0549 addresses all these challenges by providing customizable options for both the hardware and software aspects, so engineers and software developers can make design trade-offs in their applications while using common tools and infrastructure.

For example, if you want to choose a particular microcontroller or FPGA for your processing, prefer to use Python coding, or have a favorite sensor you'd like to reuse. This makes the CN0549 a powerful platform for those looking to build an optimized CbM solution where processing, power, performance, software, and data analysis can be customized to their needs.

Embedded system development

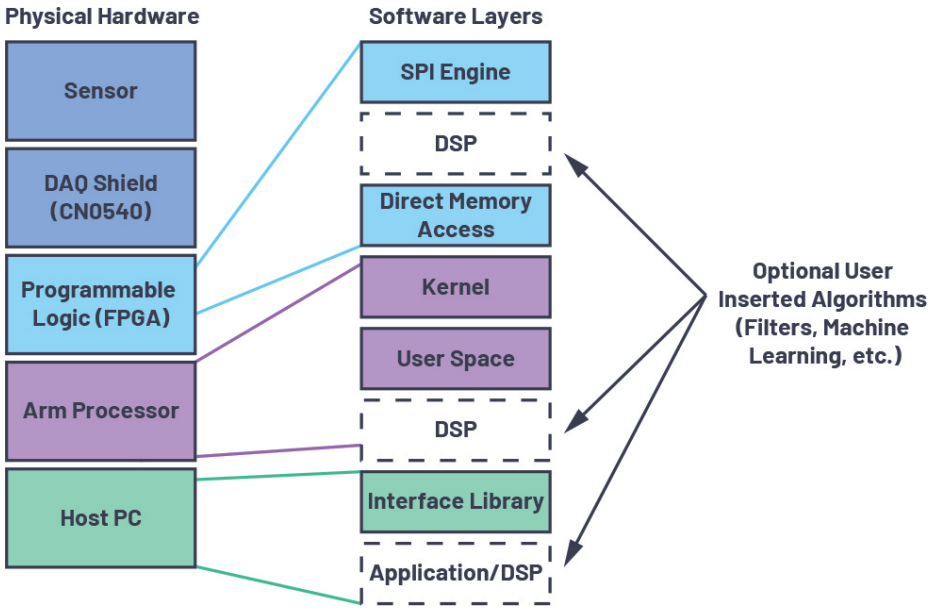
Let us consider a common development flow for an embedded system from conception to production. The figure above provides a top-level overview of an abstracted flow.

The first step in the design process shown above is the Data Research phase. In this phase, users map their requirements to the different hardware and software requirements needed for their application. From a hardware perspective, these may be parameters like shock tolerance, analog signal bandwidth, or measurement range. When considering the software requirements, the number of samples, sample rates, frequency spectrum, oversampling, and digital filtering are important parameters for CbM applications. The platform is very useful and flexible, allowing researchers to use different sensor combinations and tune the data acquisition parameters for their own application needs.

Following the Data Research phase is the Algorithm Development phase, where the application or use of the system is proven out. This usually entails developing models or designing algorithms in high level tools that will eventually be ported to the embedded system. However, before optimizing the design, it must be validated using real data and with hardware in the loop, and this is really where CN0549 excels because not only does it provide direct integration with popular high level analysis tools, but it also allows for hardware in the loop validation.

Once the design is proven, the job of optimizing and getting the necessary software components embedded begins. In the Embedded Design Elaboration phase, this can require re-implementation of certain algorithms or software layers to work in an FPGA or resource constrained microcontroller. Great care must be taken to continually verify the design as it is ported onto a prototype or near production hardware for final validation.

Lastly, we arrive at the Production phase, which likely has little resemblance to the original development environment the design began using, but nonetheless still needs to meet the same requirements. Since the final system may have migrated far from the original research system, running the same code or tests may be impossible or extremely difficult. This could lead to production testing issues and unit failures, and likely requires an additional time and money investment to remedy.

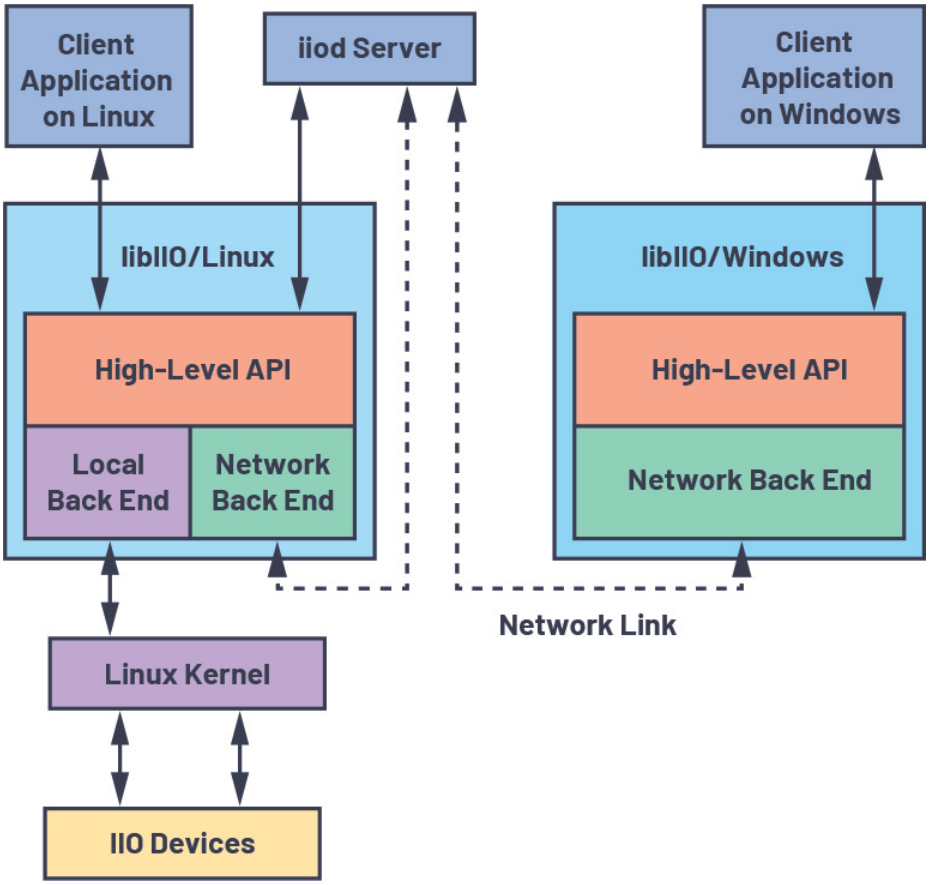


SOURCE: ADI

System stack of the CN0549 platform.

Reduce risk by maximizing reuse

One of the easiest ways to reduce risk during the design process is to reuse as many hardware and software components as possible



SOURCE: ADI

libIIO system outline using the network back end.

throughout each stage, and the CN0549 provides many resources out of the box for developers to leverage directly in all stages of the development flow.

The CN0549 solution offers schematics and board layout files, an open software stack for both optimized and full featured environments, and integration options for higher level tools like MATLAB and Python. End users can leverage validated components from ADI and choose the pieces they want to maintain or change as they move from research to production.

This also allows end users to focus on algorithm development and system integration rather than schematic entry with ADI parts or ground up software development. Leveraging hardware modules and reusing software layers, such as device drivers, HDL, or application firmware, from ADI reduces the development time required to build a system and can drastically accelerate time to market.

Development flows and processes

The CN0549 offers engineers a myriad of choices during development, allowing them to work in common languages, including C or C++, while using data analysis tools they are experienced with, such as MATLAB or Python. This is primarily done by leveraging and building on top of open standards, as well as solutions that support multiple embedded platforms from different manufacturers.

CN0549 system stack

The system stack provides the basic overview of the different components comprising the CN0549 system. In the dark blue boxes on the top left are the sensor and data acquisition (DAQ) board, while the light blue and purple boxes outline the FPGA partitions used for the data processing.

The platform directly supports the Intel DE10-Nano and the Xilinx CoraZ7-07s, covering both major FPGA vendors. The green box represents the connection back to the host PC. This provides direct data access from the hardware to the high level data analysis tools for algorithm development.

All of the hardware description language (HDL) code is open source, which allows developers to make modifications to insert digital signal processing (DSP) into the data streams within the programmable logic (PL). This could be anything from filters to state machines, even machine learning, and depending on your system partitioning, this step can also be done in the user space or the application layer. Since the code is openly available it could be ported to other FPGAs from different manufacturers or to different processor families depending on your end application needs.

Inside the Arm processor there are two software options. Their use will be dependent on use case and both likely will be used by most developers:

Linux: In-kernel drivers are provided for the DAQ shield built within the input output industrial (IIO) framework within the kernel. This is coupled with a full embedded Linux distribution called Kuiper Linux, which runs in the Arm core user space and is based off the Raspberry Pi OS.

No-OS: A bare metal project is provided with the same drivers used in the Linux kernel, which would be used with Xilinx's or Intel's SDKs. This can also be implemented into a real-time operating system (RTOS) environment as an alternative implementation.

It is recommended that developers start in Linux to learn and begin development with their system, since it provides the largest amount of tooling. Linux also provides an enormous number of packages and drivers, making for a desirable development environment. Once the system design is stable and ready for optimization, it is common to switch to No-OS and only ship the software that is necessary. However, this is highly application dependent and many will ship full Linux systems due to the flexibility they offer.

Like the HDL for the programmable logic, the entire kernel source, Kuiper Linux image, and No-OS projects are completely open source, which allows end users to modify any component as they wish. These code bases can also be ported to different processor systems if desired or different runtime environments.

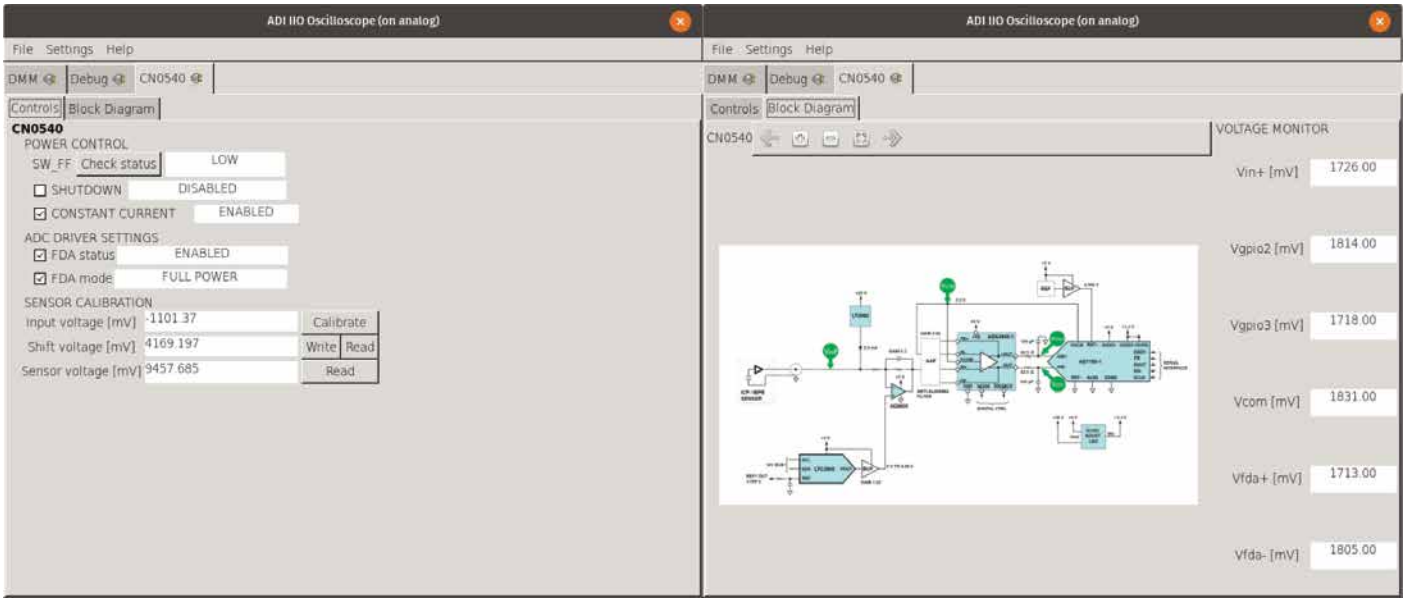
The last component of the system stack is the connection to the host PC, which is shown in the green box. When running the system, the devices can be configured, and data streamed backed to a host system for analysis where developers will create algorithms on their host machines leveraging standard tools like MATLAB or TensorFlow. Then shift those algorithms eventually to the embedded target, allowing them to use their local processing power for faster algorithm development iterations.

Accessing CbM Data

Utilizing the Arm processor and PL generally happens at stages further along in the design flow, when the system is being optimized for deployment. Therefore, a common entry point for developers initially will involve connecting remotely to the embedded system from a workstation.

When running Linux on the embedded system, running code remotely or locally on a workstation is a relatively transparent process due to how the infrastructure was designed. This is primarily due to an open library called libIIO.

libIIO is an interface library that allows for a simplified and consistent access model to different device drivers built within the Linux IIO framework in the kernel. This library is at the core of what makes using the CbM platform so flexible and provides the functionality for



SOURCE: ADI

data streaming and device control.

libIIO itself is broken into two main components. The libIIO library is a C library for accessing different IIO driver properties or functions that includes streaming data to and from devices like ADCs, DACs, and sensors.

The IIO daemon called iiod, which is responsible for managing access between the libIIO library, or clients using the library and the kernel interface to the actual drivers.

The libIIO and iiod are themselves written from different components that allow for different methods of access to the drivers in what are called back ends. Back ends allow control and dataflow for libIIO from local and remote users, and, since they are componentized, new back ends can be added into the system. Currently there are four back ends supported with libIIO:

Local: Allows for access of locally accessible drivers for hardware connected to the same machine.

USB: Leveraging libusb, this back end allows for remote control of drivers across a USB link.

Serial: Provides a more generic interface for boards connected through serial connections. UART is the most common use.

Network: The most used remote back end, which is IP based for access to drivers across networks.

The system-level overview shows how the components of libIIO would be used and how they fit into an overall system. On the left of the diagram is the embedded system, which has the libIIO library installed and runs the iiod daemon. From the embedded system, users have access to the local back end and even the network back end. In their code they could switch between both with a single line change to address either back end. No other changes to the target code are required.

The left-hand side of the diagram represents a remote host, which could be running any operating system. There are official packages for Windows, macOS, Linux, and BSD. In the diagram the network or IP-based back end is utilized, but this could also be a serial, USB, or PCIe connection. From a user's perspective, libIIO can be leveraged from the C library itself or many of the available bindings to other languages including: Python, C#, Rust, MATLAB, and Node.js. Providing a significant amount of choice for users that need to interface with different drivers from their applications.

Applications and tools

When getting started with a new device, using libIIO directly is generally not recommended. Therefore, many higher level applications exist that are built on top of libIIO that provide basic configurability for any IIO device from the command line and in GUI format. These are the IIO Tools and IIO Oscilloscope, respectively.

The IIO Tools are a set of command line tools that ship alongside libIIO and are useful for low level debugging and automatic tasks through scripting. For example, for lab testing it can be useful to set up the platform in different sample rate modes and collect some data. This could be easily done with a few lines of bash or through a batch script leveraging the IIO Tools.

However, the most common entry point for users is the GUI application IIO Oscilloscope, typically referred to as OSC. OSC, like the IIO Tools, is designed to be generic to allow control of any IIO driver, and, since it's based on libIIO, it can be run remotely or on the board itself. However, it also contains a plugin system where specialized tabs can be added for specific drivers or combinations of drivers.

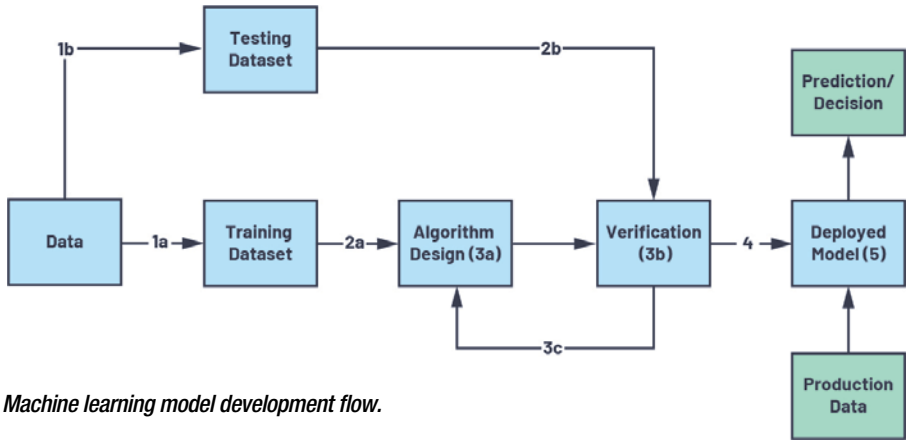
The figure above shows the plugin tabs loaded automatically for CN0540-based boards, including the controls and monitoring tabs. These tabs provide an easy interface to access the low level functionality of the CN0540's ADC, DAC, and control pins, as well as a basic diagram of the data acquisition board and test point monitoring. There is further OSC documentation available on the Analog Devices Wiki if you wish to learn about the other default tabs and plugins available.

The final important aspect of OSC is the capture window. The capture windows provide plotting capability for data collected from ADCs or any libIIO-based buffer. A capture window is used in Frequency Domain mode, where the spectral information of the data is plotted. Other plots, including time domain, correlation, and constellation plots, are available. This is useful for spot checking a device, debugging, or during the evaluation process. The plots include common utilities like markers, peak detection, harmonic detection, and even phase estimation. Since OSC is also open source, it can be extended by anyone to add more plugins or plots, or even modify existing features.

Algorithm development environment

So far, we have covered the core low level tools where most engineers start when first using the CN0549. These are important to understand first so developers can understand the flexibility of the system and the different choices or interfaces they can utilize. However, after getting a baseline system up and running, developers will want to quickly move the data into algorithmic development using tools such as MATLAB or Python. Those programs can import the data from the hardware. Additional control logic can be designed when necessary.

In the context of a machine learning development cycle, there is usually a common flow that developers will follow independent of their desired software environment for working with data. An example of this process is where data is collected, split into testing and training, a model or algorithm is developed, and finally the model is deployed



Machine learning model development flow.

SOURCE: ADI

for inferencing in the field. For real services, this overall process is continually performed to introduce new learnings into production models. Tools like TensorFlow, PyTorch, or the MATLAB Machine Learning Toolbox work with this process in mind. This process makes sense but usually the effort in collecting, organizing, and the complex task of managing the data can be overlooked or completely ignored. To simplify this task, an associated software ecosystem was designed with these tools and packages in mind.

Python integration

First, starting in Python, device specific classes for the CN0549 are available through the module PyADI-IIO. A simple example of configuring the device's sample rate and pulling a buffer over Ethernet is provided where there are no complex register sequences, obscure memory control calls, or random bits to memorize. That is managed for you by the driver, libIIO, and PyADI-IIO running on the board itself, remotely on a workstation, or even in the cloud.

PyADI-IIO, which is installable through pip and conda, exposes control knobs as easy to use and documented properties. It also provides data in commonly digestible types like NumPy arrays or native types and will handle unit conversions of data streams when available. This make PyADI-IIO easy to add to environments like Jupyter Notebook, and to easily feed data into machine learning pipelines without having to resort to different tools or complex data conversions—allowing developers to focus upon their algorithms, not some difficult API or data conversations.

MATLAB integration

On the MATLAB side, support for CN0549 and its components are provided through the Analog Devices Sensor Toolbox. This toolbox, like PyADI-IIO, has device specific classes for different parts and implements them as MATLAB System Objects (MSOs). MSOs are a standardized way that MathWorks authors can interface to hardware and different software components, and provide advanced features to assist with code generation, Simulink support, and general state management. Many MATLAB users likely utilize features of MATLAB that are implemented as MSOs without knowing, such as scopes or signal generators.

In using the CN0532 interface and a DSP Spectrum Analyzer scope, both of which are implemented as MSOs, again like PyADI-IIO, there is a friendly interface for traditional MATLAB users.

Beyond hardware connectivity, the Sensor Toolbox also integrates with the code generation tools for HDL and C/C++. These are great tools for developing, simulating, and deploying IP, even for those who are unfamiliar with HDL design or tooling but understand MATLAB and Simulink

Using TensorFlow

There are several examples provided with the CN0549 kit from basic data streaming to a machine learning classification example. Machine learning for time series data, like vibration data from CN0532, can be approached from a few different perspectives. This can include support vector machines (SVM), long short-term memory (LSTM) models, or even autoencoders if the data is interpreted directly as a time series. However, in many cases it can be more convenient to transform a time series problem into an image processing problem and leverage the wealth of knowledge and tools developed in that application space.

Let us look at this approach in Python. In one of the examples provided with PyADI-IIO, several measurements were taken by mounting the CN0532 to an oscillating fan. This was done at different settings for the fan (Sleep, General, Allergen) and, in each mode, 409,600 samples were captured. When examining this data, the time domain for the Allergen case is easily identified but the other two cases are more difficult to distinguish. These might be identifiable by inspection but having an algorithm identify these cases may be error prone in the time domain.

To help distinguish the use cases better, the data was transformed into the frequency domain and spectrograms were used to plot the concentration of different frequencies over time. The spectrograms have a much starker difference in the data and are consistent across the time dimension. These spectrograms are effectively images and now can be processed using traditional image classification techniques.

Splitting the dataset into training and testing sets, the spectrograms were fed into both a neutral network (NN)-only model with three dense layers and a smaller convolutional neural network (CNN) model. Both were implemented in TensorFlow and able to converge easily to near 100% test validation in under 100 epochs. The CNN converged in about half the time with roughly 1% the tunable parameters, making it by far the more efficient design. A training convergence plot of accuracy vs. epoch outlines the fast convergence of the CNN.

Edge to Cloud: moving into an embedded solution

Once a model is created, it can be deployed for inferencing purpose or decision making. With the CN0549, this could be placed on a remote PC where data is streamed from the CN0540 or directly run on the embedded processor. Depending on the implementation, placing the model within the processor will require more engineering effort but can be an order of magnitude more power efficient and will be able to operate in real-time. Fortunately, over the last several years there has been tremendous development growth in tools and software for deployment of machine learning models.

Leveraging FPGAs

Both Xilinx and Intel have high level synthesis (HLS) tools to translate high level languages into HDL code that runs on the FPGA. These will usually integrate with Python frameworks like TensorFlow, PyTorch, or Caffe to aid with model translation into IP cores—allowing engineers to deploy IP to either the DE10-Nano, Cora Z7-07S, or custom system.

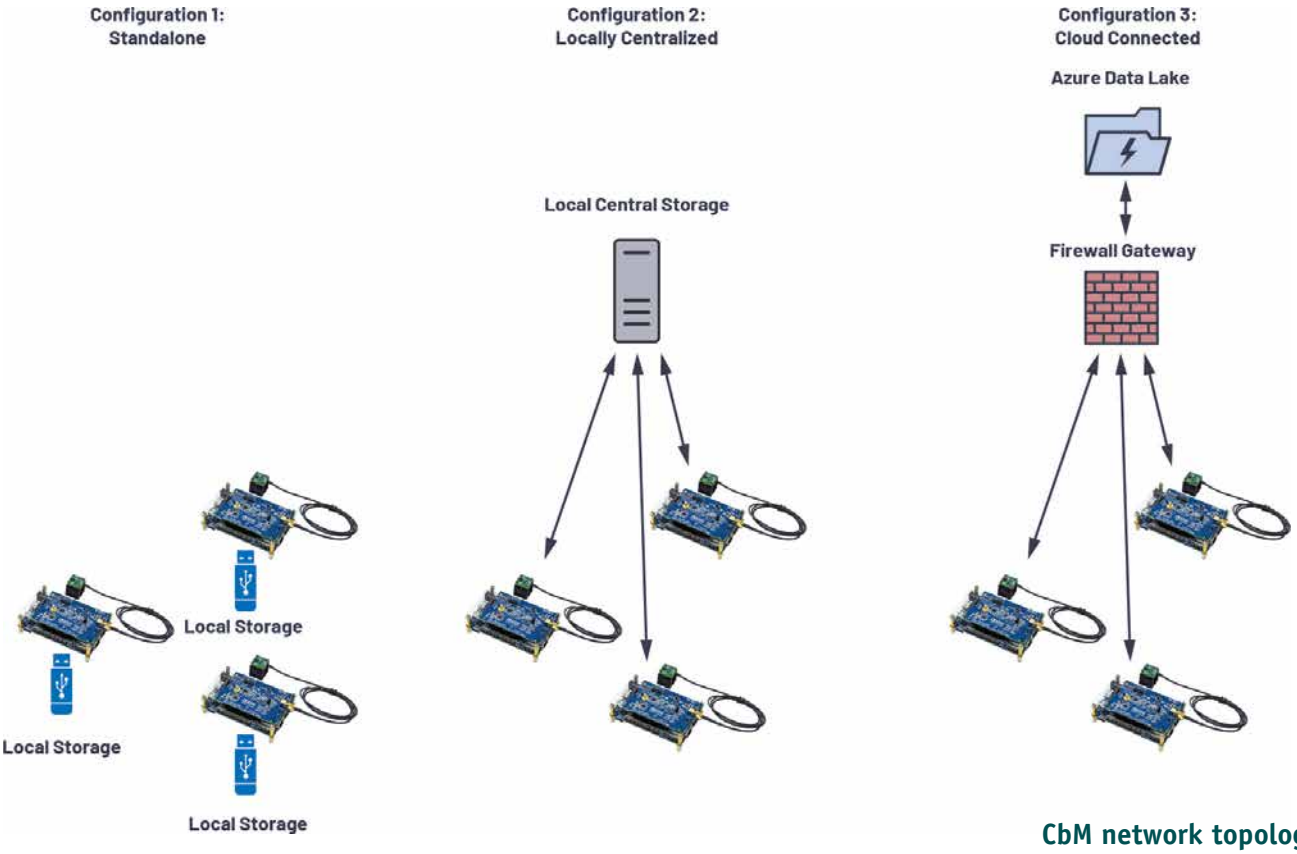
These IP cores then would be stitched into the open HDL reference designs provided by ADI. In the design, data from the CN0540 is read through the SPI pin, and the 24-bit samples are interpreted by the SPI engine and passed to the DMA controller into memory. Any DSP or machine learning model could be inserted into this pipeline directly in the datapath.

Utilizing microprocessors

Instead of converting the algorithms to the HDL layer, they could instead be run directly in the Arm core. Depending on data rates and complexity of the algorithms, this is a reasonable development path and typically much more straightforward.

Developing C code or even Python for the Arm core will take considerably less development resources and time than HDL

SOURCE: ADI



CbM network topologies

and is usually easier to maintain. Tools like MATLAB Embedded Coder can even streamline this process and automatically convert MATLAB to embeddable and optimized C code for the Arm core. Alternatively, TensorFlow has tools like TensorFlow Lite that are embeddable C versions of their Python libraries to allow for simpler transitions toward an embedded target.

Smart decision-making topology

Condition-based monitoring is not a one size fits all space for hardware and software, which is why the CN0549 was designed to be flexible. When we consider problems like anomaly detection for CbM, it can usually be approached from two time scales: one where we need to react immediately, such as in a safety-related scenario, or on a long-term time scale more related to maintenance or equipment replacement. Both require different algorithms, processing power, and approaches.

As a machine operator in the ideal case, we would have a large data lake to train our models from, and both handle short-term detections without nuisance events, as well as stream data continuously from running equipment for future maintenance projections. However, for most operators this is likely not the case and the data lakes are more like dry riverbeds.

It also may be difficult for some off the shelf solutions to perform data collection given security concerns, physical locations, networking, or topology requirements. These difficulties drive the need for more custom solutions.

CN0549 is a standalone system with several connectivity options. Since it runs standard Linux, traditional networking stacks like Ethernet and Wi-Fi work out of the box and it is even possible to connect cellular modems if needed. In practical applications, there are a few typical topologies that standout.

One configuration is the offline collection case, which can happen at remote sites or where connectivity to the internet is just not possible. In this case large storage media will coexist with the platform and is manually collected on a schedule. Alternatively, the other two options stream data to a common endpoint.

Another configuration is an isolated network that could be internal only to the organization, or just a cluster of platforms in a remote location that centrally collect data. This may be required for security concerns or just lack of connectivity. The setup is easy for any of these configurations and could be customized for an end deployment's specific needs.

A final configuration is a direct cloud option where each platform directly accesses the internet and pushes measurement to the cloud. Since the CN0549 runs on Linux, the platform can leverage APIs for different cloud vendors like Microsoft Azure IoT or Amazon IoT Greengrass easily from languages like Python—creating an easy avenue to start building a data lake for the newly connected equipment.

When there is consistent connectivity between the cloud and local process, different algorithms can be split as we have discussed between what needs or can to run locally and what can be run in the cloud. This will have natural trade-off between requirements on processing power for algorithm complexity, latency to events, and bandwidth limitations on what can be sent to the cloud. However, since it is so flexible these factors can be easily explored.

Conclusion

The CN0549 CbM platform provides system flexibility and software resources to designers when developing their applications. A deep dive into the software stacks has been provided with discussions around how the different components can be leveraged for CbM and predictive maintenance (PdM) developments.

Due to the openness of the software, HDL, schematics, and integrations with data science tools, designers can leverage the components they need for their end system throughout the entire stack. In summary, this condition monitoring design offers an easy to use out-of-the-box solution, complete with open-source software and hardware, to provide flexibility and allow designers to achieve better, customized results in less time.

Travis Collins, Senior Algorithms Engineer, ***Analog Devices.***

Visit Website

Digital performance management

New IIoT offering from PTC Is a self-monitoring, self-measuring tool for closed-loop problem solving.

PTC's new ThingWorx Digital Performance Management Solution drives manufacturing efficiency. DPM provides performance insights and enables real-time, closed-loop problem solving. It delivers one universal view of performance, communicated in an understandable business metric: hours. This metric is easily understood across frontline workers, managers, and executives, and provides a foundation for an enterprise-scale solution. DPM supports investment accountability by validating outcomes for transformational investments with real-time production data and easy-to-calculate financial improvements.

"Manufacturers consider digital transformation essential, yet often see only incremental improvements as opposed to large-scale transformational improvements," said Craig Melrose, EVP, Digital Transformation Solutions, PTC. "PTC's new ThingWorx DPM Solution enables companies to address the most valuable manufacturing improvements and solve common challenges."

With DPM, companies can identify the right performance issues to drive efficiency; empower frontline workers to take corrective action; gain visibility into bottlenecks, root causes, and the most critical areas to focus on for improvement; measure results with performance data to ensure actions produce the desired outcomes; and achieve rapid time to value and scale, with initial results in as little as 90 days.

SOURCE: PTC

Manufacturers empowered with visibility into performance, analysis of production bottlenecks, and outcomes.

The new product provides a scalable technology solution that can systematically and dynamically identify production constraints, prioritize root causes, recommend and manage corrective actions.

PTC

Learn More

New remote access solution

New solution allows OEMs to troubleshoot equipment from anywhere and reduce customer downtime.

During the global pandemic, OEMs have been using remote connectivity to customers' equipment to not only reduce workplace exposure to COVID-19, but also reduce travel, service equipment faster and reduce downtime. Now, OEMs can more easily realize the benefits of remote access using the new remote access solution for industrial equipment from Rockwell Automation.

The solution packages together everything OEMs need to remotely access and support equipment, including the following.

The FactoryTalk Remote Access cloud-based software, allows OEMs to manage, configure and initiate secure connections to a customer's equipment.

The Stratix 4300 remote access router is installed at the customer's site to provide remote access to the equipment.

The remote access solution incorporates robust security capabilities including multi-factor authentication and encrypted protocols. A digital input also gives on-site staff control of remote connections, so they're only made when enabled locally.

To ease deployment, the solution requires no changes to an existing architecture so long as an Ethernet port is available.

SOURCE: ROCKWELL AUTOMATION

The remote access solution incorporates robust security capabilities including multi-factor authentication and encrypted protocols.

The remote access solution can position OEMs to meet current and future remote support needs. The router supports today's data requirements, and all-gigabit ports make it ready for newer, more bandwidth-heavy remote support capabilities as needed. The solution is designed for OEMs that want to support remote and hard-to-reach operations.

Rockwell Automation

Visit Website

IO-Link pressure sensor

New pressure sensor, SCPSi, with IO-Link functionality for use in smart Internet of Things applications.

Parker Hannifin has launched a new SCPSi pressure sensor with IO-Link functionality to meet customer demand in more and more smart industrial environments.

The sensor, which has an optimised, compact design, enables particularly simple and fast commissioning and parameterization thanks to the IO-Link interface. This means that data is available more quickly and in a standardised form for use, for example, in an ERP system. This ultimately leads to cost savings and increased efficiency.

With the help of the IO-Link technology, data is transmitted interference-free. The data transmission is based on a 24V signal, which is completely digital. The signal transmission is very safe against external influences. Inaccuracies in measurements are thus a thing of the past.

With the IO-Link technology, a wide variety of values can be measured. This gives the user more flexibility and the possibility of simple integration into existing systems. Condition monitoring applications can therefore be easily designed. Remote diagnostics are also possible via the IO-Link sensor.

Two switching outputs are individually and safely parameterized from the machine control system via the standardized digital IO-Link interface (IEC 61131-9). This replaces manual programming and the commissioning phase is considerably shortened.

Devices can be replaced during operation without the need for reparameterization. In order to react promptly to machine status changes or process adjustments, the re-parameterization is carried out during operation.

SOURCE: PARKER

The SCPSi is a fully electronic pressure sensor that measures and monitors the pressure of machines and systems.

Parker

Visit Website

IEC 61850 ControlLogix® module

Streamlined integration between IEC 61850 devices and library of Rockwell electrical protection devices.

ProSoft Technology announced a new IEC 61850 module for ControlLogix® systems. The in-rack product integrates seamlessly with a library of electrical protection devices from Rockwell Automation. The solution enables an Intelligent Packaged Power system, connecting an industrial enterprise and increasing productivity.

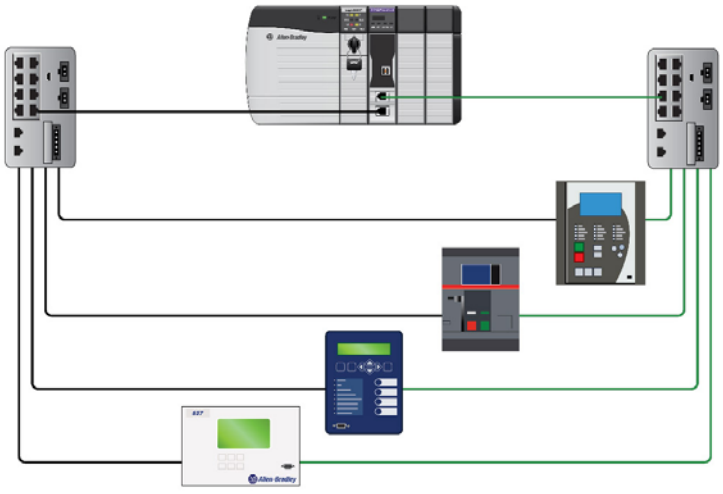
"Industrial customers in mining and metals to oil and gas face challenges to remain profitable while accommodating changing commodity pricing and regulations. Plus, they may be facing aging production infrastructure," said Andrew Schaeffler, Sr. Product Specialist at Rockwell Automation.

He explained, "Integrating reliable data is key to boosting productivity, operating efficiencies, and safety." Solutions from Rockwell Automation and ProSoft Technology connect data, equipment control, and power management in harsh manufacturing and processing environments.

Industrial customers rely on power protection relays (or IEDs) from various vendors. IEC 61850-enabled devices support a standardized data structure across these devices, increasing vendor flexibility for end users. Each ProSoft IEC 61850 client module supports up to 40 IEDs on a redundant PRP-enabled network, and up to a maximum of 225 I/O connections to the ControlLogix processor.

The new module also represents a first for ProSoft, and features the use of GOOSE Publisher, which is used to support GOOSE messaging for the product.

SOURCE: PROSOFT



A PRP-enabled network provides seamless failover of redundant networks.

ProSoft

Visit Website

Ruggedized Gigabit Ethernet Switch

Switch helps users unlock the promise of high-speed data throughput in transportation applications.

Engineered for ultra-reliable performance in the harshest industrial environments, the new LMP-1802G-M12-10G-SFP-67-24-T Gigabit Ethernet managed switch from Antaira Technologies helps users unlock the promise of high-speed data throughput in transportation applications.

It offers enterprise-class capabilities leveraging M12 shock- and vibration-proof connectors, two 1G/10G SFP slots, 16 port 10/100/1000Base-T(X) PoE/PoE+ 30W/port single cable connectivity for up to 240W total power with data, and multi-user account security to protect mission-critical applications.

The LMP-1802G-M12-10G-SFP-67-24-T employs DHCP option82 and static routes in its Light Layer 3 network management that cost-effectively supports standardized network redundancy ITU-T G.8032 ERPS v2 (Ethernet Ring Protection Switch) protocol, providing <50ms recovery time to the network. It provides one easy-to-manage solution that meets the connection needs of IT professionals for multiple Ethernet-enabled devices on the same LAN or subnet. Now, users can realize high bandwidth switching and accelerated data exchange across networks with a large port capacity to adapt to expanding connectivity requirements.

SOURCE: ANTAIRA

Switch features two 10G SFP slots and designed as solution for upgrading IoT infrastructure to gigabit speeds.

Hardened against the stresses of heavy vibrations, shock and surge, electrical noise, and temperature extremes from -40° C to 70°F, the LMP-1802G-M12-10G-SFP-67-24-T is designed to be a proven industrial-grade switching platform that meets demanding IT compliance requirements.

Antaira Technologies

Learn More

Azure machine learning support

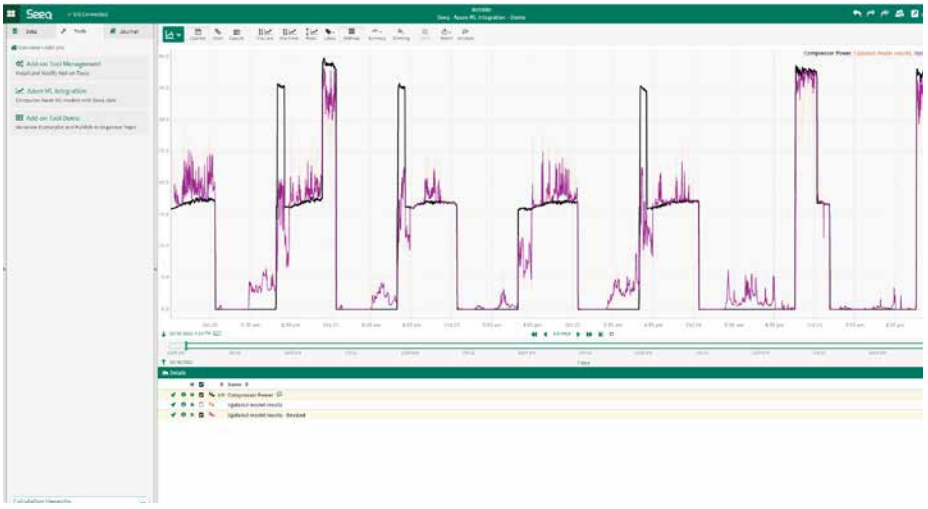
Seeq Azure add-on feature enables deployment of Azure Machine Learning algorithms to plant employees.

New Seeq Azure Add-on enables process manufacturing organizations to deploy machine learning models from Azure Machine Learning as Add-ons in Seeq Workbench. The result is machine learning algorithms and innovations developed by IT departments can be operationalized so frontline OT employees can enhance their decision making and improve production, sustainability indicators, and business outcomes.

Seeq customers include companies in the oil & gas, pharmaceutical, chemical, energy, mining, food and beverage, and other process industries. Seeq's strategy for enabling machine learning innovations provides end users with access to algorithms from a variety of sources, including open source, third party and internal data science teams.

With the new Azure Machine Learning integration, data science teams can develop models using Azure Machine Learning Studio and then publish them using the Seeq Azure Add-ons feature, available this week on GitHub.

Using Seeq Workbench, frontline employees with domain expertise can easily access these models, validate them by overlaying near real-time operational data with the model results, and provide feedback to the data science team.



SOURCE: SEEQ

The Seeq Azure Add-on creates opportunities for organizations to scale up model deployment and development.

This enables an iterative set of interactions between IT and OT employees, accelerating time to insight for both groups, while creating the continuous improvement loop necessary to sustain the full lifecycle of machine learning operations.

Seeq

Visit Website

Data-intensive IoT Edge applications

New industrial computer offers extensive functionalities and increased computing power.

Kontron is expanding the KBox A series with the box PC KBox A-150-WKL. With Intel Core U or Intel Celeron processors 8th generation KBox A-150-WKL provides high computing performance with low power consumption. The compact box PC offers a wide range of interfaces as well as numerous expansion options that make it ideal for use in fieldbus environments, in process control, as well as for industrial firewalls and many other embedded applications. The KBox A-150-WKL can be easily integrated into a wide variety of industrial environments.

The KBox A-150-WKL is the newest member of the KBox family and was specially designed for IoT gateway applications in industrial environments. The built-in 3.5 "-SBC combines powerful SoC processor technology, a compact design and extensive connectivity. With the integrated Intel Core i3-8145UE / i5-8365UE / i7-8665UE or Celeron 4305UE processors with up to four cores and 4.4 GHz (burst) each, the new box PC supports OEM manufacturers and system integrators in exploiting the full potential of their IoT infrastructures. Thanks to the compact design of 50 x 180 x 134 mm and the flexible DIN rail mounting option, the KBox A-150-WKL can also be used in a small installation space without complications. The fanless, robust design with rotatable heat sink guarantees an extended service life and high availability.

SOURCE: KONTRON

New industrial computer from the KBox A series offers 8th Gen Intel Core U processors .

To connect the KBox A-150-WKL to the sensor and machine environment, the CPU has two serial RS232 / 422/485 interfaces. For a high level of connectivity, it was equipped with numerous other interfaces, including two DisplayPort, four USB 3.1 and two Gigabit Ethernet connections with IEEE1588 support.

Kontron

Visit Website

mobilLink power interface

Softing's mobilLink power interface can now be used with Emerson's AMS Instrument Inspector.

mobiLink Power, Softing's multiprotocol interface for commissioning and maintenance of field devices in process automation can now be used with Emerson's AMS Instrument Inspector to access Foundation Fieldbus devices.

mobiLink Power simplifies mobile access to field devices for process industry operators and supports the three most used communication protocols: HART, Foundation Fieldbus (FF) and PROFIBUS PA.

It has an integrated power supply which eliminates the need for additional components during use in workbench applications. A FDI CommServer (Field Device Integration Communication Server) is now available for mobiLink Power, making it fit for accessing Foundation Fieldbus (FF) devices with Emerson's AMS Instrument Inspector.

AMS Instrument Inspector continues Emerson's commitment to openness and support for the latest device protocol standards by delivering a PC-based HART and Foundation Fieldbus host using FDI technology. AMS Instrument Inspector provides a simple device integration solution that allows users to easily perform basic device configuration tasks.

SOURCE: SOFTING

The mobilLink interface for field devices can now be used with Emerson's AMS Instrument Inspector .

The uniform FDI standard solves the problem of integrating field devices with the multitude of networks, operating systems, and control systems used in the process industries.

FDI offers a future-proof solution for uniform device integration for all control systems, field devices and protocols found in process automation applications.

Softing

Visit Website

Circular connectors deliver flexibility

Circular connectors for power, signals and networking easy to install and maintain for industrial applications.

Dinkle International announced availability of its circular connector portfolio, providing dependable connectivity options to ensure increased equipment productivity, even in the most challenging conditions.

Products are available in M12 and M8 sizes with a variety of pin arrangements, each following standard coding protocols to facilitate integration with industrial control systems, sensors, and actuators of all types. Various configurations are available for single-ended and double-ended cordsets, with straight or angled male or female connectors.

Also available are casing-mount device connectors (front lock and rear lock) with pigtails, and solderable PCB connectors.

Nickel-plated die-cast fittings deliver a positive mechanical connection even in applications with high humidity, large temperature changes, and/or excessive vibration.

Copper alloy gold-plated contacts for conductors and grounding pins provide reliable electrical connectivity, and sealing rings ensure that installed connections are airtight and waterproof.

Circular connector products are UL Listed, RoHS compliant, waterproof and dustproof to IP67 and above, and all are designed to resist corrosion from salt spray for 96 hours. They also are designed in accordance with appropriate standards, such as IEC 61076, 60512, and 60529.

High-quality cables are constructed in various materials to suit a wide variety of industrial applications. PVC is best when high rigidity and solvent resistance are required—and for high-temperature, high-pressure washdown environments.

SOURCE: DINKLE

Circular connectors designed for even in the most challenging field and factory environments.

Dinkle International

Visit Website

Industrial cellular wireless products

Westermo launches range of products to support IIoT and M2M applications at remote sites.

Westermo has launched a new range of industrial cellular wireless products designed to provide resilient data communications for remote sites. The Merlin range of compact, rugged and secure cellular solutions has been specifically developed to support industrial IoT (IIoT) and machine-to-machine (M2M) solutions in demanding utility, infrastructure and transportation applications.

The first Merlin products to be released are the 4600 series, which further strengthen Westermo's existing range of industrial wireless routers.

These four compact and feature-rich devices provide high-speed data network connectivity for demanding industrial, smart grid, and rail trackside applications. The routers meet the requirements of IEC 61850-3 Class 1 Medium Voltage substation and railway trackside EN 50121-4 standards.

The Merlin range has been designed to be easy to install and maintain. When coupled with Westermo's zero touch deployment software Activator, the Merlin devices provide cost-effective, reliable and consistent onboarding within large-scale projects.

To achieve best-in-class cybersecurity, the Merlin 4600 series is equipped with a TPM (trusted platform module) chip that keeps cryptographic keys secure, while Secure Boot ensures that the routers boot using only software signed and trusted by Westermo. A set of cybersecurity tools is available as standard, including virtual private network (VPN) and stateful firewall support for data security and user authentication.

SOURCE: WESTERMO

Compact, rugged, secure wireless routers for demanding utility, infrastructure and transportation applications.

Westermo

Visit Website

Power conversion system

Siemens presents liquid-cooled, robust power conversion system based on the SINAMICS S120 platform.

The SINAMICS PCS grid converter makes locally generated batter power usable for industrial and public power grids. SINAMICS PCS controls the charging and discharging process of the battery and helps to handle load peaks and grid disturbances via the battery storage, to store the electricity in an energy- and cost-efficient manner, and to bring the energy stored in batteries efficiently and reliably into the grid.

The grid converter is based upon the industry proven technology of the SINAMICS S120 drive platform and works very energy-efficiently thanks to liquid-cooling. The compact and robust power conversion system includes connection technology and control, line filter, drive and liquid-cooling, and can be easily integrated as a complete system in control rooms or containers.

SINAMICS PCS is certified in accordance with the "Technical Connection Rules" VDE-AR-N 4110, which is valid in Germany. This means that stationary battery storage units can be connected to the public medium-voltage grid with minimal system certification effort.

A validated Matlab/Simulink simulation model simplifies and accelerates the planning, optimization and grid integration of the power conversion system — and thanks to the SINAMICS Startdrive tool in the TIA Portal engineering framework, the grid converter can be easily integrated into the drive world. Operating states and system parameters can be read out via the Profinet communication interface, which allows data from operation to be monitored and analyzed.

SOURCE: SIEMENS

SINAMICS PCS is a liquid-cooled, robust power conversion system for battery storage systems.

Siemens

Visit Website

Embedded devices from edge to cloud

Cryptographic controller provides 30x lower power and industrial-grade protection.

Analog Devices, Inc. unveiled the ultra-low power MAXQ1065 cryptographic controller featuring its proprietary ChipDNA™ physically unclonable functionality (PUF) technology, which offers the strongest protection for edge-to-cloud Internet of Things (IoT) nodes, including medical and wearable devices, against invasive security attacks. The security co-processor provides 30x lower power when compared to similar products and its extended lifetime and operating range make it well-suited for long-term deployments in harsh environments.

The MAXQ1065 security co-processor provides turnkey cryptographic functions for root-of-trust, mutual authentication, data confidentiality and integrity, secure boot, secure firmware update, and secure communications. It includes standard algorithms for key exchange and bulk encryption, or complete transport layer security (TLS) support.

The device integrates 8KB of secure storage for user data, keys, certificates and counters with user-defined access control and life cycle management functionality for IoT equipment.

The MAXQ1065's low power consumption and wide operating range makes it suitable for battery-powered applications, and the very small footprint and low pin count enable easy integration into medical and wearable devices. The MAXQ1065 life cycle management allows flexible access control rules during the major life cycle stages of the device and end equipment, ensuring long-term operation in harsh environments.

SOURCE: MAXIM - ADI

Cryptographic controller provides 30x lower power and industrial-grade protection for battery-powered devices.

Maxim - ADI

Visit Website

GbE M12 X-Coded CMI module

Circular connectors for power, signals and networking easy to install and maintain for industrial applications.

Cincoze has launched a new GbE M12 X-Coded CMI module for railways. Cincoze realizes that safety is a top priority in rail transit, and real-time monitoring and transmission of information is critical for achieving this. This latest CMI module is compatible with two major Cincoze product lines: the DIAMOND Series rugged embedded computers (DS, DI, and DX series) and GOLD Series embedded GPU computers (GM and GP series). The new module is easy and convenient to install, stabilizes data transmission, and ensures a comprehensive safety overview of trains, gates, and other areas in rail transit.

The all-new GbE M12 X-Coded CMI module (CMI-XM12LAN01) has a server-grade Intel® i210 Gigabit Ethernet Controller, which supports jumbo frames, Wake-on-LAN, teaming, and PXE for fast and reliable data transmission and remote wake-up. The GbE LAN module has four M12 X-Coded connectors, each with a robust locking mechanism that eliminates signal loss under high vibration. This design is particularly suitable for long-term use on railways.

Given the many different X-Coded styles on the market, Cincoze has taken great care in using the industry-standard M12 X-Coded pin assignments used by more than 80% of railways. Standardizing means customers can avoid the struggle of rewiring and customizing the cables for monitor cameras and sensors after purchase. The CMI-XM12LAN01 module has an independent control chip, which improves transmission efficiency and can be used with Intel® Teaming to achieve fault tolerance and ensure sustained operational performance. This module can be paired with the PoE CFM module, for future upgrades.

SOURCE: CINCOZE

New module is easy and convenient to install, and stabilizes data transmission.

Cincoze

Visit Website

Programmable input/output module

The first industrial programmable I/O module based on new Raspberry Pi's RP2040 microcontroller.

Just a few months after the initial release of the Raspberry Pi RP2040 microcontroller, Sfera Labs has introduced the first industrial product based on this new chip. The Iono RP is a compact programmable I/O module that combines the ease of use of the Raspberry Pi with a wide choice of digital and analog input and output interfaces. The result is a rugged, safe, reliable, and easy-to-connect module (fully CE, FCC, and IC compliant) suited for installation in industrial environments.

Iono RP incorporates the RP2040, the first high-performance microcontroller chip designed by Raspberry Pi and aimed at both industrial and hobbyist markets. It features a dual-core Arm Cortex-M0+ processor, clocked at up to 133MHz, plus 264kB internal RAM and a very flexible input/output internal architecture with several standard interfaces.

Along a wide range 12-24V power supply input and power relay outputs, Iono RP supports industry-standard 0-10V/4-20mA analog inputs, a 0-10V analog output, digital input/output lines, and an RS-485 serial interface. All of this is housed in a compact DIN rail case, ready to be installed in electrical cabinets and automation control systems.

The Iono RP leverages support built up around the RP2040, as well as the powerful, yet straightforward, development tools and documentation accompanying it. Control software development could not be easier, thanks to the popular MicroPython and C/C++ programming languages and the convenience of drag-and-drop programming using mass storage over USB and the on-chip boot loader.

SOURCE: SFERA LABS

Engineers can use the Iono RP as the basis for creating exciting new automation and control applications.

Sfera Labs

Visit Website

Enclosures protect data/signals

Rectangular enclosures with EMC shielding protect sensitive signals from external electromagnetic signals.

Today's advanced automation systems are required to continuously process large amounts of sensitive data/signals to operate machines while reducing errors. However, the data/signal on the manufacturing floor has been exposed to various problems associated with electromagnetic noise made from surrounding electrical or electric machines.

When electromagnetic noise is added to electronic devices from the outside, unintended electrical signals may be induced to the circuits in the devices and it can lead to a malfunction, damage to sensitive electronic components, and downtime.

Mencom offers rectangular enclosures with EMC shielding to protect the sensitive signals from external electromagnetic signals but also to seal stronger signals from leaking to the outside and interfering with surrounding electronics. According to the transfer impedance measurement test by CESI EMC Laboratory based on German Military standards VG 95214-10 and VG 95214-11, Mencom's EMC series enclosures with dedicated electromagnetic shields provide additional improvements with better shielding attenuation than their standard metal enclosures that already provide a decent level of shielding attenuation. These EMC enclosures are especially useful when sensitive electronics transmitting critical data/signal operates near welding robots because the EMC series rectangular enclosures can effectively protect the signals and communication inward and outward from electromagnetic interference (EMI) or radio frequency interference (RFI).

SOURCE: MENCOM

The surface of the enclosures and gaskets are corrosion resistant and engineered to be extremely conducive to seal off stray EMI/RFI signals.

Mencom

Visit Website

Upgrading HART & Modbus devices

commKit supports Integrator Function Block and Standardized Connection Points for FOUNDATION Fieldbus.

Softing's commKit is a set which combines hardware, software, and customer specific consulting services for device manufacturers in the process industry who want to upgrade their existing HART or Modbus field devices for FOUNDATION Fieldbus or PROFIBUS PA in a fast and easy way. It consists of commModule MBP (Manchester Bus Powered), an interface hardware module for FF H1 or PROFIBUS PA, the software tool commScripter for generating the device-specific mapping function and a support service that accompanies the customer all the way to certification.

Pre-certified hardware and pre-installed firmware reduce complex and expensive embedded software development to writing a simple parameter mapping table. This saves extensive programming effort and guarantees a fast time to market.

In the new version (V3.50), the commScripter Software for FF now supports Integrator Function Block and Standard Connection Points (SCP). SCP Support is especially important since it will be a mandatory feature for any device to be registered with FieldComm Group in the future. Furthermore, the FF demo device (CS START HART) has been registered with the FieldComm Group. This ensures that all functions and features available in customer-specific integrations also fully comply with the FF standard. As part of this process, a basic FDI package has also been registered.

For PROFIBUS PA, support for Totalizer Function Block was added. Now all Function Block types defined in the PA profile are available.

SOURCE: SOFTING

Features simplify retrofitting of HART and Modbus devices in process industry installations.

Softing

Visit Website