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Industrial 5G coming of age

Industrial 5G is poised to make a significant impact on smart manufacturing operations. As you'll see as you start reading IEB's coverage starting with the *2023 Industrial Wireless Progress Report* starting on page six, industry experts are bullish on the impact that 5G is having on the Industrial IoT (IIoT) and automation control.

Jürgen Weczerek, Manager Product Marketing Security and Wireless Network Technology at Phoenix Contact says that: "For the first time, 5G and Wi-Fi6/6E wireless technologies now enable real-time communication in control processes as standard, which was previously reserved exclusively for wired communication or proprietary wireless solutions. This opens up new possibilities for the automation and control of processes."

Following the cover story, we offer a series of technical articles (see Table of Contents on this page) which explore how 5G will impact the factory floor in the future, the impact of various releases of 5G technology and how 5G can be leveraged on EtherNet/IP networks.

According to a white paper by the 5G Alliance for Connected Industries and Automation (5G-ACIA.org), "wireless communication is essential for the Smart Factory and Industry 4.0 because it enables seamless, pervasive, and scalable connectivity among machines, people, and sensors as well as with mobile entities such as mobile robots, automated guided vehicles (AGVs), drones, and humans. It also delivers benefits by removing cables from stationary, rotating, and other objects with limited mobility."

The white paper says a key attribute of 5G technology is that is provides "extremely reliable communication, paving the way for wireless isochronous real-time motion control, sensor systems for monitoring critical processes, and AR/VR applications. And all of these are served by a single wireless communication system."

Its conclusion: "5G delivers a number of capabilities that enable advanced industrial use cases (including isochronous real-time motion control, sensor systems for monitoring critical processes, and AR/VR applications) for deployment over a single wireless communication system. They include both stringent communications requirements and integration capabilities to enable 5G to seamlessly blend in or coexist with preexisting and evolving Ethernet technologies."

We highly recommend taking the time to review the full 5G Acia white paper, *5G for Industrial Internet of Things (IIoT): Capabilities, Features, and Potential.*

Download the White Paper >

Al Presher

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Industrial Ethernet Book

The next issue of Industrial Ethernet Book will be published in **January/February 2024.**
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Editor: Al Presher, editor@iebmedia.com
Advertising: info@iebmedia.com
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Advancing LoRaWAN® connectivity via satellite

EchoStar Mobile has joined LoRaWAN® Board of Directors, and is one of many members that form an expansive and advanced ecosystem supporting extended IoT connectivity using satellites.

THE LoRa ALLIANCE®, THE GLOBAL ASSOCIATION backing the open LoRaWAN® standard for internet of things (IoT) low-power wide-area networks (LPWANs), has announced that that member company EchoStar Mobile, a premier global provider of satellite communication solutions, has joined its board of directors, validating the strong market opportunity for LoRaWAN in satellite IoT connectivity.

"Early on, the LoRa Alliance ecosystem recognized the significant opportunities for LoRaWAN connectivity using satellites," said Donna Moore, CEO and chairwoman of the LoRa Alliance. "To support this market, we added long-range frequency hopping spread spectrum (LR-FHSS) to LoRaWAN, enabling numerous benefits including license-free connectivity that reduces costs, providing direct link to satellite which is ideal for hard-to-reach locations, along with low power requirements and increased network capacity. This allowed us to take the leadership position in the LPWAN space by enabling extended IoT connectivity with truly global reach, resulting in leading global telcos announcing deployments of satellite extensions for LoRaWAN and cellular IoT. I am very excited to have EchoStar Mobile's Telemaco Melia join our Board of Directors; it is a strong move to ensure LoRaWAN continues to meet the needs of this high-growth market, and I look forward to EchoStar Mobile's perspective and contributions to the leadership of the LoRa Alliance."

The LoRa Alliance has a large ecosystem providing LoRaWAN via satellite or delivering solutions using them. A sampling of LoRa Alliance members active in this area includes Actility, EchoStar Mobile, Eutelsat, Hello Space Systems Teknoloji A.S., Lacuna Space Ltd., Plan-S Satellite & Space Technologies Inc., Senet, TELNET and Wyld Networks, as well as hundreds of members using LoRaWAN over satellites for connectivity. LoRaWAN connectivity using satellite has proven its value across a wide range of applications, including metering, asset tracking, structural monitoring, utility and water distribution networks, precision agriculture, wilderness/remote/extreme sports safety trackers, off-grid tank delivery, remote asset monitoring, environmental/wildlife monitoring, and more.

"In our ongoing IoT research, we are increasingly hearing strong positive sentiment about LoRaWAN and satellite connectivity," said Robin Duke-Woolley, CEO and Chief Analyst, Beecham Research. "There is growing expectation that LoRaWAN is poised to change the economics of satellite for IoT, making a wide range of low data rate applications economically viable in areas where they are often not currently feasible. This includes asset tracking across borders, and many remote monitoring needs."

SOURCE: LoRa ALLIANCE

LoRaWAN has achieved leadership in low power wide area networking (LPWAN) connectivity via satellite, with LoRa Alliance members increasingly offering a variety of options for cost-effective, satellite-based connectivity in response to market demand.

"EchoStar Mobile's commercial launch of a real-time LoRaWAN based service in 2022 demonstrated commitment to our vision of providing standards-based satellite IoT services. Standards are known for reducing costs and LoRaWAN is no exception. Lower cost satellite transceivers and service combined with a single network technology stack enables all IoT devices, whether connected via satellite or terrestrially, to take advantage of LoRaWAN to deliver better return on investment and address unmet demand. Our wide area satellite coverage has created market opportunities for LoRa Alliance members to deploy their solutions in remote and low-density areas previously uneconomic to serve with terrestrial LoRaWAN infrastructure," said Telemaco Melia, VP and GM of EchoStar Mobile. "We are honored to join the LoRa Alliance board of directors to continue to advance the success of LoRaWAN in satellite based IoT."

"It is not surprising to see that the low-cost, long-range, and easy-to-access nature of LoRaWAN technology is spreading from terrestrial networks to space-based ones," said Alper Yegin, CTO of Actility and Chair of the Technical Committee in the LoRa Alliance. "The collaborative spirit of LoRa Alliance members, coupled with the low-cost integration among networks, is leading to the unification of all kinds of networks, whether public, private, or community-based, both terrestrial and satellite-based, working together to provide ubiquitous and low-cost connectivity across the planet."

"Satellites are poised to revolutionize the IoT landscape," said Muzaffer Duysal, CEO of Hello Space. "Devices with LoRaWAN infrastructure can communicate easily and directly with satellites, enabling seamless and continuous sensor data transfer over vast distances, all while harnessing the reliability and cost-efficiency of satellite connectivity. This technology supports diverse sectors including agriculture, maritime, energy, logistics, and industry, positioning it at the cutting edge of satellite IoT solutions."

As one of the earliest satellite companies to join the LoRa Alliance, Lacuna demonstrated LoRaWAN over satellite five years ago and since then has proven commercial viability with technical advancements towards massive capacity and the proliferation of proven use cases.

*News report by **LoRa Alliance**.*

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2023 Industrial Wireless Technology Update

5G and Wi-Fi6/6E wireless technologies are now enabling standard, real-time communication in control processes, which was previously reserved exclusively for wired communication or proprietary wireless solutions. This is opening up new possibilities for industrial automation and smart manufacturing operations.

SOURCE: SIEMENS

"With 5G we have the first wireless technology which has been developed with industrial use cases in mind. That's why it offers natively features that are essential for the industry like low-latency communications with a very high reliability and the possibility to connect a very high number of devices." -- Daniel Mai, Director Industrial Wireless Communication, Siemens AG.

INDUSTRIAL WIRELESS HAS A BRIGHT FUTURE heading into 2024 with technologies that are now ready for prime time. 5G and Wi-Fi 6/6E are unique -- offering high data transfer rates, low latency, and high device density that are setting them apart from existing solutions.

In this special report, the Industrial Ethernet Book reached out to industry experts to gain their insights into the megatrends driving Industrial Wireless technologies, the emergence of industry standards and the challenges facing automation engineers.

Industrial wireless expanding

Licensed spectrum with 5G and 6GHz spectrum Wi-Fi 6E leading the way.

"5G and Wi-Fi 6 are both still quite new technologies that will have a big impact on the industry," Daniel Mai, Director Industrial Wireless Communication at Siemens AG told IEB recently. "The possibilities of applying for licensed spectrum with 5G and the new 6GHz spectrum of Wi-Fi 6E will significantly increase the use of wireless technologies in industry."

"With 5G we have the first wireless technology which has been developed with industrial use cases in mind. That's why it offers natively features that are essential for the industry like low-latency communications with a very high reliability and the possibility to connect a very high number of devices. Therefore, we expect a wide adoption of the technology in industry. Also, Wi-Fi will keep playing an important role in the industrial arena. It's easy to use because of the unlicensed band, is being deployed in industrial applications since approx. 20 years and the standard is constantly evolving," he said.

Digitalized, flexible factories

Mai said that the smart factory will be a digitalized, flexible factory with quickly changing production layouts and many mobile and moving participants. Secure and reliable connectivity will be one of the key enablers for a smart and data driven production. All kinds of data is collected in the field level by smart devices and sent to the Enterprise Management System to enable data driven decisions. The basis for such a factory is reliable and secure communications networks, wired and wireless.

"Industrial 5G and Industrial Wireless LAN based on Wi-Fi 6 provide wireless connectivity for all kinds of applications that can't be wired: mobile applications like AGVs in intralogistics, moving robots or smart tools. All those applications in the OT environment require reliable and deterministic wireless communications to ensure that the production processes run smoothly and personnel on the shop floor is safe. Data from edge devices can be easily transmitted without the need of wiring them. Reliable wireless communications will be a booster for the smart factory," he stated.

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SOURCE: ISTOCK

"Wireless is a key enabler for digitization. Not only is it required to connect remote, mobile, and difficult to access applications, but it's extremely convenient. The elimination of network and cables offers organizations the ability to run their operations more efficiently, increase productivity, reconfigure their operations more easily, and reduce costs." -- Andrea Orioli, Director Product Management, IIoT Wireless, Cisco.

Mai added that every new generation of a wireless technology brings new capabilities like higher bandwidth, higher reliability etc.

Wi-Fi: The evolution of Wi-Fi ensures higher bandwidth and optimized spectrum usage with every evolutionary step. Due to the global availability of unlicensed spectrum and the outlook for 6 GHz spectrum Wi-Fi can and will be deployed in industry on an application basis as a future-proof wireless technology. With special enhancements like the iFeatures developed by Siemens, Wi-Fi technology can even be used for time critical automation tasks like wirelessly transmitted emergency stop functions.

5G: In its final state 5G will offer up to 20 times higher bandwidths than 4G, lowest latencies and a reliability of 99,999%. For industrial applications reliability and guaranteed latencies matter the most. Every network outage costs a lot of money and what is worse can lead to personnel being harmed or machines being damaged.

"With 5G, we see a major advantage in the possibility to set up local, private 5G networks that are operated on-premises by the users themselves. Companies then have full control of the network and can ensure that it supports their applications in the best possible way," Mai said.

In case of a failure, in-house experts can solve the problem in a very short time. Also, all data stay on-premises and private. Once a local private 5G network infrastructure is installed it is very efficient because it can support multiple applications running in parallel on the same network. Companies can prioritize traffic for mission-critical or safety-relevant applications making sure that they get the quality of service they require. New applications can be easily added to the system.

Industrial wireless solutions

Mai said that wireless technologies are used already today in every application that can't work with wires. For the new wireless technologies there is a multitude of possible applications. One is for sure the Augmented Workforce where personnel on the shop floor is supported by smart handheld devices, remote assistance, or Augmented Reality glasses.

Those devices require a reliable wireless high bandwidth transmission – also in the uplink. Another interesting application is the wireless download of software to manufactured products, like e.g. cars, already during the assembly process. This can significantly shorten production times.

But also, more common applications like autonomous intralogistics with AGVs and AMRs or operation of cranes will benefit from private 5G networks as they require reliable low-latency communications that 5G offers. Some customers already focus on aggregating all those applications in one wireless infrastructure. Once installed, a 5G network can support all kinds of different applications. It can even facilitate easy digitalization in brownfield installations by providing connectivity for legacy devices without the need of extensive wiring.

"Automation engineers are faced with very diverse settings on the shopfloor where a multitude of different devices from different vendors needs to perfectly work together. Additionally, industrial environments are often harsh with different temperature ranges, vibrations, dirt, dust, explosive areas etc. Sometimes machines or plants are not easy to access, e.g. if they have moving or rotating parts," Mai said.

Wear and tear of cables is another very common challenge in industry when things are moving. Reliable wireless communication instead of fixed cabling can be a game changer here. It offers more flexibility as standardized systems with standard interfaces

will enable quick and easy integration of new devices without cabling. Reliable wireless communication can replace cabling in mechanically challenging applications and make even machines with rotating parts easily accessible. Industrial grade wireless products will provide reliable connectivity even in harsh or dangerous environments where laying cables is no option.

Accelerating digitization

Wireless is a key enabler shaping the direction of industrial automation.

According to Andrea Orioli, Director Product Management, IIoT Wireless for Cisco Systems, "In every industry, organizations are accelerating digitization and increasing automation to improve productivity, reduce downtime or increase worker safety. Wireless is a key enabler for digitization. Not only is it required to connect remote, mobile, and difficult to access applications, but it's extremely convenient. The elimination of network and cables offers organizations the ability to run their operations more efficiently, increase productivity, reconfigure their operations more easily, and reduce costs."

Orioli said that many of the assets and applications that need to be connected in these industries have stringent network requirements. Automated Guided Vehicles (AGVs), robots (AMRs) in manufacturing or logistics, and teleremote applications in ports and mines all require dependable connectivity. These mobile assets can create safety risks to personnel or stop complete production if they lose their wireless connections. A wireless network that provides high-data rates, ultra-low latency, fast hand-offs, and high reliability is a must, specifically in dynamic environments with shifting dead zones and RF interference patterns.

"What we have seen in the past years is the advancement of wireless technologies to address these needs, such as Wi-Fi 6/6E and private 5G. At Cisco we have enhanced our Cisco Ultra-Reliable Wireless Backhaul (URWB) technology to increase throughput and reliability," she added.

Industrial 5G and WiFi 6

Networking for manufacturing has some of the most stringent requirements among the industrial use cases. Any glitch in the operational network could mean stoppage of the production line, leading to lost revenue and wasted materials. In the past, wireless was used mostly to connect non-critical tools, sensors, and handhelds. Today, with more reliable wireless technologies, it is possible for critical assets and applications to be connected wirelessly.

"Advances in wireless technologies are also making it possible for organizations to deploy more Automated Guided Vehicles (AGVs), Autonomous Mobile Robots (AMRs), and other mobile assets to enhance productivity. These assets need not only high reliability and low latency, but they also need seamless roaming and zero packet loss during handoffs. Which is challenging in the environments they operate in the presence of obstacles and RF interference," Orioli said.

New wireless technologies are also helping organizations improve their sustainability KPIs, which is becoming more and more important to more organizations each day. Wireless technologies can help by improving the power consumption of industrial assets. This can be achieved only with a reliable, predictable, wireless infrastructure.

Industrial wireless solutions

Connecting assets and applications in manufacturing requires a highly reliable wireless network that provides high throughput, low latency, fast hand-offs with zero packet loss, specifically in dynamic environments with the presence of obstacles and changing RF interference patterns.

"Private 5G introduces new enhancements and promises to deliver higher speeds and enhanced communications as well as highly reliable communications with ultra-low latencies. Wi-Fi 6/6E delivers higher bandwidths and lower latency than previous generations, allows for more devices to be connected and it is much more power efficient," Orioli said.

Cisco URWB delivers high-speed, ultra-reliability, ultra-low latency, and seamless handoffs. URWB is built on 802.11 standards and deploys just like Wi-Fi. Multipath Operations protects critical communication and provides uninterrupted connectivity to fast moving devices by sending high-priority packets via redundant paths. It can duplicate protected traffic up to 8x, avoid common paths and works alongside hardware availability. The result is not only lower latency and higher availability, but also less effects of interference and hardware failures.

Looking at applications

The elimination of network and cables enables manufacturers to run their operations more efficiently, increase productivity, reconfigure plant floors more easily, and reduce costs. Wireless makes it easier to deploy additional machines, sensors and PLCs. AGVs and AMRs are being deployed to move materials within the factory or between the factory and warehouses.

Private 5G, Wi-Fi 6/6E and Cisco URWB all address the needs for faster and more reliable connectivity, but they all vary not only in terms of performance but also in deployment costs and complexity.

Orioli said that private 5G is still not available everywhere and it comes with spectrum, cost, and complexity issues. Wi-Fi operates in unlicensed spectrum which lowers the TCO when compared to P5G and could be preferred for organizations that prefer a standardized solution in multiple geographies, but the variability in performance due to RF interference and number of devices connected might not be the primary choice for critical applications.

"We'll continue to see organizations use a combination of different wireless technologies that best meet the operational requirements for specific applications. Apart from the technical criteria like bandwidth and latency, organizations are considering other conditions like spectrum costs and availability as well as deployment costs and complexity," she added.

Challenges for industrial wireless

Orioli said that Wi-Fi 6E, which offers up to 1.2 GHz more spectrum, and 5G's enhanced Mobile Broadband Profile (eMBB) can address the need for increased throughput while solving concerns regarding interferences and high-density support.

Time-sensitive critical applications need high reliability and low latency. Connected devices that are moving at high speed also need seamless handoffs and zero packet loss. Technologies like Cisco URWB can be used to support these use cases.

"We have seen organizations adopting these new wireless technologies to enable more automation and increase efficiency. They have been improving their wireless strategy by adding new technologies for specific applications. For example, we have a number of customers in manufacturing that have adopted Cisco URWB to support their AVGs and AMRs and other critical applications, while continuing to support Wi-Fi for other less critical applications," Orioli said.

Key wireless technologies

Wireless mesh networks, 5G connectivity, low-power wide area networks and cybersecurity.

"As industries face increasingly rapid changes in demands and requirements due to digital transformation, industrial wireless solutions need to improve reliability, efficiency, and adaptability for industrial operations. Some key technology trends enabling new industrial wireless solutions include wireless mesh networks, 5G connectivity, low-power wide area networks, and cybersecurity," said Calvin Chuko, Assistant Manager, Industrial Wireless Section at Moxa.

"The 5G technology enables industrial networks to transfer broadband, real-time data that the previous generation (4G) of mobile technologies could not achieve.

SOURCE: MOXA

"For the first time, the 5G and Wi-Fi6/6E wireless technologies now enable real-time communication in control processes as standard, which was previously reserved exclusively for wired communication or proprietary wireless solutions. This opens up new possibilities for the automation and control of processes," Calvin Chuko, Assistant Manager, Industrial Wireless Section at Moxa.

This capability allows applications such as autonomous systems in smart factories, AR/VR, and remote monitoring to be fully migrated to the wireless network in the future."

Chuko said that mesh technology are capable of providing flexibility and reliability to a Wi-Fi network. The self-healing and failover mechanism allow devices to remain connected even in the event of link or node failure.

As more and more IoT devices, such as sensors, are contributing to data collection, low-power wide area networks (LPWAN) become essential as they provide the wireless distance and device density required while

Advances in Mobile Automation With Industrial 5G Solutions

Moxa showcased its recent advances in industrial 5G solutions at Hannover Messe 2023. The demonstration highlighted breakthroughs in tackling the complexity of Operational Technology (OT) and Information and Communications Technologies (ICT) convergence to realize private 5G networks for a wide range of industrial applications. With ultra-low latency and high-bandwidth connections, these dedicated cellular solutions provide the reliability and flexibility to address the dynamic requirements of different industries and improve industrial efficiency, productivity, and safety.

The demonstration focused on two use cases. The first case illustrated how the company's 5G onboard router enables train-to-ground (T2G) communications in a 5G network with Enhanced Mobile Broadband (eMBB), providing more than 1 Gbps throughput and Virtual Router Redundancy Protocol (VRRP) support for 50 ms recovery times with dual cellular tunnels. The second case showed how Moxa's private 5G network solutions open up new opportunities for growth and one-of-a-kind solutions by combining various devices and industrial protocols such as Modbus TCP/RTU, PROFINET, and OPC UA, enabling integrated data flows between remote I/O devices, serial device servers, Ethernet switches, and gateways for data collection and monitoring in smart manufacturing applications.

"With a proven track record of more than 20 successful private 5G proof-of-concept (PoC) and proof-of-business (PoB) projects in vertical markets including rail, manufacturing, warehousing and logistics, Moxa is well on track to becoming the world's first to deploy a private 5G network for industrial automation at a high-end manufacturing site," said Dr. David Chen, Director of R&D Center at Moxa. "Although commercial contracts are limited to a few high-end customers for now, we are seeing an increase in private 5G trials. We have our capabilities and resources ready to capitalize on emerging opportunities in the private 5G market in the Americas and the European Union, followed by Asia Pacific and Japan by 2026."

According to new research published by global technology intelligence firm ABI Research, the overall market for private networks within enterprise verticals will reach US$109 billion by 2030. This includes radio access network, edge & core deployments, as well as professional services revenues, which alone will contribute US$47 billion (44%) to the market size in 2030. The findings are from ABI Research's "The Role of 5G for Enterprise ICT Transformation" application analysis report.

consuming minimal battery power.

Cybersecurity is also the key technology trend blanketing all relevant communications technologies. It is increasingly becoming the most critical challenge that industries face, as cyber threats today are capable of bringing catastrophic losses to the industrial assets if networks are not being protected.

Industrial 5G and Wi-Fi 6

"These technologies deliver wireless network speeds sufficient to service-connected nodes while offering low latency and high reliability for a seamless wireless experience. Not to mention, the significant security improvements serve as a confidence booster for the transition from wired to wireless," Chuko said.

For example, automatic material handling robots, such as AGVs, are becoming increasingly autonomous today to minimize human intervention in factory operations. This entails a need for these moving machines to be more complex and multidimensional in their paths, enabling them to move faster and collect more data, such as video. Without 5G or Wi-Fi 6, the wireless network cannot meet the necessary bandwidth and latency requirements to keep the system operating at full capacity. 5G and Wi-Fi 6 are capable of providing such bandwidth and low latency to accommodate larger quantity of the machines while providing precise coordination and control for the robots.

Unique capabilities

Chuko said that 5G and Wi-Fi 6 are unique in the way that they offer high data transfer rates, low latency, and high device density, setting them apart from existing solutions. 5G even includes additional reliable and secure features, such as network slicing and private networks, to keep sensitive data protected.

Compared to previous generations of Wi-Fi (802.11n or 802.11ac), Wi-Fi 6 (802.11ax) can allocate more bandwidth at both 2.4GHz and 5GHz while supporting higher modulation schemes to further improve data rates. Wi-Fi 6 also taps into 6GHz band to open up more lanes for data transfer, which will be a standard frequency band for Wi-Fi 7 and beyond. Similarly, 5G's bandwidth is multiple times that of the previous generation (4G). The added bandwidth will enable applications that require large data sets, such as high-resolution videos for AMRs (autonomous mobile robots) and video surveillance.

In terms of latency, the URLLC (Ultra Reliable Low Latency Communications) capability of 5G enables the transmission of real-time data via time-sensitive network protocols (TSN). Wi-Fi 6 also demonstrates improved latency performance compared to previous standards, mainly thanks to the OFDMA protocol, which enhances spectrum efficiency for Wi-Fi. OFDMA also contributes to expanding the connected device capacity of the Wi-Fi network without sacrificing network latency.

SOURCE: ISTOCK

"5G technology enables industrial networks to transfer broadband, real-time data that the previous generation (4G) of mobile technologies could not achieve. This capability allows applications such as autonomous systems in smart factories, AR/VR, and remote monitoring to be fully migrated to the wireless network in the future." Calvin Chuko, Assistant Manager, Industrial Wireless Section, Moxa.

Bandwidth and real-time data transfer

Chuko said that the newest industrial wireless solutions are targeting applications, which require large data bandwidth, and real-time data transfer with high reliability and security for more mission critical controls. Applications, from mobile robots in manufacturing to intralogistics controlled using industrial protocols, leverage the latest wireless solutions such as 5G and Wi-Fi, aiming to provide connectivity that is more robust and meets the time-sensitive demands of future industrial networks.

Wireless technologies used for mission-critical applications, such as rail communication-based control systems (CBTC) for metros, are proven examples of how state-of-the-art wireless solutions have reached new heights in terms of reliability. However, more often than not, critical industrial control systems still rely on wired connections due to reliability and security concerns.

"The trend to adopt wireless solutions for industrial applications continues to increase. The future of industrial controls will be even more challenging for wireless solutions to fulfill their demands. 5G/Wi-Fi and other wireless solutions has just started tapping into the possibility of a full-scale wireless factory, and the pace of wireless technology maturing will only pick up in the future," Chuko said.

Some key challenges automation engineers face, which advances in industrial wireless solutions can help overcome, include the immobility of equipment and workers, limitations of cabling, and the lack of flexibility and scalability of networks. All these constraints drive costs high and lower operational efficiency within the automation sector.

"Both 5G and Wi-Fi networks enable seamless roaming within the wireless-covered infrastructure, allowing mobile devices such as AGV/AMRs and portable handhelds to move freely on the factory floor, reducing the cost of material handling," Chuko said.

SOURCE: ISTOCK

"For the first time, the 5G and Wi-Fi6/6E wireless technologies now enable real-time communication in control processes as standard, which was previously reserved exclusively for wired communication or proprietary wireless solutions. This opens up new possibilities for the automation and control of processes," Jürgen Weczerek, Manager Product Marketing Security and Wireless Network Technology, Phoenix Contact.

He added that the cost of cabling, primarily associated with installation and maintenance, can be eliminated by adopting wireless solutions. These solutions are easy to install and offer the range and coverage needed to keep floor assets connected, ensuring sufficient data bandwidth. Not only can wireless solutions help to reduce the cost of wiring, its flexibility in terms of reconfigurations of the network is unmatched compared to cables. With today's manufacturing trending for tailor-made customizable services, the ability to have a flexible and easily scalable network is imperative.

Wireless ready for prime time

Finally available for wider industrial use from 2024 and onwards..

According to Dipl.-Ing. (FH) Jürgen Weczerek, Manager Product Marketing Security and Wireless Network Technology for Phoenix Contact, we are entering an era where industrial wireless solutions will finally be available for implementation.

"Before we rush into the next wireless technology trend on the horizon, it is much more important for industrial users that the new wireless key technologies, 5G and Wi-Fi 6/6E (IEEE 802.11ax), which have been announced and discussed for some time, will finally be available for wider industrial use from 2024 onwards," Weczerek told the Industrial Ethernet Book recently.

"Both wireless technologies offer significant technical improvements in the areas of real-time capability, reliability, security, and efficiency that are important for industrial applications. Both wireless technologies have the potential to significantly increase the proportion of wireless communication in the smart factory in the future. Last year, an important step in this direction for WLAN was the release of additional transmission channels in the 6 GHz band in Europe and other countries."

Wireless solutions impact

Weczerek said that, for the first time, the 5G and Wi-Fi6/6E wireless technologies now enable real-time communication in control processes as standard, which was previously reserved exclusively for wired communication or proprietary wireless solutions. This opens up new possibilities for the automation and control of processes.

"With 5G it is possible to realize a largely wireless communication infrastructure within a factory, including real-time and safety communication. This could significantly reduce wired network connections in the future, which means more flexibility and significantly lower connection costs per network device," he said.

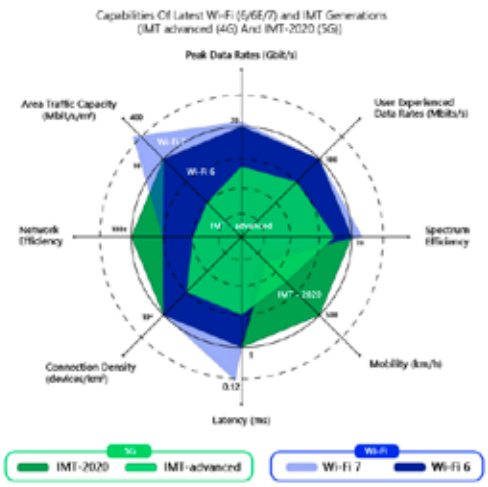
"Wireless networks generally enable simpler and more cost-efficient integration of sensors and smart devices into a network, making big data, predictive maintenance, cloud connectivity, etc. easier and more economical."

The 5G and Wi-Fi6/6E wireless technologies now have functions that make it possible for the first time to control communication via the wireless network in real time as standard. Together with other new functions and features, this improves performance, energy and resource efficiency as well as reliability. Even though wireless technologies will still not come close to the real-time capability of special automation networks, there are still many new application possibilities that were previously reserved exclusively for wired communication or proprietary wireless solutions.

In terms of wireless technology, 5G and Wi-Fi 6 often rely on the same mechanisms and functions. Therefore, the performance features are very similar on the radio side at first glance.

But what is the benefit of the best technology if you can't use it sensibly? The ability to operate 5G as a private network in a protected, licensed frequency range is therefore crucial for the industrial use of 5G.

The situation is similar with WLAN. Although the new Wi-Fi 6 standard offers significantly improved technical possibilities and performance data, this technology cannot fully exploit its advantages in the 2.4 and 5



SOURCE: WBA

"One of the biggest trends from Wi-Fi technology enabling new Industrial Wireless Solutions is the opening of the 6 GHz spectrum band to Wi-Fi, which is now available in 54 countries. Both Wi-Fi 6E and Wi-Fi 7 can use the 6 GHz band in addition to the traditional 2.4 and 5 GHz bands," Tiago Rodrigues, CEO of the Wireless Broadband Alliance.

GHz bands, which are currently often crowded. It is therefore crucial for Wi-Fi that the 6 GHz band will be opened for Wi-Fi use in Europe and other countries in 2022. This will make up to 54 new and still undisturbed transmission channels available. This is where WLAN, i.e. Wi-Fi 6E, can show off its full performance and reliability.

Applications outlook

Weczerek said that both wireless communication standards, 5G and Wi-Fi 6, can be used very universally as they adapt very flexibly to individual requirements. Either for the real-time transmission of small data packets, high data throughput, battery-saving communication with IIoT sensors or a mixture of all of these.

Nevertheless, there are fundamental systemic differences that make the wireless technologies more suitable for different areas of application.

"5G is particularly suitable as a comprehensive communication network in a factory for a wide variety of applications. From mobile communication to real-time data communication in control applications. In addition, a 5G system usually offers extensive functions such as network virtualization, priority management, resource management, access and security management, etc.," he said.

He added that the ability to use more reliable, real-time-capable and powerful wireless communication networks will enable more flexible, autonomous and efficient manufacturing processes in the future.

WLAN, on the other hand, is well suited for wireless communication solutions within local applications, as it can be scaled economically from a small network with one WLAN device to large networks with hundreds of WLAN devices. In addition, several WLAN networks can be operated independently of each other in parallel, even with 5G, in one system.

"With 5G and Wi-Fi 6, data throughput, real-time characteristics and reliability have improved significantly. This had often limited the application possibilities with current technologies. In particular, the availability of exclusively usable frequency ranges with 5G or additional transmission channels with Wi-Fi 6 often makes it possible to implement larger and more reliable wireless networks in the factory," Weczerek said.

"In addition, the new technologies offer significantly more options for meeting specific application requirements. However, they are also more complex than previous technologies, meaning that specific expertise is required for the planning, implementation, and operation of such wireless networks. This applies in particular to 5G and its many possibilities. Anyone planning to use such networks should therefore consult specialists."

6 GHz spectrum band for Wi-Fi

Businesses can take advantage of up to 1200 MHz additional spectrum.

According to Tiago Rodrigues, CEO of the Wireless Broadband Alliance, "one of the biggest trends from Wi-Fi technology enabling new Industrial Wireless Solutions is the

SOURCE: WBA

"Wi-Fi 6 and Wi-Fi 6E provide many deterministic quality of service (QoS) capabilities, such as traffic prioritization, which is a key component of Time-Sensitive Networking (TSN) for Industry 4.0 applications.," Tiago Rodrigues, CEO of the Wireless Broadband Alliance.

opening of the 6 GHz spectrum band to Wi-Fi, which is now available in 54 countries. Both Wi-Fi 6E and Wi-Fi 7 can use the 6 GHz band in addition to the traditional 2.4 and 5 GHz bands. By using Wi-Fi 6E or Wi-Fi 7 to connect their robots, autonomous material movers and other industrial equipment, businesses can take advantage of up to 1200 MHz additional spectrum."

Rodrigues said that more spectrum reduces both interference and latency and in turn directly improves the performance of their industrial wireless applications. It gives those businesses one more reason to use Wi-Fi rather than copper or fiber optimize productivity, efficiency and safety across their factories, warehouses and other industrial facilities.

"Wi-Fi 7 also anticipates increasingly demanding industrial wireless requirements for high throughput, low latency, minimal jitter, and high reliability. For example, with wider channels and 4K QAM capabilities, Wi-Fi 7 can deliver speeds over three times faster than Wi-Fi 6, so it's ideal for bandwidth-intensive applications such as artificial intelligence (AI)-powered video inspection of finished products zipping by on a conveyor belt," he added.

Industrial 5G and WiFi 6 making

"Wi-Fi 6 and Wi-Fi 6E provide many deterministic quality of service (QoS) capabilities, such as traffic prioritization, which is a key component of Time-Sensitive Networking (TSN) for Industry 4.0 applications. For example, Wi-Fi 6 TSN is ideal for applications that require latencies of 2 ms or less, such as remote control of industrial robots and material handlers," Rodrigues said.

He stated that augmented/virtual/mixed reality is a rapidly emerging application in manufacturing and other industrial environments. Wi-Fi 6/6E networks can support the bounded latency (<2ms) that AR/VR/MR require.

Another example is how Wi-Fi 6/6E can be combined with Multi-access Edge Computing (MEC) and machine learning (ML). This enables use cases such as learning how raw materials, finished products, employees and equipment such as forklifts move around a factory floor. Then the AI/ML can quickly identify anomalies such as a backed-up conveyor or suggest workflows that are more efficient, safer or more productive.

Rodrigues said that, in addition to the deterministic capabilities that I described earlier, Wi-Fi networks also can support WBA OpenRoaming™, which is currently available at over 3.5 million hotspots worldwide. This enables a Wi-Fi device to authenticate once and then automatically connect every subsequent time that it's within range of an OpenRoaming hotspot, it will automatically and securely connect — no additional login required. WBA OpenRoaming is currently available at over 3.5 million hotspots worldwide.

"WBA OpenRoaming is a good fit for a wide variety of industrial applications. For example, many companies have begun testing semi- and fully autonomous electric trucks, and many EV charging station vendors have added Wi-Fi to their equipment. So a manufacturer could using charging stations at its factories and at truck stops to enable its electric trucks to download the HD maps they need to navigate safely and successfully while also uploading diagnostic data for preventative maintenance. WBA OpenRoaming ensures that all of those connections happen automatically and with enterprise-grade security," Rodrigues said.

Applications focus

Rodrigues offered the following observations on applications, including advances in machine vision and other AI enable material handlers, robots and other mobile industrial equipment to safely and precisely navigate, load, unload and so on. Obviously copper and fiber aren't viable for providing them with a seamless network connection. Hence the value of Wi-Fi 6/6E/7 networks that can meet demanding requirements such as sub-20 ms latency, sub-1 ms jitter, 99.999% uptime and throughput in the tens of megabits.

In other use cases, the equipment is always controlled remotely by a human, such as when it's in an area that's too hot or too dangerous for employees. An ultra-reliable, low-latency Wi-Fi network ensures that operators never lose control of that high-value equipment and raw materials — not even for a second.

"All factories, refineries and other manufacturing facilities have two things in common: a lot of metal, such as racks and pipes, and a lot of electrical devices, such as conveyor belt motors. Those make it extremely challenging to ensure that every single industrial robot, material handler or inspection camera always has a reliable wireless connection, no matter where they are inside or outside the plant. For example, the conveyor motors create electrical interference with the wireless signals, while a maze of storage racks block connections," he said.

"Each generation of Wi-Fi keeps getting better at ensuring a reliable connection, which in turn enables automation engineers to implement more and more wireless use cases. The latest example is how the Wi-Fi industry is using AI/ML to enable beamforming, channel bonding and other advanced techniques to overcome interference and attenuation and ensure five-nines reliability."

*For additional examples, see **Wi-Fi 6/6E for Industrial IoT: Enabling Wi-Fi Determinism in an IoT World**, which covers advances such as the Fine Timing Measurement (FTM) protocol and Multi-Link Operation (MLO), and **Get Ready for Wi-Fi 7** on applying new capabilities to key use cases.*

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

Wireless communication key to efficient, reliable production

The wireless exchange of data enables even the smallest devices in manufacturing systems to be easily integrated into the production network. The information from these coupled devices can then be used to improved the availability, performance and quality of the manufacturing process.

SOURCE: PHOENIX CONTACT

Compact, robust, and easy-to-mount wireless modules help ensure that AGVs and AMRs function reliably.

CURRENT INTERNATIONAL DEVELOPMENTS coupled with the forecasts regarding climate change on Earth are forcing us to rethink how we handle the resources available on our planet. To this end, Phoenix Contact is aiming to meet precisely these challenges technologically with its vision of the future, the All Electric Society – among other things by optimizing the communication infrastructure in the manufacturing environment.

The All Electric Society

The All Electric Society is a world in which energy from renewable resources is available in sufficient quantities and at affordable prices. In addition to the consistent generation and use of renewable energy, the reduction of primary energy demands through energy efficiency measures is proving to be the key to a sustainable future. Companies in particular must support this development across all areas; otherwise they will be at a competitive disadvantage in the future. One particular focus in this context is on production, because this area accounts for a large proportion of a company's energy consumption. It is therefore important to increase the efficiency of machines and systems.

At the same time, it is imperative that technical availability and flexibility in application is not overlooked to ensure that a rapid response to changing market and environmental conditions is possible. By inference, this requires new technological approaches which are already finding their way into manufacturing infrastructures through the realization of Industry 4.0. The basis for this is a powerful network infrastructure.

New automation approaches in the logistics sector

The term Industry 4.0 embodies the comprehensive digitalization and networking of automation devices both within a company's in-house production facilities and across company boundaries.

Depending on the application, the components involved are networked using different technologies. Whereas wired solutions based on copper conductors or optical fibers were the mainstay in the past, wireless infrastructures such as WLAN, Bluetooth, and 5G are now increasingly being used in a variety of applications. The Internet of Things (IoT), which builds on this, aims to integrate even the smallest devices – such as sensors – into the network and to realize new automation approaches such as the use

SOURCE: PHOENIX CONTACT

Wireless communication infrastructures are increasingly finding their way into production systems to increase their efficiency and flexibility.

of automated guided vehicles (AGVs) within the logistics sector. The information and feasible solutions made available through this approach significantly improve the availability, performance, and quality of the manufacturing systems, while at the same time increasing flexibility.

Wi-Fi 6 with up to 70 percent lower latency

Current industrial trends, such as IoT and artificial intelligence, are placing ever higher demands on the availability, latency, and data throughput of industrial communications.

To provide these systems with up-to-date production data, the data sources must be connected through high-performance systems. So far, these requirements have usually only been achieved through wired data transmission. However, further developments in the field of wireless LAN (WLAN) mean that the transmission of data via wires can be extended or replaced with WLAN solutions. The handling of those mobile machines and machine parts that are not always connected and are docked, for example, is simplified because cables are not having to be constantly plugged in and unplugged.

SOURCE: PHOENIX CONTACT

Wi-Fi access point for mobile machine access for maintenance purposes, for forwarding alerts, and for monitoring

The new Wi-Fi 6 standard (WLAN 802.11ax) has increased the theoretical data transmission speed by around 30 percent. By enabling more data to be sent to multiple devices simultaneously, latency has also been reduced by up to 70 percent. This is made possible by a number of parallel data connections – an approach known as Multi-User MIMO (Multiple Input, Multiple Output). The extension of the Wi-Fi 6 standard to Wi-Fi 6(E) is proving compelling for applications in which different trades use WLAN.

Currently, this can lead to duplicate use of the channels, meaning that communication is impaired or even fails. The E extension to the Wi-Fi 6 specification means that the license-free 6 GHz frequency band is now available with 14 additional 80 MHz channels and seven additional 160 MHz channels. With this frequency band extension, additional WLAN networks can be installed alongside the existing ones without mutual interference.

Compact and robust wireless modules for AGVs and AMRs

The wireless transmission of data to superordinate fleet management systems plays an important role in automated guided vehicle (AGV) and autonomous mobile robot (AMR) systems in which the vehicles and robots are used as mobile units in manufacturing areas. It is difficult to use the AGVs/AMRs efficiently in a production scenario if the data connection to the vehicles and robots is not reliable. As a result, there are demanding and varying requirements on the wireless solutions installed in the AGVs/AMRs. These include the

limited installation space in the vehicles, the quality of the wireless communication, the availability of the data connection over the operating time of the vehicles (QoS), the robustness of the systems located in the vehicles against vibrations and temperature influences, and finally their diagnostics and maintenance functions.

To realize such requirements, Phoenix Contact has developed the FL WLAN 1010 and FL WLAN 1100 wireless modules designed for Wi-Fi transmission in the field of AGVs/AMRs. The devices can be installed easily in the vehicles. With the integrated REST interface, for example, the individual system Wi-Fi settings can be automatically transferred to the FL WLAN 1010 or FL WLAN 1100 via the vehicle control system. This saves time and eliminates incorrect configurations during vehicle commissioning.

SOURCE: PHOENIX CONTACT

The FL WLAN 1010 wireless module in the AGV, mounted directly on the vehicle chassis or a DIN rail, has two antenna inputs for improved wireless quality.

Careful planning of the wireless channel design

In addition to how the AGVs/AMRs are equipped, the WLAN building infrastructure is also crucially important. Several points must be considered when designing this infrastructure. The first is the correct placement of the access points within the building, which determines the wireless coverage. The wireless coverage within the various areas depends on how much metal is installed there in the form of machinery, equipment, and building structures, because this material can reflect the radio waves. However, simulation tools can help determine in advance the coverage and reflections.

The use of suitable antennas and their positioning must also be taken into account. WLAN transmission is a shared medium, and so it is important to make plans in advance regarding the use of the wireless channels and how they are distributed. Careful planning of the wireless channel design in relation to the respective applications can reveal potential problems in operation at an early stage. The design and planning of the WLAN infrastructure can prove to be complex and requires some experience. To this end, the specialists from Phoenix Contact provide users with support in designing the WLAN infrastructure.

Holistic security concepts for comprehensive protection

Recent events have illustrated how important it is to protect systems against unauthorized access by people or malware. Cyberattacks can quickly paralyze companies, meaning that they can no longer produce and they can no longer supply their customers. It may take several weeks to repair the damage. In order to quickly counteract the increasing risks of cybersecurity attacks, Phoenix Contact has developed a corresponding service portfolio and has had it certified by TÜV in accordance with the IEC 62443 standard for the IT security of industrial communication networks. With this portfolio, the automation specialist provides 360-degree security, from individual products and services right through to complete solutions. In this respect, cybersecurity is firmly rooted in the life cycle of its products and solutions: in the form of a secure product development process, in the sense of modern security functions, when advising customers, when creating secure network concepts, and also through a professional vulnerability management system (PSIRT).

Summary

The wireless exchange of data enables even the smallest devices to be integrated into the production network. The information from the coupled devices improves the availability, performance, and quality of the manufacturing systems. The compact, robust, and easy-to-mount FL WLAN 1010 and FL WLAN 1100 wireless modules with special integrated antennas help ensure that AGVs and AMRs function reliably, among other things.

Frank Brockhagen, System Design Digital Factory VMM Factory Automation; Özkan Öztürk, Manager System Design AGV VMM Factory Automation; Lukas Wehage, Solution Engineer VMM Factory Automation, ***Phoenix Contact Electronics GmbH.***

Learn More

Latest releases guide future of 5G on the factory floor

5G cellular technology is poised to bring new capabilities to smart manufacturing operations. The four releases slated for 5G included Releases 15, 16, 17 and 18 -- and the latest releases each bring both significant changes and opportunities to leverage enhancements in production environments.

SOURCE: ISTOCK

Unlike 4G LTE solutions, 5G technology allows for much higher flexibility and scalability that is key to potential uses in industrial environments.

5G CELLULAR CONNECTIVITY BRINGS EXCITING promise to the Industrial Automation sector. This article tries to answer the questions of what enhancements to industrial communication we can expect in the near term, such as release 17 and 18, and what we can expect in the long term, such as 6G.

We will also try to understand what near term and long term is, when we can expect technology to adopt these solutions, as well as define some of the overarching political and market fundamentals which change when and why this technology is used. We will look at the present state of 5G solutions to drive an understanding of what forces are currently resisting this change and who is currently benefiting. This is a supplement to David Brandt and Scott Griffith's paper from the 2020 ODVA technical conference "*5G - Not Just for Cell Phones Anymore.*"

The certain path for 5G on the industrial floor, paved by 5G-ACIA, the supplementary organization to assist 3GPP in delivering 5G technology for industrial applications, has had a long gestation period since ACIA's inception. What can we expect in the next generation of 5G releases, and upcoming 6G technology on industrial networks?

Release 16

There have been significant changes in release 16 to the main tenets of industrial space, specifically enhancing, or, increasing the flexibility of the URLLC specification to allow for further use cases to be applied. With release 15, a base foundation was added so as the reliability (99.9999% or 6 9's) and latency (1-2 ms) requirements of URLLC could be achieved within release 16.

The foundational elements were many. Use of multiple SCS and Bandwidth flexibility are used to create dynamically arranged Grants, which allow for per traffic scheduling. This allows for per traffic scheduling, instead of the cell based per unit (per UE) scheduling. In addition, per traffic schedule also segments types of traffic, i.e., status updates over parameter updates from a downlink and uplink perspective.

Within this solution resides the problem of allocating resources for time sensitive data vs non-time sensitive date which share the same resource. This problem has been addressed in release 16 by creating a priority of priorities, as it were by addressing priority by normalized use of the resource and available data to transmit.

Reliability constraints with release 15 regarding lack of a proper compression solution to lower radio transmission have been addressed with a new compression algorithm, which does not compress the IP or transport layers, thus allowing Industrial networks to properly utilize the ethernet frames. To address resiliency, packet duplication would allow multiple gnB (antennas) to address a node at once.

Scheduling enhancements

Unlike 4G LTE solutions, 5G allows for much higher flexibility and scalability in scheduling uplink and downlink methods to decrease round trip time, or RTT. Instead of connecting directly to a system with one channel, a system can connect to multiple points within the system with their own dedicated schedule, thus optimizing the complete network.

SOURCE: ISTOCK

No manufacturer can ignore 5G's potential in realising many of the technologies and processes coming to the factory in the near future.

Increasing PDCCH (downlink transmission) monitoring bandwidth

In release 15, downlink transmission channels can only be monitored by slot. This prohibits accurate monitoring due to sub-slot uses using OFDM. Monitoring errors can occur, which can increase latency and reliability possibilities.

Release 16 monitors downlink transmission in a different way. The downlink transmission is monitored per slot symbol, and the number of downlink transmission frequencies are limited which means transmission data is constantly applied.

Continued challenges

Thus far, we have looked at the current state of 5G, now we delve into the challenges running a Industrial network over 5G, and the timeline for significant enhancements. One topic of concern is ensuring an IP routable network, such as that which 5G is, can be used. There are multiple protocols, such as DLR, which are based on Layer 2 implementations, which do not have IP frames, thus, are not routable in a 5G network. In addition, non-LLDP devices use a discovery protocol using UDP/IP, the protocol uses IP Broadcasting, which is not IP routable. In addition, IP Multicast frames are routable on an IP network, but need routers with specialized configuration.

Most of these functions are not necessary on every application, therefore, they can be ignored or turned off on the Controller or device. This may cause problems due the inherent default options for most devices are DLR and discovery.

One option which would allow both DLR and discovery to occur is use of Ethernet Packet Data units (PDU). Although PDU's are a relatively old technology, its use on the Ethernet layer (Layer 2) is a new interpretation of this technology and is not of general use in the market yet. Additionally, significant use of the broadcast protocols may cause saturation of the cellular connection. Additionally, LAN switches typically implement IGMP snooping to handle excessive packet congestion by limiting multicast frames to the subscribed IP subscribers. IGMP is an IETF (Internet Engineering Task Force) recognized protocol.

IEEE (Institute of Electric and Electronic Engineers) does not offer IGMP as a feature set. IEEE is recognized by the organization which codifies and standardizes current cellular network technology, 3GPP (3rd Generation Partnership Project) as a partner in standardization body. As such, IGMP may not be considered as a protocol adopted by the telecom industry, therefore, may not be supported by cellular networks.

One workaround to consider is use of tunneling on devices on the 5G network implementing EtherNet/IP. This would allow use of all Layer 2 protocols, as well as broadcast messages. This can be done by Virtual Extensible Local Area Network implementation or Generic Routing Encapsulation (GRE). This provides scalability and significant segmentation implementations heretofore unavailable. This implementation does have some challenges. A 64-bit header is necessary for VXLAN, therefore more overlay and processing therein, however advanced QoS implementation would lower the degree to which this degrades the determinism. VXLAN behavior on a 5G network has been studied. In addition, VXLAN is a IETF standard protocol, IEEE has not investigated standardizing VXLAN technology.

Generally, 3GPP has looked at IEEE as the de facto organization to align internet technologies.

TSN enablement

Enablement of 1588, as well as TSN is an important function which enhances utilization of 5G on the factory floor. As outlined in the 5G-ACIA white paper "Integration of 5G with Time Sensitive Network for Industrial Communications. Release 16 adds (g) PTP synchronization which allows IEEE 1588 operation. Motion applications seem ideal for 5G use, as many of the incongruent variables, such as high node count and unknown interference do not exist in many highly deterministic applications, such as CNC's and Semiconductor fabrication processes.

Release 17

RedCap and mmWave spectrum enhancements provide important technical advancements in Release 17.

RedCap enhancements

RedCap, or reduced capacity, is built for solutions which do not need the determinism of URLLC requirements. Generally, increased data throughput without a significant increase in cost. This opens the possibility for 5G wearable devices and powered industrial sensors for monitoring vibration, pressure, and temperature. These types of sensors do not require high latency but high reliability, which RedCap can efficiently deliver.

The RedCap spec was devised to ensure that heterogeneous 5G solutions were available. One of the significant advantages of RedCap is designing 5G to a more power-efficient solution, to allow battery power. Fast upload and download speeds create a significant

SOURCE: ISTOCK

One of the most exciting use cases for the higher mmWave spectrum technology is Autonomously Guided Vehicles.

burden on the power. Thus, some creativity can be derived to lessen the load on the processor or change the processor altogether to a lower-style version.

Additionally, RedCap allows for higher latency for non-deterministic applications, making it more flexible and versatile than traditional 5G solutions. Of course, latency reduction allowance is the byproduct of various changes in specification. Halving the bandwidth, allowing half-duplex, limiting the number of Quadrature Amplitude modulation channels, and limiting the number of transmit and receive channels create this relaxed latency.

Another critical advantage of RedCap is its cost-effectiveness. eMBB requirements place a high cost on video upload and download times, which require an increase in gating, and clock speed, among other processor enhancements. Wearables are a significant discount; just the chips cost will be inherently 5 to 6 times less expensive to meet the current market pricing. This makes it an attractive option for companies looking to develop wearable devices and sensors that are more affordable for consumers.

mmWave enhancements

Release 17 enhances the mmWave spectrum, 24 GHz to 300 GHz range, called FR2-2, to use the 52.6 to 71 GHz range. The mmWave spectrum is in a higher part of the spectrum, which limits its use to closer range.

It does so by use of beamforming technology, the range capacity is significantly increased compared to your standard 3.5 GHz range. Beamforming can be used in several ways to improve coverage, network efficiency, and reduce interference, making 5G networks even more reliable than before.

The FR2-2 update adds almost 18 GHz in new bandwidth, which is a significant increase. And since the bandwidth is within a range of usable high frequency, it's perfect for places like stadiums, docks, train depots, and large factory floors. The FR2-2 5G NR specification provides enhanced features for use cases that require ultra-low latency and ultra-high throughput.

This means that it includes features such as frequency division duplex (FDD) and time division duplex (TDD) operation, support for Massive MIMO (Multiple Input Multiple Output) antenna arrays, beamforming, and beam tracking. It also supports multiple access technologies, such as Orthogonal Frequency Division Multiple Access (OFDMA) and Non-Orthogonal Multiple Access (NOMA).

One of the most exciting use cases for the higher mmWave spectrum technology is Autonomously Guided Vehicles (AGVs). AGVs require a lot of effort to engineer, commission, and maintain due to the amount of control done in the vehicle itself. By creating a pathway to low latency data, a lot of the control can be done externally, making the AGV more agile and cost-effective. The distance AGVs typically go is within the range of a mmWave antenna and switching can be coordinated to allow for switching over long distances.

Release 18

We can consider Release 18 a study release, meaning many Factory automation requirements, validations, testing, or case studies are considered and studied, rather than applied. There are significant studies under consideration. Increases in positioning for use in Factory Automation is considered practically in the Technical Specification Group Services and System Aspects under "Service requirements for cyber-physical control applications in vertical domains". This requirements document is significant to further specification alignment to the factory automation and process industries.

Ambient IoT

The Next generation of Low/No Power sensors and solutions will use power from various sources, known as Energy harvesting. Various considerations for applications are considered. Intralogistics and automotive inventory tracking, as well as sensing, positioning and IO could all be considered in this technology. Low cost, low/no power solutions would enable large arrays of sensors. Enabling systems which typically used RFID could enable a significant increase in data transmission.

Three categories of devices are considered. Device A is the No Power passive device which uses backscattering transmission to react to inputs. Device B is the Semi-passive device with some energy storage. Device C is an active device with independent output signaling.

Four topologies are considered when applying a theoretical Ambient IoT application within a 5G network.

Topology 1: Backscatter network to the Ambient IoT device (Device A)

Topology 2: backscatter network to an intermediate (mesh) node to the Ambient IoT Device (Device A)

Topology 3: Backscatter network to a node assistance to an Ambient IoT Device (Device B) transmitting to a Backscatter network.

Topology 4: User Equipment (5G enabled phone) to an Ambient IoT Device (Device A)

Urgency is needed due to multiple considerations from other technologies, such as Wi-Fi, Bluetooth, and many others. Some estimations of possible applications are like the RFID market. RFI currently at 20 billion units in 2022, should reach 49 billion Units by 2031. Considerations to limit topologies and devices into release 19 would increase the speed of the standardization.

This was done with 5G specifications with emBB releases early in the scheduling, with URLLC happening much later. To achieve some result, case studies in TR 22.840 and outlined basic use cases, as inventory is, and a focus towards these baseline attributes, such as communication range, positioning accuracy, etc.

Rob Lodesky Director, Strategic Accounts, ***HMS Industrial Networks.***

Learn More

Industrial 5G boosts efficiency in real-life intralogistics

Industrial 5G is changing the way companies make decisions, manufacture products and maintain factories. Thanks to Industrial 5G, the MF-K factory has become an example that has proven that companies will even further increase efficiency and productivity as they implement real-world applications.

SOURCE: ISTOCK

MF-K manufactures automation and process control systems, Ethernet switches, Industrial Wireless LAN devices, mobile wireless routers, and Industrial PCs.

THE SIEMENS PRODUCTION FACILITY FOR Manufacturing Karlsruhe (MF-K) incorporates Industry 4.0 in a double sense.

On the one hand, the factory produces a wide variety of key components for automated and digitalized manufacturing processes. At the same time, MF-K follows the approach of "using what we sell". Products from their own portfolio are used daily – proving that private Industrial 5G networks already enable increased efficiency and flexibility today.

Today's manufacturing is subject to VUCA (Volatility, Uncertainty, Complexity, and Ambiguity). This is manifested in a high number of product variants, shortened development times, and fluctuating order quantities. The exploding need for variety results in ever-smaller lot sizes. At the same time, there is a demand for customized high-quality products at the cost level of mass production.

The more unpredictable customer behavior and supply chain become, the quicker factories need to react. Fluctuations especially impact intralogistics, making agile workflows necessary. As a result, real-time information flow, flexibility, and reliable communication become the centerpiece of modern production processes – all made possible by Industrial 5G at MF-K.

Solution highlights

- Increased efficiency and productivity
- Smooth operation of AMRs without interferences from other users
- Mission-critical or safety-relevant applications run smoothly
- Smooth operation of AMRs without interferences from other users
- A secure and stable 5G network handling the high information flow and offering fast adaptability
- An agile workflow closing the gap between unpredictable delivery times and short-cycled customer demands
- The complete solution from one supplier – private 5G infrastructure, user equipment, and end devices

SOURCE: SIEMENS

Industrial 5G routers in the making: "At MF-K, we do not only produce them, but we use them as well."

Stefan Förschner proudly presenting the Factory of the Year Award 2021.

Forming innovation through technology and humans

MF-K is located at the heart of Siemens-Industriepark Karlsruhe, Germany. Manufacture ranges from automation and process control systems to Ethernet switches, Industrial Wireless LAN devices, mobile wireless routers, and Industrial PCs. The manufacturing concept with its matrix production is based on agile and digital production processes enabled by cutting-edge technologies. However, the success of MF-K doesn't rely on technology alone.

Its main advantage is the seamless collaboration of people and digital solutions. In 2022, the MF-K received the renowned "Factory of the Year 2021" award. One of the reasons: extraordinary adaptability and active involvement of all employees in the ongoing transformation process. This perfectly fits MF-K's mission "it's only through people that our digital factory becomes intelligent."

MF-K acting as a pioneer by

- Proving how 5G increases the efficiency and productivity of manufacturing
- Offering future Industrial 5G users a solution proven in practice
- Pushing further development and optimization of Industrial 5G
- Showing how manufacturing companies can strengthen competitive production even in high-wage countries

Achieving flexible intralogistics by implementing Industrial 5G

One of the focus areas of the human-machine collaboration at MF-K is intralogistics. Typically, shuttles, AGVs (Automated Guided Vehicle), or mobile robots provide workers with exactly the required tools, raw materials, and semi-finished products – right when they need them. One of the core elements of the factory is the "matrix production in flow". Each product can be produced on any module. For every order, the production management system autonomously chooses the next available module – a concept that has proven effective in avoiding bottlenecks, accelerating throughput, and increasing customer orientation.

Mobile "cobots" (collaborative robots) with cuddly names support intralogistics at MF-K. They communicate wirelessly using Industrial Wireless LAN. Hence, using also 5G for this purpose was a logical step to go. The supply process was identified as an ideal area to implement 5G-driven applications in a tough real-life environment. In MF-K, Autonomous Mobile Robots (AMRs) fulfill their task on the shopfloor by moving components and semi-finished products to their relevant location. They communicate in a private 5G network.

MF-K acts as a pioneer by incorporating a private 5G network into daily work: "We've been producing industrial solutions for a very long time, and we know what's needed for the future of industry. Private Industrial 5G is an essential part of this story", states Stefan Förschner, Head of Factory Operations. "Many manufacturing companies consider establishing private Industrial 5G networks. We at Siemens believe in the new communication standard and have supported its standardization and industrial implementation by developing a corresponding portfolio. Here in MF-K, we already produce 5G routers, and we also use the private 5G infrastructure in a very early stage", adds Stefan Förschner.

"Our private 5G network allows us to smoothly operate AMRs. MF-K has extreme requirements in terms of quality and productivity. Using a private Industrial 5G network under such demanding conditions is an excellent reference on the path to broader applications for various industries. And, of course, we are planning to expand the

number of our AMRs, which will exclusively work with Industrial 5G in the future", explains Uwe Bollinger, IT Infrastructure & IT Security Manager.

Working with private Industrial 5G: advantages of a campus network

At MF-K, a private 5G network is implemented. Such a network is run locally at a defined location: here, it's at a manufacturing site. It is operated by the user with an own 5G infrastructure and works with a private frequency. The MF-K uses the private 5G spectrum of 3.7-3.8 GHz that was introduced by the German government.

The private 5G infrastructure in the MF-K comprises a 5G Core and a Radio Access Network (RAN). They run on two Siemens Industrial PCs in a server room close to the shopfloor. One IPC hosts the 5G Core, which manages the entire 5G network including the RAN. The RAN is hosted on the second IPC and consists of a software-based Central Unit (CU) that manages the wireless network and the Distributed Unit (DU) that translates Ethernet into digital radio signals. Finally, the Radio Units (RU) – also part of the RAN – make the radio signal available on the shopfloor. They are connected to the DU via fiber optics and are mounted on the ceiling in the production area. They ensure the even transmission and distribution of the 5G signal on the shopfloor. Each AMR is equipped with a Siemens 5G router, a SCALANCE MUM856-1 that connects it to the 5G network. The device was chosen because it offers a protection class of IP65 and can be mounted directly on the AMR without an additional cabinet.

SOURCE: SIEMENS

"Wickie", one of MF-K's mobile "cobots" (collaborative robots), delivers semi-finished products – right when they are needed.

"Our private 5G network with our private frequency gives us the possibility to smoothly operate AMRs without interferences from other users. We can assure that mission-critical or safety relevant applications run without any problems", says Uwe Bollinger

Siemens is developing a complete private Industrial 5G ecosystem consisting of a private 5G infrastructure and end devices. The application in the MF-K is a first proof of the solution in a real-life production plant. "And it works just well", says Stefan Förschner.

Manufacturing companies will benefit from Industrial 5G in a wide range of areas. With its characteristics, Industrial 5G will change the way companies make decisions, manufacture products, and maintain factories. Thanks to Industrial 5G, companies will even further increase their efficiency and productivity as real applications in the MF-K factory has proven.

Iwona Baranska, Head of Marketing Industrial Wireless Communication, ***Siemens.***

Visit Website

Difference between private and public 5G network

5G can be deployed in public or private networks. Public 5G networks are run by Mobile Network Operators (MNOs) and usually focus on providing a high bandwidth to a high number of participants, e.g., smart phones. Private 5G networks – so-called campus networks - are run locally at a defined location, e.g., a manufacturing site. They are operated by the users themselves on a private 5G frequency using an own private 5G infrastructure. The users can adapt the networks to exactly support their applications with regard to real-time behavior, reliability, or needed bandwidth.

Industrial automation wireless networks update

Wireless technology choices are growing led by Wi-Fi, 5G/Private 5G, sensor networks, Bluetooth, ultra-wideband and other reliable wireless technologies. These technologies offer enhancements for industrial use cases and also present new opportunities to enhance safety, security and efficiency in factory environments.

INDUSTRIAL WIRELESS IS NO LONGER JUST AN extension of the Enterprise Wi-Fi. Industrial wireless use cases are increasing in industrial operations: AR/VR assistance for personnel, location services, high speed SW downloads to products and mobile machinery and assets.

The wireless technology choices are also growing: Wi-Fi, 5G/Private 5G, sensor networks, Bluetooth, ultra-wideband and other reliable wireless technologies. The technologies are making enhancements for industrial use cases. All offer opportunities to enhance safety, security, and efficiency.

This article will explore the wireless options providing key considerations around Use Case, Spectrum, Distance, Reliability, Speed, Latency, Management and Total Cost of Ownership. Additionally, we will consider how ODVA may be able to help users and vendors integrate wireless technologies for use in CIP communications.

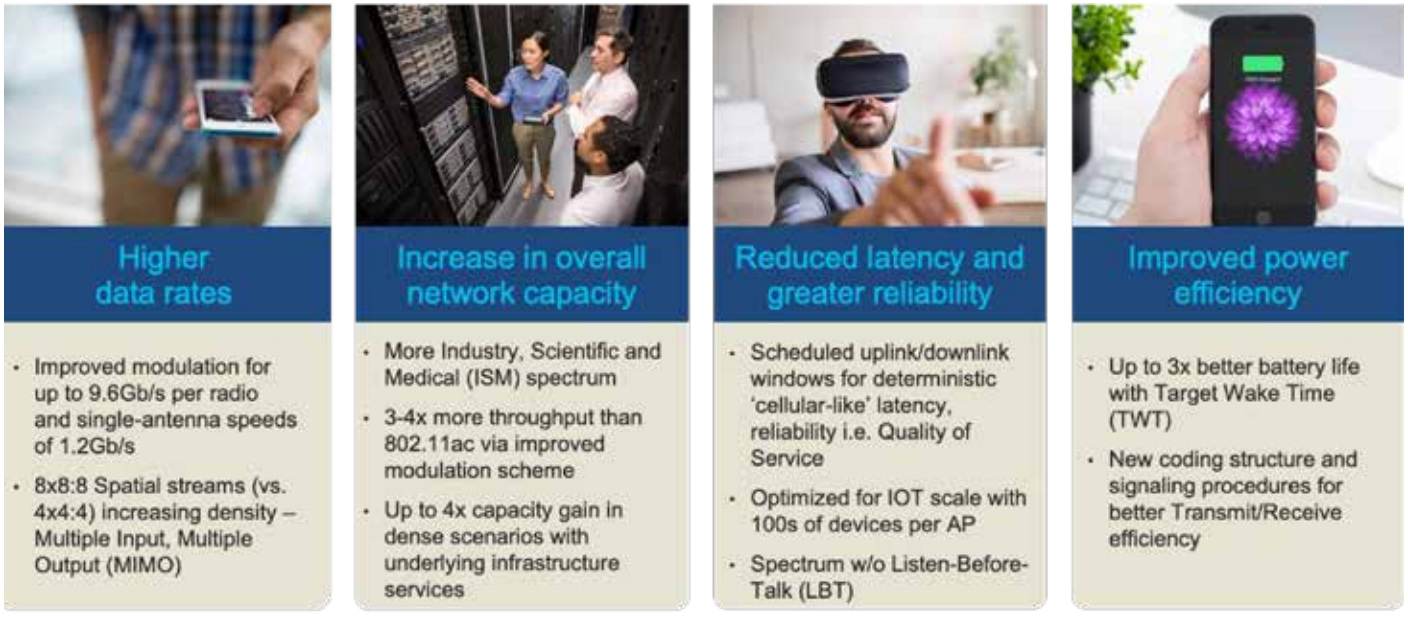
SOURCE: ISTOCK

Wireless is increasingly finding use cases where it can play a key role in smart factories.

Use cases

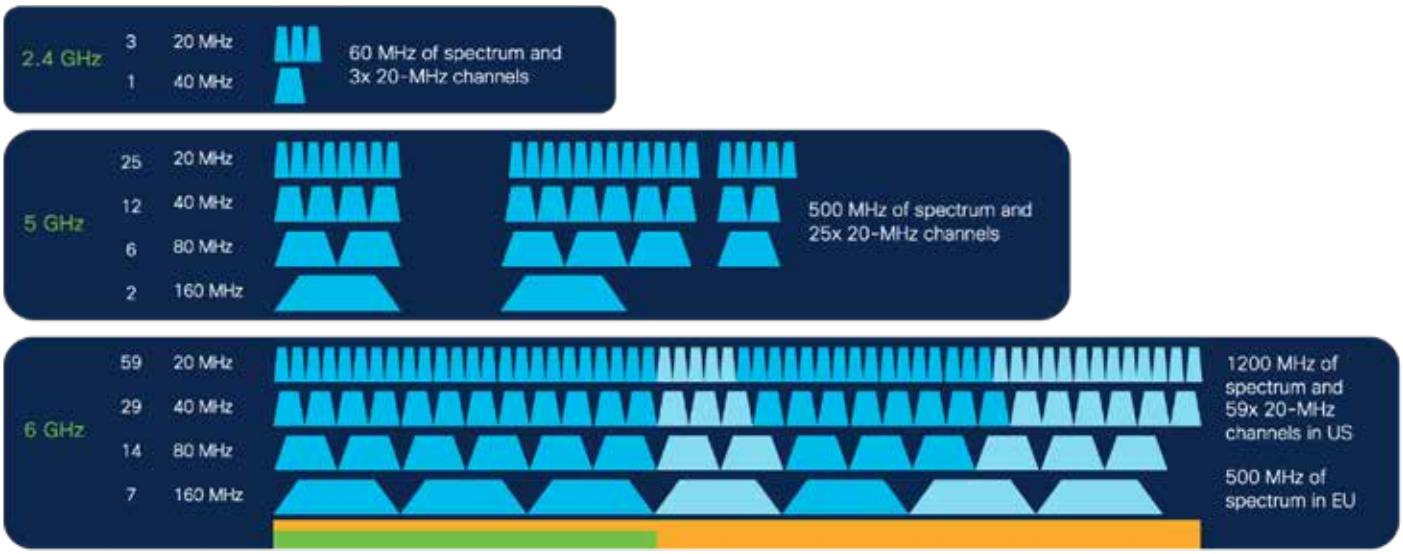
Industrial wireless technologies are ever improving and evermore utilized in industrial operations. The technology improvements are meeting more and more of the industrial requirements, including:

- High-bandwidth and throughput to bandwidth intensive applications such



SOURCE: ODVA

Figure 1 – Wi-Fi 6/6E enhancements



SOURCE: ODVA

Figure 2 – Wi-Fi 6/6E available spectrum diagram.

as video streaming, augmented/virtual reality and tele-remote support
- Low latency to support tighter industrial automation and control applications, including CIP Safety
- High-availability via improved interference avoidance, faster roaming and lower packet-loss rates

Key use cases where industrial wireless play key roles include:
- *Smart devices:* smart phones and tablets
- *Automated Guided Vehicles:* autonomous robots and vehicles moving product and parts around production facilities
- *Surveillance Cameras:* streaming video for surveillance and vision control
- *Human Machine Interface:* mobile HMIs keep operational personnel connected
- *Remote Expert:* integrated remote engineers and support for deployment and problem resolution
- *Augmented Reality/Virtual Reality:* mobile AR/VR headsets to improve personnel effectiveness
- *Sensors, Actuators:* wireless sensors and actuators where wired connectivity is challenging
- *Wireless Tooling:* More effectiveness and efficient tooling when not tethered
- *Mobile Work-Cell:* flexible, nomadic production equipment and assets
- *Product Downloads:* download Software and data to intelligent products.

Wi-Fi current state

Currently, the most recent available Wi-Fi technology is based on Wi-Fi 6/6E technology. Wi-Fi 6 technology (IEEE 802.11ax) is currently shipping where much of the infrastructure is ready to support the additional spectrum allocation referred to as Wi-Fi 6E.

As of the writing of this article, Wi-Fi 6E is available in a number of countries, including the US, although only a limited set of devices support it yet. Specifically, low-power indoor (LPI) devices support 6E. Most industrial Wi-Fi 6 devices must disable support for 6E because they do not have integral antennas and/or have enclosures that could be used outdoors (even if they are intended to be used indoors, but must withstand washdown).

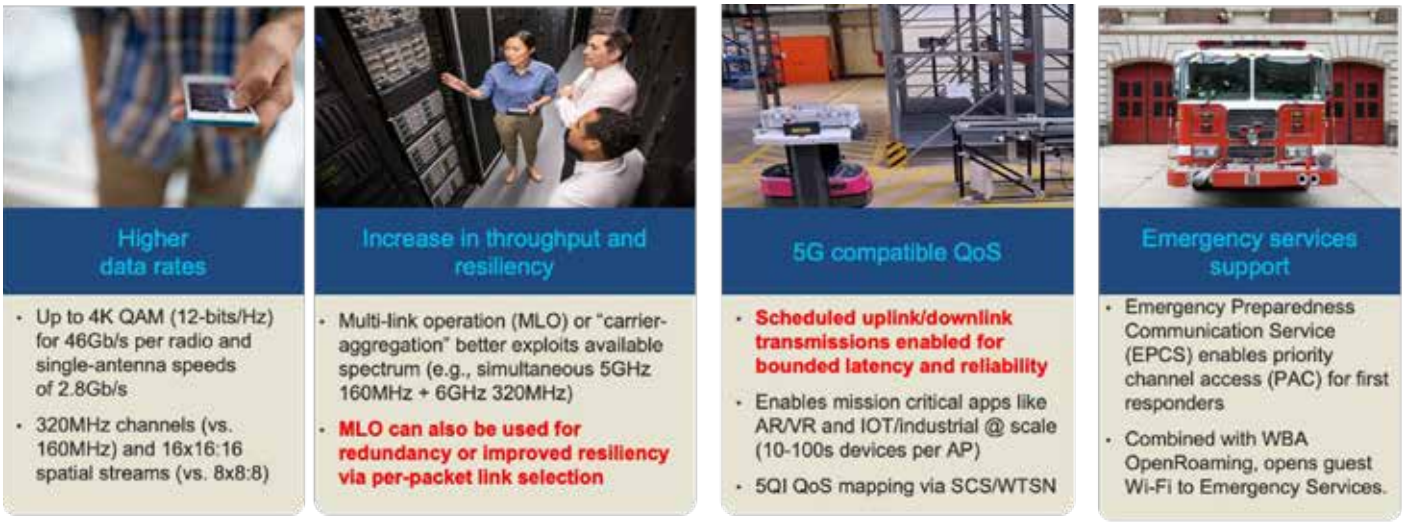
Wi-Fi 6/6E update

The following summarizes key enhancements in Wi-Fi 6/6E. In addition to these features, Wi-Fi 6E grants additional access to 1200 MHz of relatively clean spectrum in the newly-opened unlicensed 6 GHz band that significantly increases the available spectrum (roughly @200% increase in the US, @100% increase in EU), improving data rates, lowering interference and supporting more applications.

Wi-Fi 7 update

As of the writing of this article, the Wi-Fi Alliance is working on Wi-Fi 7 and is expected to be ratified in 2024. The IEEE IEEE is still working on IEEE 802.11be.

Wi-Fi 7 continues the improvements in resiliency, bandwidth and denser deployments of devices. Wi-Fi 7 currently includes enhancements for industrial applications



SOURCE: ODVA

Figure 3 - Enhancements expected in Wi-Fi 7.

Feature	Release 15 (2018/2019)	Release 16 (2020)	Release 17 (2022)
URLLC (Ultra-Reliable Low-Latency Communication)	All basic features (for IMT-2020 compliance)	Adds redundant transmissions, QoS monitoring	No new features
Ethernet PDU	No	Yes	Yes
Time Sync Support	None	IEEE 802.1AS gPTP only	IEEE 1588 PTP (CIP Sync)
Positioning	< 50 m	< 3 m	< 1 m
Network Slicing	Basic slicing features (similar to VLAN)	Adds network slice-based authentication (NSSAA)	Adds slice groups (NSSRG), enhanced RAN support
IIoT	Relies on LTE	5G core support for NB-IoT	NR RedCap (replacement for LTE Cat 1)

SOURCE: ODVA

5G feature releases.

around resiliency and priority.

5G update

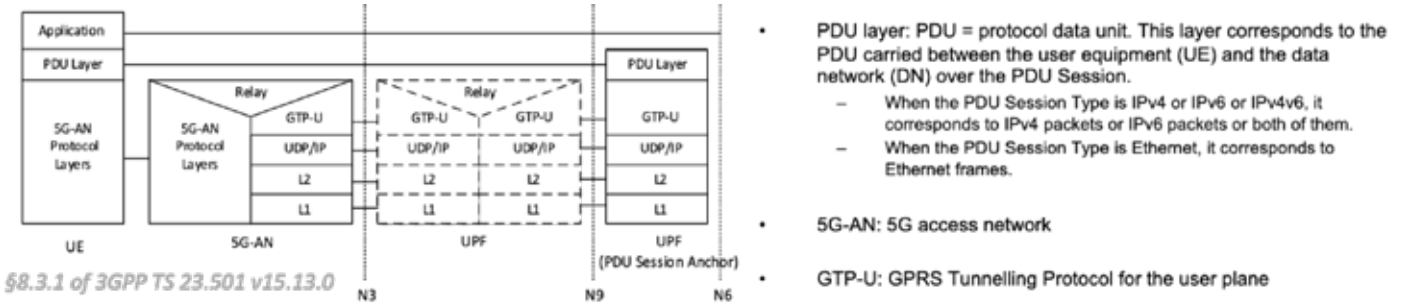
3GPP is the organization that creates 5G standards. The standards cover the complete 5G architecture – UE (User Equipment) end-devices, RAN (Radio-Access Network) and Mobile Packet Core. The standards are delivered in releases. Here are some considerations about 3GPP standards:

- Feature release for telecom providers remains 5G vendor priority
- There is significant lag between 3GPP specification release and commercial availability (particularly of "industrial" features not needed by telecom): Release 16 completed in 2020; no infrastructure supporting Release 16 features (e.g., time sync support) until end of 2023 / early 2024
- 5G modems more closely follow 3GPP releases: some updates are via firmware, but many require new silicon; more likely to see 5G modems advertised as "Release 16-compliant"
- Infrastructure adds features from future 3GPP releases incrementally: typically via software update; follows vendor internal roadmaps; features from lower-numbered 3GPP releases are generally added first; and some features (e.g., localization) may require special hardware support in basebands
- Even though the standards are released groups, UE, RAN and MPC vendors can pick and choose what features and functions to deliver.

5G and CIP

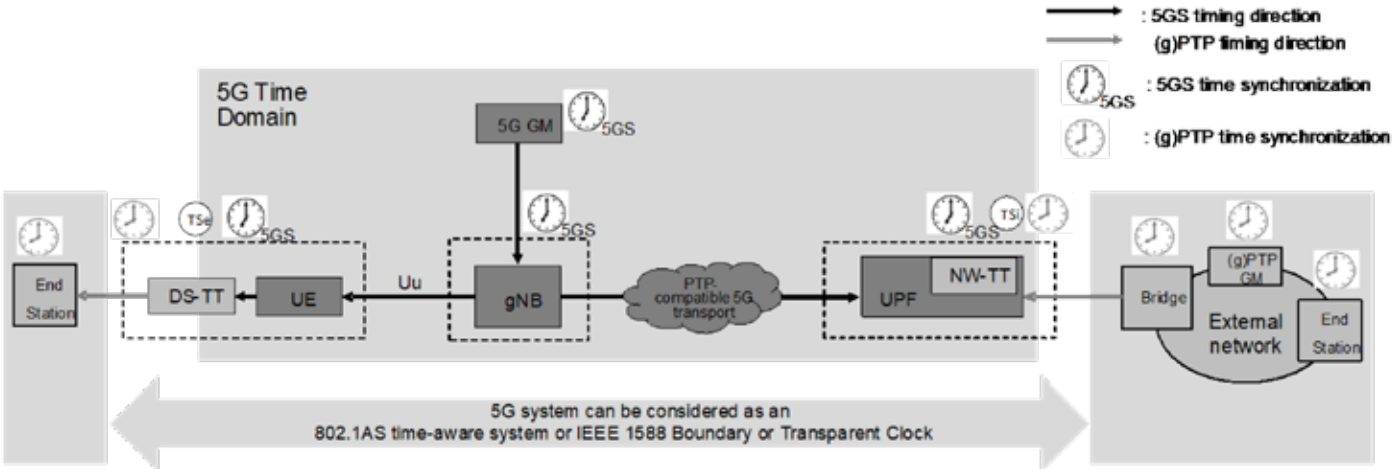
The good news is that 5G natively carries EtherNet/IP traffic, as it is based on TCP/IP. A few other notes about 5G and industrial networks:

- Support for Ethernet frames was added in 3GPP Release 16, specifically Ethernet protocol data unit (PDU) sessions: most existing 5G equipment on the market today does not support Ethernet PDU
- EtherNet/IP is carried by TCP and UDP, so EtherNet/IP can run on any 5G: most industrial protocols need special tunneling (e.g., VXLAN) or Ethernet PDU support
- Special support is needed for: Time synchronization (motion); Multiple devices behind a UE
- 5G typically requires UEs to request a schedule to send data uplink which may disrupt low-latency communications, which can be mitigated via Grant-Free Scheduling
- Along these lines, typical 5G systems are configured to prioritize downlink data (e.g., video streaming) over uplink, whereas industrial communication creates nearly symmetric uplink and



SOURCE: ODVA

Figure 4 – 3GPP 5G support stack in Releases 15 through 17.



SOURCE: ODVA

Figure 5 – 3GPP PTP support as of Release 17

downlink traffic. This can be mitigated with 1:1 slot ratios.

5G and Precision Time Protocol

5G base stations must be synchronized to a GPS-derived clock to avoid interference with neighboring cells. GPS time is distributed to UEs via a system information block (SIB), specifically SIB 9 for standalone networks and SIB 16 for non-standalone networks that rely on LTE. The distribution of GPS clock data, combined with a method such as timing advance (TA) to correct for signal time of flight, allows all elements of the 5G system to remain synchronized.

3GPP has added features to support industrial PTP protocols (IEEE 802.1AS gPTP in Release 16 and standard PTP / CIP Sync in Release 17).

While details may be vendor-specific, the basic mechanism to support PTP works as follows:

- A 5G system (5GS) supporting Release 16+ will correct residence time via TSN Translators (TTs)
- There are two types of TTs: device-side TT (DS-TT; TSN master), and network-side TT (NW-TT)
- Ingress traffic into the 5G system is timestamped; on egress, the TTs subtract the current time from the ingress timestamp to compute residence time, which is added to a correction field
- In essence, the 5G system acts like a single switch implementing a PTP transparent clock
- The PTP Grandmaster may be internal or external to the 5G system; at most one NW-TT can be a TSN slave

Support for multiple devices behind single UE

Cellular was originally designed for phone and eventually smart phone use, where all traffic was to/from a single end device. As such, it is still developing "bridging" functions similar to Work-Group Bridges found in Wi-Fi networks.

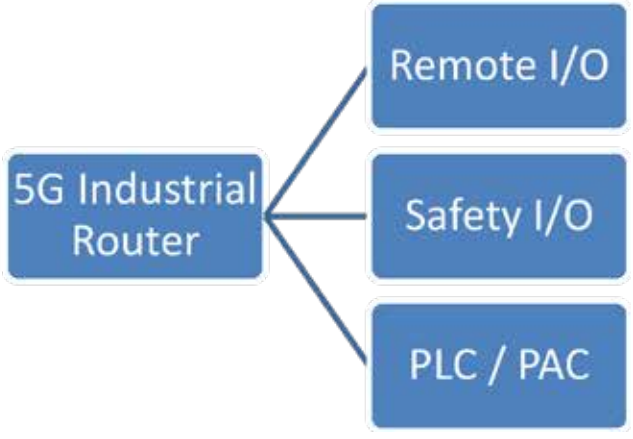
A few points about support for multiple devices behind a single 5G user equipment (UE):

- It is advantageous if a single UE can support multiple automation devices: 5G UEs (modules or routers) are expensive; many automation devices are located in metal cabinets that block RF, so it often doesn't make sense to integrate 5G radios in these devices
- Tunneling / VXLAN can be used to support multiple devices behind a single UE: mMay need an "extra box" behind UE to act as a tunnel endpoint; and some UEs have tunneling support or can run containers (e.g., with OpenVPN)
- 5G also supports "framed routing" (3GPP TS 23.501 §5.6.14): originally developed as part of RADIUS (RFC 2865); 5G vendors may call this feature "Routing Behind Mobile Station" or "Routing Behind UE", but it is typically implemented using framed routing
- Example of how framed routing works: allocate small subnet (/27 or smaller) behind UE; this subnet is associated with a user name and password, stored in the 5G core; when a 5G UE initially connects (attaches) to a network, it authenticates using SIM credentials (primary authentication); a 5G UE may also authenticate to a specific data network using EAP (typically via PAP or CHAP) with a user name and password; this is called secondary authentication; and when the UE performs secondary authentication, a route is created in the core to the subnet associated with the secondary authentication credentials.

Grant-free scheduling

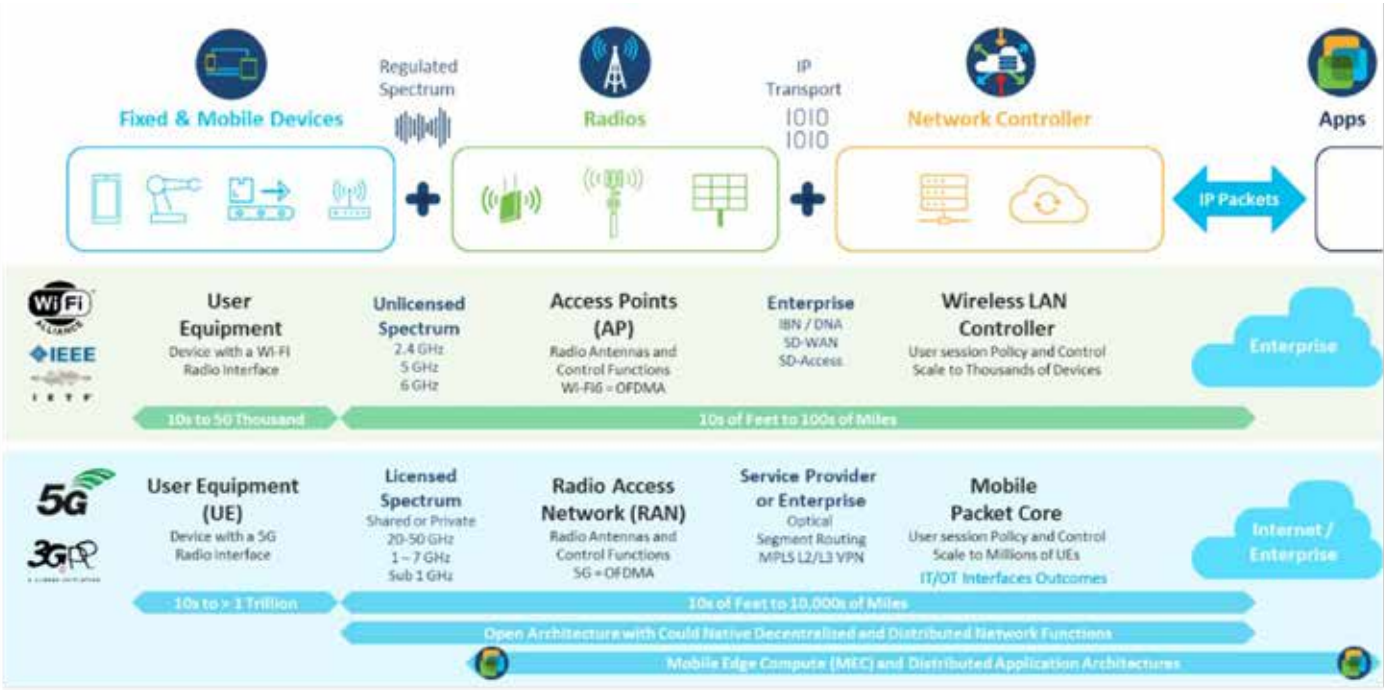
5G UEs typically must request permission (a grant) to send uplink data. This adds delay

https://www.industrialnetworking.com/pdf/HMS-anybus-wireless-bolt.pdf



SOURCE: ODVA

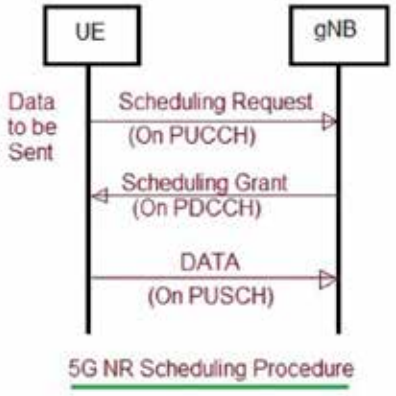
Figure 6 – Industrial Use Case – multiple devices behind a UE connection.



SOURCE: ODVA

Figure 7 – Wi-Fi and 5G architectures.

and increases inter-packet delay variation (colloquially called jitter), both of which are problematic for CIP protocols. The added delay from this scheduling procedure also generally precludes very low-latency applications.



5G NR Scheduling Procedure

Grant-free scheduling (also called transmission without grant, TWG) avoids the added delay and packet delay variation caused by uplink scheduling. It works as follows:

- The 5G base station reserves resources for uplink for each UE; the UE can transmit on these reserved uplink resources at any time
- The periodicity of the grant-free uplink resources is adjustable; ideally this period would be the same as the CIP packet interval, but synchronization may not be possible
- In general, grant-free schedule reduces latency at the expense of throughput since reserved uplink resources may not be used

1:1 slot ratios

EtherNet/IP typically has approximately equal traffic in each direction. Typical cellular use cases are downlink heavy (e.g., streaming video). In fact, most 5G equipment initially only supported a few fixed downlink to uplink ratios with at best a 4:1 downlink to uplink ratio.

This downlink uplink asymmetry creates several problems for EtherNet/IP traffic. First, it creates a bottleneck in the uplink direction, which may cause extra queuing delay for CIP connections in this direction. A second, less-obvious effect is that it also increases the time required for physical-layer retries when the uplink slots are fewer and farther apart. This adds delay and increases inter-packet delay variation.

Therefore, usage of slot ratios as close to 1:1 as possible is advantageous for EtherNet/IP traffic. A few points about 1:1 slot ratios:

- 5G divides resources in time into frames, subframes, slots, then symbols; Individual symbols can be allocated for downlink, uplink, or flexible
- With time-division duplexing, slots (each containing 14 symbols) are typically allocated as downlink (D), uplink (U), or special (S; mix of symbols)
  - It takes time to switch radios between transmitting and receiving, so blocks of downlink or uplinks slots allows higher throughput
- Slot patterns sets ratio of uplink to downlink traffic, as well as retry delay
  - 5G base stations and UEs initially offered only a few fixed slot ratios
  - Closest to symmetric was 4:1 downlink to uplink, such as DDDSUUDDDD
  - Current 5G equipment may offer nearly 1:1 slot ratio, e.g., DDSUU
- Even with an exactly 1:1 slot ratio, downlink throughput is typically better due to MCS differences, such as higher-order QAM in downlink

Key industrial considerations

The key considerations when choosing wireless communications include:

1. What are the devices to connect? Cranes, AGVs, tablets, sensors etc.
2. What are the applications requirements? Latency, reliability, nomadic/stationary, etc.
3. What are the deployment Scenarios? Regional regulations, spectrum, indoor/outdoor, access/backhaul
4. What are the potential technology options? *Wired*: Ethernet, serial, DSL; *Wireless*: Wi-Fi and Ultra-Reliable Wireless Backhaul, 5G Cellular, Wi-SUN, LoRaWAN; and *Spectrum*: Unlicensed, Licensed: Private, Public, Shared
5. CapEx and OpEx Implications?

ODVA Impact

As stated above, CIP and EIP are already well suited for both Wi-Fi and 5G communications with a few noted caveats, especially around time synchronization and motion applications. Both technologies are designing improvements for industrial control applications.

David Brandt, Principal Engineer, ***Rockwell Automation****; Paul Didier, Solution Architect,* ***Cisco****; and Bob Voss, Distinguished Engineer* ***Panduit.***

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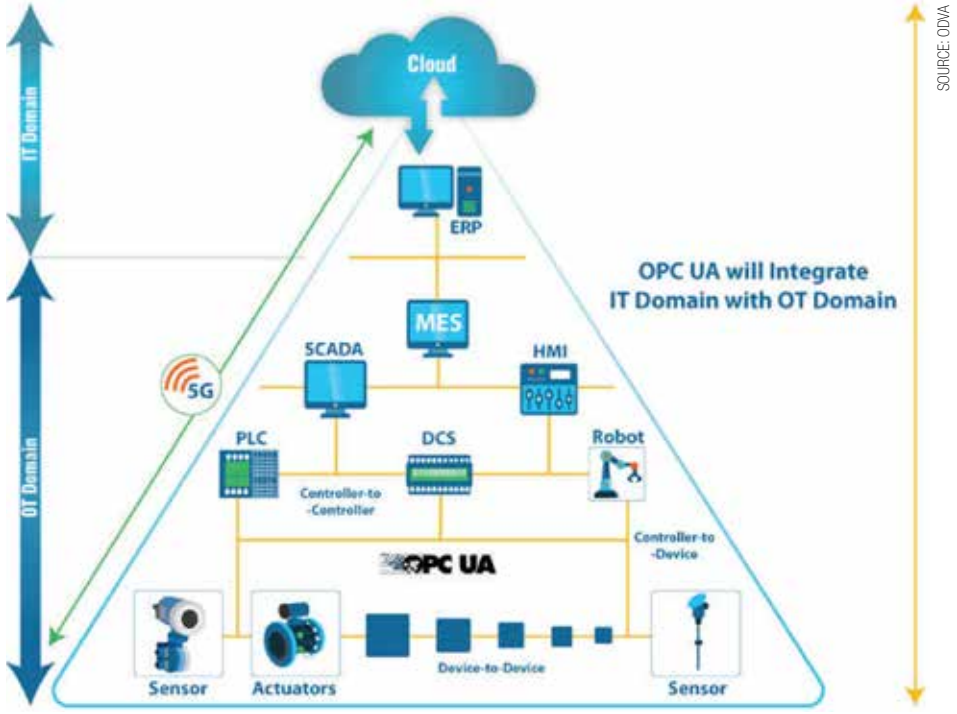
Leveraging 5G networks and EtherNet/IP communications

Combining 5G networks with EtherNet/IP represents a pivotal advancement in industrial automation, bolstered by the potential of Time-Sensitive Networking. This synergy promises ultra-responsive, deterministic, and broad bandwidth communication platforms uniquely suited to the multifaceted requirements of industrial ecosystems.

INDUSTRIAL INTERNET OF THINGS (IIOT) technologies are developing rapidly, opening new avenues and revolutionizing the industrial automation landscape. This article explores the synergistic integration of 5G networks with EtherNet/IP, emphasizing the possible advantages of real-time data communication, deterministic networks, and sensor-to-cloud architecture. With 5G integration as the backbone for Time-Sensitive Networking (TSN) in industrial applications, the focus is on converging 3GPP technologies, EtherNet/IP, and high-fidelity communication.

The unique characteristics of industrial Ethernet networks, including real & non-real-time, with short cycles, demand a communication infrastructure that can cater to diverse requirements. This method allows different clusters to communicate simultaneously, ensuring effective data sharing and reducing bottlenecks by using Layer-2 (L2) Tunneling for integrating automation control systems.

By leveraging the power of 5G networks driving TSN, organizations can achieve the necessary balance between ultra-low latency, determinism, and high bandwidth. Such a balance also orchestrates the varying needs of diverse applications running in parallel. This article specifies the prerequisites of the physical layers, network architectures, and other aspects to consider for a functional, safe device. Further, it explores the testbed collaboratively developed by Rockwell Automation, Ericsson, Qualcomm, and Verizon. This collaborative research examines the current state of Industrial Private 5G networks and their compatibility with EtherNet/IP.



SOURCE: ODVA

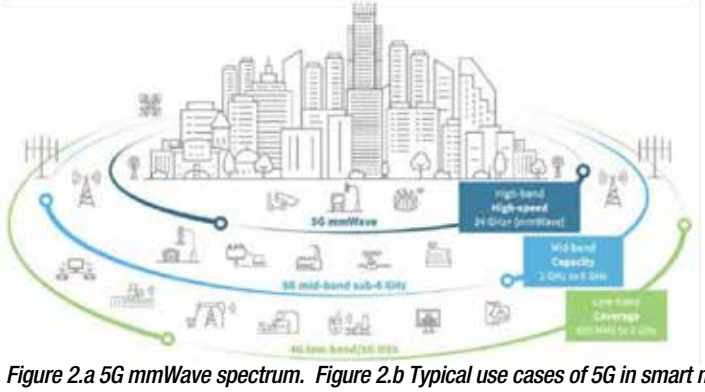
Figure 1. 5G in a smart manufacturing landscape with OT-IT integration.

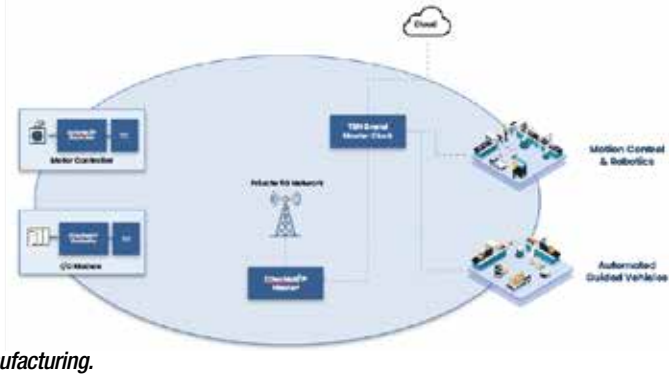
This article includes proposed hardware and software architecture and reference design for anyone looking to start their MVP and reference platform for further evaluation and PoC/Pilot setup. The reference design includes two hardware section, one that runs wireless encapsulation framework and the other that runs the EtherNet/IP CIP applications.

Overall, we will explore how integrating 5G networks with EtherNet/IP offers a transformative opportunity for industrial automation. This illustrates how integration (5G+EtherNet/IP) enables real-time data communication, enhances network performance, and empowers industrial enterprises to thrive in digital transformation.

Smart manufacturing and OT-IT convergence

Digitalization is a benchmark every industry uses to achieve greater flexibility, improved responsiveness, and enhanced performance. Industrial communication technologies act as facilitators to achieve this goal. The recent efforts towards improving communication have





SOURCE: ODVA

Figure 2.a 5G mmWave spectrum. Figure 2.b Typical use cases of 5G in smart manufacturing.

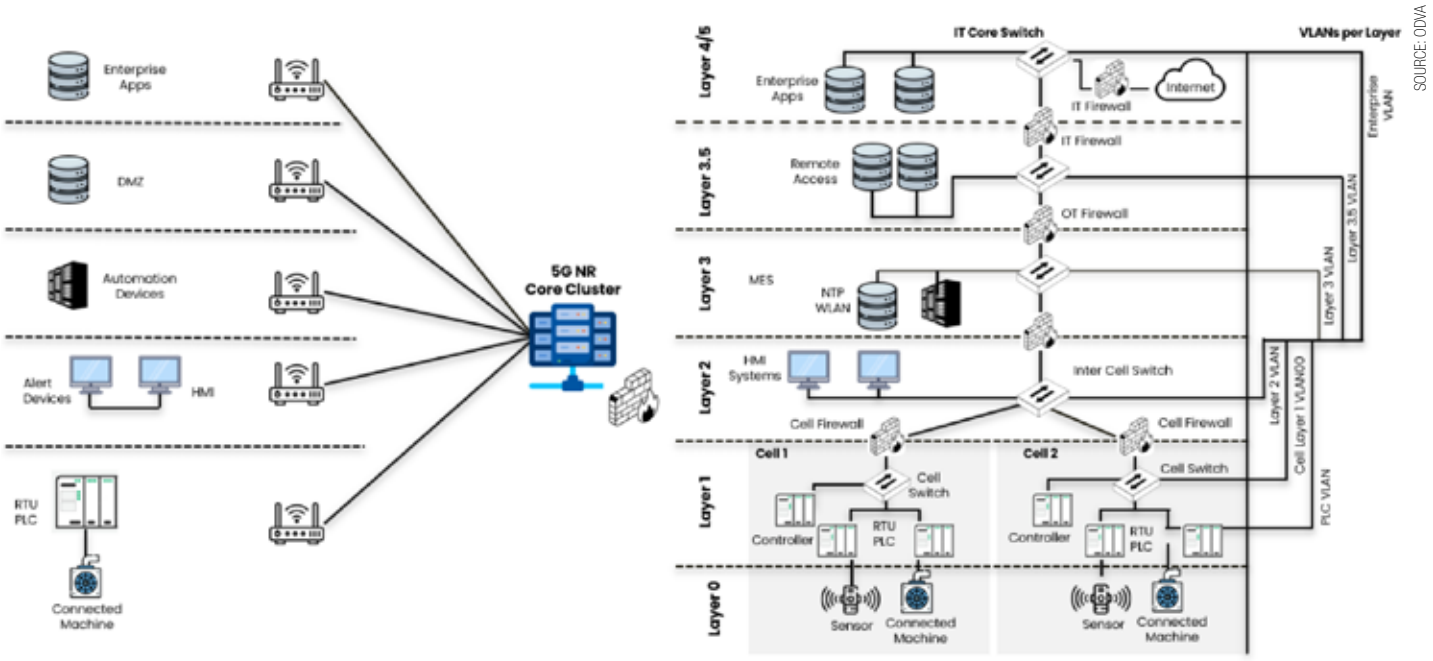


Figure 3. 5G Integration with an OT Environment as per the Purdue Model.

leaned towards integrating IT technologies with the products, systems, solutions, and services across the automation value chain.

The goal is to enable secure, reliable, and seamless access to information at every level. Industrial IoT- comprises of a wide range of devices that cannot be connected over IP-based networks. While Ethernet is popular in industrial architecture, a standardized and integrated way of communication still needs to be included.

- *M2M Communication (Horizontal Communication):* M2M Communication (Horizontal Communication): Machine-to-machine communication is essential to Industrial IoT. IIoT requires transcending from the IT to the OT domain and enabling communication between sensors and actuators. Plant floor equipment/machines and field devices are expected to process data collected from other peer devices.
- *Device-to-Cloud Communication (Vertical Communication):* Vertical communication implies communication across all layers. In a network architecture, the controllers communicate to the SCADA/HMI systems, which then communicate with MES/ERP systems. Such multi-layered and complex communication calls for a seamless exchange of information among heterogeneous systems across multiple layers of the automation pyramid.

Smart manufacturing revolves around networking dissimilar systems within and outside the factory and process boundary. Modern industrial communities and consortiums have made and are making immense efforts toward addressing the horizontal and vertical communication requirements.

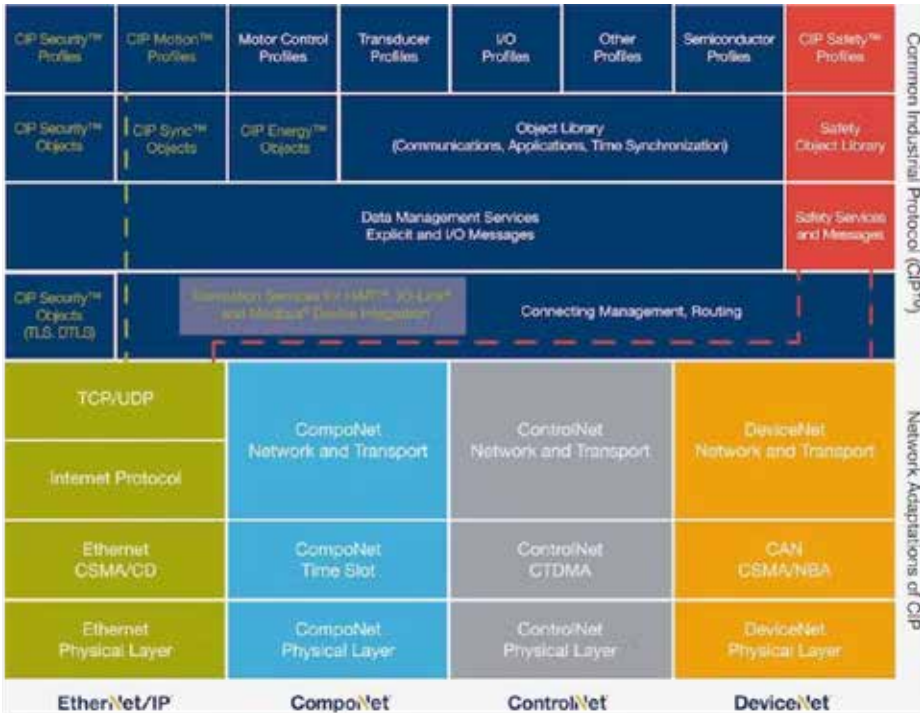


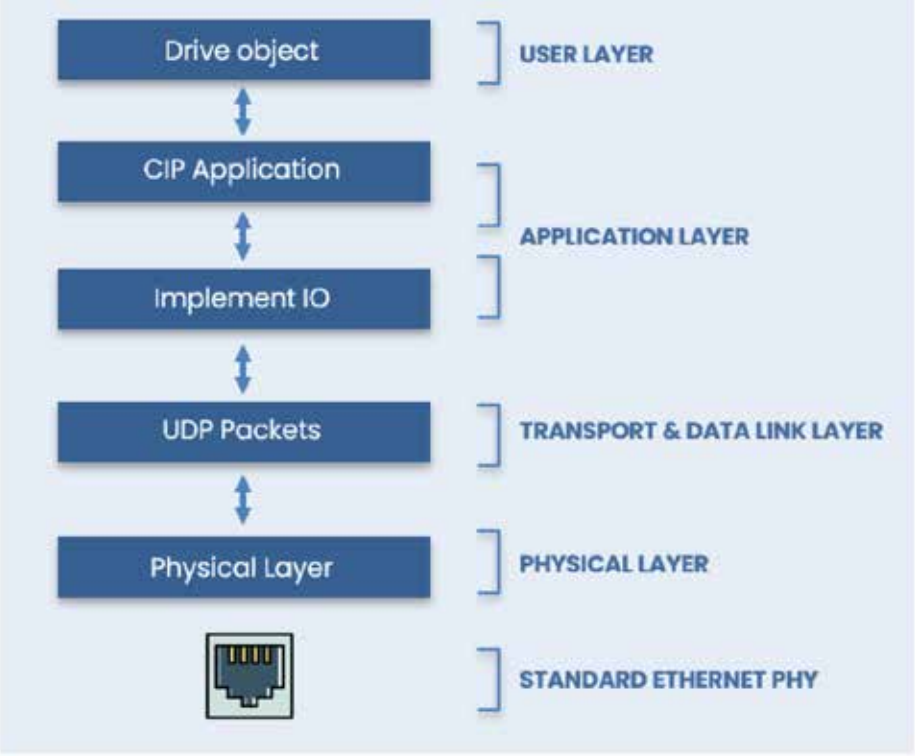
Figure 4. EtherNet/IP as per the typical OSI Layer

5G in smart manufacturing

Speed is also an important parameter to judge the quality of a network. While wireless networks are considered an alternative for many industrial communications, 5G is the new buzzword industrial enterprises look forward to.

3GPP (3rd Generation Partnership Project) is a standard that creates specifications for mobile networks. 5G is the 5th generation cellular network, up to 100 times faster than the 4th generation 4G network. This modern technology promises to deliver a unified connectivity fabric that will take industrial automation to a new level. The 5G specifications defined by 3GPP include the following elements that make it the next big thing for intelligent factories:

- *QoS (Quality of Service):* 3GPP has defined four parameters for 5G based on the types of traffic, i.e.,
  - *Periodic Deterministic Traffic:* Stringent requirements are defined.
  - *Aperiodic Deterministic Traffic:* No pre-set sending time, but stringent requirements



SOURCE: ODVA

in terms of timeliness and availability are defined.
- *Non-Deterministic Traffic:* Specifying lesser stringent requirements.
- *Mixed Traffic:* Minimum stringent requirements.

- *End-to-End Latency:* As less as 0.5 milli second that goes up to 500 milli seconds
- *Data Rate:* Up to Gbits/second
- *Communication Service Availability:* 99.9% to 99.999999%
- Seamless integration with wired technologies on the same machines

Faster speed, ultra-low latency, and increased bandwidth are some of the highlighting features of 5G. What makes 5G stand out is its capability of network slicing. Being capable of slicing the network, 5G allocates different speed segments to different network slices, thereby defining dedicated bandwidth and network modes. Such features allow 5G to achieve highly improved performance - something that previous cellular network generations could not achieve.

High-band or millimeter wave (mmWave) 5G: High speed but short range. High band 5G frequencies range from 24 GHz to 100 GHz, making it incredibly fast - enabling multi-gigabit per second speeds. But these high frequencies cause trouble going through buildings and walls, making it useful only for short distances.

5G & Purdue Model for industrial automation

Typically, OT environments follow the Purdue model. This model allows robust control and security by building on traffic choke points defined by the mode. Hence, traffic can be easily controlled and secured between the layers. All traffic inside a layer can communicate with other devices in the same layer, but inter-layer traffic is access controlled. Private 5G can easily break this model as it can leapfrog layers, ensuring clean deployment to create the Purdue model or integrate with it.

EtherNet/IP with 5G Networks

The Industrial Internet of Things (IIoT) is altering the industrial automation environment and opening new opportunities for productivity, efficiency, and creativity. It is crucial to investigate cutting-edge strategies that may fully utilize the potential of IIoT technologies as they develop rapidly. One such strategy is the combination of EtherNet/IP, a widely used industrial communication protocol, and 5G networks to produce a potent synergy that elevates industrial connectivity to new levels.

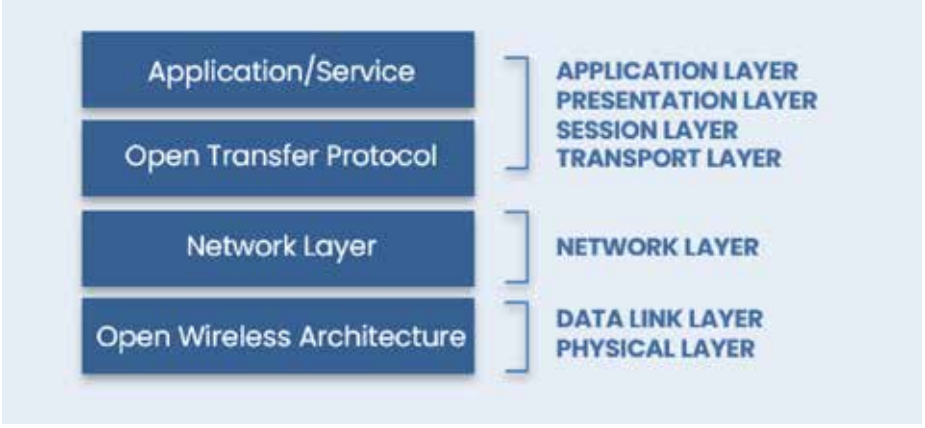
For real-time data communication, 5G network integration with EtherNet/IP has enormous promise. Such integration allows businesses to transmit crucial data in real-time, enabling quick decisions and prompt solutions to tackle operational difficulties. It also enables a new age of real-time communication, allowing transmission of sensor data from far places, control of machines, and seamless collaboration across various components of an industrial ecosystem.

Deterministic connectivity is possible by combining 5G networks, EtherNet/IP, and TSN. Such a combination enables mission-critical communication and makes it easier to coordinate an organization's entire landscape of time-sensitive processes.

In addition to real-time communication and deterministic networks, the sensor-to-cloud architecture has tremendous potential when a 5G network is combined with EtherNet/IP. Organizations can fully utilize the possibilities of sensor networks to gather enormous amounts of data - thanks to 5G's fast speeds, low latency, and abundant bandwidth. Once the data is processed and examined in real-time, it can be utilized to generate insightful decisions and operational improvements. Organizations can achieve seamless communication, data aggregation, and analysis using 5G networks and EtherNet/IP capabilities.

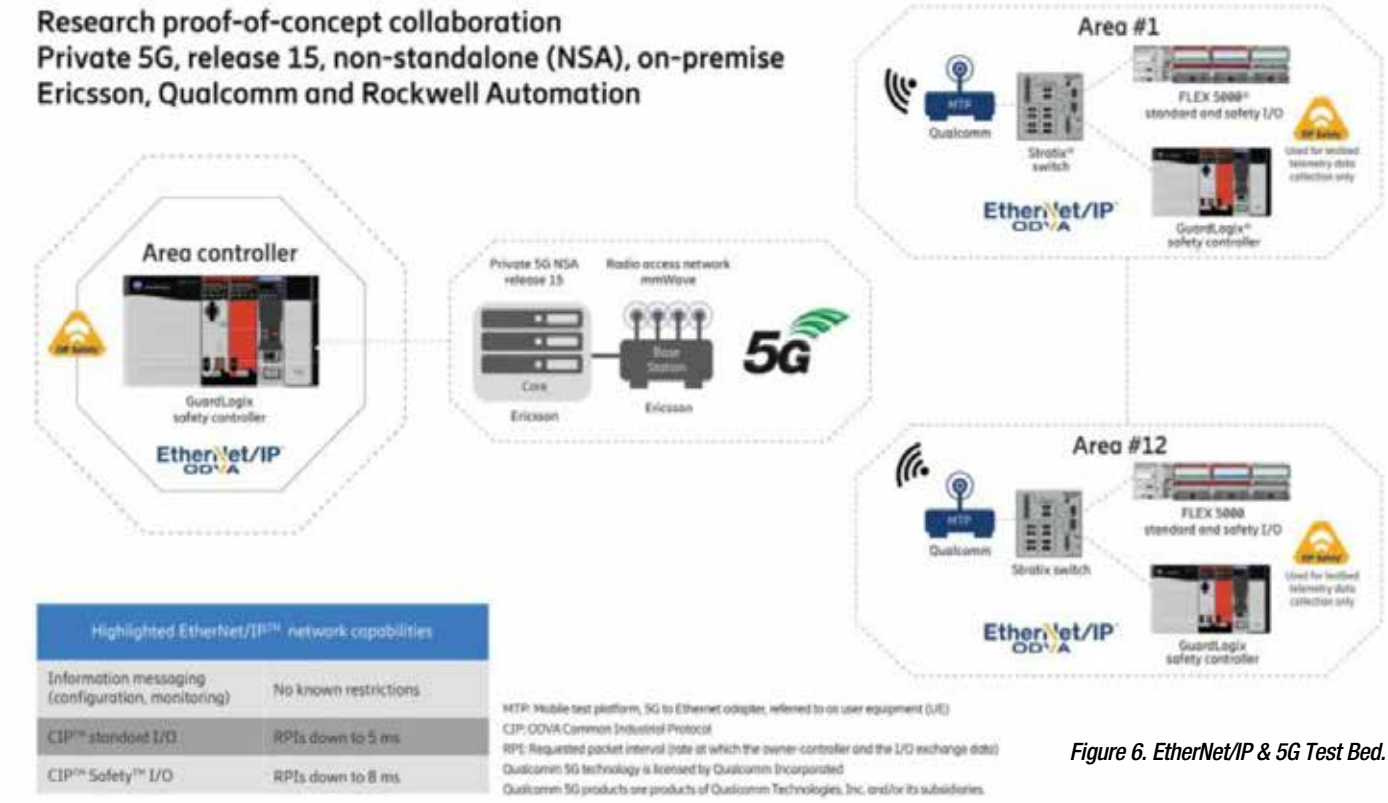
As organizations embark on their digital transformation journey, integrating 5G networks with EtherNet/IP emerges as a critical enabler. This convergence offers unparalleled opportunities for real-time data communication, deterministic networks, and sensor-to-cloud architecture in the IIoT landscape. By leveraging both technologies' strengths, organizations can overcome existing limitations, optimize operational efficiency, and unlock new avenues for growth and innovation.

This article explores the synergistic integration of EtherNet/IP and 5G networks,



SOURCE: ODVA

Figure 5. OSI Layer – Breakdown for EtherNet/IP & 5G Integration



SOURCE: ODVA

Figure 6. EtherNet/IP & 5G Test Bed.

highlighting its many benefits for sensor-to-cloud architecture, deterministic networks, and real-time data transfer. Organizations can overcome conventional constraints, improve connection, and unlock the full potential of the IIoT ecosystem by seamlessly integrating various technologies.

Synergistic integration of EtherNet/IP with 5G networks

Blended architecture mapping to OSI Layer: The need of accurate timing and synchronization are essential to networks' deterministic properties. Due to EtherNet/IP's strong and tested capabilities, deterministic communication is available in industrial applications. Organizations may create deterministic networks that guarantee predictable and consistent performance by integrating 5G networks as the foundation for EtherNet/IP. EtherNet/IP generally has two kind of communication, implicit and explicit.

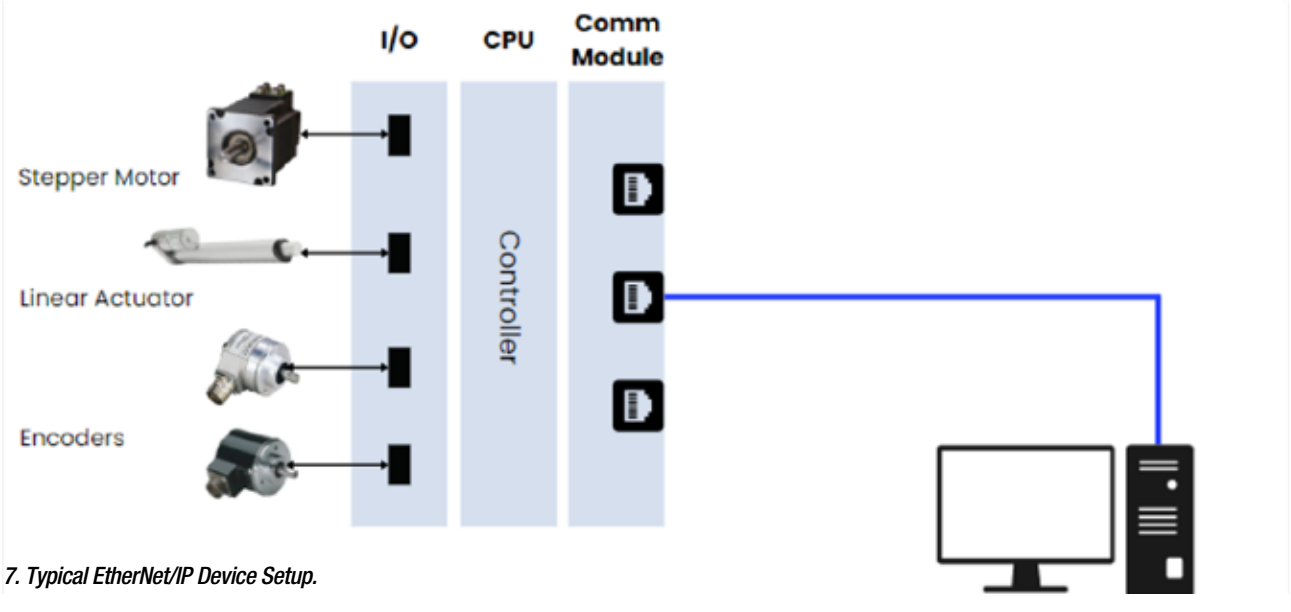
Explicit Communication: Under this type of information exchange, each device communication is a unique 'query-response' pair. Originating from a source as an 'information request', the receiving device or node decodes the query and returns the response to the device/note requesting the query.

Such communication is generally used for non-critical messaging, such as data diagnosis for maintenance purposes. This paper explores the use cases associated with explicit communication.

Implicit Communication: Using EtherNet/IP, such communication between the source and the destination/s is used for time- critical communication. Implicit communication transmission is real-time and is used for high-speed and low-latency applications.

Typically, scheduled exchange of information or notifications between controllers uses an implicit form of information communication.

EtherNet/IP is built upon the foundation of the Common Industrial Protocol (CIP), which follows an object- oriented approach to handle



SOURCE: ODVA

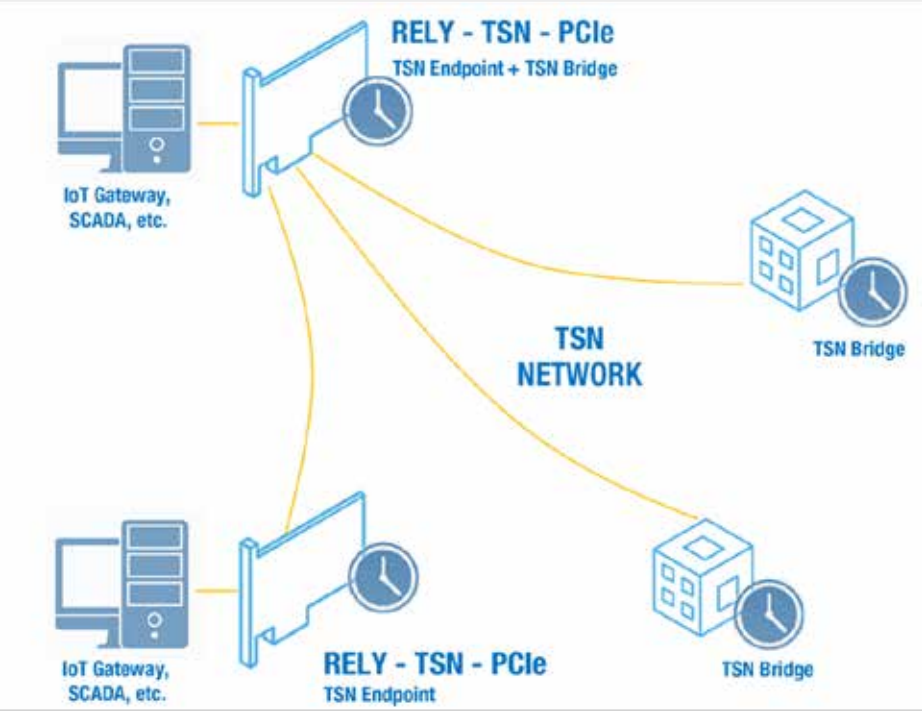
Figure 7. Typical EtherNet/IP Device Setup.

data presentation, connection management, and message exchange across the various layers of the OSI model. By adopting CIP, EtherNet/IP enables seamless integration of automation services and applications like control, synchronization, motion, and safety.

The Common Industrial Protocol (CIP) layer is the application layer, with UDP as the underlying transport layer protocol and the physical layer typically based on EtherNet/IP integrated with 5G technology. One of the key advantages of EtherNet/IP is its flexibility in selecting the physical communication medium due to its reliance on CIP and IEEE standards at the application layer. This adaptability allows for a variety of communication setups to suit different requirements.

To ensure successful integration, it is crucial to map EtherNet/IP and 5G networks synergistically onto the OSI stack, with 5G as the physical layer and EtherNet/IP as the application layer. This pairing enables efficient communication and data exchange between the two systems.

By leveraging CIP's functionalities and



SOURCE: ODVA

Test setup.

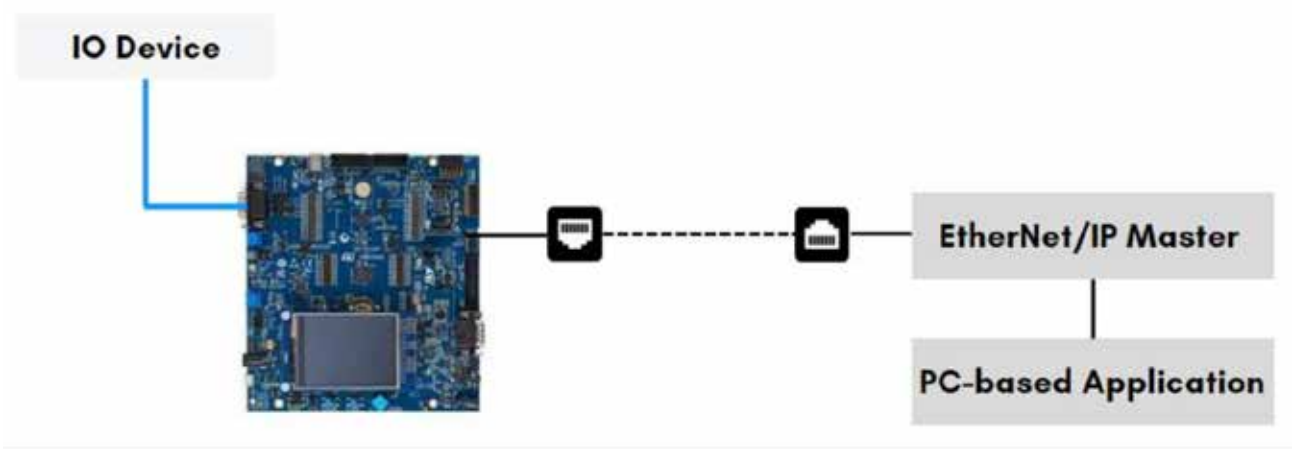
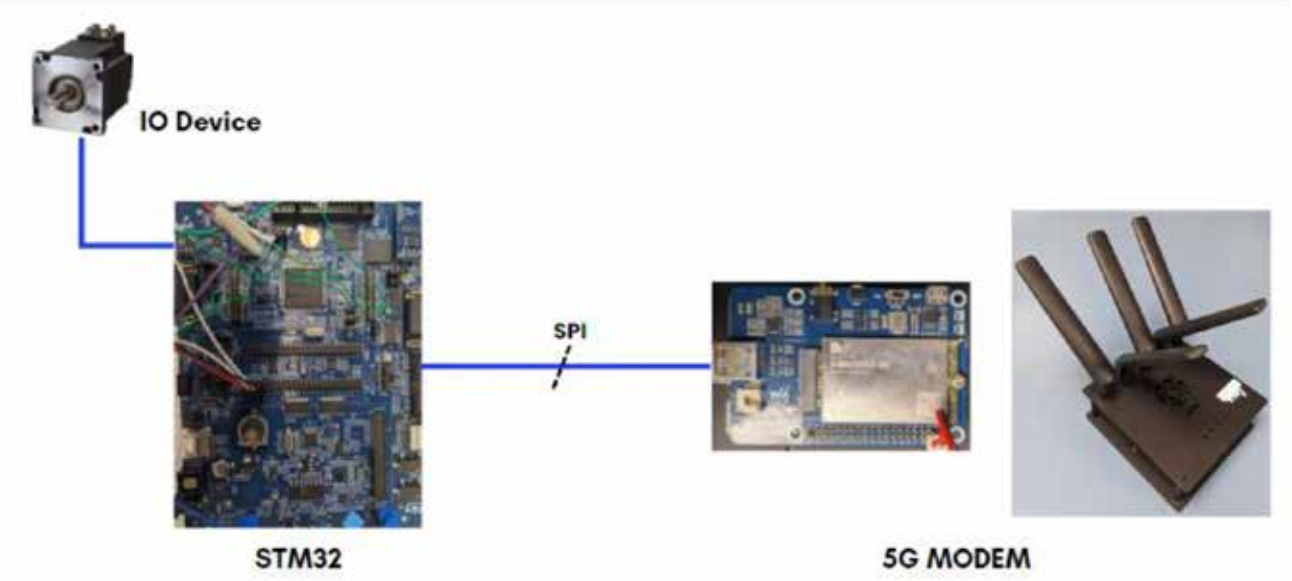


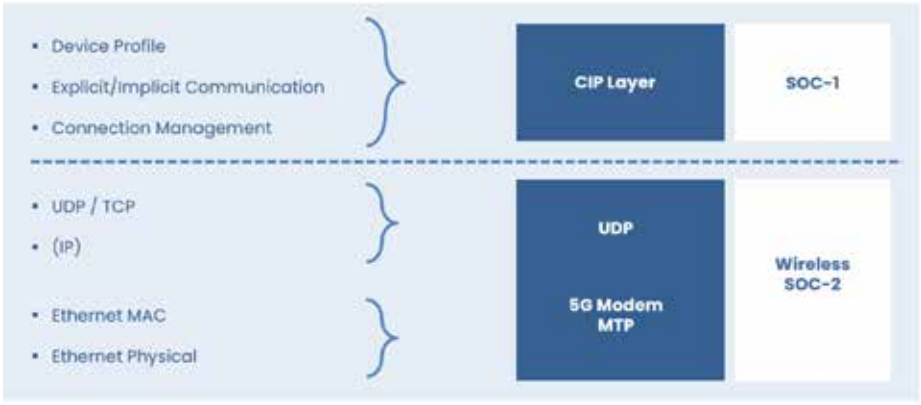
Figure 8 a. Typical EtherNet/IP Device Setup.



SOURCE: ODVA

Figure 8 b. EtherNet/IP Device Integration with a 5G Modem.

Figure 9. Blended Architecture - OSI Layer



adapting it to work seamlessly with Ethernet and Internet protocols, EtherNet/IP becomes a powerful solution for industrial automation, providing reliable and efficient communication between devices and applications in modern manufacturing environments.

The 5G network leverages on MTP – Message Transfer Part, typically used for communication in public switched telephone networks since it is reliable, unduplicated, and in sequence transport of SS7 messages between communication partners. Hence, MTP is used as the protocol for the Network Layer and Data Link Layer for seamless integration.

EtherNet/IP & 5G test bed

To fully understand the feasibility of this synergistic integration of two technologies, it is crucial to understand the prior work and evaluation in the area. Four companies (Rockwell Automation, Ericsson, Qualcomm, and Verizon) collaborated on a unique project to test "Private 5G" in industrial settings. They found that this technology can replace wired connections in industrial networks.

SOURCE: ODVA

Designed for industrial IoT and automation, 5G offers reliable and fast connections using private networks and a "millimeter wave (mmWave) spectrum." The test used specific equipment from the companies, and the results showed that the 5G network performed even better than wired connections.

This breakthrough is significant because it eliminates industries needing expensive wired infrastructure. Instead, they can use wireless 5G, saving time, money and being more environmentally friendly. Based on these positive results, the team plans to explore more applications of 5G technology in various industrial settings.

The research proved that 5G technology works well in industries, providing reliable and fast connections without costly wired infrastructure. These benefits can revolutionize industries by saving costs, increasing flexibility, sustainability, and operational speed. The researchers are excited to explore future possibilities for this technology.

Use case - motion control driver

A typical EtherNet/IP device has an EtherNet/IP Slave Device; for example, Motion Control Driver, the Ethernet I/P Object will be Motor Object. The same EtherNet/IP setup is referred to for bringing in 5G Integration.The 3GPP specification 16 & 17 Rotary [Reference] for implementation of mission control or specific I/O motor control platform taking a use case of EtherNet/IP motion object as per the above spec. For such motion control use cases, the unlicensed spectrum 17-mmWave-52.6 > 71GHz is suggested to be most suitable for implementing RTT (Round-Trip Time) based method for TSN to achieve deterministic networks.

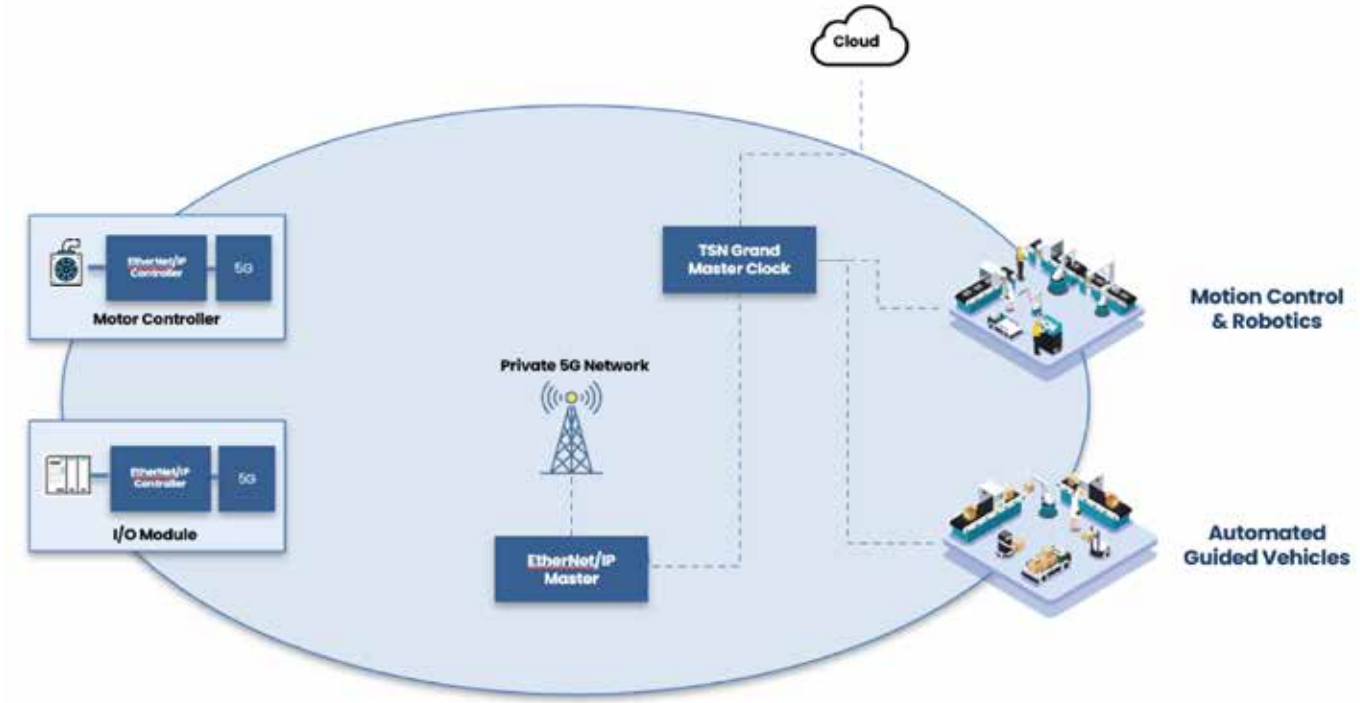
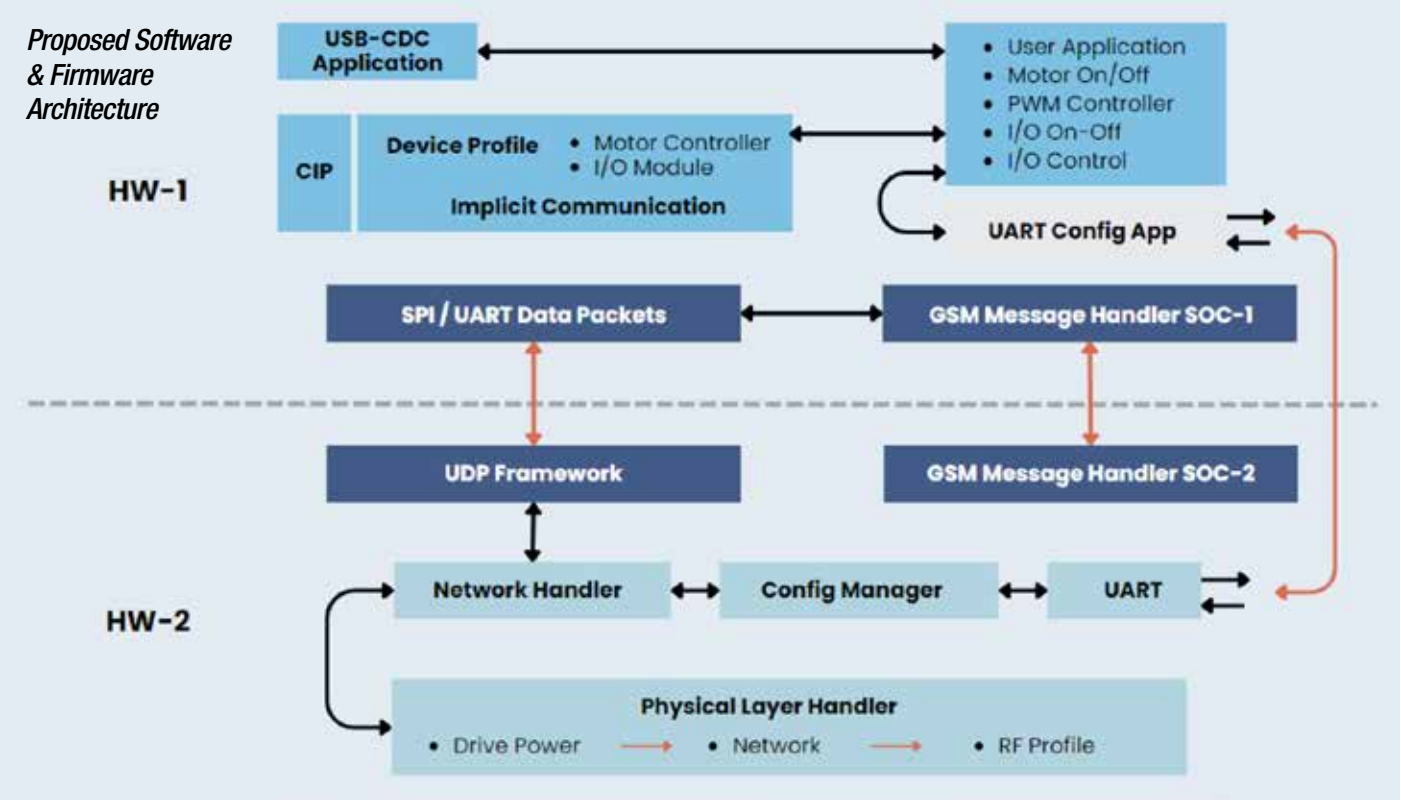


Figure 11. EtherNet/IP Scanner with Private 5G Network for Manufacturing Use Cases.



SOURCE: ODVA

Typical applications

Following are two real-life applications of 5G in industrial automation:

Robotic Motion Control: Controlling machine tools, assembly robots, precision AGVs (Automated Guided Vehicles), etc., are some of industrial automation's most demanding use cases of 5G communication systems. These operations require an exceptionally reliable network with high availability and low latency. However, the latency requirements make retransmission impractical with moving equipment on the plant floor. 5G URLLC can be used in this scenario to support the dual need for high availability and low latency by deploying architectures using a robotic arm or AGV.

Intelligent Transport: With an unprecedented speed, 5G URLLC allows real-time routing, spacing, and controlling trains' operations. Preventing the trains from taking colliding routes, optimizing track usage, maintaining a safe distance, etc., can be reliably carried out with minimal signal latency to optimize transport more efficiently.

Factory automation: Typical wired factory automation infrastructure can be replaced by a private 5G network with TSN Grant master connecting over the wireless 5G device will minimize the wiring the effort and cost

Test setup

A high-level architecture of the test setup to replicate a typical EtherNet/IP-based Motion Control Driver use case is shown. The test setup to evaluate the integration of EtherNet/IP with a Private 5G Network included an I/O Device connected to an STM32 Evaluation Board with an EtherNet/IP Slave Stack. The objective was to connect the I/O Device with a PC-based Host System with an EtherNet/IP Master.

The physical layer between the two systems is leveraged by integrating a 5G modem. SPI communication was used in this blended system. The corresponding OSI architecture to signify this setup is shown below. The Application and Session Control is done by the STM32 Board, UDP Protocol over SPI is used as the Transport Layer, and the 5G Modem is used for the Network and Physical Layer. The mapping against the OSI Layer ensures compliance with Ethernet Standards.

The SPI communication between the two hardware was configured as:

- *Clock Speed:* 1MHz
- *Mode:* Full Duplex

Connected factory of the future

EtherNet/IP Master with I/O Scanner, along with Private 5G forms the basis for Industrial Communication for uses cases like Motion Control, Robotics, and AGVs, as highlighted in the representation below. This forms the bases for a 5G network-based protocol network for connected shopfloor or large factory.

The below section describes the proposed hardware and software architecture for integrating EtherNet/IP with 5G networks. It provides a design reference for anyone looking to start their MVP and a reference platform for further evaluation and PoC/Pilot setup.

The figure shows the blended architecture for implementing 5G network layer with EtherNet/IP. In this case, two hardware components - SoC 1 & SoC 2 was be used as represented. EtherNet/IP-related implementation is done on SOC 1. The EtherNet/IP specific CIP layer implementation includes the Device Profile and Explicit/Implicit communication. The 5G implementation in SoC-2 was through UDP and MTP. This includes the complete transport to physical layer implementation.

The hardware architecture for SoC-1 & SoC-2 was implemented as per the below hardware schematics. This proposed hardware design provides a design reference for anyone looking to embark on the feasibility study for integrating EtherNet/IP with 5G Networks.

The architecture describes the high-level software/firmware architecture of a 5G-based EtherNet/IP Device, which can control a DC motor's speed and handle some of the I/O functions.

- Encapsulation for EtherNet/IP to work with 5G.
- This architecture describes the message handling between the two SoCs.
- The two SoC hardware are interconnected over an SPI bus to have a maximum 10mbps connection
- Inter-chip connection over serial (UART) interface with a USB-CDC connection device class was used to configure the SoCs.

Jegajith P.T., Embedded Practice Head and Chatrapathi G.V., Director - Industrial Communications, ***Utthunga Technologies Pvt Ltd.***

Visit Website

The role of IoT in delivering grid stability in the age of renewables

As renewable energy from sources including wind, solar and hydro becomes a reality rather than just an alternative for most of us in the future, we can only hope that IoT and related technologies will become the tools of choice in driving change towards more sustainable energy future.

SOURCE: ISTOCK

Of the renewable energy sources we have available, from wind farms and geothermal, to hydro and others,solar is the only technology on track to deliver on a global commitment to net zero emissions by 2050.

WITH THE INCREASED USE OF RENEWABLE energy resources there's an even greater need for grid stability. Phil Beecher, CEO and President, Wi-SUN Alliance, looks at the role of the IoT and wireless communications in delivering enhanced grid stability together with improved management and maintenance of renewable energy sources.

Global additions of renewable power capacity are expected to rise by a third this year, according to the International Energy Agency (IEA), driven by government commitments to net zero and a need to reduce our reliance on fossil fuels, combined with growing fears over energy security in the wake of recent geo-political events.

Much of this will come from solar PV and wind power, with solar capacity expected to account for two-thirds of the projected growth in renewable energy capacity.

The IEA reports that progress is "promising" with 2022 a standout year for renewable electricity capacity additions, amounting to around 340 GW. But of the renewable energy sources we have available, from wind farms and geothermal, to hydro and others,solar is the only technology on track to deliver on a global commitment to net zero emissions by 2050.

For grid operators and utilities, there are serious considerations when it comes to renewable energy generation, particularly when it comes to the intermittent nature of distributed energy sources (DER). Integrating many variable sources presents both technical and operational challenges, not least in ensuring power grids are stable and can deliver the right voltage and frequency for customers when and where they need it.

The Internet of Things (IoT) can provide benefits, however. Not only for enhanced grid stability, but also for the real time monitoring of renewable assets, many of which are in remote, hostile or hard-to-reach locations.

IoT-enabled smart grids can boost grid stability and reliability. Balancing supply with demand is fundamental for any grid operations and for those dominated by renewable energy, this balance becomes more challenging.

When the wind blows

Most renewable energy sources – if we accept that solar and wind farms are the main sources right now – rely on the right weather conditions. Sometimes demand exceeds supply, but there are times when supply might exceed demand, if there is too much sunshine

SOURCE: ISTOCK

IoT-enabled smart grids can boost grid stability and reliability. Balancing supply with demand is fundamental for any grid operations and for those dominated by renewable energy, this balance becomes more challenging.

or too much wind for example.

Energy storage technologies like batteries play an important role in helping to control the fluctuating nature of renewable energy, storing it for future demand. But is there a role for IoT at the source of the power?

Solar farms are an interesting use case, where you could wirelessly control solar panels to follow the sun, ensuring they are at the optimum angle for maximum power generation. If they are over-generating, and the operator is unable to store the power, they could then rotate them away from the sun.

Then there's wind power, much of which is generated offshore, which provides its own unique challenges. According to McKinsey research, global installed offshore wind capacity is expected to reach 630 GW by 2050, up from 40 GW in 2020. The Asia-Pacific region has the greatest long term potential, while in the US it's still early days, although President Joe Biden has issued an executive order calling for 30 GW of offshore wind capacity to be installed by 2030.

Offshore wind farms are hard to reach, but still require constant monitoring and maintenance for the structural integrity of the turbines. Wind turbines are large and complex, subject to wear and tear especially component parts like bearings. A typical wind turbine consists of more than a dozen bearings that are expected to work simultaneously and continuously for up to two decades.

The problem is that bearings and gearboxes are susceptible to failure well before their end of life, and failures in equipment are major causes of downtime leading to costly unplanned repairs and replacement.

In this scenario, IoT sensors could be fitted to the turbines to continuously monitor the health of the structure, sending information back via wireless connections on each turbine, which then can connect to a border router at the point of aggregation. In fact, communication via a wireless connection is more reliable in case of potential damage to subsea cabling.

The solar challenge and opportunity

Solar farms present similar challenges. Like wind farms, solar technology requires constant monitoring and maintenance, and wireless communications can play a key role here with the strategic placement of IoT sensors and devices in locations where other technologies cannot reach.

In the US, mostly in areas like California, Nevada and Texas, there are some the biggest solar developments in the world. Such environments are inhospitable, hot and very challenging to work in. The extremes in desert temperatures can also cause expansion and contraction of solar panels, while sand and dust can affect the structural integrity of equipment and potentially cause mechanical stress.

Many of these large-scale structures run autonomously with no on-site maintenance crew so having real time data and information about damage, from natural disasters or deliberate sabotage, is critical.

New technologies can offer solutions to these problems. For example, the opportunity to use drones to inspect solar panels, incorporating artificial intelligence for visual inspection, but also coupling this with sensors mounted on the panels to detect incident light energy and power generated. A Japanese research organisation is already testing Wi-SUN FAN (Field Area Networks) on drones.

Energy companies like Hawaiian Electric are also recognising the huge potential of wireless communications as an enabler for large-scale IoT applications as it focuses on providing clean, reliable, and sustainable energy to customers and communities alike.

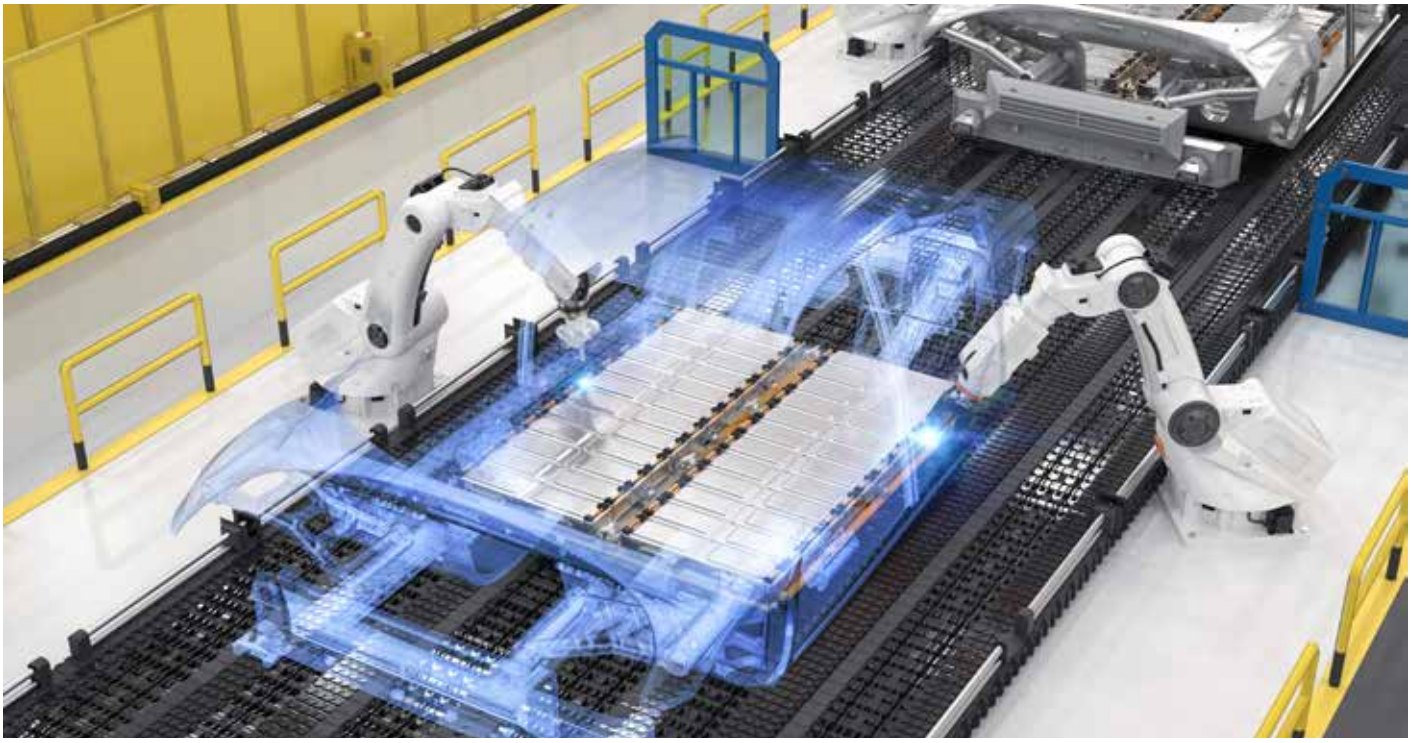
As renewable energy from sources including wind, solar and hydro becomes a reality rather than just an alternative for most of us in the future, we can only hope that IoT and related technologies will become the tools of choice in driving change towards more sustainable energy future.

Phil Beecher, President & CEO, ***Wi-SUN Alliance.***

Learn More

Industrial Ethernet machine control and data connectivity

Industrial Ethernet machine control continues to leverage new software innovations, AI and cloud connectivity solutions. But Industrial Ethernet is not merely a tool for connectivity. It represents a comprehensive, secure, and intelligent networking solution is merging traditional machine control with advanced data analytics.



SOURCE: ISTOCK

"Ethernet in the industrial space is evolving at a fast pace. There used to be a time where you had to be in front of a machine on site to control or gather data or really have any great visualization into the overall process. The evolution of industrial Ethernet has been able to expand us far beyond that," Mike Willett, Network Engineer, Red Lion.

INDUSTRIAL ETHERNET TECHNOLOGY, EVEN after 25 years in the factory, is continuing to re-invent itself -- developing new levels of advanced networking solutions for industrial automation and machine control. Energized by the demands of IIoT requirements and driven by computer and software technology innovations, Industrial Ethernet continues to evolve and provide technology improvements.

For this Industrial Ethernet trends and solutions update, we reached out to industry experts to gain their perspectives on the state of machine control networking in modern factories. Here is what they told us.

Industrial Ethernet continues to move ahead

Remote access, capable routers/firewalls and fast, reliable managed switches on-site.

"Ethernet in the industrial space is evolving at a fast pace. There used to be a time where you had to be in front of a machine on site to control or gather data or really have any great visualization into the overall process. The evolution of industrial Ethernet has been able to expand us far beyond that," Mike Willett, Network Engineer at Red Lion, told IEB recently.

Due to devices like Red Lion's FlexEdge and Remote Access Platform, Willett said that remote access is becoming more and more accessible, easily deployable while adding a huge value to the landscape of what can be achieved on site and remotely.

"We now have much quicker response time utilizing methods to passively monitor and control systems and enable alarming to alert users when a particular process needs attention. This Industrial Ethernet advancement has made the devices inside a network perform more efficiently. This is all possible with the addition of managed switches on site with faster port speeds, more advanced traffic shaping and prioritization and much more advanced security measures to keep a network running efficiently but also very securely as well," Willett added.

Expanded networking capabilities

White said that all of this is possible due to the power of remote access, capable routers/firewalls and the benefits of fast and reliable managed switches on-site. The capabilities on site have expanded tremendously with better visualization. An example is the N-Tron series NT5000 managed switches which have a modern look and feel, with a very intuitive web interface and command line.

"One aspect that is so great is that it definitely can cater to a more IT centric user with an intuitive command line structure, but it also has a very user-friendly web interface for a non IT centric user to navigate. Bringing in those enterprise level capabilities while focusing on the ease of use aspect is a huge development which allows these networking solutions to continue to shape the future of

Industrial Automation. Putting that power into the hands of the industrial user and empowering them to manage the network infrastructure is a huge improvement in the overall process and efficiency of networking solutions," Willett said.

According to Willett, new solutions can offer a variety of technological benefits while providing unique capabilities. A fully managed switch can offer faster speeds with gigabit on every port.

"We are definitely seeing the need for faster port speeds within Industrial Networking environments. As surveillance cameras and video scanners become more advanced so do the speed requirements for the network. New solutions can also offer more advanced security options. Not just security from a one device perspective but security encapsulating the entire network that spans from switches to routers to firewalls, etc. This also includes security down to the individual devices such as RADIUS authentication to authenticate a user and Port Security to further lock down ports from inbound devices and users," he added.

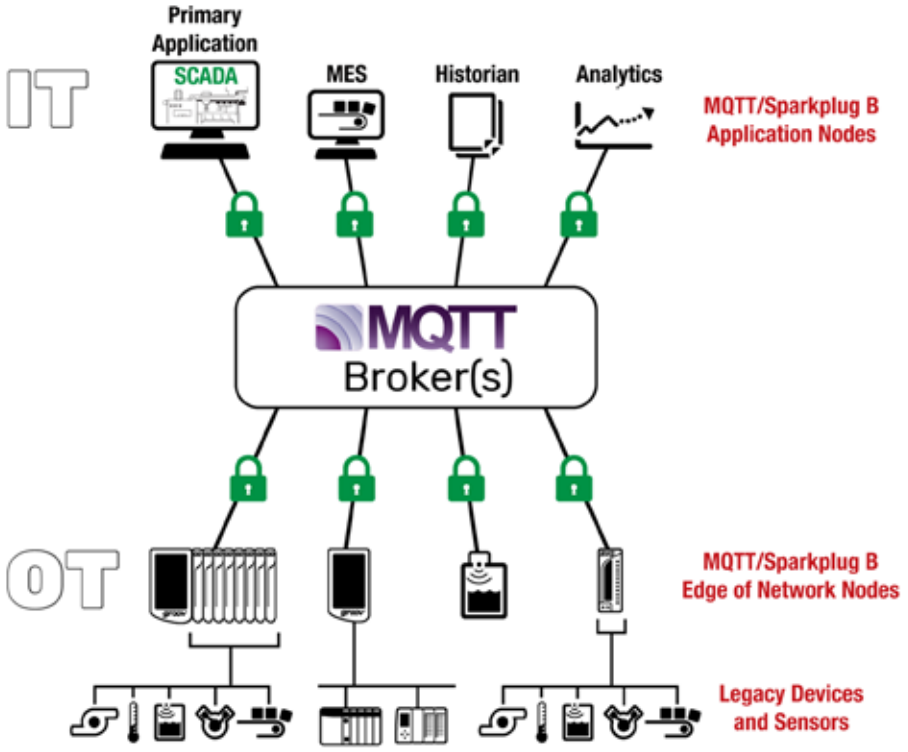
The NOTron series NT5000 switches incorporates all of these capabilities and more with a very modern design. The very intuitive and graphical web interface is designed for a user to navigate very easily. So, being able to offer a new solution that aggregates all the technological benefits but also focuses on the ease of use for the user is a huge innovation.

Types of applications

"We are seeing plant floor environments leveraging advanced networking to display manufacturing productivity. Also, the use of passive monitoring so that network related or data flow issues can be alarmed and addressed immediately rather than the potential of issues building up over time and causing real outages and downtime," Willett said.

"Utilizing these tools upfront is essential to help reduce downtime and troubleshooting efforts that can cause delays in production. As manufacturing applications get more involved and various types of devices are introduced into the plant network, being able to utilize faster port speeds on network devices is huge. Also being able to segment traffic with the use of features like VLANs and to shape the traffic more efficiently with advanced networking can become very powerful. We are seeing the use of advanced networking everywhere from food and beverage to automotive plant networks. It is definitely emerging to every industry," he added.

As the feature sets and technology of Industrial Ethernet become more and more advanced, Willett said that it is very important to maintain a level of user friendliness. The entire idea behind the NT5000 series of switches from Red Lion is to address exactly this.



SOURCE: OPTO 22

"Industrial Ethernet is revolutionizing machine control networking. Newer and more modern products like groov EPIC edge controllers integrate technologies like MQTT Sparkplug B, OPC UA, and RESTful APIs," Daniel White, Director of Technical Marketing, Opto 22.

"I always mention that this switch series can certainly cater to the IT centric user that expects more advanced tools like an intuitive command line, for example, but this user has a certain level of networking expertise to assist in this workflow that they prefer," Willett said.

"But this series of switches can also cater to the automation engineer who needs to administer and configure the network switches but doesn't necessarily have the networking expertise or knowledge that an IT user would have. In the web interface of this switch series there are no shortage of icons with hover over text to highlight features. Also, there is an imbedded manual in the switch under each page to further explain features and terms. There is definitely a fine line when networking becomes more and more advanced to keep the common user in mind. That means the level of user friendliness must progress as well."

Revolutionizing machine control networking

Key technologies include MQT Sparkplug B, OPC UA and RESTful APIs.

"Industrial Ethernet is revolutionizing machine control networking. Newer and more modern products like *groov* EPIC edge controllers integrate technologies like MQTT Sparkplug B, OPC UA, and RESTful APIs," Daniel White, Director of Technical Marketing at Opto 22 told IEB recently. "This facilitates rapid and efficient communication between machines. The enhanced communication allows for real-time data sharing and seamless integration with cloud platforms. The cloud offers expansive data storage and provides sophisticated tools for in-depth data analysis. This analysis can reveal valuable insights, identify potential issues, and guide informed decision-making."

White said that security remains paramount in this evolution. Modern Industrial Ethernet solutions prioritize robust security measures, employing VPNs, advanced firewall management and SSL certificates to ensure data protection. Furthermore, the incorporation of AI and machine learning into these networks is transformative. These technologies enable the network to autonomously learn from the data, refine operations, and optimize machine control processes.

"In essence, Industrial Ethernet is not merely a tool for connectivity. It represents a comprehensive, secure, and intelligent networking solution that merges traditional machine control with advanced data analytics. This integration is paving the way for a more interconnected and intelligent industrial landscape," White said.

Shaping the future

Networking solutions are transforming the landscape of industrial automation. Machines are no longer isolated entities; they're becoming part of a larger, interconnected

system. By leveraging technologies like MQTT Sparkplug B and RESTful APIs, machines can communicate with each other and the cloud in real time. This communication isn't just about data transfer; it's about understanding and interpreting that data.

"The cloud plays a pivotal role, offering vast storage and powerful tools for data analysis. With the help of advanced analytics and AI, this data is transformed into actionable insights. These insights enable machines to operate more efficiently, adapt to changing conditions, and continuously improve," White said.

Furthermore, the traditional barriers between Operational Technology (OT) and Information Technology (IT) are breaking down. This convergence leads to a more integrated and collaborative industrial environment. The result? A future where machine control is not just about connectivity but about harnessing the power of data for continuous innovation and growth.

"Today's networking solutions are setting the stage for a smarter, more integrated, and data-driven future in industrial automation machine control," he added.

Technology benefits

White added that new technologies in the industrial sector are more than just upgrades; they're changing the way we operate. One of the biggest changes is how fast we can transfer data in real time. This, combined with machine learning and AI, means we're not just collecting data but using it smartly. It's not about having lots of data; it's about understanding it and making better decisions.

Cloud storage and advanced analytics help turn this data into useful insights. Machines can now adapt and even predict future needs, making operations smoother and more efficient. On top of this, there's a strong focus on cybersecurity. This ensures our data is safe and also helps bridge the gap securely between Operational Technology (OT) and Information Technology (IT).

In short, these new technologies are making our industrial operations smarter, safer, and more connected. It's not just about machines doing tasks; it's about them working together, learning, and constantly improving.

Advanced networking is making big waves in various industrial sectors, enhancing operations and bringing in data-driven solutions. Some examples include:

1. Water/Wastewater Management: IIoT devices and analytics help improve treatment processes. They can predict when equipment needs maintenance, ensuring water treatment runs smoothly.
2. Food and Beverage: Intelligent networking ensures high quality and safety. It uses real-time data to monitor and control factors like temperature and humidity during production and storage, while also collecting and storing data to adhere to regulatory requirements.
3. Mining: Networking allows for remote monitoring and control of machinery. This not only boosts efficiency but also ensures the safety of equipment and workers.
4. Concrete and Aggregates: Sensors and AI work together to perfect the batching process. This ensures consistent product quality while saving resources.
5. Cold Supply Chain: Advanced networking, combined with IIoT and analytics, helps maintain the right conditions during storage and transport. This ensures product quality, meets regulations, and promotes energy efficiency.

In all these sectors and many more, advanced networking is changing the game. It's helping industries move from just reacting to problems to predicting and preventing them. The result is smarter, more efficient, and sustainable operations.

Connectivity challenges

"Automation engineers grapple with several challenges, with cybersecurity being paramount. As they endeavor to merge operational technology (OT) with information technology (IT), they often confront the complexities of integrating older, less secure systems with modern frameworks. This juxtaposition can introduce potential security vulnerabilities," White said.

Advanced features in new products like groov EPIC and RIO offer rich Ethernet networking security tools, providing secure and dependable connections and facilitating the seamless integration of OT and IT. Essential security measures such as VPNs, user authentication, and firewalls are now built-in as a standard practice, fortifying data protection. Additionally, TLS/SSL certificates play a crucial role in encrypting communications within the network.

"Another significant challenge is ensuring consistent and real-time data flow. Engineers require immediate data for decision-making, but safeguarding this data across diverse devices and platforms is vital. Industrial Ethernet champions newer communication methods like MQTT, designed explicitly for secure and efficient data transmission," he said.

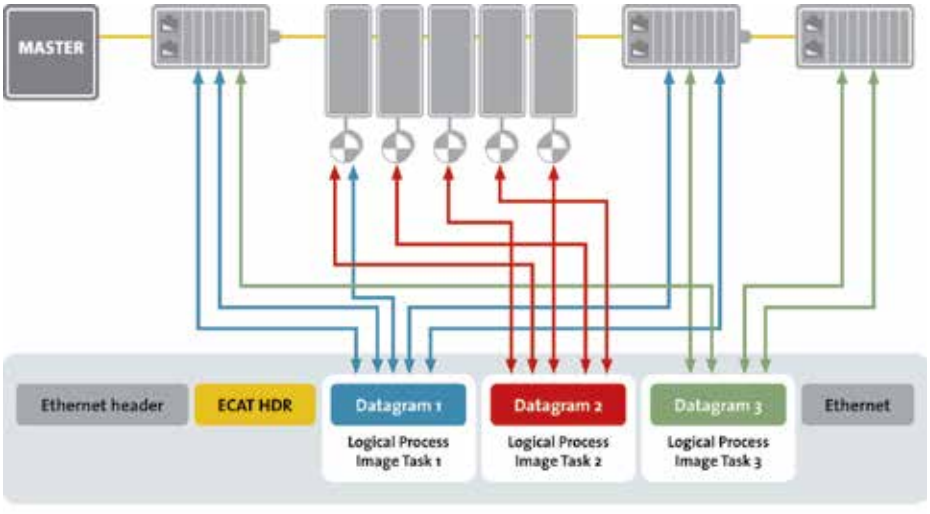
"Merging OT and IT offers numerous advantages but also presents inherent risks. Thanks to newer products running on Industrial Ethernet, engineers have a robust toolkit to navigate these challenges, guaranteeing that systems remain both potent and secure."

EtherCAT technology

Processing of frames on the fly delivers highest network performance.

According to Martin Rostan, Executive Director of the EtherCAT Technology Group, "Industrial Ethernet technologies have become the fieldbus technologies of choice for machine controls. However, many users do not realize how big the differences are between the technologies on offer. Some even believe that it ultimately doesn't matter which protocol is used; after all, everything is Ethernet-based and therefore has comparable properties."

Rostan added, however, that the choice of the right technology has a decisive influence on the central characteristics of the machine



SOURCE: ETG

Inserting process data on the fly

"Due to its special functional principle, the processing of frames on the fly, EtherCAT fulfills the above-mentioned performance requirements particularly well; it is not for nothing that the technology is regarded as by far the fastest Industrial Ethernet technology," Martin Rostan, Executive Director of the EtherCAT Technology Group.

or system. The bus system is the core of the control architecture because it determines whether the performance of the controller can be utilized at all. But most industrial Ethernet technologies work with cycle times of well over one millisecond and can therefore no longer keep up with the CPU performance of modern PC-based controllers which allows users to close control loops in well under one millisecond.

"But it's not just about the cycle time, but also about the reaction time: how quickly can a control system recognize and react, for example, that a part has arrived, a cylinder has reached its end position, or another transition condition has been fulfilled. If you can react faster here, you can speed up your machine or system and achieve higher throughput - even with relatively slow mechanics," Rostan added

Advanced networking solutions

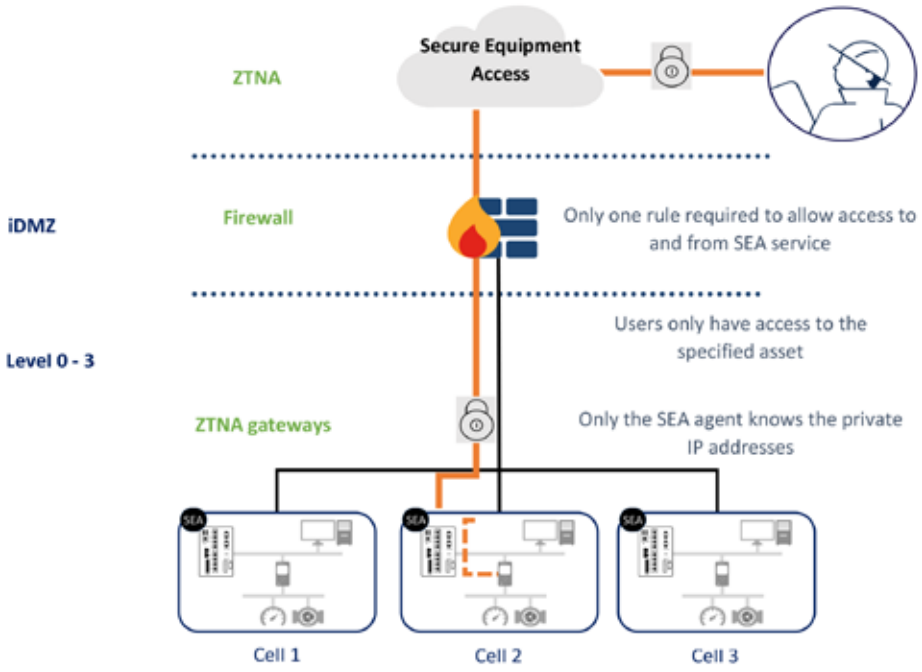
When asked how networking solutions are shaping the future of Industrial Automation machine control, Rostan said "it's not only about performance. Because the bus system links the components together, it has a decisive influence on the selection of components and therefore on the cost of the control system: only a widespread bus system guarantees healthy competition between suppliers and therefore low prices."

"And here some systems have considerable deficits, especially on the controller side, because the technology is mainly supported by one PLC supplier. It is therefore worth taking a close look when selecting the Industrial Ethernet solution and not just viewing it as a 'by-catch' of the controller," he added.

EtherCAT technology benefits

"Due to its special functional principle, the processing of frames on the fly, EtherCAT fulfills the above-mentioned performance requirements particularly well; it is not for nothing that the technology is regarded as by far the fastest Industrial Ethernet technology," Rostan said.

"It is easy to demonstrate that EtherCAT and PC-based control improve the throughput of many systems by several percent. EtherCAT is not only particularly fast, but also particularly easy to use; you don't need switches or routers and you don't need to be an IT expert to use EtherCAT. The addresses are distributed automatically during start-up; EtherCAT supports any network topology with virtually no restrictions and the diagnostic properties of EtherCAT are unique. Safety over EtherCAT provides integrated functional safety and EtherCAT P combines data and power supply on the same cable, eliminating the need for a separate supply cable. EtherCAT therefore has a whole bundle of unique selling points, which has led to the technology having by far the greatest variety of devices on the market."



SOURCE: CISCO

"AI and cloud solutions are driving the biggest changes in industrial operations. AI enabled applications in datacenters and cloud rely on accurate and timely data from operations processes to derive insights to help improve product quality, product yield, perform maintenance, etc. Corrective actions flagged by these insights need to be brought back to operations for a "closed loop" machine control," Vivek Bhargava, Product Marketing Manager, Cisco Industrial IoT.

Machine control applications

Rostan said that, while EtherCAT was initially used primarily in applications that benefited in particular from its outstanding performance, the technology has now established itself in almost all areas of application. He added that, after all, the handling benefits, robustness, simple commissioning and low costs come into their own almost everywhere.

EtherCAT is used in all types of manufacturing machines from semiconductor production, to plastics machines and machine tools. EtherCAT is used in intralogistics, in packaging technology, in mobile machines and in power generation and distribution, and even space technology relies on this innovative and proven technology. Even the process industry is increasingly recognizing the advantages of EtherCAT, especially as high availability and the connection of intrinsically safe sensors and actuators are no problem with EtherCAT.

Engineering challenges

Rostan said the one challenge for system engineers implementing these types of systems is the increasing demand for cyber security resilience of the connectivity solutions used. Two aspects are primarily important here.

Firstly, the system architecture, which must ensure that not every I/O node and drive is exposed to direct attacks via the company network. A hierarchical architecture has proven its worth here: the controller separates the subordinate network from the company network in terms of both performance and security and acts as a kind of firewall, while at the same time providing structured process data and status information and enabling controlled and security-monitored access to the subordinate devices.

And secondly, the integrated properties of the underlying bus system must ensure that any attack on the system itself does not lead to success. EtherCAT also has advantages in this respect: as EtherCAT is not based on the Internet Protocol, the attack surface is massively reduced from the outset, and non-EtherCAT frames are recognized and filtered out by the EtherCAT chips in hardware. "With EtherCAT, even a network node with compromised firmware cannot influence the other nodes. EtherCAT is therefore ideally prepared for the challenges of the future," Rostan said.

AI and cloud operations

Industrial Ethernet solutions are helping make advances possible.

According to Vivek Bhargava, Product Marketing Manager, Cisco Industrial IoT, Industrial Ethernet is advancing the state-of-the-art in machine control networking.

"AI and cloud solutions are driving the biggest changes in industrial operations. AI enabled applications in datacenters and cloud rely on accurate and timely data from operations processes to derive insights to help improve product quality, product yield, perform maintenance, etc. Corrective actions flagged by these insights need to be brought

SOURCE: ISTOCK

"A cohesive, comprehensive networking architecture is a must for modern operations. Operations have sometimes grown over the years in a piecemeal fashion and consist of a variety of networking equipment with their own management systems, and no consistent way to secure them," Vivek Bhargava, Product Marketing Manager, Cisco Industrial IoT.

back to operations for a "closed loop" machine control. Today's Industrial Ethernet solutions are helping make these advances possible," Bhargava said.

To enable these applications, industrial networking extracts, transforms, and transports operations data in real-time to the datacenter or cloud. Most of the communication between devices in production environments is local to the LAN and never leaves the network segment. With newer advancements, some traffic needs to flow between the zones and the applications. Some of this traffic could potentially require higher bandwidth, for example, high-resolution video captured by cameras used to monitor product quality. This not only increases the complexity of networking within the zone, but also all the networking components that connect to the cloud.

"Such use cases are driving requirements for an increase in network bandwidth capacity. The increasing dependency on the network also means that the network performance itself needs to be monitored and always assured," Bhargava added. "Modern Industrial Ethernet now offers GE, mGig, and even 10GE speeds. Intelligent management of industrial Ethernet switches helps assure this performance so that production uptime is maintained. Security constructs built in the switches further protect operations."

Industrial automation networking

Bhargava said that a cohesive, comprehensive networking architecture is a must for modern operations. Operations have sometimes grown over the years in a piecemeal fashion and consist of a variety of networking equipment with their own management systems, and no consistent way to secure them. This increases network complexity and necessary changes like expanding production lines, adding new assets, or changing the product mix become very difficult. Extracting meaningful data and introducing software-based control by connecting such operations to applications in the cloud is nearly impossible.

Networking solutions are responding to these challenges. Architectures like Cisco and Rockwell Automation developed Converged Plantwide Ethernet (CPwE) is an example of a complete networking, management, and security solution. CPwE provides a validated implementation for secure connectivity between the lowermost cells and zone to control systems over to IT managed enterprise network and the cloud.

Wireless solutions are making autonomous guided vehicles (AGV) mobile robots possible on factory floors, warehouses, and distribution centers. Secure Access Services Edge (SASE) architectures are easing secure connectivity of distributed field assets. Security advances that leverage the network rather than depend on complex set of firewalls are improving visibility, limiting malware flow by segmentation, and making remote access to industrial assets simpler.

Benefits and unique capabilities

"An integrated network architecture offers a standardized, validated, and proven blueprint ready for deployment. It allows for easy scalability as it follows well-defined guidelines and best practices. This makes it easier to add or remove network components as the organization's needs change," Bhargava said. "Standard network architectures ensure compatibility and interoperability between various network devices and components. This simplifies the integration of equipment into the network, allowing for seamless communication and data transfer."

With a standard architecture, network administrators can efficiently manage and maintain the network infrastructure. Following consistent processes and procedures for configuration, troubleshooting, and monitoring, leads to improved network performance and reduced downtime – making it simpler to incorporate security best practices and protocols and implement robust security measures.

Bhargava said that cybersecurity measures must be built into a network design. CPwE, for example, relies on Cisco Cyber Vision, a visibility sensor that runs within Cisco industrial switches avoiding the need for laying out extra SPAN networks and servers. The

visibility insights help inform segmentation policies to contain any malware and protect operations. Such security measures also include zero-trust network access (ZTNA) to allow workers to remotely access assets in a secure and controlled manner, with the switches acting as gateways.

Using a standard network architecture helps in reducing costs associated with network design, implementation, and maintenance. They are well-documented and widely supported by various vendors. This means that organizations have a larger pool of vendors to choose from for their network equipment, software, and services.

Advanced networking in manufacturing

"An advanced technology now being increasingly being used in manufacturing is communications redundancy," Bhargava said. "This means every Ethernet frame from the source is replicated across different and separate network devices and delivered to the destination. The technology is called Parallel Redundancy Protocol (PRP). It works at the Ethernet layer. By replicating all the Ethernet frames, the reliability and dependability of the communication between two devices really increases."

Control systems virtualization, a recent advancement in manufacturing environments depends on the reliability and dependability that PRP enables. Virtualizing PLCs and other hardware resources involves removing dedicated hardware systems from the factory floor to onsite datacenters. Virtualization can provide a host of benefits including better scalability and agility, increased security, improved disaster recovery, and better sustainability.

However, for this virtualization to work, the network that connects assets to controllers must be highly available to ensure uninterrupted production. While high-bandwidth, high-performance, continuous monitoring, QoS parameters such as delay, latency, jitter, etc., are important, the network must also provide deterministic delivery and guard against packet loss. Usage of PRP is a must to ensure uptime.

Implementation challenges

Bhargava said that the biggest challenges that automation engineers face in this age of Industrial IoT is the exploding number of devices and sensor that they need to deploy, the network that must be built to connect these new assets, and to ensure the performance and security of such networks. Connecting operations to software applications in datacenters and cloud also adds new requirements that automation engineers may not be equipped to handle.

Automation engineers should partner with the organization's IT department. IT knows how to deploy, scale, and maintain large networks, whereas the engineer knows the production assets and their connectivity needs. Industrial Ethernet and associated management and security tools make achieving this collaboration much easier. For example, when Industrial Ethernet switches are managed and secured by the same set of tools that IT knows and trusts.

"Cisco Industrial Ethernet switches incorporate several security measures, as well as integrate with tools such as AAA servers (such as Cisco Identity Services Engine), SoC platforms (such as Cisco XDR) for incident detection and response. These capabilities directly address automation engineers' challenges allowing them to focus on production processes, incorporate new innovations, and not have to worry about whether the network is up to the task," he said.

SOURCE: CLPA

"We are now seeing a move towards a single converged network architecture that delivers a number of key benefits by combining all of these different traffic types together onto one network. This is being enabled by the adoption of Time-Sensitive Networking (TSN). This is an extension of Ethernet that enables determinism and provides the foundation for converged networks," John Browett, General Manager, CC-Link Partner Association Europe.

Impact of Time-Sensitive Networking

Single converged network architecture enabled by adoption of TSN.

According to John Browett, General Manager, CC-Link Partner Association Europe, it was often necessary in the past to use separate networks to address each type of control traffic on a machine. This often meant a separate network was used for functions such as safety, I/O and motion control, etc. Moreover, if there were functions not directly related to real time control, such as TCP/IP traffic related to printers, bar code readers or video, etc., this was also handled separately.

"We are now seeing a move towards a single converged network architecture that delivers a number of key benefits by combining all of these different traffic types together onto one network," Browett said. "This is being enabled by the adoption of Time-Sensitive Networking (TSN). This is an extension of Ethernet that enables determinism and provides the foundation for converged networks. Another key topic relates to the "explosion" of data that is related to the introduction of Industry 4.0. More devices are producing more data, which, if properly handled, can provide valuable insights for optimizing processes. This is driving the move to industrial Ethernet that offers gigabit bandwidth as a means to handle this data effectively."

Networking solutions

Browett said that a key concern for any company is to make sure their processes are operating in the most optimized way. This will allow maximum productivity, minimum waste, and so on. Combined together, these allow

SOURCE: ISTOCK

"Industrial Ethernet is continuously evolving to make it possible for significant increases in efficiency as well as innovative business models for OEM machine builders. With ever-present supply chain challenges, OEMs often wait on device availability, and this can reduce the time allocated for machine commissioning in order to keep the project on schedule," Steve Fales, Director of Marketing, ODVA.

the highest level of competitiveness in their industry.

"To help achieve this, it's necessary to have a clear understanding of what the process is actually doing. The advent of Industry 4.0 is seeing the introduction of systems that can produce a tremendous amount of data regarding their operation. TSN is a key tool to help increase transparency of processes, as instead of multiple disparate streams of data all having to be analyzed separately, the opportunity now exists to combine them together and deal with them as one coherent picture. This is a key contributor to increasing transparency and therefore process optimization," Browett said.

"When gigabit bandwidth is added to the picture, this allows more data to be handled more easily, further contributing to performance and accelerating the ability complete analytical tasks faster."

New solutions offer unique capabilities

Since it's no longer necessary to have separate networks for I/O, motion, safety and IT related functions, the engineering effort of machines is reduced, as now multiple separate networks can be reduced to a single architecture. Hence costs are reduced, as less development time and hardware is required. This then translates into greater competitiveness as machine costs and time to market are also reduced.

When a machine is up and running, it also means increased uptime, as simpler systems are easier to maintain. Non time critical functions, such as printing a shift log, or maintaining a video stream, can share the same network with time critical, deterministic data such as I/O or motion control, without getting in each other's way.

As we have seen, it also helps to increase the transparency of the process. This means productivity is increased, because the process can run in a better way and have increased uptime as we just mentioned. In the end, this is the key point. Customers want to know that a new technology can help address their business challenges.

Advanced networking in manufacturing

Browett said that CLPA is already seeing over 100 companies worldwide who have adopted TSN in their operations. These cover a wide range of industries such as automotive, semiconductor, food & beverage, lithium batteries, consumer packaged goods and consumer electronics.

A specific example is Keller, a leading OEM of machines that perform screen and pad printing as well as hot stamping based in Poland. They have developed an innovative new machine that leverages TSN network technology to deliver next level productivity via deterministic motion control over 65 motion axes. This has resulted in significant improvements in terms of performance, accuracy and precision.

"The machine offers end users a modular, versatile solution that delivers enhanced productivity, cost-effectiveness, flexibility and high print quality. Moreover, the setup is scalable, as it can incorporate up to 8 different colours (and their necessary axes) and is completely reconfigurable. It can be extended to include additional printing modules to deliver a highly integrated system," Browett said.

Keller identified the convergent network architecture benefits that TSN can deliver for future development and plans to add additional machine functions like vision systems on the same network architecture.

Challenges for automation engineers

Browett said that ongoing challenges relate chiefly to engineering machines faster, reducing costs, making them more productive and reliable. TSN can assist automation engineers to address all these challenges as we have seen already. It can reduce the complexity of a system, thus making it simpler to engineer and therefore quicker to produce a design, helping to decrease time to market.

Machines that take less time to develop and are simpler consume fewer engineering resources and have lower hardware costs, thus decreasing overall costs. This means that a more competitive product can be offered.

"Once out in the field, we have already outlined how the benefits of TSN allow machines to be operated in a more efficient, optimized way, since the processes they contain can be understood better due to the increased transparency. This leads to a more productive manufacturing line. Since the systems are less complex, maintenance becomes less of an issue, meaning that when problems do occur, they can be addressed more quickly, leading to greater uptime and increased productivity," he noted.

Industrial Ethernet continues to develop and evolve

Leveraging bandwidth into greater efficiencies and smoother device integration.

"Industrial Ethernet is continuously evolving to make it possible for significant increases in efficiency as well as innovative business models for OEM machine builders. With ever-present supply chain challenges, OEMs often wait on device availability, and this can reduce the time allocated for machine commissioning in order to keep the project on schedule," Steve Fales, ODVA Director of Marketing, told the Industrial Ethernet Book recently.

"New technologies such as LLDP, which is available with EtherNet/IP and other industrial Ethernet networks, can allow machine builders to simplify and shorten device commissioning through automatic discovery of devices, enabling smoother device integration. LLDP also increases security by transmitting device information to directly connected peer devices, since a connection isn't needed to obtain the network topology."

Fales said that the increased speed and bandwidth of Ethernet has opened the door to a wide variety of network and device information that was previously not possible. Industrial Ethernet enables additional diagnostic information as well as remote connectivity to allow OEM machine builders to sell service contracts, without having to have personnel ready to get on a plane 24/7 or be located onsite, and even offer machines as a service that can be billed by usage. EtherNet/IP, in particular, provides access to the Big 12 network diagnostics that expose key network health and device loading information via the standard network diagnostic assembly.

The future of industrial machine control

"The future of machine control is poised to transition from running static control programs and having maintenance workers reacting to devices failing, to control programs that learn over time and are capable of predicting when devices need to be replaced," Fales added. "One of the key steps in the process of enabling data to be transferred from a PLC to the edge and/or cloud for analysis and action is to ensure that the field devices support data models such as PA-DIM and OPC UA as well as standardized diagnostics such as NAMUR NE 107."

Data scientists today spend a lot of time cleaning and organizing data, which isn't a scalable approach to enable a future powered by machine learning and predictive maintenance. Instead, data will need to be labelled and contextualized in a consistent manner regardless of communication protocol or device manufacturer. This will ensure that data is ready for machine learning and predictive maintenance analysis. EtherNet/IP supports PA-DIM, OPC UA, and NE 107 to provide end users with the critical information when and where they need it to make informed business decisions with the aid of automated tools.

Solutions and technology benefits

Fales said that solutions such as standardized information models for Industrial Ethernet can make technology like augmented reality more accessible, since the data is ready to be used, which can help to increase worker efficiency by making training manuals, device replacement instructions, and diagnostic explanations for machines more easily available. Additionally, Industrial Ethernet has made safety networking possible without a separate hardwired safety system.

"This has helped safety to become more common and enabled smaller safety zones that don't require a whole machine to shut down when a hazardous area needs to be briefly accessed by a worker," Fales said.

CIP Safety for EtherNet/IP is an Ethernet enabled solution that allows for small light curtains to be placed in many areas of a machine to increase worker safety and efficiency. Additionally, security is another service that can be built into Industrial Ethernet to allow for device level protection for secure remote access by OEMs to enable 24/7 service for end users. CIP Security for EtherNet/IP provides device level security as a part of a defense in depth approach for automation networks.

A wide variety of applications also utilize advanced Industrial Ethernet networking features such as safety networks for stamping equipment and robotic welding or preventative maintenance predictions for packaging machinery and conveying systems.

Fales said that one of the newest applications for Industrial Ethernet has been wireless solutions such as Wi-Fi and 5G. An example is an Automated Guided Vehicle (AGV) in a factory moving on a fixed route to supply components to a machine or to transport finished goods to a delivery vehicle loading area. This requires the usage of Industrial Ethernet, wireless, and safety together. EtherNet/IP can be used in this application since it is a physical layer independent protocol that can run over 5G and offers the CIP Safety extension.

The devices on the AGV would use CIP Safety to detect any failures in communication and that would then cause the system to move to a safe state. Additionally, wireless AGVs can transmit data about the number of components or finished goods that have been transported over a given period of time via Industrial Ethernet to provide a better understanding of operations and how to improve them. This data can be transported either to the edge or to the cloud for further processing or inclusion in KPI dashboards making the promise of IIoT a reality.

Application challenges

When asked about application engineering challenges, Fales said that automation engineers are tasked with continuing to increase efficiency while maintaining reliable, safe, and secure operations. Industrial Ethernet has offered scalable and proven solutions for many years to automate basic repetitive tasks in a safe manner to allow workers to focus on higher value activities.

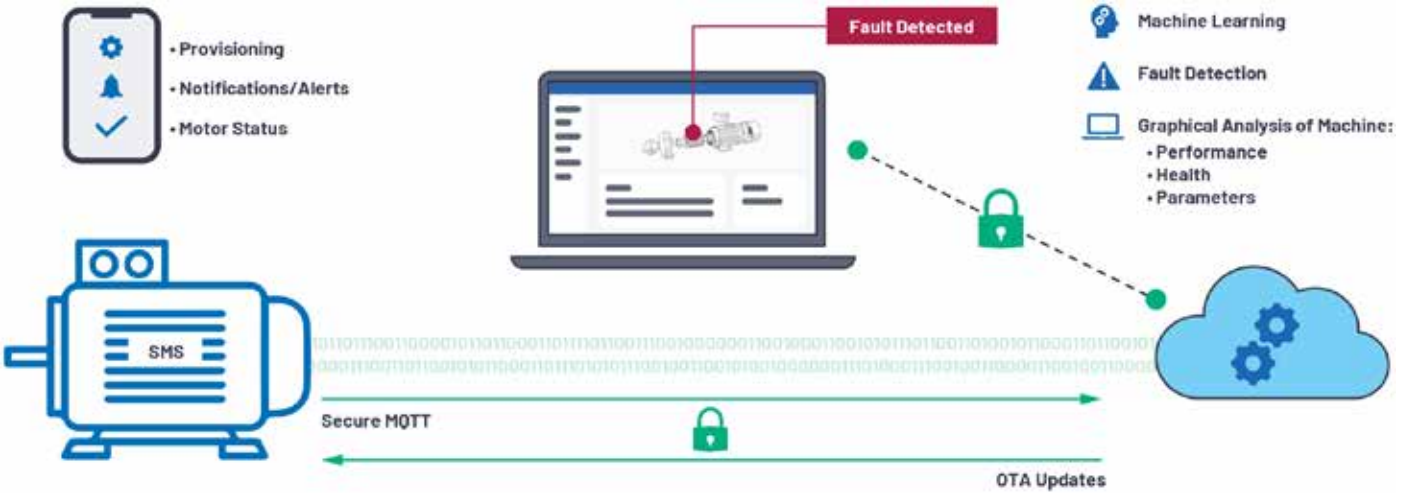
This has been accomplished via combining the increased speed and bandwidth of Ethernet combined with specific accommodations for the industrial environment such as safety where protocols like CIP Safety are capable of detecting communication errors via diagnostics and internal calculations to ensure that the device moves to a safe state if any issues are found.

"Industrial Ethernet will also be up for the challenge of integrating wireless, security, preventative maintenance, and machine learning into machines to continue to increase Overall Equipment Effectiveness (OEE) as the era of Artificial Intelligence is set to begin," he said. "This will be accomplished through Industrial Ethernet communication networks that are physical layer independent, utilize open security standards, and support standard information modeling, such as EtherNet/IP."

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

Software-driven, secure predictive maintenance for electric motors

The Smart Motor Sensor (SMS) is a flexible, out-of-the-box, end-to-end secure wireless predictive maintenance (PdM) solution that combines software, hardware, and domain expertise in electric motors to create a secure scalable offering for the predictive maintenance of electric motors.



SOURCE: ANALOG DEVICES

Figure 1. End-to-end predictive maintenance solution for electric motors.

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

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

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

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

One common demand is for a full turnkey wireless solution that combines hardware and software and that is easy to install and use. Industries need a solution that does not require experts to manually gather data and/or install and maintain dedicated networks.

SOURCE: ANALOG DEVICES

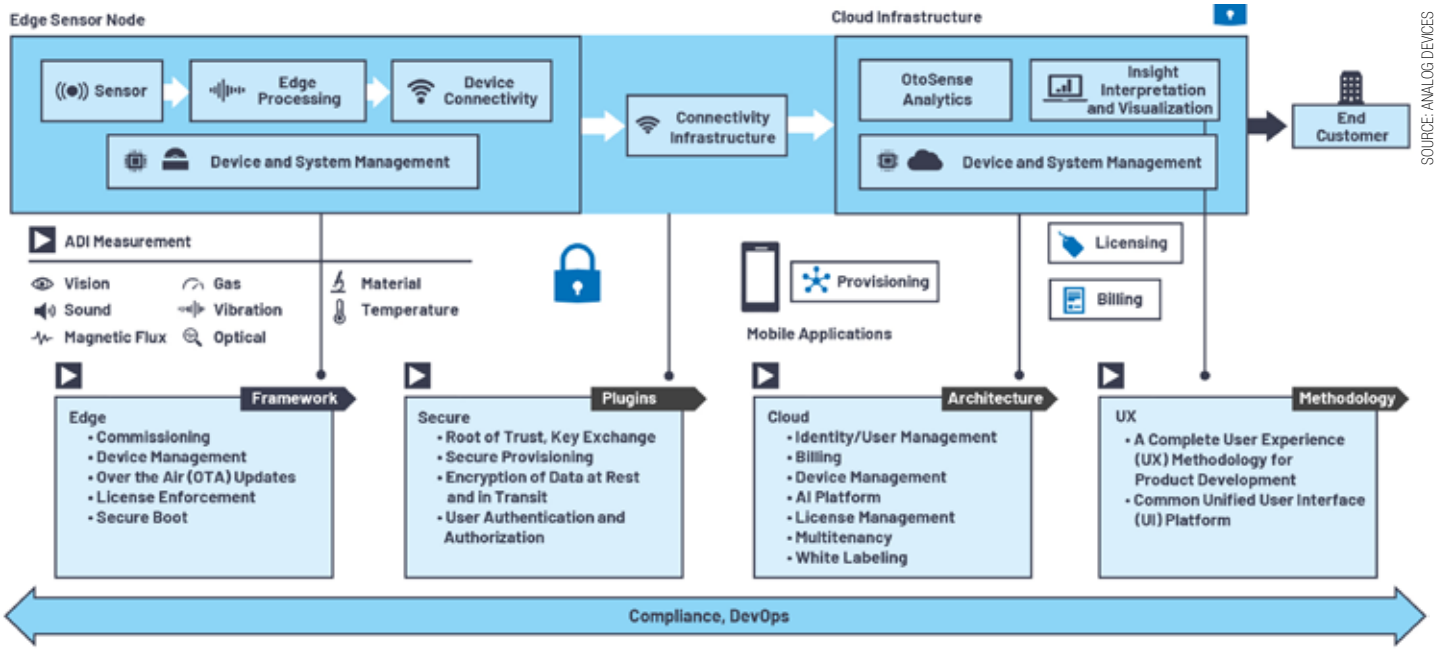
Figure 2. An overview of the ADI OtoSense™ Smart Motor Sensor.

Smart Motor Sensor (SMS) and how it works

The Smart Motor Sensor (SMS) is a flexible, out-of-the-box, end-to-end secure wireless predictive maintenance (PdM) solution that combines ADI software, hardware, and domain expertise in electric motors to create a secure scalable offering for the predictive maintenance of electric motors.

The Smart Motor Sensor (SMS) works with Android and iOS mobile applications for easy setup of the sensor, visibility on deployment data, and in-app notifications and alerts on critical events. A cloud hosted dashboard provides a complete overview of machine health diagnosis and fault detection with detailed information and visualization of each motor's status along with AI-based analytics to detect commonly occurring faults in electric motors.

The battery-operated SMS device combines ADI's MEMS sensors, precision converters, and signal chains. Firmware embedded in the SMS device captures various parameters of the motor (such as vibration, temperature, speed, and magnetic flux) and sends these data securely over a Wi-Fi connection to the back-end cloud for processing. An artificial intelligence (AI) engine that runs on the cloud and is integrated into the web application



SOURCE: ANALOG DEVICES

Figure 3. Sensor-to-cloud secure software framework.

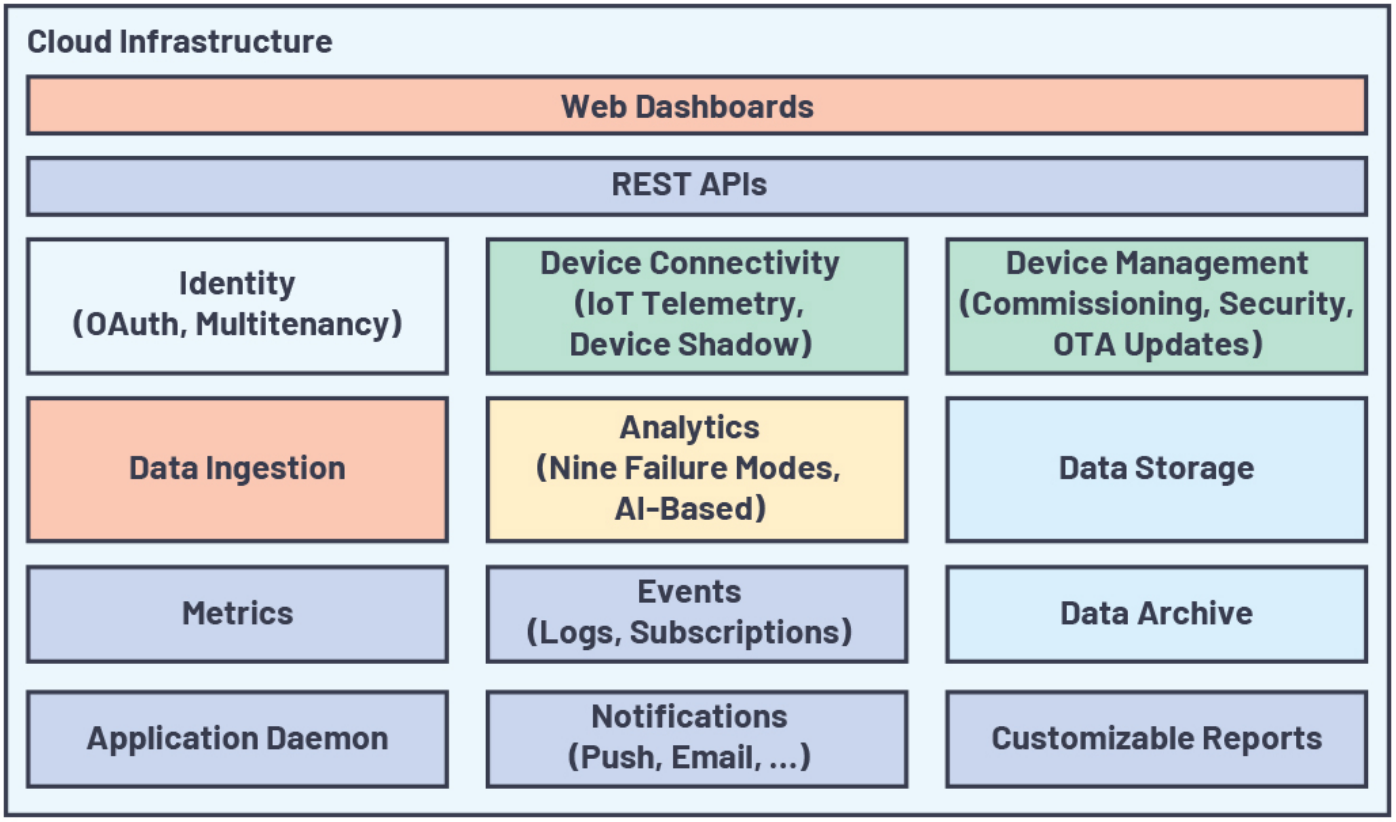
analyzes the data and monitors the health of the motors.

The system can predict nine different electrical and mechanical failures that commonly occur in motors and, upon detecting one, sends out push notifications or emails to inform the user about the appropriate action to take. The Smart Motor Sensor product suite is available direct to customers as an end-to-end solution or via a REST API.

Sensor-to-cloud software building blocks

Figure 3 above illustrates ADI's sensor-to-cloud software framework, which was leveraged to build the necessary software for the SMS solution. The sensor-to-cloud secure software framework helps to meet the desire for complete solutions, without the frustration and complexity of putting together a full system to capture actionable insights from real-world data.

The framework also enables greater reusability, which helps reduce time to market, and allows the software team to focus on delivering the domain-specific solution for



SOURCE: ANALOG DEVICES

Figure 4. SMS cloud components from a secure software framework.

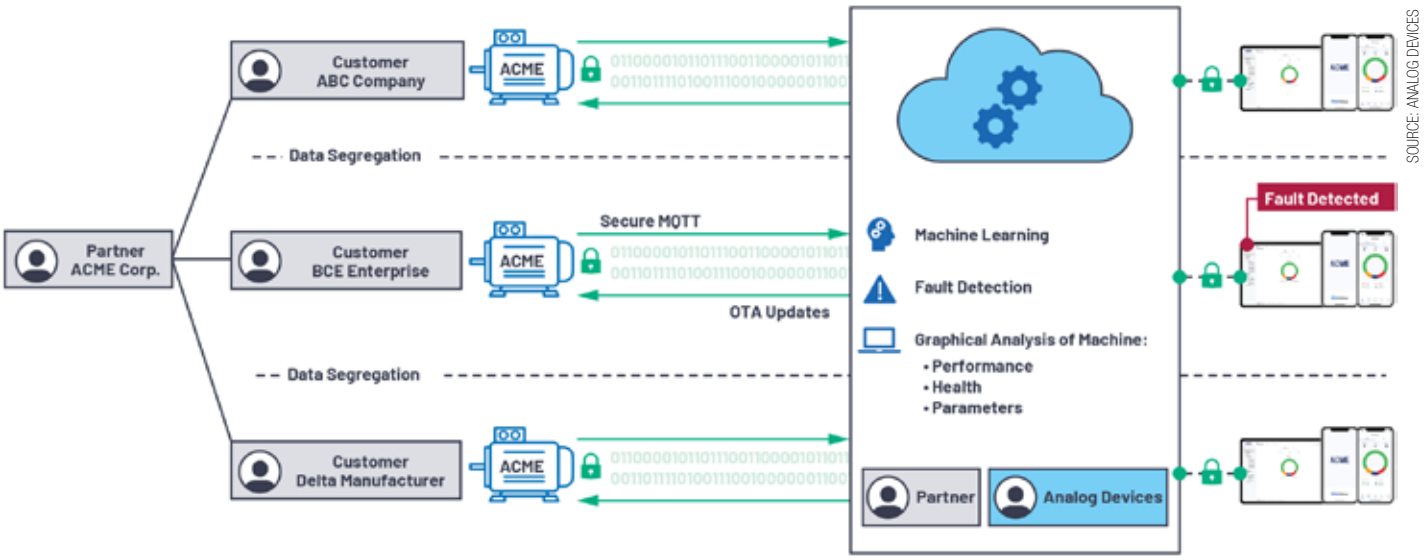


Figure 5. Multitenancy ensuring customer data segregation.

any given product.

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

SMS cloud and web

The OtoSense SMS cloud back end is built on and extends the secure software framework. Figure 4 depicts the components of the cloud infrastructure. The application is multitenanted to support onboarding multiple customers and ensuring data segregation.

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

SMS mobile applications

ADI OtoSense SMS mobile applications have been architected with code reuse as a priority. The core application consists of several modules, including an SMS communication module, API communication module, and a core application module (views and navigation).

These modules represent everything that can be reused across all custom label partner applications. For each new custom label application, a new configuration set is created that contains the partner's branded UI components and API configuration. This software architecture enables the mobile applications development team to create new partner applications quickly and easily, as well as release new features and updates to all partner applications efficiently.

SMS AI engine

The OtoSense AI platform can address any sensing interpretation challenge. This platform has been leveraged to implement the machine learning components of the Smart Motor Sensor solution. ADI's in-depth knowledge in electric motors has been used to create a digital blueprint of an electric motor's optimal behavior, across all ranges of loads, rotation speeds, and temperatures. However, each motor once sold deviates from this initial model. Its environment, usage, and maintenance operations make it unique.

After installation on a motor, ADI OtoSense SMS initially acquires data to learn how this motor differs from the blueprint and creates a unique digital twin for the motor the SMS edge device is attached to. From there, OtoSense SMS compares the data coming from this motor to its digital twin running in the exact same operating conditions. If there is a substantial difference in behavior between the physical motor and its digital twin, OtoSense SMS analyzes this difference to determine the most probable root cause of this discrepancy

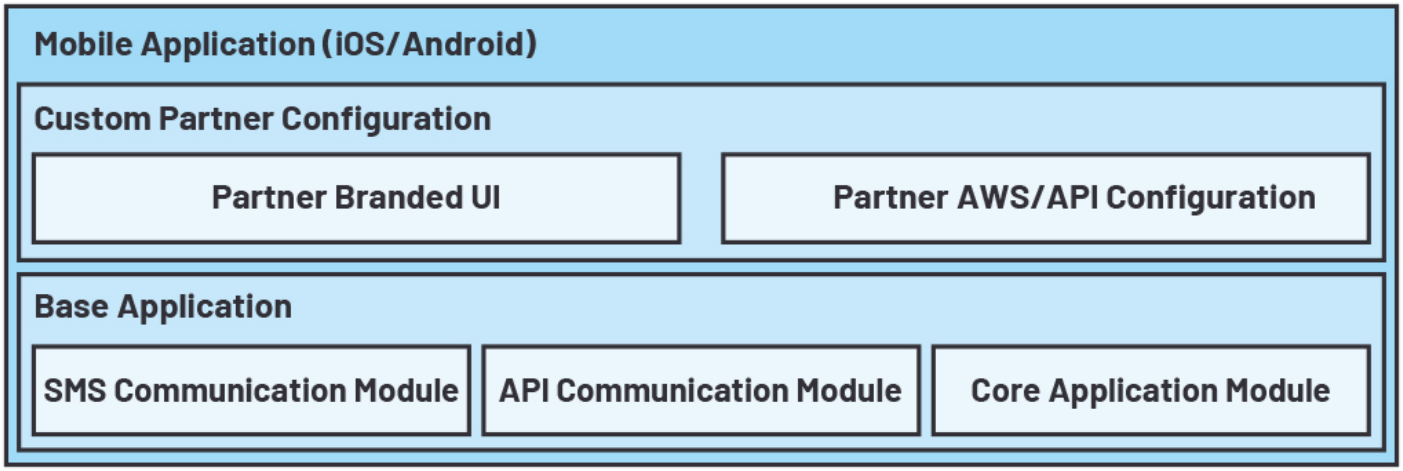


Figure 6. Mobile applications architecture.

SOURCE: ANALOG DEVICES

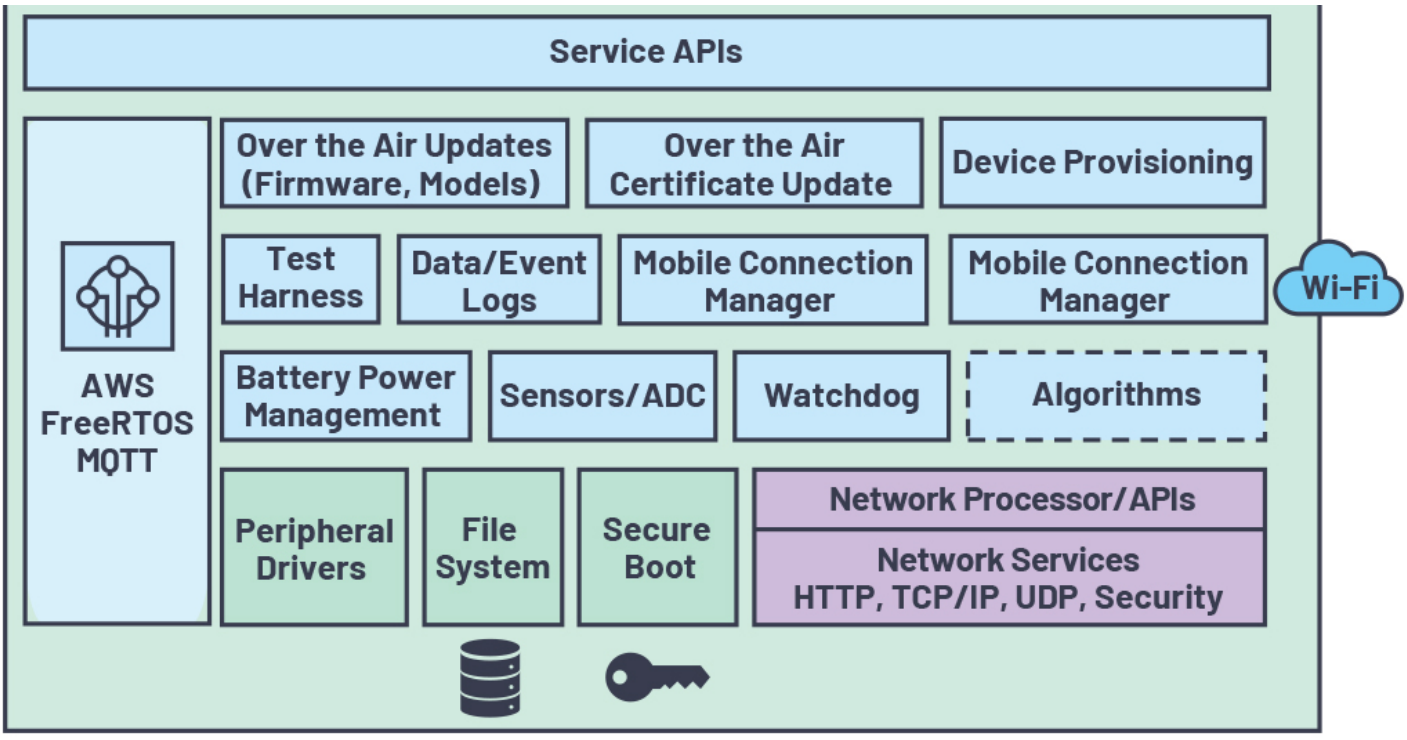


Figure 7. Secure firmware framework functional blocks.

and informs the user about the existence of a fault, its origin, and the action to perform to resolve it.

The system is capable of detecting the following nine commonly occurring issues:

- Faults in the motor power system that can cause an asymmetry in the motor currents.
- Machine rotor unbalance as a consequence of the gravity center displacement of any of the motor rotating parts.
- Loss of alignment between motor and motor load.
- Faults caused in the motor stator, leading to asymmetry in the motor currents.
- Malfunction of the motor when the concentricity between the stator and the rotor is not maintained.
- Problems in the motor cooling system, such as obstruction of the ventilation outlet or the fan stop, in case of independent ventilation of the motor.
- Rotor failures such as discontinuities in the active part of the rotor, such as rotor bars or short-circuit ring, or problems in the welds of the copper rotor.
- Bearing failures such as lack of lubrication or defects in the inner and outer race, the cages, or the rolling elements.
- Problems in the fixing system of the motor to the operating bench, like soft/loose foot.

SMS firmware

The firmware embedded in the SMS captures various parameters of the motor (vibration, temperature, speed, magnetic flux) that it is attached to and sends this data securely over a Wi-Fi connection to the back-end cloud for processing.

The SMS firmware connects with an iOS or Android smartphone via the Wi-Fi interface to enable device installation and provisioning. The firmware provides diagnostics information for troubleshooting the device during and after deployment and can be updated securely over the air.

The SMS firmware was built leveraging a portable service oriented architecture-based framework. This framework consists of modular, reusable functional blocks wrapped in application agnostic service APIs to enable reuse for other IoT applications. It also enables application developers to easily integrate application-specific signal processing functions and algorithms along with service APIs into the product. Figure 7 shows the functional blocks of the framework.

End-to-end security

ADI OtoSense SMS is designed from end to end with industry-best security protocols and controls, which ensure that SMS data and insights maintain their accuracy and precision, are reliably processed, are transmitted with no interruptions, and are always and only accessible by authorized OtoSense SMS users.

Each SMS customer has a dedicated account on the OtoSense Cloud, and all data (sensor data, insights, account information, etc.) are partitioned using the customer ID as the top-level partition key. Access to customer data is restricted to members of the customer account, and access authorization is enforced via identity and access management services offered by premier cloud services providers.

User account creation, management, and username/password login security (including password reset functionality) leverage trusted user management and authentication services from premier identity and login service providers, which ensures safe and secure user login from both the mobile application and web dashboard.

Sessions between the SMS device and the web application are exclusively established via mutually authenticated TLS. All data to or from the SMS device is encrypted and transmitted via the MQTT-over-TLS protocol. This includes sensor data, commands sent to the SMS device, and over-the-air updates transmitted to deployed SMS devices.

Conclusion

All the software building blocks, combined with ADI's advanced technologies like MEMS sensors, precision converters, and signal chains and expertise in electric motors, make for a complete out-of-the box solution for the predictive maintenance of electric motors.

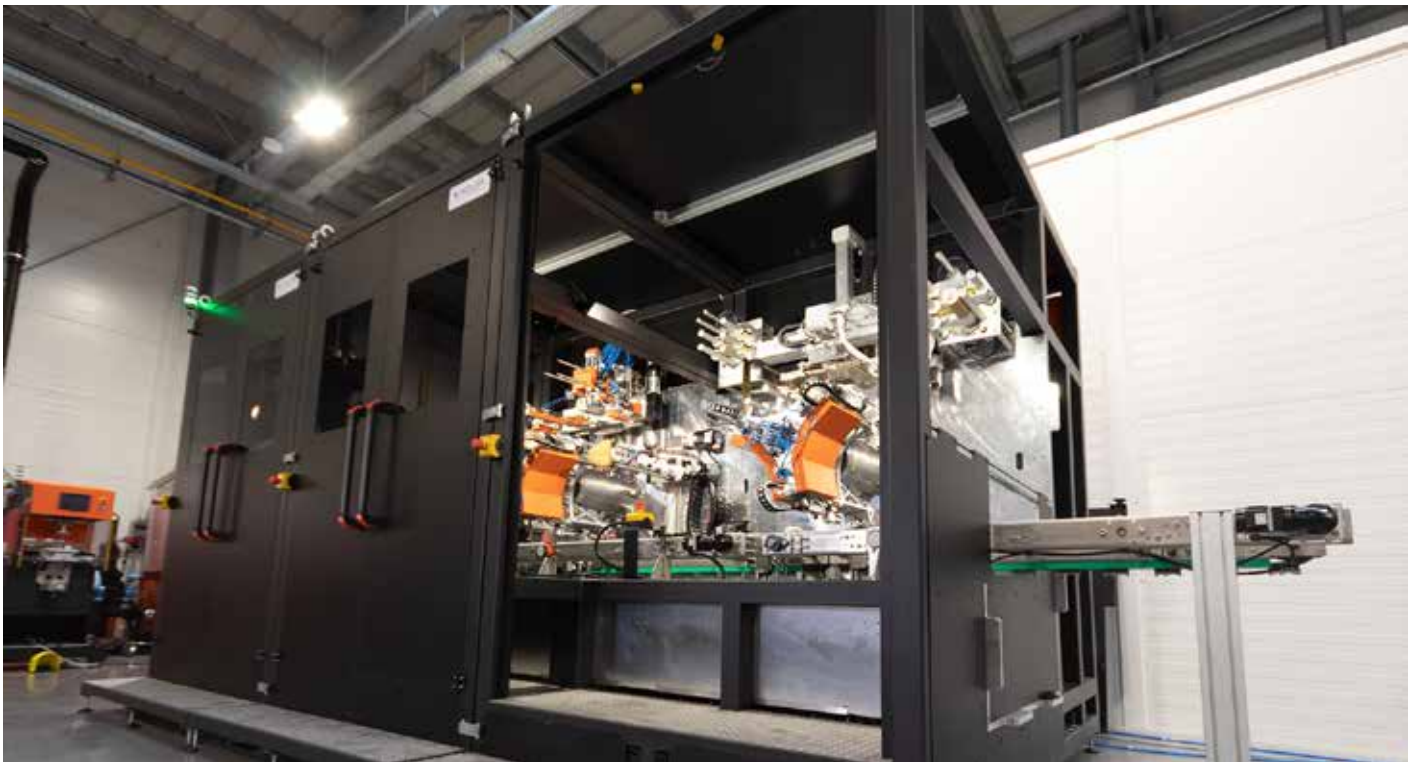
The end-to-end secure solution is designed to provide trusted insights to increase equipment uptime, reduce operational cost, extend equipment lifetime, and improve worker productivity.

Shankar Malladi, Director - Embedded Software and Product Quality, Jason Griffin, Director - Technology Solutions and Sebastien Christian, Product Line Director, ***Analog Devices.***

Learn More

Redefining industrial connectivity with Time-Sensitive Networking

By providing a platform for IT-OT convergence, Time-Sensitive Networking can help create simpler, leaner and more cost-effective networks that streamline troubleshooting. It supports data-driven, decision making with its ability to facilitate the merger of information technology (IT) and operational technology (OT).



SOURCE: CLPA

Keller, a leading OEM of machines that perform screen and pad printing as well as hot stamping, has developed an innovative new system that leverages CC-Link IE TSN network technology to boost productivity. (© Keller poligrafia dla przemysłu)

IN THE DYNAMIC LANDSCAPE OF INDUSTRY 4.0, a significant and transformative interconnectivity wave is sweeping the globe, Time-Sensitive Networking (TSN). The technology, supported by a large portfolio of industrial automation devices that leverage CC-Link IE TSN open industrial gigabit Ethernet with TSN functions, is being rapidly adopted and enabling remarkable productivity gains in manufacturing.

Benefits of TSN technology

TSN is a network technology designed to advance industrial Ethernet communications through determinism and convergence. Thanks to these capabilities, it enhances the way companies' processes operate as well as how their machines and components communicate, bringing with it a host of benefits that can drive competitiveness throughout the industrial landscape.

The solution can guarantee determinism across a network, enabling machine builders and users to set up ultra-high speed industrial automation applications, such as complex motion systems, and improve productivity.

In addition, by providing a platform for convergence, TSN can help create simpler, leaner and more cost-effective networks that streamline troubleshooting. Also, it supports data-driven decision making, thanks its ability to facilitate the merger of information technology (IT) and operational technology (OT).

Driven by the competitive advantages that TSN can bring to companies in various manufacturing sectors, for example, the demand for the technology is rapidly growing. To address this, automation vendors at the forefront of the industry are beginning to offer devices that can leverage TSN, with CC-Link IE TSN open industrial Ethernet a popular choice. This network technology, which combines TSN functions and gigabit bandwidth, already boasts over a hundred compatible products that are readily available and can support advanced Industry 4.0 setups. As a result, the number of CC-Link IE TSN applications is rapidly growing.

CC-Link IE TSN's rising sun

The CC-Link IE TSN adoption curve found its origin point in Asia, where forward-thinking companies across the continent quickly realised the potential of the network technology as well as its many benefits. For example, Shashin Kagaku, a Japanese producer of additive manufacturing systems, also known as 3D printers, turned to CC-Link IE TSN for its new SZ-6000 machine. The resulting solution provided the company with a significant lead over other businesses in what is already a highly competitive marketplace. More importantly, its customers can also benefit from a significant increase in productivity through a highly cost-effective unit.

In China, CC-Link IE TSN has been adopted by a leading producer of automated lithium-ion battery manufacturing lines. The company was looking for a new technology that would improve the productivity of its systems,

while simplifying their designs and reducing time to market. Also, the Instrumentation Technology & Economy Institute (ITEI) of the People's Republic of China selected CC-Link IE TSN as an enabling technology within the Smart Manufacturing Comprehensive Test Platform. This is a full-scale, fully automated demonstration of a manufacturing system that leverages key technologies to showcase best practices for future manufacturing facilities.

Another leading example of the advantages of this cutting-edge network technology was developed by Orisol, a leading provider of automated systems for footwear production. The company saw its OFA240 series upper to sole flash activator machine as an ideal candidate to benefit from TSN technology. By using CC-Link IE TSN, this updated setup could increase the speed of internal communications by a factor of 220, with execution time shortened by 7 times and application speed increased by 12 times overall. CC-Link IE TSN also enabled machines to be synchronised to an accuracy of 1 millisecond for almost instant data sharing, delivering precise communications within the machine itself, and to other devices and IT systems.

SOURCE: CLPA

Shashin Kagaku is a Japanese manufacturer of AM systems that form high precision parts using a ceramics-based process turned to CC-Link IE TSN to add value to additive manufacturing operations. (© Shashin Kagaku)

Go west

The adoption of CC-Link IE TSN in Asia, highlighted by the aforementioned examples, marked the first steps in a global shift towards a more interconnected and efficient industrial landscape. The European market is now following in the footsteps of companies in the East. Applications built on CC-Link IE TSN are helping companies enhance their connectivity, productivity and efficiency.

The latest project completed by Keller poligrafia dla przemysłu, for example, stands as a testament to the technology's fast-growing adoption in Europe. The Polish company, a leading OEM of machines that perform screen and pad printing as well as hot stamping, developed an innovative bottle printing system that leverages CC-Link IE TSN network technology to boost productivity. By incorporating TSN, the solution delivers next level productivity via deterministic motion control over a multitude of servos. This has resulted in significant improvements in terms of speed, accuracy and precision that can greatly benefit end users.

The success of Keller's implementation demonstrates that CC-Link IE TSN is not merely an Asian phenomenon but a growing global trend. As more companies recognise the transformative potential of this technology, we can anticipate further breakthroughs and improvements in industrial processes in Europe as well as on a global level.

SOURCE: CLPA

Orisol saw its OFA240 series upper to sole flash activator machine as an ideal candidate to benefit from the principles of TSN technology. (© Orisol)

Global shift towards CC-Link IE TSN

Today, more and more companies spanning various sectors have embraced CC-Link IE TSN. These include industry players in automotive, food and beverage, logistics, consumer electronics, semiconductor, lithium-ion batteries as well as consumer packaged goods. This broad spectrum of industries leveraging the technology underscores its ability to address Industry 4.0 challenges across the board and signals a turning point in the industrial connectivity landscape.

The continuous increase in applications that use CC-Link IE TSN for effective communications is a compelling indicator of the technology's role as enabler for the creation of the Connected Industries of tomorrow. The total number of installed devices that are compatible with the CLPA's range of open technologies, from CC-Link fieldbus to CC-Link IE open gigabit Ethernet and CC-Link IE TSN, surpasses 40 million globally and continues to climb. This therefore provides an unmistakable sign that the trend of adopting CC-Link IE TSN is not merely a passing phase but a fundamental shift that is here to stay.

John Browett, General Manager, ***CLPA Europe.***

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Lika Electronic unlocks new opportunities with CC-Link IE

Lika equipped its high-performance, compact EXM58 fully magnetic encoder and EXO58 optical sensing devices with the CLPA's software stack to ensure compatibility with CC-Link IE Field Basic. End users can now easily leverage the EXM58 and EXO58 devices within a CC-Link IE Field Basic network architecture.

SOURCE: CLPA

Lika equipped its well-established high-performance, compact EXM58 fully magnetic encoder and EXO58 optical sensing devices with the CLPA's software stack to ensure compatibility with CC-Link IE Field Basic.

WITH RAPID ADVANCEMENTS TAKING PLACE IN the industrial automation landscape, staying competitive is more critical than ever for device vendors.

As companies seek to setup increasingly more demanding Industry 4.0 applications, offering state-of-the-art devices that are compatible with the right industrial communications solutions is key. To address market demands and deliver value-adding products to its customers, Lika Electronic chose to develop new encoders compatible with network technologies from the CC-Link Partner Association (CLPA).

In the era of smart manufacturing, industrial automation device vendors play a pivotal role in the digital transformation of shop floors and entire enterprises, providing the enabling technologies to succeed in this journey. In particular, as interconnected factories become the norm, these vendors need to equip their devices with suitable communications solutions. They should be able to support the reliable transfer of increasingly larger volumes of data across multiple network components, some of which may come from different equipment providers.

Identifying key market opportunities

Lika, a leading developer of solutions for the automation industry and well-established manufacturer of optical encoders, magnetic measurement systems and positioning units, regularly updates its product portfolio to address market and customer-specific needs. When looking at how to best support its customers in the creation of smarter systems, the company concluded that ensuring compatibility with the CC-Link family of open industrial networking technologies was a must.

Marco Calabrese, Managing Director - Sales & Marketing at Lika, explained: "This latest development project started when one of our customers asked our specialists for a reliable encoder solution that could communicate through the CLPA's standards. This also aligned perfectly with our ongoing plans to strengthen our portfolio by adding products that are interoperable with a wide variety of solutions offered by many other CLPA partners. This also helps us to expand the support we offer for the creation of advanced Industry 4.0 setups."

In line with this commitment, Lika decided to embark on a journey that would start with adding CC-Link IE Field Basic compatibility to some of its existing products. This is a popular, 100Mbit version of the CC-Link IE open industrial Ethernet. This offers compatibility with a range of other products, such as controller from Mitsubishi Electric. The move would also help the company eventually progress to develop new devices that would support CC-Link IE TSN. In this way, the company could grow its capabilities without overwhelming its teams as well as sustainably balance its investments.

Therefore, Lika equipped its well-established high-performance, compact EXM58 fully magnetic encoder and EXO58 optical sensing devices with the CLPA's software stack to ensure compatibility with CC-Link IE Field Basic. As a result, end users can now easily leverage the EXM58 and EXO58 devices within a CC-Link IE Field Basic network architecture.

Streamlined and straightforward development process

As Lika leveraged the CC-Link IE Field Basic solution, it was possible to implement this network on any existing 100Mbit device solely through an established software

SOURCE: CLPA

IT/OT convergence is on the rise, and the next generation of solutions has arrived and is paving the way for advanced manufacturing.

implementation route, without any additional hardware or changes required. This option simplifies and streamlines the development process, shortening time-to-market while minimising investments.

An additional element that supported the rapid development process was the use of the netX 90 System-on-Chip (SoC) from another CLPA partner company, Hilscher. Lika had been using the solution for a long time on a number of products, therefore the ability to utilise it to support CC-Link IE Field Basic was highly beneficial. Lika is also typical of the strong user base of companies that use Hilscher's solutions, which are served by the portfolio of existing CC-Link IE Field Basic development options they offer.

Once the prototypes were ready, the company proceeded certifying them through the CLPA's conformance testing process to ensure interoperability and compatibility with other CC-Link IE devices. For CC-Link IE Field Basic, CLPA members can conduct a self-assessment to prove compliance through an approved certification tool that evaluates if the product being investigated meets key requirements. This option helps vendors reduce testing times and costs, empowering them to promptly address market demands.

Alberto Griffini, Business Developer at the CLPA Europe, comments: "The process to implement and prove compliance with CC-Link IE Field Basic is particularly easy, enabling new partners to kickstart the release of products that incorporate our network technologies. In this way, companies like Lika can embrace our solutions in a stepwise approach that doesn't overwhelm their teams."

Calabrese added: "We found both the development and certification processes extremely intuitive and accessible, with plenty of resources available to support us. To meet our customers' demands, we offer encoders that utilise different standards, and implementing CC-Link IE Field Basic has certainly been the most straightforward and uncomplicated. In particular, the CC-Link IE Field Basic certification was done in-house, enabling us to offer these new encoder options quickly and benefitting end users looking for such solutions.

"We are also extremely grateful for the extensive support received throughout all the different development stages. It helped us succeed but also showed us how interested and attentive the CLPA is to its members." By assisting in the development of a growing number of automation products, the organisation is helping to advance the creation of Connected Industries.

Broadening Lika's horizons

Lika is already benefitting from the extended product offering, as customers in Asia, where the CC-Link family of network technologies is a de facto standard, and are keen to leverage the company's renowned encoders for key applications. Therefore, this strategic move is driving growth in valued markets.

Furthermore, now that Lika's first CC-Link IE Field Basic compatible encoders have been released, the company is aiming to progress further in its compatibility journey with the creation of more devices, including solutions that use CC-Link IE TSN for general and safety applications. This is the first open industrial Ethernet technology to combine gigabit bandwidth with Time-Sensitive Networking (TSN) functions to support highly deterministic, convergent Industry 4.0 applications. Looking ahead, this will help the encoder leader offer cutting-edge devices that are sought after by industry players further along their digitalisation journey.

Calabrese said: "We are keen to include CC-Link IE TSN in our portfolio and look forward to the release of more supporting products that are compatible with this network technology, such as Hilscher's netX90 SoC, to fuel our development activities."

John Browett, General Manager at the CLPA Europe, concludes: "We are delighted that Lika decided to become part of the CLPA and invest in the development of compatible products. It is perhaps even more pleasing to see how this choice is boosting the company's competitiveness. We look forward to supporting Lika and many other automation specialists in the development of solutions that enable the creation of highly effective Industry 4.0 applications."

*Application report by **CLPA Europe.***

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Private 5G solution for industry

Solution provides infrastructure for private industrial 5G networks with a focus on automation applications

FOR THE FIRST TIME, THE TECHNOLOGY company Siemens is launching a private infrastructure developed in-house for the 5G mobile communications standard. The solution enables industrial companies to build their own local 5G networks that will provide optimal support for automation applications.

"By building their own 5G networks, industrial companies are launching the next stage of connected production," said Axel Lorenz, CEO of Process Automation at Siemens. "5G is crucial for applications like mobile robots, autonomous logistics, and driverless transport systems in factories. Siemens' private 5G infrastructure also gives users sole control over the data in their 5G network at all times, and they can custom-configure the network for their applications."

Other scenarios for industrial 5G wireless technology include the integrated use of connected tablets, VR glasses, and smart tools. In addition, edge devices can be used flexibly: for example, in brownfield applications where it's difficult to lay cables. In contrast to other wireless technologies, private 5G networks use a licensed frequency band and can therefore be operated without interference.

SOURCE: SIEMENS

Private industrial 5G infrastructure for the deployment of a local 5G network.

5G network components from a single source

Siemens has developed its 5G infrastructure specifically for the requirements of industrial customers and industrial applications. It consists of a 5G core and a radio access network (RAN). The RAN includes the central unit (CU), the distributed unit (DU), and the radio units (RUs). Different 5G end-devices can connect to the 5G infrastructure and communicate in the private network. The all-in-one 5G solution is also designed for use in harsh industrial environments.

Before the market launch, Siemens extensively tested its private 5G infrastructure in real production environments like at the Siemens production site in Karlsruhe. By implementing and operating the prototype network in its own production facilities, Siemens was able to extensively test and refine the technology, ensuring that it can withstand the requirements of industrial production environments and support industrial applications.

The private Siemens 5G infrastructure is now available in Germany, and other countries will follow. One of the pilot customers for the complete 5G solution is the German steel group Salzgitter AG: "We don't just want to build any 5G network, we want an industrial 5G that meets the enormous requirements of the steel industry," said Gerd Baresch, Chief Technology Officer at Salzgitter Flachstahl GmbH. "Wherever we need to wirelessly transmit data reliably and securely – from real-time camera images to safety-relevant emergency-stop signals for driverless transport systems – we need future-proof communication technology. Siemens has been a longstanding reliable partner for network solutions, and this is precisely why we decided to work with them."

SOURCE: SIEMENS

Solution enables companies to build local 5G networks to support automation applications.

Highest data security with 5G infrastructure in campus networks

Private 5G networks, also known as campus networks, are 5G networks restricted to a defined company premises, a defined area, or an individual building. From Siemens' point of view, private 5G networks offer many advantages for industry: Companies build them locally at their locations and can precisely modify them to meet their needs and applications. Companies also have full control over their data, because private 5G networks use their own local 5G spectrum. A private 5G infrastructure like the one offered by Siemens is required for building a local 5G network and making the 5G signal available on the company's premises.

Siemens has been offering industrial 5G routers like the SCALANCE MUM853-1 and MUM856-1 for connecting robots, AGVs, and other industrial devices to a private 5G network since 2021. These routers are the final components necessary for efficient wireless connectivity in industrial environments.

Siemens

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Solution democratizes operational data

Edge environment provides sandbox to deploy and run applications with easy, secure, contextualized data access.

The DeltaV™ Edge Environment is what Emerson claims is a first-of-its-kind integrated software solution that expands the capabilities of the evolving DeltaV automation platform to provide an operational technology (OT) sandbox for data manipulation, analysis, organization and more.

Teams can deploy and execute applications to run key artificial intelligence (AI) engines and analytics close to the data source with seamless, secure connectivity to contextualized OT data across the cloud and enterprise. The DeltaV Edge Environment empowers teams to more quickly deliver operational improvements tied to productivity, sustainability and other business objectives.

Valuable data in intelligent devices, machines and systems helps enable enterprise-wide analytics, expands operational insight and feeds the AI engines catalyzing innovation. However, OT data is often trapped beneath layers of systems and networks, adding complexity and removing meaningful context. The DeltaV Edge Environment expands the horizons of the distributed control system (DCS), creating a secure data superhighway where users can seamlessly socialize contextualized data directly with cloud and enterprise applications while also leveraging a built-in execution sandbox—a testing environment for critical innovation tasks such as generating dashboards, running applications and training AI tools.

"Operations and IT increasingly rely on data from the control system to optimize production and increase intelligence for OT improvements, sustainability and other digital transformation initiatives," said Claudio Fayad, vice president of technology for Emerson's process systems and solutions business. "The DeltaV Edge Environment is the first step in defining the control system of the future, extending the DeltaV DCS with the capability to move data and configuration easily and securely while simultaneously empowering users to drive innovation as they safely run applications and scripts inside the DCS."

SOURCE: EMERSON

Integrated software solution expands the capabilities of evolving DeltaV automation platform.

The DeltaV Edge Environment helps production teams meet their need to more easily and securely engage with automation data and manipulate it into actionable information to steer digital transformation. A single, encrypted, outbound-only flow of data helps authorized users ensure they have constant access to near real-time data without risk of users accessing the control system—a common risk with traditional custom-engineered solutions. Users can run applications for visualization, analytics, alarm management, digital twin simulations and other needs with the contextualized data available on the DeltaV Edge Environment. OT teams will know the rich data they use is a precise replica, always up to date and fully reflective of the current operating condition.

The DeltaV Edge Environment leverages open, common protocols such as OPC Unified Architecture (OPC UA) to provide contextualized data while standard application programming interfaces like representational state transfer architectural style (REST API) and scripting tools like Python provide the sandbox environment in which users can design and run applications.

Emerson

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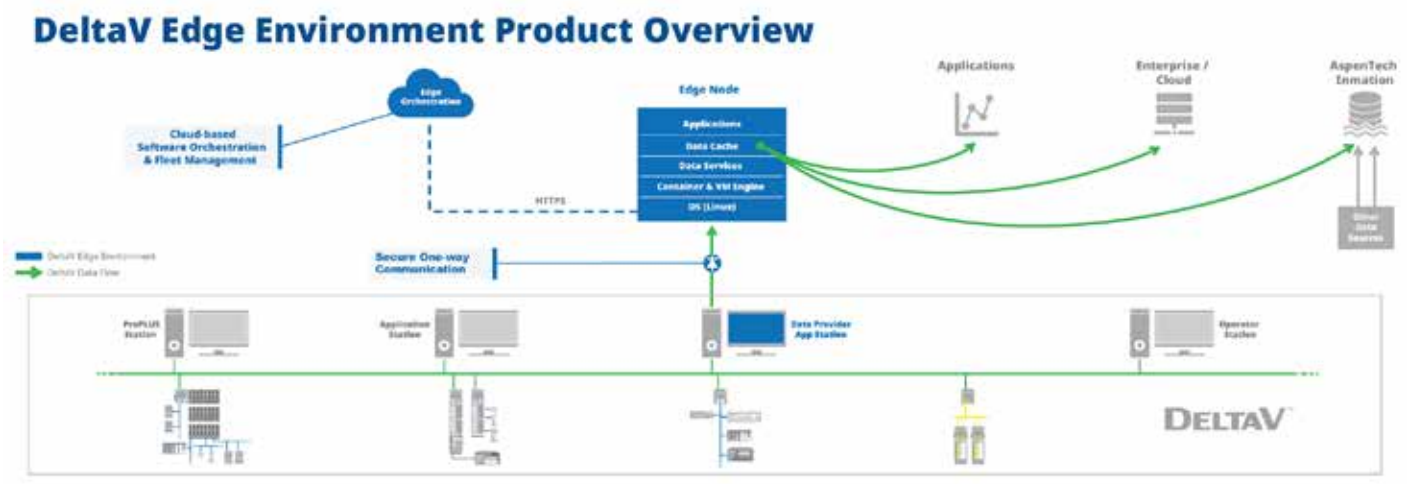


New Ethernet media converters

New generation of Ethernet media converters designed for specific industrial environments and challenges.

Phoenix Contact is introducing three new families of media converters to the market, each designed for specific industrial environments and challenges.

These devices are designed for high performance, durability, and flexibility to meet the wide range of industrial requirements, from low-cost solutions to high-temperature and high-EMC environments.

Designed for price-conscious industries, the MC 1000 series media converters provide an affordable yet reliable connectivity solution. The converters enable Ethernet transmission over fiber optics and seamless communication without compromising quality.

The MC 1000T series converters have an extended temperature range and are also a robust solution for use in harsh environments. They ensure seamless connectivity even under harsh conditions.

The MC 1000E series has been designed specifically for environments with electromagnetic interference and potentially explosive areas and ensures the stable exchange of data. In addition, the devices have a comprehensive approval package.

SOURCE: PHOENIX CONTACT

The MC 1000 series media converters meet the stringent requirements of industrial environments, meaning that they are setting a new standard for seamless data transmission.

The new media converter portfolio is an extension of the successful Phoenix Contact Ethernet switch family and includes a broader range of fiberglass interfaces, application- oriented functions, approvals, and installation locations.

Phoenix Contact

Learn More

Fail Safe over EtherCAT (FSoE)

A latest drive release from Mitsubishi Electric enhances MR-J5 safety communications.

Mitsubishi Electric is expanding the capabilities of its MELSERVO MR-J5 drives with the addition of Fail Safe over EtherCAT (FSoE) compatibility. This latest update enables interconnectivity with industrial automation devices that are compatible with EtherCAT, further enhancing multi-vendor interoperability, flexibility and convergence.

MR-J5 EtherCAT compatible servo amplifiers can be connected to an approved EtherCAT master to control safety functions over FSoE. This TÜV-certified network technology meets the IEC 61508 and IEC 61784-3 standards on safety-related systems and their messages.

This addition enables users in a variety of sectors, including automotive, food and beverage as well as lithium-ion battery production, to simplify safety installations, reducing wiring and costs. Also, industry players can benefit from an even broader industrial automation product base when developing advanced control and safety servo-based applications. Besides, they can easily integrate the new product within existing EtherCAT-based systems to deliver machines with high machine reliability and performance.

As a result, it is easier to plan, commission and manage more flexible safety systems. In particular, this pre-certified product helps to fulfil the safety requirements of machines and streamline development, certification and validation activities while reducing costs.

SOURCE: MITSUBISHI

The new release enhances the capabilities of the well-established MR- J5 series. In effect, the latest range of servo drives from Mitsubishi Electric features key energy saving and predictive maintenance functions within a compact footprint. In addition, users can benefit from equipment with exceptional performance and reliability as well as remarkable uptime and service life.

Mitsubishi

Learn More

USB-to-Serial converters

Moxa USB-to-Serial converters optimized for serial port expansion in industrial networks.

SOURCE: MOXA

Legacy serial devices remain commonplace in industrial plants, a situation that is leaving technicians using modern laptops, workstation PCs, or thin clients unable to connect to them for maintenance. Moxa is bringing needed serial port expansion to industrial networks with its UPort 1400-G2 Series of 4-port USB-to-Serial Converters ruggedly engineered for harsh environments.

An essential accessory for computers that do not have a serial port, UPort converters feature a single USB port compatible with the USB 3.2 SuperSpeed standard (5Gbs) plus is backward compatible with USB 1.1 and USB 2.0. The converters' four serial DB9 ports ensure high-performance connectivity at 921.6 kbps maximum baudrate for fast data transmission. Flow control and the 512-byte on-chip FIFO cache further improve performance.

UPort 1400-G2 converters seamlessly convert the USB host connection to RS-232/422/485 serial protocol signals. All five models that make up the UPort 1400-G2 Series are compatible with legacy serial devices such as sensors, bar code scanners, PLCs, industrial instrumentation, and point-of-sale applications.

Industrial network equipment is frequently exposed to high temperatures, electrical interference, moisture, and vibration. Moxa UPort 1400-G2 converters are safeguarded from the elements within an IP20-rated metal housing. The converters feature a wide temperature range (0° to 60° C or -40° C to 75° C), integrated protection against shock and vibration, double-sided LEDs displaying power, TX, and RX statuses, and 2 kV isolation protection on its serial ports ("I" models). Moxa UPort 1400-G2 converters also provide the most secure connection between them and the computer thanks to a new latch-and-screw USB lock.

Moxa

Visit Website

Embedded hardware security modules

Embedded hardware security module safeguards industrial and consumer applications.

SOURCE: MICROCHIP

Industrial and consumer application designers should consider implementing security functionality in devices during the development process as security threats evolve and become more sophisticated. To allow designers to easily integrate security into their applications, Microchip Technology announced a new family of PIC32CZ CA 32-bit microcontrollers with a 300 MHz Arm Cortex-M7 processor, an integrated Hardware Security Module (HSM), and a wide range of connectivity and Flash memory options for added flexibility.

The new family of PIC32CZ CA devices includes the PIC32CZ CA90 with a HSM or the PIC32CZ CA80 without the integrated HSM. The HSM in the PIC32CZ CA90 is a monolithic solution that provides advanced security for industrial and consumer applications. The HSM operates as a secure subsystem with a separate MCU on board that runs the firmware and security features including hardware secure boot, key storage, cryptographic acceleration, true random number generator and more.

For products that require added security, factory provisioning is available on the PIC32CZ CA90 which provides customers with pre-provisioned devices ready to be deployed. Microchip's Trust Platform Development Suite is an in-house secure provisioning tool that enables a secure supply chain channel at scale or in low-volume production.

The PIC32CZ CA MCUs can be configured using a wide range of connectivity options including USART/UART, I2C, SPI, CAN FD, High-Speed USB and Gigabit Ethernet. The Ethernet option includes Audio Video Bridging (AVB) and Precision Time Protocol (PTP) based on the IEEE 1588 standard.

Microchip

Learn More

Ultra-compact IPC performance

Controllers tackle multi-axis motion, machine learning and vision applications, reduced space requirements.

The new C6040 ultra-compact Industrial PC (IPC) adds scalability in terms of power and interface options to its proven C60xx series. Leveraging 12th Gen Intel Core processors with up to 16 cores, the controller is ideal for handling extremely complex automation projects in one ruggedized controller measuring just 132 x 202 x 76 mm.

As such, the C6040 enables a range of new applications for the popular C60xx family. This includes even greater capabilities for sophisticated multi-axis motion, complex HMI applications and systems with extremely short cycle times. That reaches all the way up to onboard machine learning or machine vision integrated into the standard automation software and hardware from Beckhoff.

SOURCE: BECKHOFF

With its other 12th-generation processors, Intel classifies the different CPU types into performance or efficiency cores exclusively. However, the Intel Core i7 and i9 processors used in the C6040 are the first to be installed in a hybrid architecture. This means that four additional efficiency cores are added to the Core i7 and eight to the Core i9 processors. This unique combination of performance and efficiency cores allows applications to be implemented on a total of 12 or 16 processor cores.

Performance cores are primarily suitable for high-performance, single-thread applications. However, many additional threads can be executed in real time or in user mode on the additional efficiency cores.

Beyond that, each individual core can be configured individually via the clock frequency. The additional power supply integrated on the motherboard, which is developed and produced by Beckhoff in-house, offers ample power reserves to fully utilize the enormous computing capabilities of the processors.

Beckhoff

Learn More

Terrestrial/satellite IoT communications

u-blox and ORBCOMM partner for highly integrated terrestrial and satellite IoT communications solutions.

u-blox and ORBCOMM have announced a partnership to start developing solutions for the convergence of terrestrial and satellite IoT communications markets.

With this partnership, u-blox will directly integrate support for ORBCOMM's satellite communication protocols into its UBX-R52/S52 LPWA (low-power wide-area) modem SoC (system-on-a-chip). The result: a chipset highly optimized, smaller, less complex, and that offers dual connectivity at a lower cost. This chipset will be at the core of future u-blox module products supporting terrestrial LPWA and satellite IoT protocols, enabling connected solutions almost anywhere in the world.

"The UBX-R52/S52 chipset is a mature technology platform with proven market acceptance among IoT solution providers. Specifically designed for IoT applications with long lifecycle needs, it will further strengthen u-blox's leadership in asset tracking. u-blox partnership with ORBCOMM will integrate satellite protocol support alongside cellular protocols. This integration will expand the addressable market for IoT applications, including remote locations without reliable cellular coverage," said Martin Leach, Head of Product Center Cellular at u-blox.

SOURCE: U-BLOX

The AX88279 is a high-integrated, easy-design and cost-efficient USB Ethernet controller solution. It is suitable for various smart home and office network applications, which require establishing 2.5G Ethernet network connectivity through the USB 3.2 interface, such as laptops, USB Ethernet dongles, docking stations, smart mobile device cradles, POS terminals, game consoles, smart cameras, set-top boxes, 5G/LTE router, and embedded systems with USB 3.2 interface.

u-blox

Learn More

Digital valve controller edge solution

Digital valve controller leverages embedded edge computing to streamline workflows, optimize performance.

Emerson has announced the Fisher FIELDVUE DVC7K Digital Valve Controller, a new design improving upon 30 years of field-proven innovation. The DVC7K features Advice at the Device™ technology with embedded computing and analytics that convert raw data into actionable information locally with Bluetooth capability, within the device. This means maintenance personnel can receive the data via their phone, tablet, or computer wirelessly without having to be in a control room at the plant location.

The new valve controller technology improves the performance, reliability, and uptime of both on-off and control valves—and by extension an entire process plant or facility—in a wide variety of process industry applications, and provides the information required to create streamlined work processes.

Digital valve controllers are available as accessories for control and on-off valves to provide local analysis of valve data, digital communications with host systems, and other features. These features improve uptime by alerting personnel to developing problems, reduce maintenance costs by providing the actionable information required for proactive rather than reactive maintenance, and cut troubleshooting time in the event of an issue by providing recommended corrective actions. For example, a control valve may be reacting slowly to commands requiring it to move, which is often an early sign of impending issues. The DVC7K will recognize this type of condition, alert personnel, and provide recommendations for fixing the problem.

SOURCE: EMERSON

The DVC7K interprets data to create an optimized path to action by combining patented technology, experience-based algorithms, and continuous real-time analytics with flexible connectivity and easy integration.

Emerson

Visit Website

PROFINET communication module

The PROFINET device interface offers an integrated 2-port switch, plus MRP and S2 system redundancy.

The new UNIGATE FALCON – PROFINET compact DIN rail module, in addition to the PROFINET device interface, has serial interfaces (RS232/RS422/RS485) as well as an additional standard Ethernet port and an optional CAN interface. It enables a variety of automation components to be quickly and easily connected to a PROFINET network. The PROFINET device interface has an integrated 2-port switch. MRP (Media Redundancy Protocol) and S2 system redundancy are also supported. Up to 1024 bytes of input and output data can be transmitted via this interface.

By using the ready-to-run communication modules, design times and the time-to-market of an end product can be optimized. The range is modularly designed with the aim of realizing the best possible application solution in a cost-optimized way. The new module is characterized by an extremely compact design and, with dimensions of 25.0 x 95.0 x 95.0mm (W x H x D), is a good 30 percent smaller than the predecessor model. The size of the new DIN rail modules is identical in all bus versions.

UNIGATE FALCON is based on the ARM Cortex-M processor technology, which offers a significantly higher performance. The transmission rates of the serial interfaces are 6 MBaud and are thus about ten times faster in RS485/422 operation. The configuration of the UNIGATE FALCON modules is done comfortably via web interface over the Ethernet interface.

Free programming is possible with the Protocol Developer IDE and the easy-to-learn Deutschmann Script language. It allows the emulation of proprietary protocols as well as the implementation of standard protocols. Simple scripts can be processed in a few microseconds.

SOURCE: DEUTSCHMANN AUTOMATION

Deutschmann Automation

Learn More

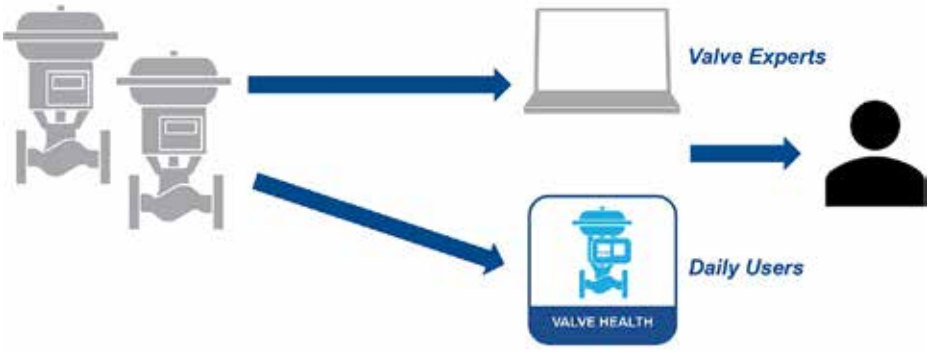
Custom data analytics for valves

Emerson software optimizes maintenance based on valve condition data, saving manhours and downtime.

A new Valve Health app from Emerson uses custom data analytics to provide timely plantwide health indicators for improved safety, maintenance, and performance. The Plantweb Insight Valve Health Application combines Fisher control valve expertise with advanced analytic algorithms.

The new app makes it possible for users to visualize an entire connected fleet of valves, while prioritizing actions based on the health index of each valve. This helps plant personnel optimize valve repair activities, resulting in faster and better maintenance decisions, leading to reduced downtime.

Most process plants and facilities have hundreds of control valves installed and operating in various applications. These valves have multiple parts that must frequently move in concert to regulate flows of process media, with some of these parts coming into constant, direct contact with the media. These operating conditions create wear and tear, requiring maintenance personnel to track the condition of each valve. This is typically done by examining each valve individually, either locally or remotely, a time-consuming endeavor that requires a high level of expertise to ascertain valve health and follow-up action.



SOURCE: EMERSON

The Plantweb Insight Valve Health Application speeds and simplifies this control valve monitoring task by providing a user-friendly interface, with easy-to-understand and intuitive graphics. The app includes Emerson's Valve Health Index, produced by a proprietary algorithm, which shows plant personnel the level of health for each valve.

The Valve Health Index allows users to enter information regarding their plant's processes, including criticality of the valve and financial impact if the valve were to fail, making the index more informative.

Emerson Fisher Valves

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Industrial Ethernet Switches

New Unmanaged SPE T1 and ruggedized Gigabit M12 IP65/67 Industrial Ethernet switches offer flexibility.

The T1-XS82 SPE with 2x Gigabit uplink from TERZ offers cabinet-less networking directly in the field with just one pair of wires.

This new T1-Switch with vibration-resistant M12 connectivity on 10 ports has been specially designed and developed for use in harsh industrial environments outside of switch cabinets, with an extended temperature range from -40°C to +70°C. The robust IP65/67 metal housing is dustproof and protects against water ingress. The data from the 8x D-coded ports are transmitted at Gigabit speed via the two X-coded M12 standard Ethernet ports.

One of the two uplink ports provides a bandwidth of 2.5 Gbit/s according to the 2.5GBase-T standard. The eight 100 Mbit/s ports are divided into 6x SPE-Master, 1x SPE-Slave, and 1x standard Ethernet ports. The T1/SPE ports comply with the IEEE 802.3bw 100Base-T1 standard. Retrofitting existing applications where the space in the switch cabinet is exhausted is possible, as is the setup of optimized new installations with a focus on component decentralization.

The NITE-XS82 with 2x Gigabit uplink ports offers reliable, robust and efficient networking of machines, decentralized without a control cabinet directly in the field.

SOURCE: TERZ

The new NITE-XS82 Gigabit M12 Industrial Ethernet Switch is perfectly suited for use in harsh industrial environments outside the control cabinet and for networks in passenger trains, buses, commercial vehicles and agricultural machinery. The retrofitting of existing applications in which the installation space in the control cabinet is exhausted, is just as possible as the construction of optimized new installations with the focus on the decentralization of the components.

TERZ

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Drive-controlled pumps

New AC20F AC drive controller serves as the central component of its enhanced drive-controlled pumps.

SOURCE: PARKER

The Industrial Systems Division Europe of Parker Hannifin has announced the launch of a new AC20F drive controller. The modular drive was specially developed for motor control in hydraulic applications. It is therefore also ideally suited to use in variable-speed hydraulic pump systems, such as the company's Drive Controlled Pump (DCP).

The AC20F is available in numerous power levels from 1.5 kW to 180 kW and thus covers a comprehensive range of applications. Despite its compact dimensions, the new drive controller offers a wide selection of ready-integrated functions, such as the sensor-less vector mode for controlling AC induction motors. Condition monitoring of hydraulic power units is also supported: oil level and temperature as well as the condition of the filter are automatically detected and, if necessary, lead either to a warning or even to the application being stopped.

The AC20F is particularly suitable as a drive controller for the enhanced DCP, Parker's variable-speed hydraulic drive solution. Four operating modes are supported: in flow control (Q) mode, the AC20F sets the correct pump speed based on the specified flow rate. In pressure (P) mode, the drive controls pressure based on the control signal and feedback from a closed-loop pressure transducer. PQ mode combines these first two options. In addition, the AC20F also offers an electronic load compensated pump (eLCP) mode. With this load-sensing function, it is possible to combine the high dynamics of the throttle valve used with the efficiency and energy saving potential of the Drive Controlled Pump.

The range of functions can be extended by optional modules. The I/O capability of the basic version can be extended with I/O option cards; an optional encoder feedback card allows an incremental encoder to be connected, taking advantage of closed-loop vector control.

Parker

Visit Website

Filters protect high speed motors

New high-end sinusoidal filters reduce the EMC load and increase the service life of high speed motors.

SOURCE: KEB

The aim of new COMBILINE Z2 series output filters is to reduce the EMC load and increase the service life of motors in machines and systems. But there are also other factors since the KEB filters have been designed specifically for use in high speed applications.

Through the interaction of KEB drive controllers and EMC technology, plant and machine builders use the full potential of the drive. Against this background, the Z2 sinusoidal filters are characterised by the fact that a high degree of flexibility is provided by the combination of choke and capacitor.

For the individual combinations, the system is simulated and analysed in advance on the basis of motor, filter and system data. A new tool is also currently under development that will be integrated into KEB's COMBIVIS Wizard software, which will allow users to specify all the required characteristics for the application so that COMBIVIS parameters for the system are automatically filled in correctly.

The motor is supplied with a sinusoidal voltage, which prevents additional losses due to ripple currents of the drive converter switching frequency in the stator and rotor. The result is reduced heating of the magnets in the rotor and a longer service life of the motor. With the Z2 sinusoidal filters and the standard drive converters from KEB, fast rotating machines up to 100,000 rpm can be operated in the power range from 750W to 450kW. Last but not least, motor noise is reduced and the EMC behaviour of the overall drive is improved by the filters. Therefore, the sinusoidal filters, designed with a low-loss core material and a particularly high efficiency, are designed as "high speed filters" that significantly reduce losses in the motor.

KEB

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Intrinsically safe 5G smartphone

An intrinsically safe 5G smartphone is designed for future-oriented digitalization of hazardous areas.

Pepperl+Fuchs has launched an intrinsically safe Smart-Ex 03, a new and future-proof 5G- and Wi-Fi 6- enabled smartphone that was developed entirely in-house in Europe. The 6-inch device combines all the expertise and know-how of Pepperl+Fuchs subsidiaries ECOM Instruments as a pioneer in intrinsically safe mobile devices and Aava Mobile as an expert in industrial tablets and wireless technologies.

The smartphone with the cutting-edge AndroidTM 13 operating system complies with the latest technical standards such as 5G, Wi-Fi 6 and eSIM and is therefore ideally equipped for flexible worldwide use in public and private networks of mobile network providers or companies. Thanks to fast and secure transmission of large amounts of data, users benefit from state-of-the-art functions for communication and collaboration such as remote support, video conferencing or push-to-talk.

The Smart-Ex 03 is predestined for a wide range of applications such as communication, digital workflows and work order management, operational safety, scanning, asset management, predictive maintenance,

SOURCE: PEPPERL+FUCHS

augmented reality applications or IoT integration. Employees along the entire value chain in the process industry, the hydrogen industry, the energy industry or battery production thus benefit from end-to-end digital processes right into hazardous areas.

Thanks to the technical standard 5G, the Smart-Ex® 03 provides outstanding connectivity. The technology enables fail-safe transmission of high data rates of up to 10 Gbit per second with a latency of less than 5 milliseconds.

Pepperl+Fuchs

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Securing critical infrastructure

New advanced switching platform unlocks secure connectivity.

As critical infrastructure networks are digitalizing rapidly, OT networks must handle large data volumes from increasing IoT devices in the field and connect intelligent electronic devices to IT systems securely. To this end, Siemens has launched the RUGGEDCOM RST2428P, an advanced multilayer Ethernet switching platform, designed to provide secure and error-free communications for networks in harsh environments like electric power, transportation, or oil and gas plants.

Driving digitalization with a future-proof solution

"In critical infrastructure OT networks, precise time synchronization, reliability and high availability are non-negotiable", said Jeremy Bryant, General Manager, Siemens Ruggedcom. "Also, we're seeing an increasing demand for devices that enable end-to-end security in network communications. We've designed the RUGGEDCOM RST2428P as a way for utilities to invest in a networking platform that will simplify scaling the network to support higher data volumes and adopt future-ready networking and cybersecurity technologies without having to undergo costly

SOURCE: SIEMENS

replacements. Whenever they are ready for it."

RUGGEDCOM devices operate across a wide temperature range from -40 to +85°C with high immunity to electro-magnetic interference (EMI) and shock and vibration resistance. Their fan-less design with no moving parts minimizes risk of mechanical failures over their lifetime. The new RUGGEDCOM RST2428P was designed to offer greater flexibility to network operators through its hot-swappable power supply and hot-swappable modular design.

The RUGGEDCOM RST2428P comes with 28 ports, 10 Gigabit bandwidth, and Power-over-Ethernet of up to 500 W capability.

Siemens

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LEMUR Lite managed switch family

New switches include easy-to-use LEMUR Lite managed switches and Hirschmann entry operating system.

New, cost-optimized LEMUR managed switches provide powerful features, including advanced security and full Gigabit Ethernet, to support today's complex automation environments. Built on all-new, sophisticated HiEOS software, LEMUR switches feature an intuitive web interface to simplify setup and maintenance with no special information technology (IT) expertise required.

Facing the challenge of digital transformation, heightened security threats and budget constraints, enterprises need switches that offer essential features and a secure, ruggedized design at an attractive price point. With Power over Ethernet (PoE) and PoE+ options, offering up to 180 W of power with no separate power supply and IP30 protection, LEMUR switches were developed in accordance with International Electrotechnical Commission (IEC) 62443-4-1 security standards.

The LEMUR Lite Managed Switch Family provides powerful benefits such as: easy configuration and management without need for IT intervention via the user-friendly HiEOS web interface; and cost-optimized design including full Gigabit Ethernet, high port count, and advanced security.

SOURCE: BELDEN

Essential features, plus high reliability delivering "set it and forget it" capability simplify maintenance and lower total cost of ownership. Running on LEMUR switches, HiEOS offers essential Layer 2 managed switching capabilities – like port control, remote diagnostics and PoE/PoE+ options.

Delivering exceptional performance, HiEOS provides a rich feature set including:

Enhanced security including SSHv2 and multiple privilege levels for high reliability.

Redundancy protocols including Ethernet Ring Protection Switching (ERPS)*, Rapid Spanning Tree Protocol (RSTP) and Media Redundancy Protocol (MRP) Client.

Belden

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Fully managed Ethernet switches

Rockwell Automation offers more functionality on the plant floor by releasing new, fully managed switches.

Stratix® 5200 fully managed Ethernet switches from Rockwell Automation have higher port speed options, all gig ports and still offer redundant and resilient system features, including DLR and PRP. The Stratix switches are easier to set up, configure and offer enhanced security features.

New Allen-Bradley® Stratix 5200 fully managed switches offer various hardware configurations and features. These options give machine builders more value and flexibility.

Key features include:

- Expansion of higher port speed options with all gig SKUs
- Redundant and resilient architecture options that support fully managed and high performance switch tiers
- Simplified portfolio and switch selection that is streamlined for fully managed and high performance

SOURCE: ROCKWELL

Stratix 5200 managed switches are based on the Cisco® IOS® XE platform that includes a new graphical web user interface for improved performance, enhanced troubleshooting tools, fundamental disaster recovery features and customizable dashboards. They also align with Cisco Cyber Vision Sensor options and tie into Cisco TrustSec software for a defined segmentation approach. In addition, they offer fundamental protection against counterfeit hardware and software risks and additional encryption options.

The switches include a robust set of switching features to support a wide range of architectures and complies with international standards, such as IEC 62443-4-2 for cybersecurity, offers port security, and access control lists.

Rockwell Automation

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