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The Journal of Industrial Networking and IoT

WiFi 6 certified for next generation connectivity 8

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WiFi 6 and 5G wireless

The combination of WiFi 6 Certified and 5G wireless communications is bringing a promise of more speed, reliability and convenience to both mobile and enterprise users. Touted as complementary technologies, together they offer higher data rates, lower latency, increased network capacity and an ability connect more devices.

The sixth generation, or Wi-Fi 6 and also known as 802.11ax, has recently been certified. It provides more speed, lower latency, and increased device density. The fifth generation of wireless, or 5G, is the newest cellular technology, engineered to increase the speed and capacity of wireless networks. 5G is especially creating a buzz in business and corporate sectors but both are significant advances from where we are today.

According to a Cisco blog post which recently highlighted five things to know about WiFi 6 and 5G, these two technologies "are built from the same foundation and will co-exist to support different use cases." WiFi 6 will be the network of choice for indoor networks, and 5G will be the designated choice for outdoor networks.

Nearly everyone agrees that a big beneficiary of both of these technologies will not only be in IoT applications but also in automation and control networking for monitoring and control of large numbers of devices.

Both Wi-Fi 6 and 5G offer opportunities to reliably connect a much larger group of devices using wireless technology. This is important for mission-critical IoT devices being used in manufacturing automation, healthcare, energy, and many other industries. Other areas where the technology is expected to make an impact is augmented and virtual reality applications.

With the certification of WiFi 6, next up is the ratification process moving through the IEEE process, which is expected to be completed by the middle of 2020. But regardless, WiFi 6 certifed products are entering the marketplace and will begin to make an impact.

The timeline for the introduction of 5G networks and services is that over the next 3-5 years, users and enterprises will transition to the new standard with more clients and access points coming on the market.

According to a Siemens report, "one of the benefits of 5G is the significantly greater bandwidth which allows much more data to be sent simultaneously than previously. Estimates start at ten gigabits per second, 10 times more than with 4G. In addition to this, 5G will have a substantially lower latency and greater reliability than current mobile technologies."

On the whole, both of these developments are a huge net plus for our industry.

Al Presher

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Industrial Ethernet Book

The next issue of Industrial Ethernet Book will be published in **January-February 2020**
Deadline for editorial: December 20, 2019 **Deadline for artwork:** January 17, 2020

Product & Sources Listing

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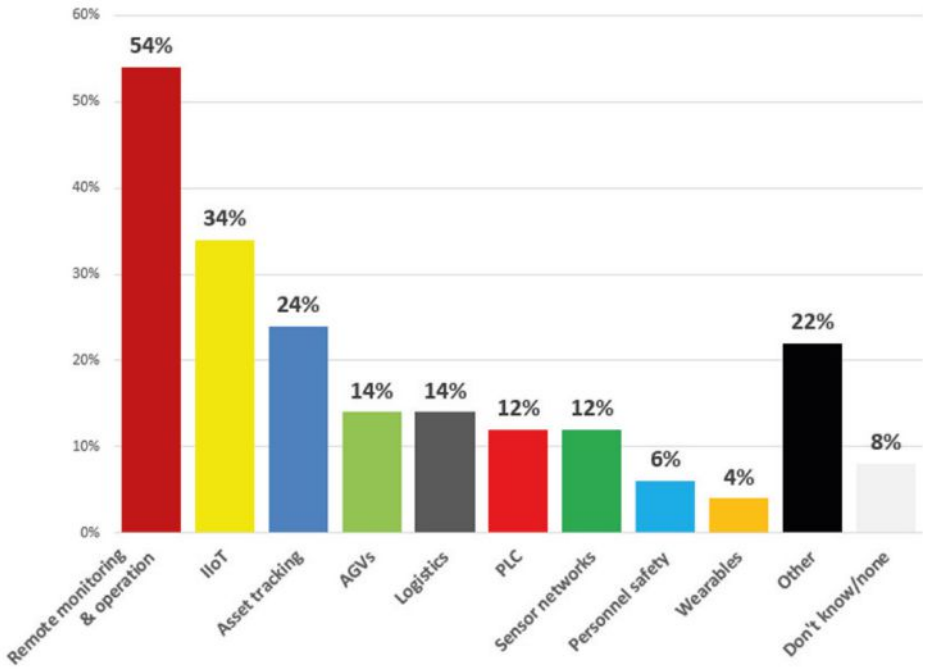
Study looks at the preparedness of industry for 5G

New research from HMS Networks shows that half of the industry professionals surveyed are clearly positive about 5G in manufacturing, and see it as a way to achieve universal connectivity.

A SURVEY OF INTERNATIONAL INDUSTRY professionals in spring 2019 inquired about the positioning of wireless communication in their companies, and to see how they are getting ready for the launch of 5G. The results of this study provides state-of-the-art insights into the current situation in the manufacturing industry in terms of 5G preparedness.

The research conducted by HMS Networks provides an overview of the industry's opinions towards 5G technology as an emerging trend and future standard in the manufacturing and industrial automation industry. It also touches on the use of wireless technologies in the industry today and future directions of this technology.



SOURCE: HMS NETWORKS

Research showed remote monitoring going wireless, but the usage of wireless technologies is also quite broad.

Key research takeaways

Key findings of the research study included the following insights:

More than half (54%) of the interviewees indicated using wireless communication solutions for remote monitoring and remote operation of assets. One third of the respondents (34%) stated that their companies were using wireless communication for different kinds of IIoT.

Half of the interviewees (48%) were clearly positive about 5G in manufacturing. They mostly appreciated that the technology will replace cables, unreliable Wi-Fi, and the many industrial standards in use today.

For the majority (58%) of the respondents, the reliability and robustness of wireless systems plays a decisive role in whether to adopt 5G or not, and this was voiced equally by representatives of OT and IT. Low latency was mentioned as important by more than a quarter (26%) of the interviewees.

"The survey clearly showed that the industry is getting increasingly aware of 5G benefits for industrial communication. What the industry really needs is technical information and practical examples" said Marcela Alzin, Program Manager at HMS Labs at HMS Networks, who conducted the research. "This is why I created a fictional model of a typical OT professional and his attitude towards 5G. This should help to better understand the situation on the market".

Waiting to see

Sixteen percent of respondents were rather neutral in expressing their views about the possible usage of 5G in industry. The following answers were obtained:

- "Will see when first 5G capable machines are in operation"
- "Wait until (3GPP) Release 16 is approved"
- "Customers are already asking about it"
- "I am aware of 5G but don't know much about it"

This shows a rather cautious approach of some companies which prefer to observe the activities of early adopters and then decide if they will use 5G on their own factory floor (or develop 5G capable products).

The neutral statements came mostly from OT people and proportionally there was no difference in terms of company size of respondents.

To download a copy of the whitepaper, visit https://www.hms-networks.com/industrial-iot-solutions/5G/ready

*Press release by **HMS Networks.***

5G-ACIA expands dialogue focused on Industrial 5G

THE 5G ALLIANCE FOR CONNECTED INDUSTRIES and Automation (5g-acia.org) is a central global forum for shaping 5G standards for industrial and IoT applications.

5G-ACIA members including an array of industrial automation and connectivity suppliers are jointly preparing for the disruptive changes that 5G will bring, promote a better understanding of industrial needs, and gain insights into a highly attractive emerging market.

As Dr Andreas Müller (Bosch), Chairman of 5G-ACIA, stated: "With the publication of initial standards, and the availability of the first chipsets and infrastructure components, 5G is quickly gaining momentum. This is reflected clearly in the diverse 5G-related activities at this year's Hanover trade fair. In fact, many companies are beginning to recognise the crucial role this technology will play in the digital transformation of their businesses. At the same time, it is becoming apparent to the ICT industry that 5G for manufacturing has great potential for their business as well."

*Press release by **5G-ACIA.***

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Over 15 million installed base of AI-enabled devices in 2024

ABI Research's Industrial AI Market Tracker report is forecasting the total installed base of AI-enabled devices in manufacturing will reach 15.4 million in 2024, with a CAGR of 64.8% from 2019 to 2024.

ARTIFICIAL INTELLIGENCE (AI) IS TOUTED as a powerful technology that will revolutionize the industrial manufacturing space. The sentiment has its validity, but the reality is extremely complex.

AI in industrial manufacturing is a collection of various use cases at different phases of manufacturing, such as generative design in product development, production forecasting in inventory management, and machine vision, defect inspection, production optimization, and predictive maintenance in the production phase.

Forecasting explosive growth

ABI Research, a global tech market advisory firm, forecasts that the total installed base of AI-enabled devices in industrial manufacturing will reach 15.4 million in 2024, with a CAGR of 64.8% from 2019 to 2024.

"AI in industrial manufacturing is a story of edge implementation," said Lian Jye Su, Principal Analyst at ABI Research. "Since manufacturers are not comfortable having their data transferred to a public cloud, nearly all industrial AI training and inference workloads happen at the edge, namely on device, gateways and on-premise servers."

To facilitate this, AI chipset manufacturers and server vendors have designed AI-enabled servers specifically for industrial manufacturing applications. More and more industrial infrastructure is equipped with AI software or dedicated AI chipsets to perform AI inference.

Despite these solutions and the wealth of data in the manufacturing environment, the implementation of AI in industrial manufacturing has not been as seamless as was expected by the industry. Among all the use cases, predictive maintenance and equipment monitoring are the most commercially implemented so far, due to the maturity of associated AI models.

The total installed base for these two use cases alone is expected to reach 9.8 million and 6.7 million, respectively, by 2024. It is important to note that many of these AI-enabled industrial devices support multiple use cases on the same device due to advancements in AI chipsets. Key startups such as Uptake, SparkCognition, FogHorn and Falkonry are introducing cloud- and edge-based solutions that monitor the overall performance of industrial manufacturing assets and process flows.

Inspection applications

Another commercial use case currently gaining momentum is defect inspection. The total installed base for this use case is expected to grow from 300,000 in 2019 to over 3.7 million by 2024.

This is a use case that is extremely popular in electronic and semiconductor manufacturing, where major manufacturers, such as Samsung, LG and Foxconn, have been partnering with AI chipset vendors and software providers, such as CEVA, Gyrfalcon Technology, Lattice Semiconductor, Instrumental, Landing AI, and Neurala, to develop AI-based machine vision to perform surface, leak and component-level defect detection, microparticle detection, geometric measurement, and classification. Conventional machine vision technology remains popular in the manufacturing factory, due to its proven repeatability, reliability, and stability.

However, the emergence of deep learning technologies opens the possibility of expanded capabilities and flexibility. These algorithms can pick up unexpected product abnormalities or defects, go beyond existing issues and uncover valuable new insights for manufacturers.

At the moment, manufacturers are facing enormous competition in building and training in-house data science teams for AI implementation. Most AI talents prefer to work with webscale giants or AI startups, making talent acquisition a challenging task for industrial manufacturers. "As such, they are left with one viable option, which consists of partnering with other players in the AI ecosystem, including cloud service providers, pure-play AI startups, system integrators, chipset and industrial server manufacturers, and connectivity service providers. The diversity in AI use cases necessitates the creation of partnerships," Su concluded.

*News by **ABI Research**.*

Industry 4.0 machine tool standard uses OPC UA

SEVENTY COMPANIES FROM 10 COUNTRIES have connected 110 machines and 28 value-added services at EMO Hannover 2019 via the OPC UA based umati standard Interface.

Created and prototyped by seventeen machine builders and the VDW, the umati demonstration facilitates context rich communications between machines and software solutions from a wide variety of vendors. Unprecedented in scale, the demonstration showcases seamless use of multi-vendor machine data by end-user applications using OPC UA connectivity and information modeling.

Beyond moving data between machines and applications for production purposes, the umati companion specification preserves the context of the machine data, and standardizes how it is expressed. This consistent semantic representation enables rapid development of meaningful dashboards, HMI displays, and reports from multivendor systems.

Dr. Alexander Broos, umati project manager and Head of Research and Technology explained umati has also already made a strong impression internationally. Three international consortia from major machine tool manufacturing countries have joined the interface: ProdNet from Switzerland, Edgecross from Japan and NCLink from China. In addition, machine tool associations from China, the United Kingdom, Italy, the Netherlands, Austria, Switzerland, Spain and Taiwan as well as the European machine tool association Cecimo are supporting the project.

"umati is opening up a new chapter in production," said Dr. Heinz-Jürgen Prokop, Chairman of the VDW. "Choosing the OPC UA standard as a basis for the development of the interface supports international dissemination. It ensures that umati can be used free of charge worldwide," Prokop explained.

Ninety companies are contributing to the standardization work in the Joint Working Group together with the OPC Foundation. The release of Version 1.0 of the Companion Specification, the next milestone, is planned for the middle of 2020.

*Press release by **OPC Foundation**.*

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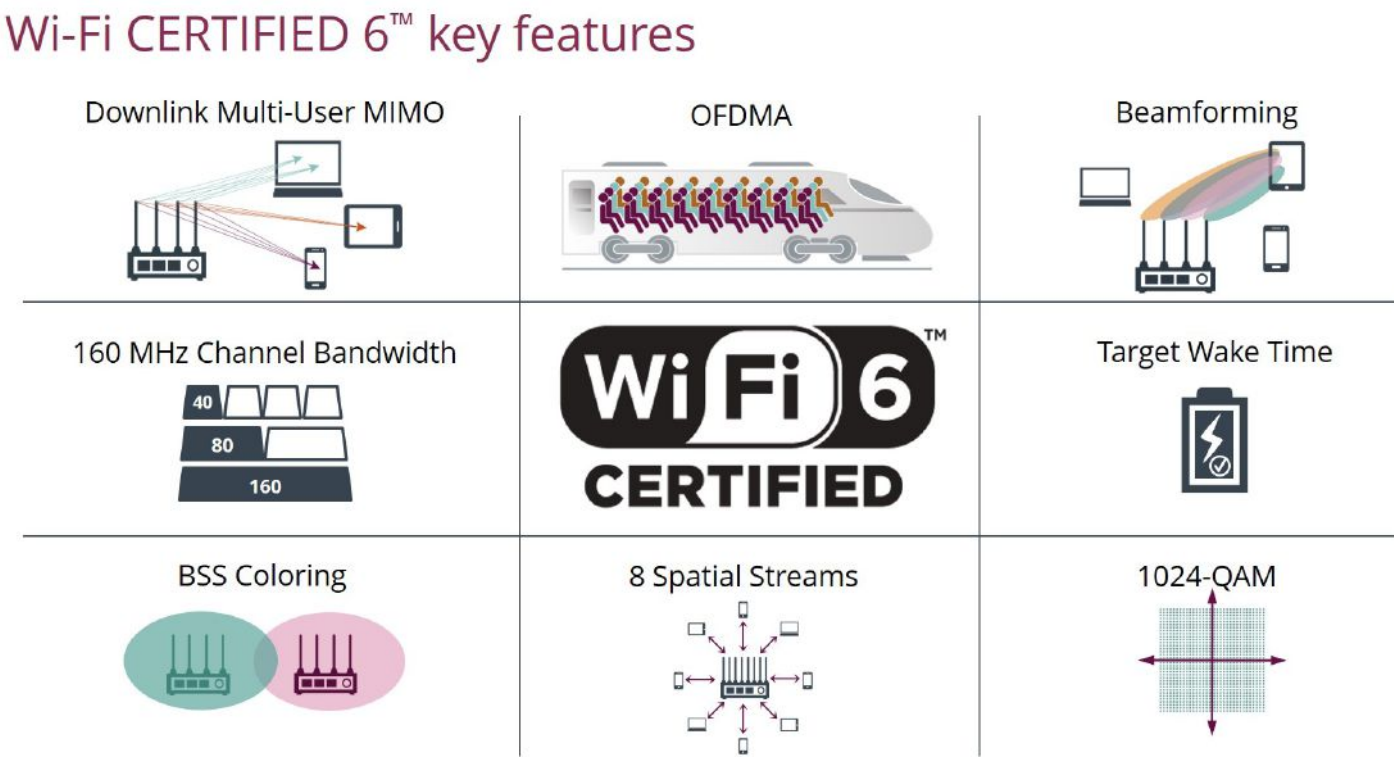
Next generation Wi-Fi 6: the future of wireless connectivity

The growing expectations on Wi-Fi performance, coverage, security, support for new use cases, applications and devices require a step forward in the evolution of Wi-Fi. Wi-Fi 6 increases data rates and capacity, optimizes transmission in congested environments and extends support to new devices and use cases.



SOURCE: WIFI ALLIANCE

WiFi 6 Certified includes a range of new features , many of which will strengthen the ability to use wireless communications for enterprise connectivity solutions.

WI-FI IS THE WORLD'S PREDOMINANT WIRELESS technology. It serves more users, connects more devices, and carries more traffic than all other wireless technologies combined. Today, we expect to find Wi-Fi connectivity in virtually all mobile devices and in most indoor environments.

Wi-Fi now has a nearly 100 percent attach rate in smartphones and laptops, and adoption is quickly expanding to innovative consumer electronic devices, Internet of Things (IoT), and vehicles. Users choose to use a Wi-Fi connection when one is available even if there is no obvious cost benefit to them, and as a result, a majority of wireless data traffic goes over Wi-Fi. Globally, Wi-Fi carries more than half of all data traffic. In Japan, Wi-Fi carries 83 percent of smartphone traffic and in Germany, Wi-Fi carries more than 87 percent of all smartphone traffic.

Success of WiFi

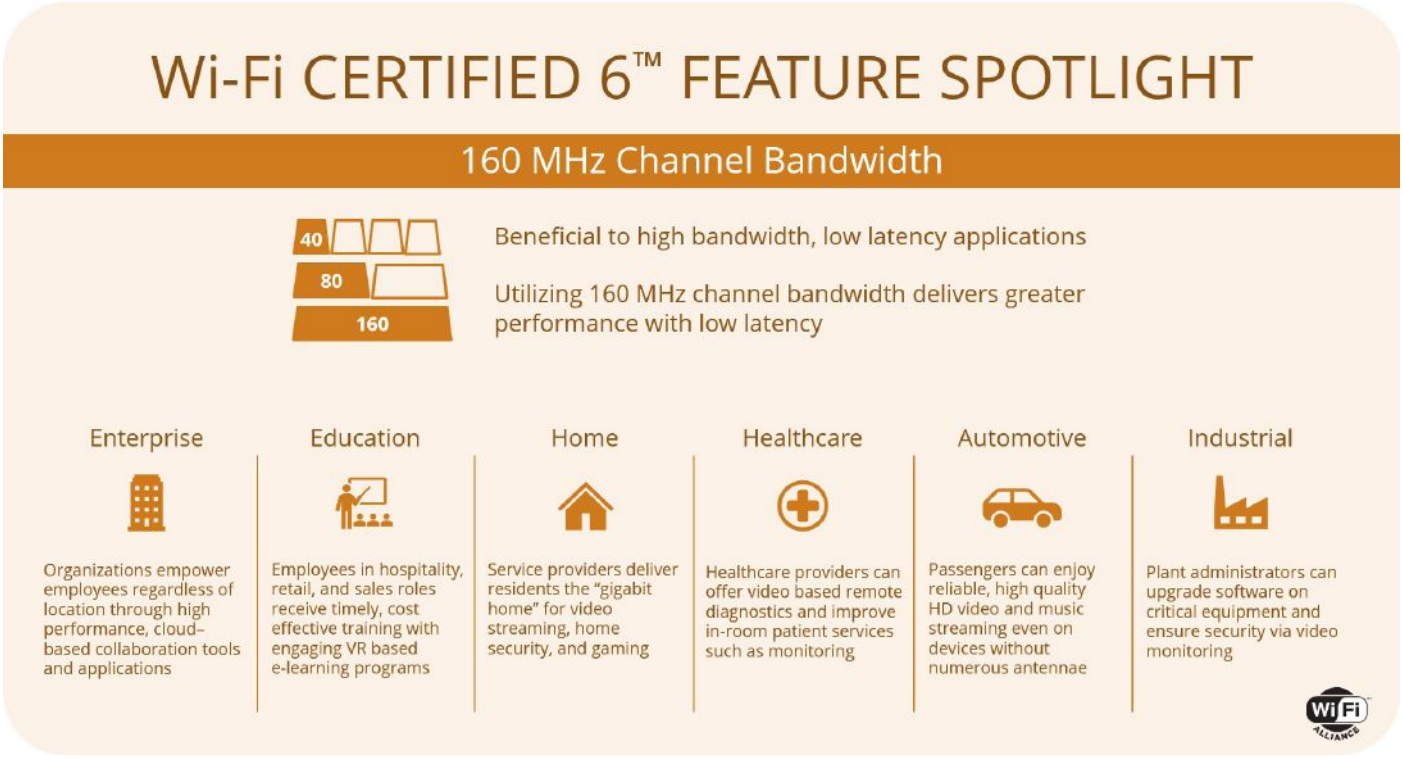
Wi-Fi access has become synonymous with broadband access. Nearly all broadband homes have one Wi-Fi access point (AP) or a mesh Wi-Fi network. Cities provide free public Wi-Fi to deliver broadband access to their citizens to bridge the digital divide and provide services. It is virtually impossible to find an airport or a hotel that does not offer Wi-Fi access to visitors and guests. Within the home, Wi-Fi is the preferred connectivity method that goes beyond broadband connectivity to smartphones and laptops: most new smart home devices utilize only Wi-Fi and depend on it for setup, authentication, and operation.

The success of Wi-Fi rests on a solid foundation established over the last 20 years, reinforced by its excellence at meeting the needs and expectations of users today, providing continuity with backwards compatibility, and propelled by a fast-paced and robust technological evolution.

Wi-Fi started as a disruptive technology that demonstrated the value and benefits of wireless Ethernet. As the first wireless access technology that used unlicensed spectrum on a wide scale, Wi-Fi has empowered individual users, enterprises, and service providers to deliver use cases and establish new business models in ways they could not with licensed spectrum. Most notably with hotspots, Wi-Fi so successfully established the concept of broadband access as a service or as an amenity that now many see this as a requirement. In turn, hotspots opened the way for stand-alone Wi-Fi service providers and enriched the offerings of existing enterprises.

Over the last two decades, Wi-Fi networks created a distributed connectivity fabric that enables Wi-Fi to carry the vast majority of wireless traffic and provide broadband connectivity where it is needed the most: in homes, inside buildings, and in dense outdoor areas. Wi-Fi has done this while making very efficient use of available unlicensed spectrum.

On the device side, Wi-Fi first unexpectedly presented the bring-your-own-device (BYOD) model and showed smartphone users the potential of wireless broadband at a time when 3G cellular networks were not ready to match the Wi-Fi user experience. Furthermore,



SOURCE: WIFI ALLIANCE

The ability to utilize 160 MHz channels increases bandwidth to deliver greater performance with low latency.

Wi-Fi gave users the power to choose to utilize unlicensed spectrum and take more direct control of their connectivity options. Wi-Fi's ubiquity, with more than twenty billion cumulative devices shipped worldwide since 2000, opens almost endless possibilities for product innovation to support scenarios where users demand connectivity.

The increase in data consumption and in performance expectations in terms of speed, latency, reliability, and security has created new requirements for operators, businesses, consumer users, and vendors. There are nine billion Wi-Fi devices currently in use, demonstrating how successful Wi-Fi has been in meeting our growing connectivity needs. Growth continues, with three billion new devices shipping annually. Wi-Fi draws from a strong portfolio of capabilities supported by existing Wi-Fi Alliance certification programs: Wi-Fi CERTIFIED ac for the air interface, Wi-Fi CERTIFIED WPA3 for security, and Wi-Fi CERTIFIED Enhanced Open for protection in open networks.

Key takeaways

The inherent strengths of Wi-Fi are critical to deliver the next generation of use cases and services, including those expected from 5G. Wi-Fi 6 & 5G are complementary technologies, both contributing their strengths to expand the richness and power of the overall wireless connectivity fabric. Wi-Fi will deliver mission critical connectivity and will continue to carry a bulk of the world's data traffic as 5G networks are deployed. Wi-Fi also delivers both high performance and cost effectiveness to enable a wide range of new, disruptive business models and monetization opportunities. It also uses unlicensed spectrum with unparalleled efficiency, while effectively sharing spectrum resources among users and also with other technologies

Next generation Wi-Fi CERTIFIED technologies preserve interoperability with legacy equipment and offer support for frequent refresh cycles; Wi-Fi networks can be fully upgraded while still allowing older devices (e.g. scanners) to operate on the network.

To meet the demands of multiple use cases, including those in the Internet of Things (IoT) and dense public spaces, Wi-Fi HaLow operates in low bands (900 MHz), Wi-Fi in the middle bands (2.4 GHz and 5 GHz) and WiGig in the high bands (millimeter wave, 60 GHz). Wi-Fi CERTIFIED 6 will be capable of operating in 6 GHz when the band becomes available for unlicensed access.

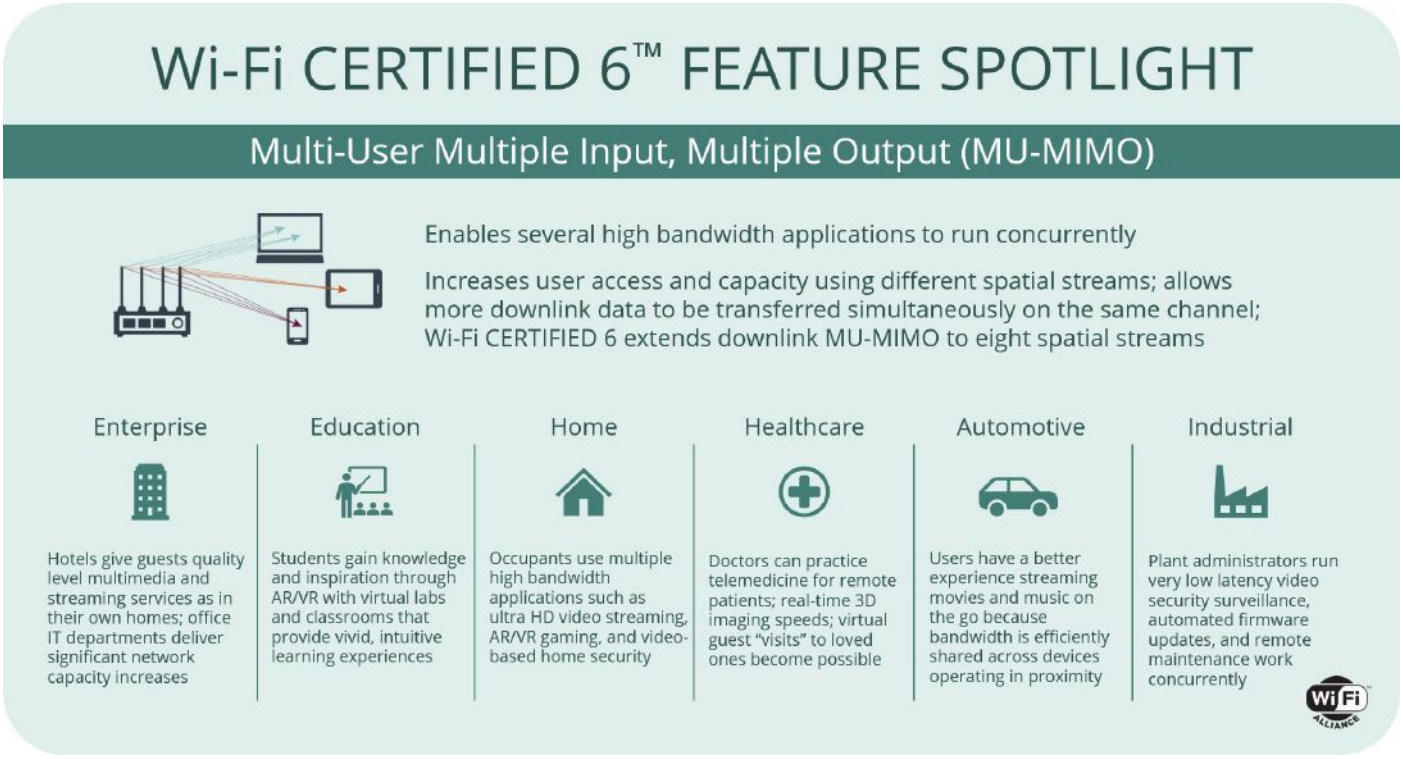
Technologies such as Wi-Fi 6 and WiGig will provide greater capacity and speed, as well and low latency to support next generation use cases, such as augmented reality (AR), virtual reality (VR), multi-user gaming, Ultra High-Definition (Ultra HD) video, and multiparty video calls. Capacity and performance will be further enhanced once 6 GHz becomes available for unlicensed access.

Integration across multiple wireless access technologies enables Wi-Fi to deliver a powerful and seamless transition to cellular networks for operators, enterprises, and users when outside of Wi-Fi coverage areas. The end result is that Wi-Fi delivers exponential societal and financial benefits, and is crucial to everyday productivity. Wi-Fi's massive global footprint contributes nearly $2 trillion in economic value annually in 2018, $3.47 trillion by 2023.

Wi-Fi CERTIFIED WiGig is used for connectivity in the 60 GHz band, and a robust portfolio of technologies provides additional options for connectivity, ease of access, applications and services, and network optimization. The Wi-Fi CERTIFIED 6 certification program is currently available for products that support technology based on IEEE 802.11ax. In an era filled with multiple technologies and manufacturers working together to deliver next generation use cases to users, the Wi-Fi CERTIFIED seal of approval is the way to ensure products meet industry-agreed standards for interoperability, security, and other application specific protocols that provide the best Wi-Fi experience.

Despite its success, Wi-Fi is not standing still. Wi-Fi is ready to deliver the next generation connectivity experience, and to expand its reach to new users, new devices, and new use cases. Wi-Fi 6, the next generation of Wi-Fi, brings higher speed and capacity, lower latency, and more advanced traffic management.

These enhanced capabilities will strengthen Wi-Fi's ability to support high traffic loads, hyperdense deployments, and latency-sensitive services with increased spectrum efficiency, range, reliability, and security. At the same time, WiGig is widening its capabilities in 60 GHz with the future introduction of IEEE 802.11ay and Wi-Fi HaLow is utilizing 900 MHz



SOURCE: WIFI ALLIANCE

Multi-user multiple input multiple output allows downlink data to be transferred at once and enables an access point to transmit data to a larger number of devices concurrently.

for low power.

Wi-Fi 6 will work in 2.4 and 5 GHz but is also expected to operate in the 6 GHz band. When available, 6 GHz will nearly double the amount of spectrum available for Wi-Fi today. In the US, the Federal Communications Commission (FCC) has proposed making 5925-7125 MHz (6 GHz) band available for unlicensed use.

In Europe, the European Commission has mandated to study the allocation of the 5925-6425 MHz band for unlicensed access. The opening of the 6 GHz band for Wi-Fi deployment will provide additional spectrum that Wi-Fi needs to accommodate the anticipated growth in traffic. Wi-Fi Alliance is committed to support this regulatory development globally.

The expansion of use cases in smart homes, enterprises, carrier access, smart cities, and IoT applications will continue to be fueled by Wi-Fi. Augmented reality (AR) and virtual reality (VR), immersive digital experiences, multiparty video and gaming applications, home and enterprise automation, and connected cars are some of the emerging use cases which Wi-Fi will empower in new ways. Wi-Fi already supports many next generation use cases expected from the 5G cellular world, well ahead of 5G commercial availability.

In addition, Wi-Fi 6 and WiGig will provide the improved performance and scalability that is needed to support massive adoption of next generation use cases well beyond those expected from 5G. Wi-Fi Alliance is confident Wi-Fi delivers the capacity, latency, affordability, spectrum efficiency, and security to satisfy wide-ranging demands for a new level of next generation connectivity. Many strengths in today's Wi-Fi further pave the way towards next generation connectivity.

Affordable performance

The combination of high performance and equipment affordability has played a major role in establishing the ubiquity and dominance of Wi-Fi. The marginal cost of adding Wi-Fi to a device or an AP that can support multiple users continues to decrease, yet the value of Wi-Fi connectivity to users is high. This has made it easy and inexpensive to add Wi-Fi support in new devices, and for these devices to operate in existing networks.

Wi-Fi's affordable performance has also driven further adoption of Wi-Fi and expanded monetization opportunities. For instance, location-based marketing applications in a retail mall are effective because they can reach an enormous number of shoppers that already use Wi-Fi devices.

While Wi-Fi equipment is interoperable across vendors, a wide choice of options is available to meet the varying requirements of service providers, enterprises, venue owners, and end users, as reflected in the features and cost of equipment.

In the US, for example, Amazon sells APs with limited capabilities for less than $20, while the most advanced APs can be significantly more expensive. This flexibility ensures Wi-Fi delivers cost-effectiveness at the right level of performance for all types of deployments. The reliability, security, traffic and user management, and radio frequency (RF) planning needs in a stadium or large enterprise are different from those in a home network.

Across nearly all deployment scenarios, Wi-Fi consistently offers a compelling value proposition because of its relatively low equipment, installation, and operating costs whether used in residential, enterprise, or public networks. More importantly, per-bit costs are lower than cellular because of the combination of lower Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) with higher capacity.

Unlicensed spectrum operation

The global availability of spectrum bands for unlicensed access is an advantage for Wi-Fi as it secures the broadest addressable market, compared to cellular spectrum allocations which vary by country. No other access technology has a comparable reach and long history of coexistence with other technologies in unlicensed spectrum as Wi-Fi, making it well-equipped to coexist fairly with any future technologies that may also be introduced in unlicensed bands.

With Wi-Fi, enterprise, city and public entities are empowered to try out new deployment and business models, and to take control and ownership of the wireless infrastructure. Mobile and cable operators and other service providers also benefit financially from deploying Wi-Fi in unlicensed spectrum for hotspot deployments and roaming partnerships.

Wi-Fi has a distinct competency of operating in unlicensed spectrum; Wi-Fi is adept at understanding the unique benefits

and challenges of unlicensed spectrum and managing interference in dense environments with many users. Because of Wi-Fi's ability to accommodate many concurrent users on multiple networks in the same location, Wi-Fi has an exceptionally high spectrum utilization and frequency reuse that make it possible to transport 83 percent of global wireless traffic and 43 percent of global IP traffic using only 600 MHz in the 2.4 GHz and 5 GHz bands, while efficiently sharing these bands with other technologies.

Ease of use

Effortless, transparent, and seamless connectivity makes Wi-Fi a technology that is loved by users worldwide – and a technology they continue to use even when also having unlimited cellular data plans with no financial incentive to use Wi-Fi. Wi-Fi also gives users the choice to turn connections on and off as they wish, and the ability to control the cost of the connection, if any, and avoid unexpected charges as may occur with cellular data.

With the digital transformation, Wi-Fi's ease of use is extending to new use cases, such as smart homes and smart cities. Wi-Fi has quickly evolved to ensure ease of use in the setup, customization, and operation of smart home devices that is crucial to encourage adoption. Wi-Fi continues to evolve its capabilities in these application areas.

While increasing affordability has driven the wide deployment of Wi-Fi networks and availability in devices, Wi-Fi's adoption is not primarily tied to cost savings, but to quality of experience (QoE). A recent study shows that Wi-Fi accounts for 88 percent of wireless data usage in the US with no pre-paid data plans, and 85 percent of those with a limited data plan with a data allowance. Among unlimited subscribers, Wi-Fi still accounts for 70 percent of wireless access, a very strong indication of connection preference.

Today, users can effortlessly connect to new and trusted networks: their devices can automatically select the best Wi-Fi network, authenticate the user, and ensure the network is secure. New capabilities will continue to offer additional security, data protection, and service support that improve the user experience and operator's ability to manage Wi-Fi connectivity, further contributing to ease of use for both the Wi-Fi device user and Wi-Fi network provider.

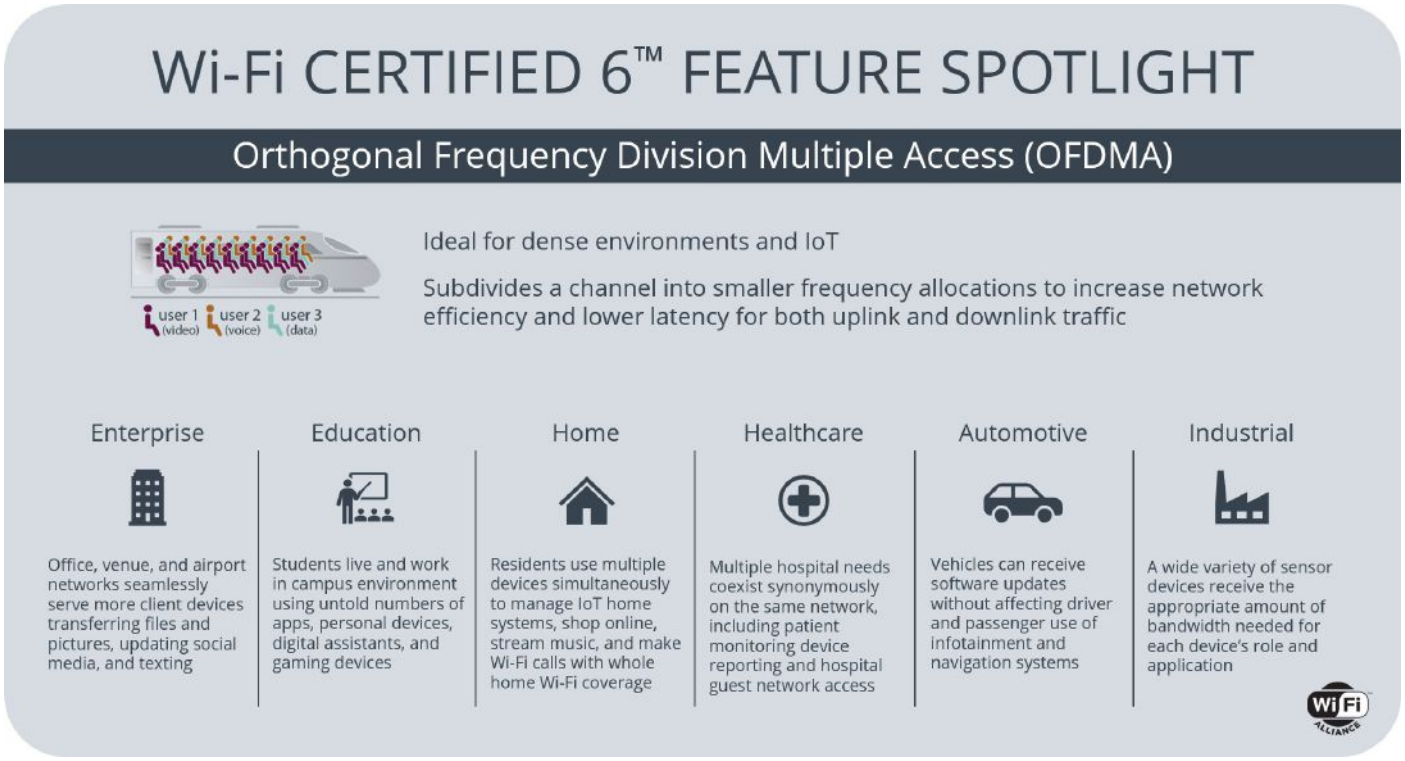
Self-deployment

It is now possible for nearly anyone to easily deploy a Wi-Fi network with the latest Wi-Fi CERTIFIED technologies at home, in the enterprise, or in public areas. And they can do so on their own, independent from a network operator or service provider. Wi-Fi enables individuals, enterprises, and public entities to deploy and operate their own networks, to have full control over the networks, and to optimize their networks for the services they support and the users that connect to them.

Self-deployed Wi-Fi networks do not require extensive RF planning, as there are many tools now available to optimize network topology and manage interference. Such networks can also be easily customized to enable differentiated services and support new business models.

Network owners have control over the Wi-Fi infrastructure: they can optimize network performance using analytics which provide data to meet their needs and goals. For instance, wireless internet service providers (WISPs) can use Wi-Fi to provide broadband connectivity to residential and small business users. Service aggregators, cities, or other public entities can share access to existing Wi-Fi infrastructure to provide basic connectivity and social or economic services.

The ability to deploy and operate a stand-alone Wi-Fi network encourages new uses of the technology like detecting location and activity of subscribers or motion context. Artificial intelligence and machine learning can acquire data through a Wi-Fi network for applications aimed at Wi-Fi users in the premises and for internal automation, monitoring, security and safety applications, and to also optimize network performance.



SOURCE: WIFI ALLIANCE

Orthogonal frequency division multiple access effectively shares channels to increase efficiency and lower latency for uplink and downlink traffic in high demand environments.

Long-term compatibility

Backwards compatibility has always been a long-standing commitment of Wi-Fi as it evolves to improve performance and expand capabilities. Each new Wi-Fi CERTIFIED device or AP will to be able work with Wi-Fi equipment already in use. Wi-Fi's legacy of interoperability makes it possible to fully upgrade a Wi-Fi network to the latest technology while still enabling earlier generation devices to operate on the network. Wi-Fi devices can be upgraded separately from the Wi-Fi infrastructure.

This commitment to interoperability provides investment protection for a Wi-Fi network because it can support frequent refresh cycles. New technologies can be integrated into the existing infrastructure without a full network upgrade, ensuring that Wi-Fi continues to deliver a good user experience with both new and legacy devices coexisting within the same band. As a result, Wi-Fi can address next generation use cases right away without requiring a network overhaul.

A steady transition to Wi-Fi CERTIFIED 6 devices will build upon the installed base of the prior generations and minimize the financial impact of technology upgrades.

Unlicensed spectrum bands

In mid-band spectrum today, Wi-Fi is deployed in 2.4 GHz and 5 GHz, and has used both bands efficiently for nearly 20 years. The 6 GHz band may soon also become available for unlicensed access in the US, as well as in Europe and other countries, which will enable a major expansion for Wi-Fi performance and capacity.

Wi-Fi also operates in the 900 MHz band with Wi-Fi HaLow, which offers longer range and low-power connectivity for low-bandwidth IoT applications. Wi-Fi HaLow enables a variety of new power-efficient use cases in the smart home, connected car, and digital healthcare, as well as industrial, retail, agriculture, and smart city environments.

WiGig is ready for multi-gigabit speed deployments in the 60 GHz band – the millimeter wave region of the spectrum. Millimeter wave increases the opportunity for spectrum reuse and effective interference management.

The 60 GHz band is well suited to deliver multi-gigabit speeds and to serve highly concentrated, high-traffic users, and offload traffic from other access technologies with higher per-bit costs. Improvements coming with the IEEE 802.11ay specification will deliver even faster speeds and longer ranges in 60 GHz.

Wi-Fi's performance and versatility already enables many advanced use cases that target both human users and IoT applications and services.

Next generation 5G connectivity

Wi-Fi is improving performance, scalability, and reliability to strengthen its support for next generation use cases. Wi-Fi 6 will satisfy an even broader range of next generation connectivity scenarios, including those envisioned for 5G. ABI research forecasts that Wi-Fi 6 global annual chipset shipments will exceed 1 billion by 2022, driven by an enormous growth in Wi-Fi-enabled devices, increased per-user traffic demand, greater number of users per AP, increased cellular offloading, higher density Wi-Fi deployments, growing use of outdoor Wi-Fi, heterogeneous device and traffic types, and a desire for more power and spectral efficiency.

Wi-Fi 6 elevates Wi-Fi to a higher level of performance and richer set of capabilities. Wi-Fi 6 further reinforces the ability of Wi-Fi to meet 5G requirements for stationary and nomadic connectivity across a wider set of deployment scenarios.

While Wi-Fi 6 is the most anticipated step in the evolution of Wi-Fi towards the next generation connectivity, WiGig and Wi-Fi HaLow also play a crucial and complementary role in Wi-Fi's ability to address next generation connectivity scenarios, including many 5G scenarios, by expanding Wi-Fi to low bands and high bands.

The Wireless Broadband Alliance (WBA) published a report that analyzes how Wi-Fi specifically meets the IMT-2020 requirements for:

- Area traffic capacity, i.e., densification
- User-experienced data rates
- Spectrum efficiency
- Latency
- Connection density

Along the same lines, WiGig, with the upcoming IEEE 802.11ay standard, will be able to significantly boost the peak data rates in the 60 GHz (mmW) band in excess of 100 Gbps with the addition of 8x8 MIMO, and downlink MU-MIMO. Devices based on IEEE 802.11ay will not only increase the peak data rates, but also do so while reducing latency.

Keeping up with Wi-Fi security

Protection of Wi-Fi users and networks is a top priority. Since each market segment may have different security needs and abilities to support security solutions, Wi-Fi offers multiple tools that ensure each user and network are most effectively protected at the required level of security.

Wi-Fi CERTIFIED WPA3 provides next generation security capabilities through WPA3-Personal, with Simultaneous Authentication of Equals (SAE), and WPA3-Enterprise, using 192-bit encryption to protect networks with the tightest security requirements. WPA3 enables more robust authentication, delivers increased cryptographic strength for highly sensitive data markets, and maintains resiliency of mission critical networks.

Wi-Fi security is continually evolving to address new industry security threats associated with next generation connectivity scenarios.

Summary

Wi-Fi is the predominant wireless access technology today. It will continue to carry the bulk of the world's data traffic, even with the deployment of 5G, because of its ubiquity in devices, extensive coverage, and inherent strengths which will be retained with the next generation of Wi-Fi. These strengths include:

- Affordable performance
- Unlicensed spectrum operation
- Ease of use
- Self-deployment
- Long-term compatibility

Leveraging its inherent strengths, commitment to security, and efficient operations in unlicensed bands, Wi-Fi today already supports many advanced next generation use cases. With the introduction of Wi-Fi CERTIFIED 6, along with Wi-Fi CERTIFIED HaLow, Wi-Fi CERTIFIED WiGig, and other Wi-Fi CERTIFIED programs including Wi-Fi CERTIFIED Vantage, Wi-Fi CERTIFIED Easy Connect, and Wi-Fi CERTIFIED Passpoint, Wi-Fi will reinforce its ability to serve current and new use cases such as VR/AR, advanced video applications, and enterprise and smart home IoT services with scale, and to provide better throughput, lower latency, more advanced network management and optimization, and enhanced user access.

Wi-Fi's installed base of more than nine billion devices enables delivery of next generation connectivity as part of a gradual transition, with backward compatibility ensuring support for legacy devices. Wi-Fi 6 will be introduced where needed, as an upgrade or expansion of current Wi-Fi networks, and it will not require the sizeable investment expected for 5G but will still provide many of same advancements in performance and capacity. Similarly, users will be able to upgrade to Wi-Fi 6 devices as desired.

Wi-Fi's ability to serve many next generation use cases today reduces the pressure and urgency for operators to deploy more expensive 5G networks in order for their customers to take advantage of new services. Operators can leverage nearly ubiquitous, high-performance Wi-Fi already deployed in many homes to deliver advanced applications and innovative services to users today. Customers can leverage their existing Wi-Fi mobile devices to experience these advanced use cases and available services.

Next generation connectivity will continue to require many technologies, including both Wi-Fi and 5G, further reinforcing their complementary nature. Neither, on their own, could address the full scope of connectivity needs in terms of capacity and coverage.

With the evolution to Wi-Fi 6, Wi-Fi will once again redefine what wireless connectivity means to users. Twenty years ago, Wi-Fi showed that broadband does not need wires. Next generation Wi-Fi will soon show users how wireless broadband can be transformative, and how it will be the main driver of digital transformation for both people and things.

*Technology report by **WiFi Alliance.***

Compact M8 connectors for future-proof data transmission

D-coded, circular M8 connectors are an excellent solution for compact and future-oriented data transmission in Industrial Ethernet environments. The symmetrical contact arrangement of its pin connector pattern prevents performance losses and allows stable real-time data transmission with bandwidths up to 100 Mbps.

THE FOURTH INDUSTRIAL ELECTRONIC revolution is in full swing; its pace is accelerating every day. Manufacturers of automation technology have to react to the growing demand for data, and constantly offer new, powerful solutions for continuous real-time data transmission between company, control and field level.

New 4-pin D-coding in the design of space-saving M8 built-in device connectors supplements the proven reflow product range with an important component, and thus future-oriented and standardized solutions for compact data transmission.

With the increasing automation of production plants, buildings and infrastructure facilities, the classic automation pyramid is being turned upside down. More and more "intelligent" devices are processing and transmitting signals and data directly in the field. At the same time, these devices such as industrial PCs, I/Os or sensors and actuators are becoming increasingly powerful and compact.

This in turn increases the demands on the installed interfaces. Device and cable connectors must fit into compact device fronts and control cabinets and simultaneously transmit a large number of signals, high data rates, as well as power. In addition, they must be able to be efficiently integrated into the production process - in order to enable high unit numbers and thus economies of scale - and at the same time offer a high degree of robustness and flexibility. Sounds like an all-in-one device? The M8 standard already offers many of these features today.

A question of coding

Thanks to its standardized metric thread, its compact design and its industrial and robust design, the M8 circular connector has already established itself in many areas of industrial cabling. With the spread of Industrial Ethernet, however, this circular connector is increasingly conquering new areas of application in decentralized data transmission. By now, it is not only the overarching elements such as controllers and production control computers that communicate with each other via protocols such as Ethernet/IP or Profinet, but also sensors and actuators at the lowest field level.

SOURCE: PHOENIX CONTACT

From the sensor to the cloud: M8 connectors for Ethernet and Profinet enable continuous data transmission.

The M8 standard is ideal for these compact applications. However, the contact arrangement of the A-coded pin connector pattern limits the application in the field. Thanks to the asymmetrical arrangement of the four contacts, the pin connector pattern is protected against mis-mating, but the electromagnetic fields of the contacts located closer to each other also have a stronger influence. The result: stronger Near End Cross Talk (NEXT).

In practice, the A-coded M8 connectors for Ethernet and Profinet allow bandwidths of up to 100 Mbps. However, they do not meet the requirements of the CAT5/Class D transmission category, as the connection may not have sufficient reserves to compensate for additional influences such as long cable lengths, EMC interference or other couplings. This can cause the bandwidth to drop below a stable 100 Mbps, causing data packets to be lost and resent. The connection thus becomes unreliable.

Phoenix Contact offers D-coded M8 connectors specifically for data transmission in Ethernet/IP and Profinet environments. The standardized, symmetrical arrangement of the four contacts also enables transmission rates of up to 100 Mbps, according to IEEE 802.3, and also meets the requirements of CAT5.

The contacts positioned opposite each other form pairs to which either two opposite wires of a star quad cable or wire pairs of a twisted pair cable are connected. Since the electromagnetic fields cancel each other out due to the symmetrical contact arrangement, data losses due to near-end crosstalk are avoided. This makes the pin connector pattern ideal for secure data transmission in demanding environments such as welding cells.

Efficient process integration

In addition to the reliability and speed of data transmission, device manufacturers are increasingly focusing on their own production processes. Worldwide markets and the high variance of application areas require device designs that can be implemented cost-efficiently and easily adapted if necessary.

As the central component of every industrial electronic device, the printed-circuit board and its components are of great importance. In order to reduce production time, enable higher quantities and thus reduce unit costs, manufacturers rely on partially

or fully automated assembly processes. Phoenix Contact therefore supplies all device connectors for SMT or THR mounting in tape-on-reel packaging. The applicable standard DIN EN 60286-3 ensures that the two-piece connectors can be inserted into the feeders of all common assembly machines, fed without interruption and picked up by nozzles or grippers and placed on the printed-circuit board.

The SMD design has one major advantage. The connectors assembled on one side require less space on the printed-circuit board and therefore allow a higher packing density than conventional components for wave soldering. With a co-planarity of less than 0.1 mm between armature plates and contacts, the SMD versions still contact safely and reliably.

The new D-coded M8 connectors are also design-compatible with the already established two-piece M8 and M12 circular connectors. Electronics suppliers and device manufacturers can thus install all M8 and M12 codings on an identical printed-circuit board and housing level. Even for different applications such as power transmission via M12 and data transmission via M8, the printed-circuit board and device design remains the same. The finished device can therefore be developed without adaptation for different markets and applications; complex individualized housing contours are not necessary.

A further advantage of the two-piece design: printed-circuit board and housing can be manufactured at different locations, and only be married later during final assembly. This allows for greater flexibility in the selection of electronics suppliers and at locally, regionally and internationally distributed production sites.

Complete flexibility

Different mounting types are offered for front or rear mounting. Even a press-fit variant or direct integration into the customer housing are possible. Thanks to this variety of options, it is even possible to install different printed-circuit board versions in one and the same housing. The user not only saves development time, but also tool and storage costs.

In order to ensure safe operation even under harsh industrial conditions, the new M8 connectors are designed in protection class IP67 (according to IEC 61076-2-114). Physical environmental influences such as dirt, dust or water therefore do not affect the real-time data transmission between cable and device connectors.

In addition to the two-part device connectors, the product range also includes the matching D-coded cable connectors. Whether with open cable end, double-sided M8 connector or in combination with an RJ45 connector, Phoenix Contact technology offers standardized or customized solutions for different cable lengths.

Summary

D-coded circular M8 connectors are an excellent solution for compact and future-oriented data transmission in Ethernet environments. The symmetrical contact arrangement of the pin connector pattern prevents performance losses and allows stable real-time data transmission with a bandwidth of up to 100 Mbps. The two-piece device connectors are suitable for fully automated SMT and THR processes and offer different options for front and rear mounting.

Device manufacturers and electronics suppliers can thus efficiently integrate the connectors into their own production and develop uniform printed-circuit board and device designs for different application areas and markets. Thanks to their standardized pin connector pattern, the connectors fit perfectly into the wide range of circular connectors. The combination of different suppliers for device and field cabling is also possible without any problems, creating a symmetry that sticks.

Christian Rathgeber, Product Manager, ***Phoenix Contact Connector Technology.***

New paradigm with network control system technology

With a focus on increasing project execution speed and efficiency, new Experion PKS HIVE technology decouples the assignment of IO modules, control strategies to specific controllers and computer resources to servers-delivering a new approach to engineering and maintaining industrial process control systems.

THERE ARE FEW TECHNOLOGY ENVIRONMENTS more complex than those required for industrial control systems. These environments must incorporate critical functions including cybersecurity, redundancy, high-speed networking and deterministic operations. With these capabilities, customers control safety-critical process manufacturing facilities with the highest levels of reliability.

While process control systems have served the industry well over 40 years, there is an opportunity to harness the power of new technology to make a step change in benefits. Industry sees an opportunity to drive down capital cost by shifting from customization to standardization. And subsequently improving operations by converting data into knowledge and transforming knowledge into precise action. The challenge to automation solution providers? Enable plants to execute projects in less time with lower risk while also improving throughput, quality, and operational reliability.

Decades of implementations and customer collaborations have armed Honeywell with first-hand knowledge of the pain points throughout plant operations that impede continued gains in project efficiencies. Helping customers to overcome these roadblocks has resulted in a fundamentally new approach to deploying and operating industrial control systems.

Focused on taking automation out of the critical path, Honeywell's LEAP is a paradigm shift in the way automation projects are implemented. Introduced in 2014, LEAP removes the traditional dependencies that used to force project flows to be sequential in nature by combining Universal IO, virtualization, virtual engineering, and automated commissioning.

The result? Separating physical from functional design, breaking down task dependencies, using standardized designs, and enabling engineering to be done from anywhere in the world can result in significant risk and cost reduction.

Highly Integrated Virtual Environment

Experion PKS HIVE is a new generation of control system technology that uses LEAP project execution principles, software and networking to unchain control applications from physical equipment, and controllers from physical IO. This approach enables control systems to be engineered and implemented in less time, at lower cost and risk, and with simpler, modular builds.

SOURCE: HONEYWELL

Traditional control engineering requires meticulous planning driven by a hierarchical approach and the physical topology. New technology now allows multiple physical controllers to appear as a single virtual controller or HIVE.

Eliminating complexity: Decoupling control from the physical platform and reducing IT costs are some of the tenets that help overcome the roadblocks preventing simplified control system design, implementation, and lifecycle management for project operations. Let's take a look at the components.

Moving IO to the field: This shifts the control system closer to production units.

Control centers are notoriously jammed with system cabinets along with massive amounts of wiring. Cost saving opportunities abound in these environments. Experion PKS IO HIVE technology distributes the control system closer to the process equipment, so users can achieve greater operational savings with fewer wires, reduced engineering hours, and less space requirements.

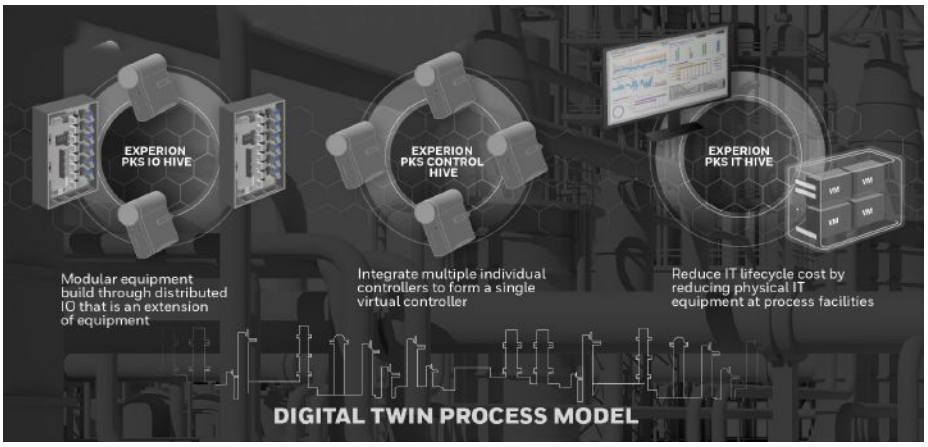
Accommodating increased data flow requires a highly resilient, high-speed Ethernet field IO network that connects controllers to Honeywell's Universal IO mounted in the production areas. As the foundation for IO communications, the Experion PKS IO HIVE network is cybersecure, with a built-in firewall and enhanced with encryption technologies where needed. Consider the benefits of this higher speed network.

Universal IO discovery: This provides the ability for any C300 controller to access any IO module and channel on the Experion PKS IO Hive network.

This is a step beyond the traditional approach of controller to IO communication having a direct 1-1 physical connection. This new approach eliminates a significant amount of planning and manual work by seamlessly allowing any control to communicate with any IO without restriction. Now, engineers set the control strategy, assign it to a controller and it will automatically find its relevant IO. The benefit? Significantly lower project engineering planning and engineering.

Universal Wireless Hotspot: Wired or wireless communication to field instruments

SOURCE: HONEYWELL



Controller technology leverages modular distributed IO and a single virtual controller to reduce IT lifecycle costs.

enables each field IO box to be a wireless hot spot. This significantly increases the ability of field workers to execute digital procedures with live access to control system data during commissioning and operations.

Modular commissioning: This creates an ability to commission field IO cabinets independent of the control system.

With this capability, users can run C300s on a laptop, plug directly into the remote cabinet and perform a set of commissioning activities as if they are connected to the rest of the control system.

These combined capabilities provide significant project engineering flexibility that enables project execution in less time with lower risk. For example, eliminating the risk and re-work inherent to late changes keeps automation from being on the critical path.

Power of single virtual controller

Traditional control engineering during a project requires meticulous planning since it is driven by a rigid hierarchical approach defined by a physical topology. Inefficiencies, re-work and risk materialize during seemingly inevitable late changes to IO or controls that require a physical reconfiguration of the entire system.

Experion PKS Control HIVE uniquely addresses this challenge by allowing multiple physical controllers to appear as a single virtual controller, or a Controller HIVE. In essence, this is like a controller data center where process controls can automatically be load-balanced across the available controller compute. The advantages are powerful, especially when applied to the processing of late changes. With the Experion PKS Control HIVE, control strategies no longer need to be manually assigned to specific physical controllers.

Decoupling control from the physical platform opens up significant opportunities for project operations, including the flexibility to run control on any hardware platform including traditional PC servers. The location roadblock shatters, letting control run in any location–from adjacent to the process unit, to the control room, or to the data center.

Reducing process control IT costs

Honeywell's virtualization technology reduces IT costs by eliminating the amount of physical IT nodes by as much as 80%. However, even with that effort, a large IT infrastructure remains onsite for reliability and scope of loss reasons. Experion PKS IT HIVE continues the mission to lower project delivery and lifecycle costs by using the power of virtualization and replicating virtual machine files from offsite to the onsite location.

The result is a fault tolerant architecture that enables users to operate and manage the system from a central location or a regional data center. Furthermore, the virtual machine images can be started at the onsite location to preserve operational integrity in a worst case network outage.

This approach to multi-site consolidation enables the standardization critical to an efficient foundation for project operations, considerable when deploying Experion PKS IT HIVE on an enterprise scale. For example, consider the simplification in assuring consistent deployment of Windows patches, antivirus updates and Experion releases. The result? Process control engineers can focus on optimization rather than performing administrative tasks.

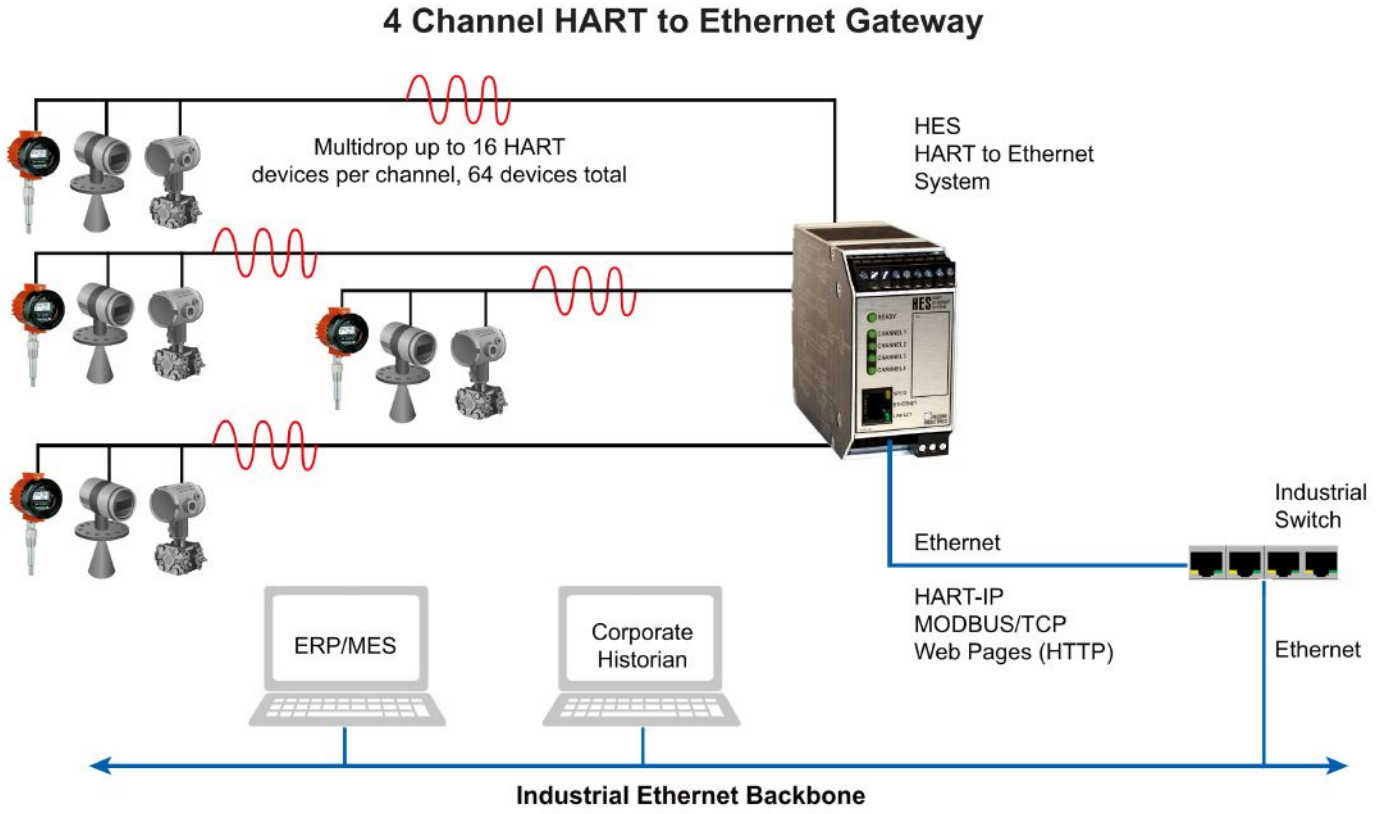
Conclusion

Experion PKS HIVE technology fundamentally changes how we think about the relationship of assigning devices to IO modules, control strategies to controllers, and compute resources to servers. Rather than physically running fiber optic cables from a central control room to add a field cabinet, the cabinet is added to the Experion PKS IO HIVE and benefits from universal IO discovery.

Jason Urso, Chief Technology Officer, ***Honeywell Process Solutions.***

IIoT benefits without heavy front-end investment

Taking process data from smart HART field devices and sharing it with higher level systems, no longer has to be difficult or expensive. Industrial Ethernet backbones and wireless networks, IIoT HART devices, open industry protocols and ease of programming provides a quick and seamless way to share process data.



SOURCE: MOORE INDUSTRIES

HART to Ethernet Gateways offer a quick and economical way of sharing critical HART data with higher level systems.

THOSE WHO WORK IN INDUSTRIAL PROCESS control and monitoring marvel at the newfound excitement and hype the commercial market revels in regarding IoT (Internet of Things). Sharing of data between devices and across platforms has been taking place for more than 35 years within our industry; we just referred to it as data exchange, distributed control or a host of other terms that described simple data sharing.

Nonetheless, advances are being made with open communication standards with smaller packet headers, agnostic platform requirements, exception-based reporting, minimizing network bandwidth and less expensive microprocessors that enable seamless exchange of data between all devices. And following suit, all we needed to do was to give it a new name – IIoT (Industrial Internet of Things).

However, even with advancements, the industrial and automation industry does not have the luxury of simply replacing existing instruments and control systems with new ones just because new capability or technology arises. All process facilities and their leadership are accountable for capital investment ROI, and that cannot be achieved by discarding perfectly good instruments and control systems. The ability to use existing industrial Ethernet and wireless networks in process manufacturing plants and automation facilities has made data exchange within a facility, and even throughout global corporate networks, easier than ever.

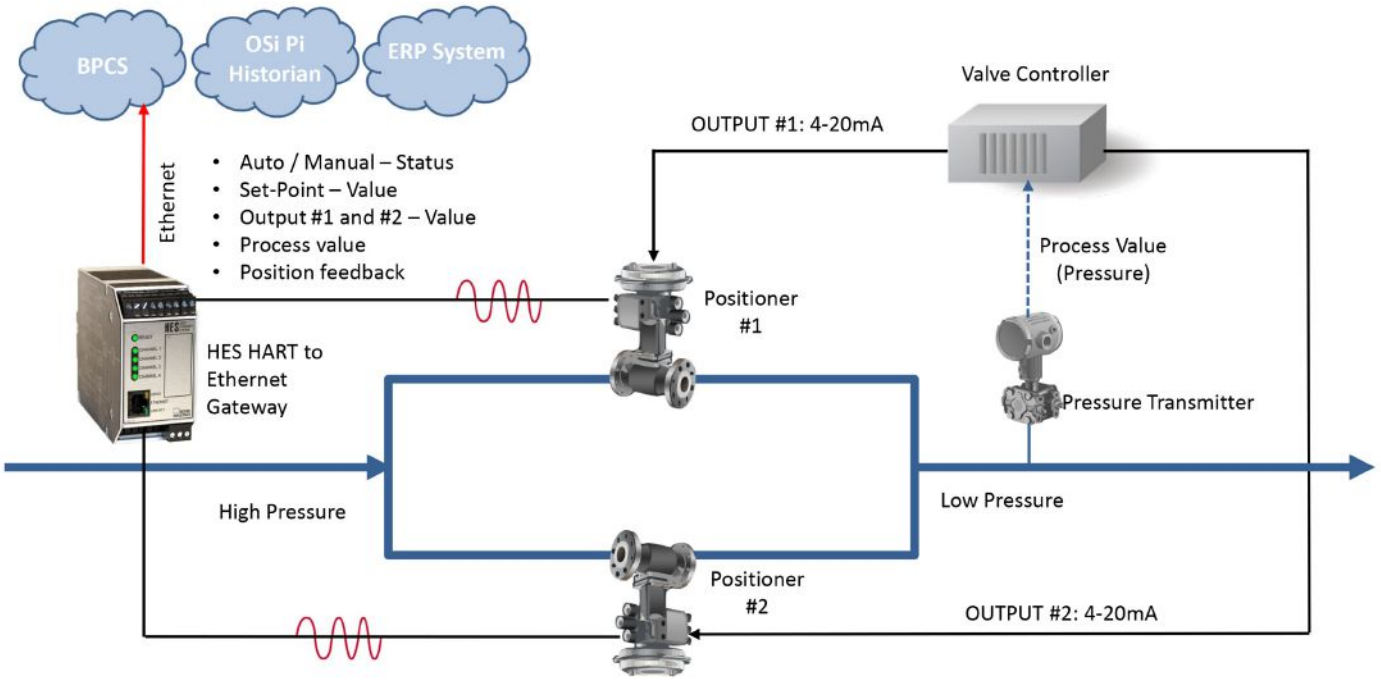
Today most process facilities have substantially invested in and utilize industrial Ethernet and wireless infrastructures to connect multitudes of devices to one another and to monitoring and control systems. These larger control systems often hold price tags of multiple millions of dollars. Additionally, each smart field instrument costs thousands of dollars each. With all of this investment in the control and monitoring system, network infrastructure and smart field instruments there are often remaining challenges with getting all of the data in one place in order to effectively perform data analytics.

Predictive modeling, historical analytics, process optimization and proactive preventative maintenance are just a few of the latest trends being implemented to reduce cost and improve overall performance. But in order to achieve these results, data must not only already exist but flow easily from the plant floor to higher level control, MES (Manufacturing Execution Systems) and ERP (Enterprise Resource Planning) systems.

The challenge remains for the slower adopting process industries: how do they get the benefits of what IIoT is promising without the heavy front end investment? Obviously, the answer to that question lies with exploring ways to take advantage of existing infrastructure investments.

One of the most efficient ways to capitalize on such investments is to take advantage of the digital HART data in your smart HART

SOURCE: MOORE INDUSTRIES



Using the HES HART to Ethernet Gateway to stream precise positioning data from electronic valve positioners.

devices, convert it to a widely used digital communications protocol such as MODBUS/TCP, and transmit it using the existing Ethernet and wireless networks.

HART Protocol

With over 40 million installed HART devices worldwide, HART continues to get updated revisions that continually enhance data exchange capacity, speed, number of devices on a network, support over Ethernet, and wireless capability. It enables end users to have unfettered access to process and diagnostic data that can be shared with all areas of the new Smart Factory that supports IIoT endeavors. In many cases, HART instruments were installed simply because they could be configured and diagnosed easily with a HART handheld communicator (HHC). However, the HART digital signal often contains additional process measurements and other variables that may include instrument status, diagnostic data, alarms, calibration values and alert messages.

A simple and cost-effective solution for gathering HART information is to use a HART interface device. These HART interface devices make acquiring HART data a fairly simple proposition. This HART data can then be made available to the control system, asset manager or plant Ethernet backbone where it can then be shared with higher level systems or corporate WANs (Wide Area Network).

HART Interface options

There are several ways to interface with HART smart field devices in order to acquire the digital process and diagnostic information. They vary from HART enabled 4-20mA input cards, HART multiplexer (Mux) systems, slide-in PLC gateway cards, custom coded software interfaces for asset management and MES/ERP systems and standalone gateways that typically convert the HART data to some other proprietary or open industry format.

HART multiplexers are common and typically their interface is a custom RS-422, RS- 485 or RS-232 serial connection and is custom configured for a particular vendor's hardware interface, asset management system or control system. Each of these options is quite costly and often avoided. The most expensive but also most specific HART interface to have is one written by a programmer which can then be customized to exact user and hardware specifications.

Standalone HART gateways, such as the Moore Industries HES HART to Ethernet Gateway System, often provide the most economical pathway to extracting HART data from field devices, making the data readily available to higher level systems. These products usually offer one to four channels or ports that allow several HART devices to be multidropped for maximum data concentration

Application of HART Interfaces

These highly flexible HART gateways have been applied in multiple ways that have allowed the users to collect, convert and transmit the process and diagnostic data to systems that can perform the needed analytics while avoiding expensive system upgrades and extensive additional wiring.

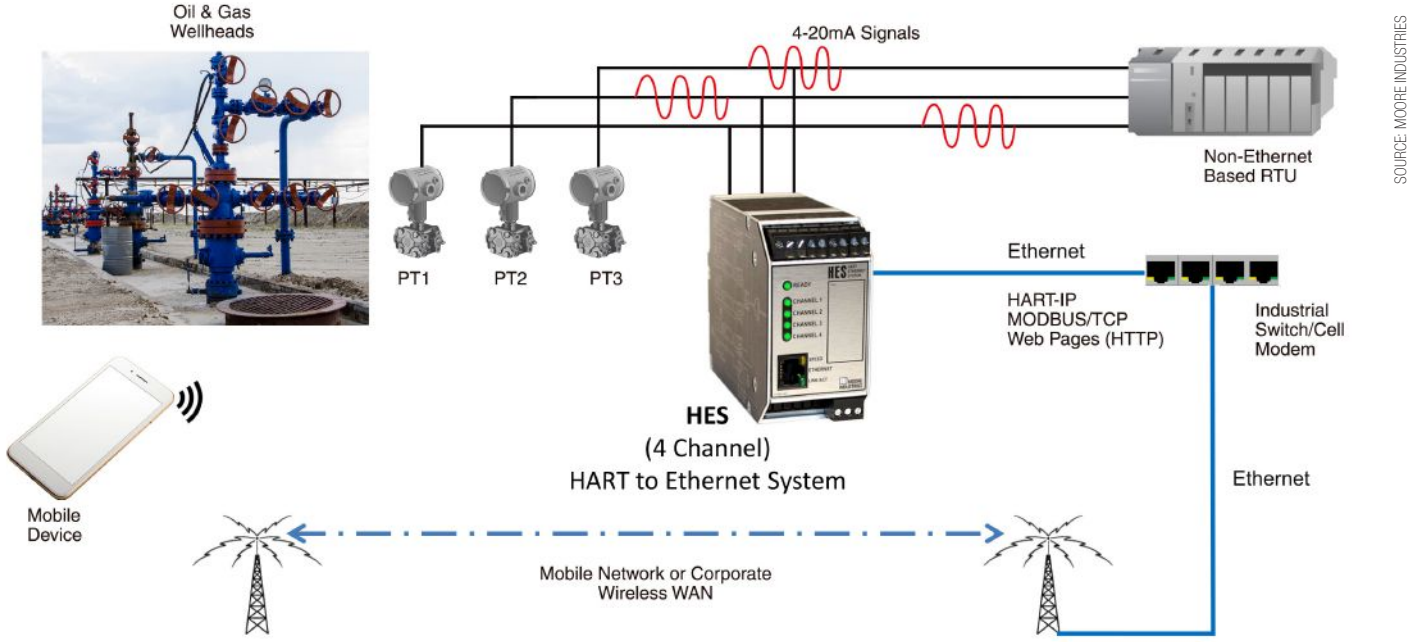
Stream precise positioning data

It is common for customers to upgrade the top works of their valves with smart HART positioners. However, as stated above, upgrading valve controllers or control systems to read back HART positioning and diagnostic data from these new positioners can be quite an expensive proposition. In a recent application, a customer needed to control two valves which had smart HART positioners installed and had a further requirement to communicate actual valve position over Ethernet using MODBUS/TCP to their higher-level systems.

Originally the customer wanted to use a ¼ DIN PID Controller to control the two valves in order to balance and/or limit each valve's travel to maintain final pressure through the system, but they realized that the remote controller's communication capability did not support MODBUS/TCP as their BPCS and Historian required.

Moreover, the higher-level monitoring systems needed to monitor and record where actual stem positions currently were, not where the valve controller was driving them via the 4-20mA signal – which was what the BPCS was currently recording. This could only be obtained by reading the HART data from the smart positioners.

The HES HART to Ethernet gateway, 4-channel model, was utilized to pick up the actual stem position HART data from the smart positioners and send it directly to the higher-level systems – no longer requiring the valve controller to communicate the CV (Controlled Variable), or desired stem position, output. The HES was an effective and economical solution that enabled the customer to take advantage of existing HART data from the positioners and share that critical data with their higher-level systems on their existing Ethernet infrastructure.



SOURCE: MOORE INDUSTRIES

The HES gathers real time pressure and diagnostic data from insitu pressure transmitters at Oil and Gas wellhead and shares it via corporate wireless WAN and mobile devices.

From flowmeters to Ethernet

A water treatment facility in Texas is saving the cost of an expensive host system upgrade by using a HART to Ethernet gateway to pull in totalizer values from magnetic flowmeters. Updated local and state laws required that totalized flow values at various effluent locations be historically archived and simultaneously shared with higher level municipal corporate systems.

Since the original SCADA system used for monitoring and control included PLCs that were incapable of reading HART data, expensive flowmeter upgrades were going to be required. This entailed purchasing new flowmeters with pulse output options. In addition new PLC input cards with pulse-counting capability would need to be procured; not to mention the new wire that had to be pulled for the pulse output signals.

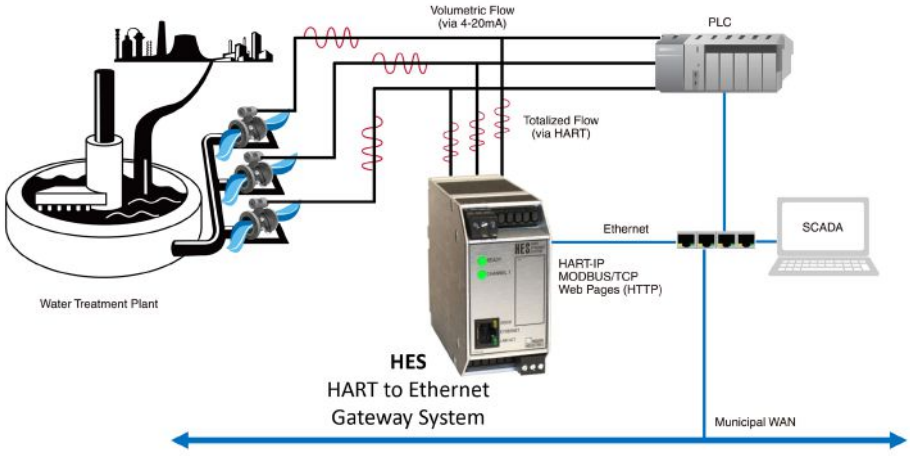
By utilizing existing wiring, existing smart HART flowmeters and the existing PLC that had Ethernet communication capability along with the HES HART to Ethernet gateway, the municipal treatment facility saved tens of thousands of dollars. Now the local SCADA system is able to historically archive the totalized effluent flow data, along with other flow diagnostics and readings, locally and share this data over the municipal WAN (Wide Area Network) to other higher-level systems to meet reporting requirements.

Archive & display critical pressures

Fracking technology has presented boundless opportunities with extracting oil and gas in West Texas and other regions. However, as supplies and inventories of oil and gas increase, this obviously presents new pricing pressures within the market as the price per barrel of oil and per cubic foot of gas declines. These pricing pressures immediately evolve into the need to lower operational, maintenance and monitoring costs of upstream wells.

Since most of these wells are remote, Wireless WAN infrastructures have been put in place to cost effectively remotely control, report and monitor upstream assets. Unfortunately, many existing RTUs (Remote Terminal Units) don't have smart HART communication capability or Ethernet capability. Upgrading these RTUs across several hundred oil and gas sites can be costly and downright time consuming.

An oil and gas company had a new requirement to locally and remotely continuously monitor wellhead pressure for production, and for safety of personnel and equipment. The HES HART to Ethernet gateway enabled a quick and cost-effective retrofit solution for all of their remote wellheads. The HES can capture direct pressure data from insitu smart HART pressure sensors and immediately make that available over Ethernet to the Wireless WAN system, which included Ethernet based modems. Moreover, this also allowed for the HES to offer direct viewing of pressure to local Ethernet based HMIs and quickly gave the company access to any other critical measurement variables from installed smart HART transmitters or valves to any remote or mobile phone monitoring apps.



SOURCE: MOORE INDUSTRIES

HART Totalized Flow Data converted to MODBUS/TCP and transmitted over Ethernet and a Municipal WAN.

Conclusion

Taking critical process data from smart HART field devices and sharing it with higher level control and information systems, whether in a manufacturing facility or between remote locations, no longer has to be difficult or expensive.

With the acceptance of industrial Ethernet backbones and wireless networks, IIoT HART interface devices, open industry protocols and ease of programming provides a quick and seamless way to share process data with the entire corporate infrastructure.

Technology report by ***Moore Industries.***

Choosing the right plant-level Industrial Ethernet protocol

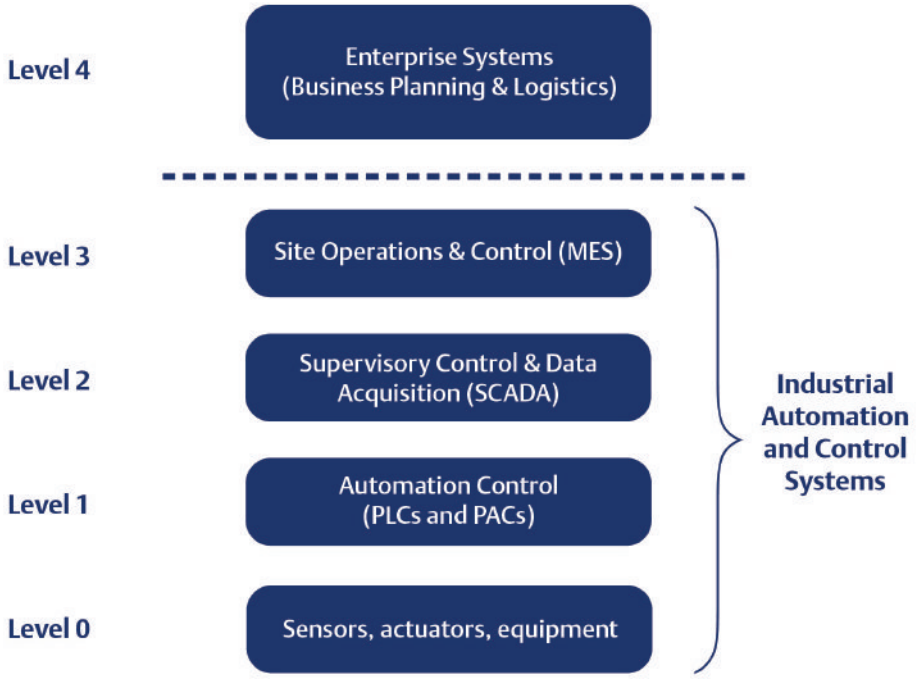
Ethernet dominates industrial automation communications, but users must choose the best industrial protocols for use at various architecture levels. Contextualization is key to transporting raw OT data. Object-orientation promotes consistency and efficiency, and compatibility with the latest programming languages.

INDUSTRIAL AUTOMATION APPLICATIONS RELY on connectivity from the lowest to the highest levels. The most basic field connections are hardwired I/O points, which over the years have been supplemented and even superseded by industrial fieldbuses. Other networks and protocols are more suitable for communications between higher level automation elements.

A significant advancement over the past decade has been the increasing use of Ethernet for industrial connectivity. Ethernet has emerged as a clear leader over many options, but even though this seems to simplify the issue, end users must still choose the right industrial Ethernet protocols.

Installations may require multiple protocols depending on the application and where each protocol is to be used within an automation systems architecture. Some industrial Ethernet protocols have deep roots and are mature, but many incorporate less than ideal legacy concepts. Other protocols are optimized for specific applications, such as high-speed motion. At the upper levels of industrial automation architectures, which is the plant-level networking above the controller network, there are specific requirements driving protocol selection, with a different emphasis than lower-level field device and I/O level networks.

Plant-level networks are where many different systems interact with each other, demanding a secure networking protocol which delivers rich contextual objects so the raw data is made available as useful information. This article discusses why OPC UA is an industrial protocol to consider for providing these features in a plant-level network. The OPC UA feature set makes it an effective protocol for supervisory connection to the industrial internet.



SOURCE: EMERSON

Industrial automation and control systems are architected with many levels of devices and networking.

Building A Plant Network

Industrial automation systems are built from many devices and components connected or networked together. Field devices—such as sensors, actuators, and smart systems—are connected to controllers. These programmable logic controllers (PLCs) and programmable automation controllers (PACs) monitor and command the field devices, communicate with each other, and are networked to higher level systems for human-machine interface (HMI), supervisory control and data acquisition (SCADA), historizing, analysis, and other roles.

Industrial networking hierarchies are defined by many characteristics and are not always a precise definition because some network levels can be virtualized or collapsed together on one physical network. Here is one representation of relevant levels which must be networked within an industrial plant:

- *Level 4:* Business planning & logistics
- *Level 3:* MES, for site supervision
- *Level 2:* HMI and SCADA, supervisory control
- *Level 1:* Local PLC and PAC automation control
- *Level 0:* Field sensors, devices, and networks

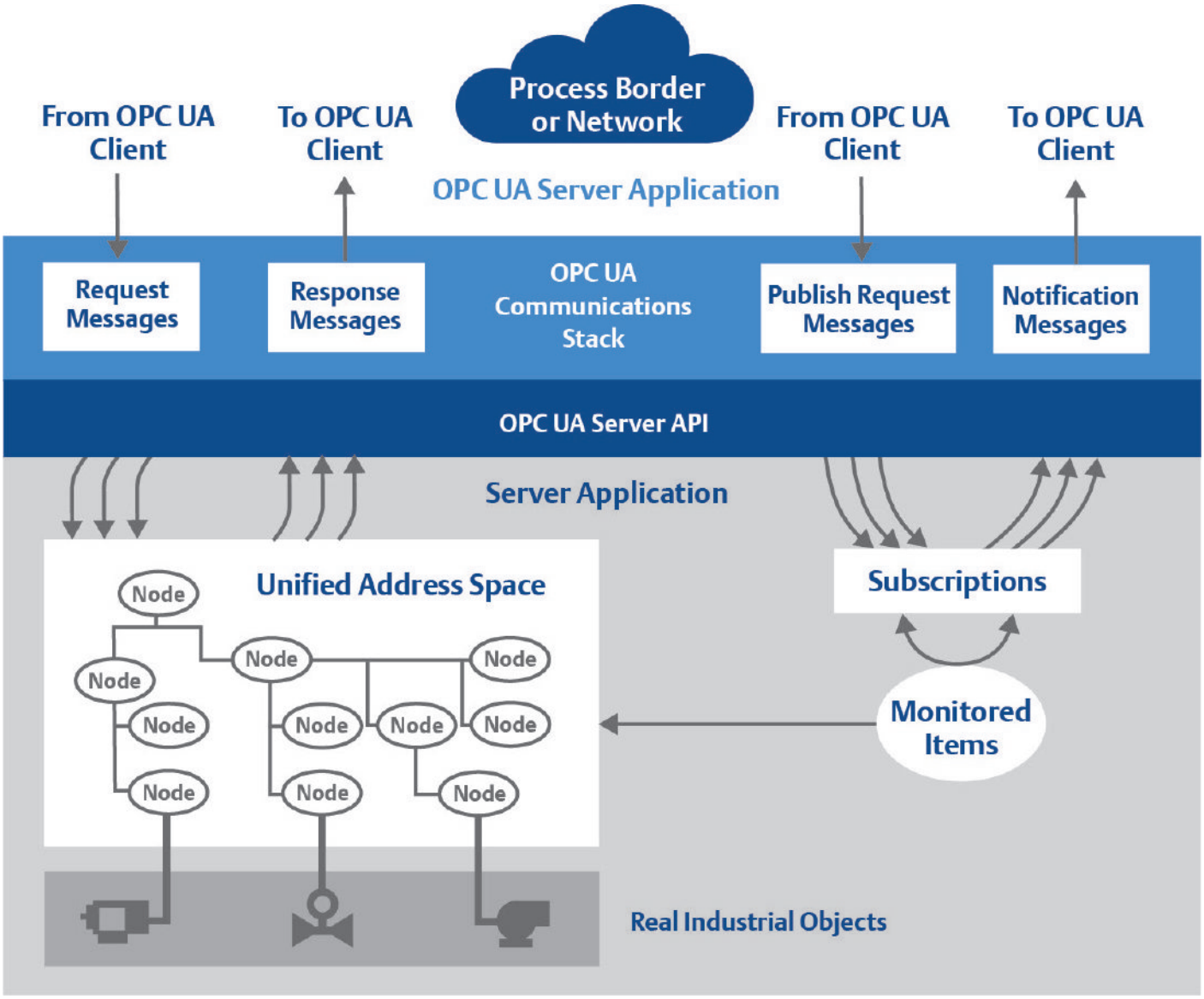
Controllers can interact with field devices (and with each other) at Levels 0 and 1 using hardwired I/O, fieldbus networks, and industrial Ethernet. These connections are local to a site and are generally made up of small data packets which must be rapidly communicated because physical devices must be directly controlled in real time.

Communications above and among controllers have different needs. The industrial networks connecting Level 1 and above are sometimes collectively referred to as plant-level networks. Compared to lower level communications, plant-level data packets may have less stringent time requirements.

Plant-level networks interconnect widely varied systems compared to the more dedicated lower levels. This imposes new requirements for modern industrial plant-level network communications:

- *Secure:* Providing built-in security features
- *Contextualized and Object-Oriented:* Able to define and organize transported data
- *Platform Independent:* Enabling distributed applications to communicate seamlessly

As noted previously, Ethernet has become the physical network of choice. This is true for enterprise and business information technology (IT) applications as well as industrial operations technology (OT) systems. From a physical standpoint, Ethernet can operate using copper wires, fiber optics, and even wireless methods. What really



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The OPC UA industrial communications protocol provides security and data contextualization using a platform independent architecture.

differentiates Ethernet for use in IT and OT settings is the different communications protocols that run over Ethernet.

Protocols

Adapting commercial IT Ethernet for industrial OT applications presents some challenges. Ethernet can rise to prominence for OT field networking based on the availability of good protocol choices such as ProfiNET, Ethernet/IP, and many others.

Field networking protocols are quite mission-specific for their OT roles, but the specialized nature and legacy roots of field networking protocols makes them less suitable for higher levels of the networking hierarchy. At these levels, users need protocols with greater flexibility and capability so they can interact with many system types. They prefer open solutions, but with the security provisions necessary for business and internet-facing connections.

Over the years, the OPC Foundation has developed and maintained specifications for delivering secure and reliable interoperability. The most recent development, first released in 2008, is OPC Unified Architecture (UA).

At the Level 1 and above, OPC UA defines how information is modelled and communicated with specific security, contextualization, and object-oriented features—making it a good choice for most industrial applications. The comprehensive, modular, and scalable nature of OPC UA allows users to create a "system of systems". That is, an integrated overall industrial automation system built from many subsystems of all sizes interacting seamlessly with each other. Clients and servers are defined as interacting partners.

Security

As Ethernet and the internet have improved the ability for digital systems to communicate, they also have created security risks. Information security is defined by the triad of confidentiality, integrity, and availability (CIA). Traditional fieldbus networks and earlier industrial Ethernet protocols focused on availability and integrity, with little or no consideration for confidentiality. Often this is referred to as the availability, Integrity and confidentiality (AIC) or reverse approach. Higher level networking demands a more balanced approach regardless of CIA or AIC.

Some protocols can be extended with the addition of security features like virtual private networks (VPNs) or transport layer security (TLS), although this is less than ideal. A better method is to design security constructs right into the protocol. OPC UA uses a built-in set of services for handling security certificates and establishing secure client/server sessions at the application level, channels at the communication level, and socket connections at the transport layer.

OPC UA provides native security mechanisms for clients to discover available servers, manage and distribute certificates and trust lists, and mediate with the certificate

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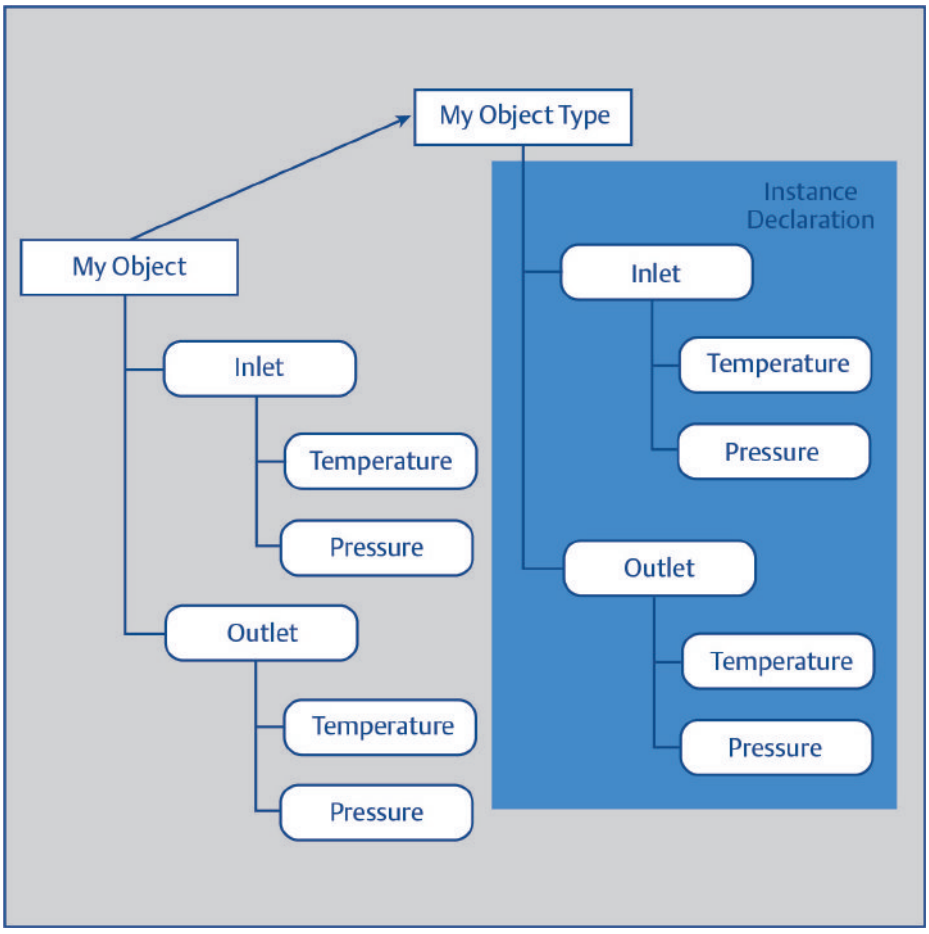


SOURCE: EMERSON

Object-oriented techniques improve efficiency,enabling designers to create, re-use, and combine information models.

authority. OPC UA is well qualified for the role of a modern Ethernet protocol for secure industrial communications spanning Levels 0 through 4.

Context and object-orientation

Classic industrial protocols have emphasized reliable transmission of raw data. It was up to the designers to arrange the incoming data signals, and then to process these signals at the destination controllers to transform the raw data into useful information. Such processing included defining what the information was and scaling the values into engineering units, for instance.

This becomes burdensome if it must be performed at every step of a communications channel, such as from I/O signal to controller, from controller to HMI and SCADA, from SCADA to MES, and from SCADA or controller to historian.

A better method, called contextualization, calls for data to be transported with inherent semantics eliminating the need to program and configure PLCs and HMIs independently and carefully map the signals between them because the meaning of the data is understood by both collaborating applications. Contextualization lets users work using the same source data. The sophisticated self-discovery ability of OPC UA allows an HMI configuration to navigate into a PLC configuration to obtain the desired data, with all scaling and properties inherently available in a standard format. OPC UA also supports the concept of hierarchy, which can be used by careful designers to keep the data organized in useful arrangements, much like a folder-based file system on a PC.

Contextualization enables an aggregation server to centralize the information for one or more areas of an industrial automation site. It can then serve this information to many clients for use by visualization, analytical, historian, and other applications.

Each client need only point to the node encapsulating all the needed information because the supplementary data is delivered in a structured format where data variables and properties are separated by references that define the relationship between them. This flattens the automation hierarchy to some extent and makes meaningful data available to each key stakeholder at their fingertips.

Object-oriented techniques are an organizational feature that can be used to formulate an information model and convey meaning in a standard format. For instance, a construct could represent the inlet and outlet temperatures and pressures of a pump.

Using object-oriented concepts, designers can develop best practice configurations that can be reused. Not only that, the concept is expandable such that objects can also refer to and be assembled from other objects. Object-oriented design therefore improves efficiency and consistency.

Along with exposing information, an OPC UA server provides clients with a sophisticated set of services, including discovery services, subscription services, query services, and node management. It allows users to create object models that any client application can consume easily.

Platform Independence

OPC UA was created to remove the limitations imposed by OPC Classic, including dependence on Microsoft technology, and to address emerging requirements for security, communication across firewalls, and support of complex data structures. This allows distributed applications running on variety of platforms including real-time operating systems such as VxWorks or QNX prevalent in Level 1 real-time deterministic high-speed PLC/PACs to communicate with Level 2 systems in a seamless fashion

TSN is next level technology

Time Sensitive Networking (TSN) is a development supplementing standard Ethernet in the areas of Quality of Service (QoS), including bandwidth reservation, as well as synchronization. TSN enables determinism, security and the concept of guaranteed bandwidth crucial for demanding industrial applications while converging various standard and real time protocols into a single network. Using OPC-UA over TSN is an obvious evolution in industrial automation space to get the best of both worlds—contextualization, even more security, and guaranteed bandwidth.

OPC UA built for Industry

Designers are faced with many protocol choices when it comes to industrial automation connectivity, even though physical Ethernet is so prevalent. Sometimes they are constrained by the physical networks or digital protocols compatible with selected devices. However, modern architectures for plant-level networks demand that any communications be secure, contextualized, and object-oriented.

These exact features are built into OPC UA. The security provisions follow proven IT concepts. Contextualization is the key to transporting raw OT data to many different higher-level IT/OT systems with a framework of supporting information. Object-orientation promotes consistency and efficiency, and compatibility with the latest programming languages. Combined, these benefits make OPC UA the industrial automation communication protocol of choice.

Vibhoosh Gupta, ***Emerson.***

Building a future-proof data processing solution

Developing efficient, reliable, and maintainable data handling as part of an IoT solution presents challenges. System integrators looking to deploy IT solutions in the Industrial IoT world are faced with requirement specifications and customizing these applications to suit specific industrial automation (IA) requirements.

MOST INDUSTRIAL INTERNET OF THINGS (IoT) discussions have been about connecting new devices and rapidly bringing them online. But with the implications of bringing such a large number of devices online, namely the need for efficient methods to collect information from these devices, the question is how to handle the large amount of data collected from these devices.

Industrial IoT solutions are judged on their ability to adapt to various data acquisition needs and how they can transform the data collected from devices into useful business insights that can help decision makers. What makes an Industrial IoT solution truly stand out is the flexible data handling possibilities that it can provide.

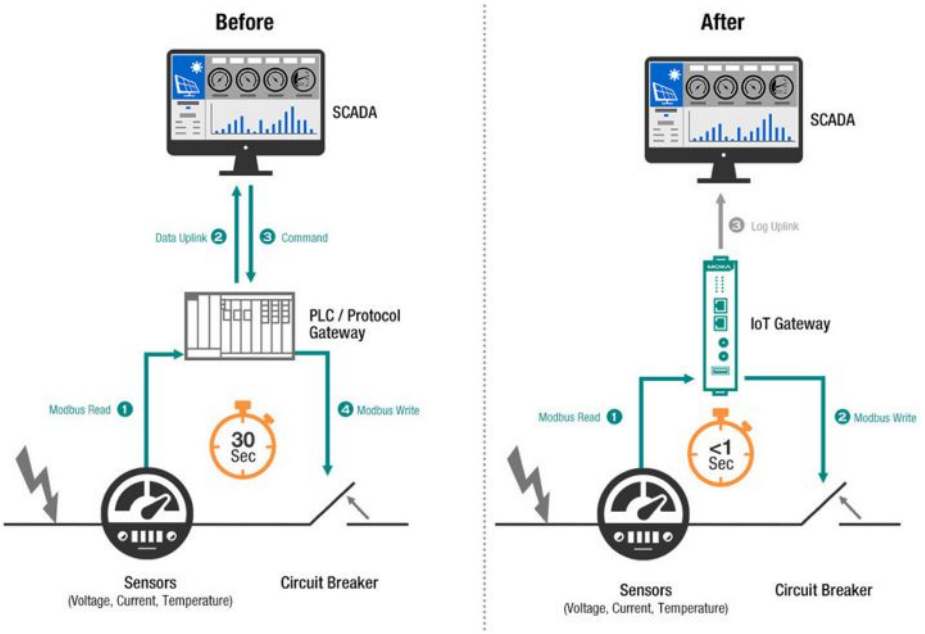
However providing efficient, reliable, and maintainable data handling as part of an Industrial IoT solution presents significant challenges because of the very nature of data-management solutions that exist today, which are designed mainly for information technology (IT) applications. System integrators looking to deploy IT solutions in the Industrial IoT world are faced with complicated requirement specifications and have to spend a lot of time and money customizing these applications to suit specific industrial automation (IA) requirements.

In the following sections, we will discuss some of the key challenges of converging IT solutions with the Industrial IoT.

Customizing apps for Industrial IoT

Most solution integrators are not familiar with the various fieldbus protocols used by field devices in industrial automation. They typically end up deploying standard data management solutions that can cater well to IT applications but cannot support the data-acquisition, storage, processing, transmission, and data-analytic needs of industrial automation solutions.

Furthermore, the solution integrators might not have the necessary skills to customize these data management solutions for the needs of the Industrial IoT. A customized solution that can fill the gap between the IT and IA applications is required. IT experts, who are oriented more towards the needs of business applications, need to be trained on the critical requirements of industrial applications so that they can build data solutions that are a good fit for Industrial IoT solutions.



SOURCE: MOXA

An intelligent IoT gateway or an intelligent edge device results in faster decision making. A centralized architecture where data is sent to the SCADA system for processing does not provide the fast response time that is required.

Customized Industrial IoT solutions

It is common knowledge that any customization of controllers, data loggers, and routers requires huge investments of time and money. Embedded computers are highly customizable, but you have to build what you need from scratch.

An intermediate solution that combines the capabilities of a controller, data logger, router, and customized software will significantly shorten the time-to-market. Such a ready-made solution will allow you to focus on your core competencies rather than build a customized solution.

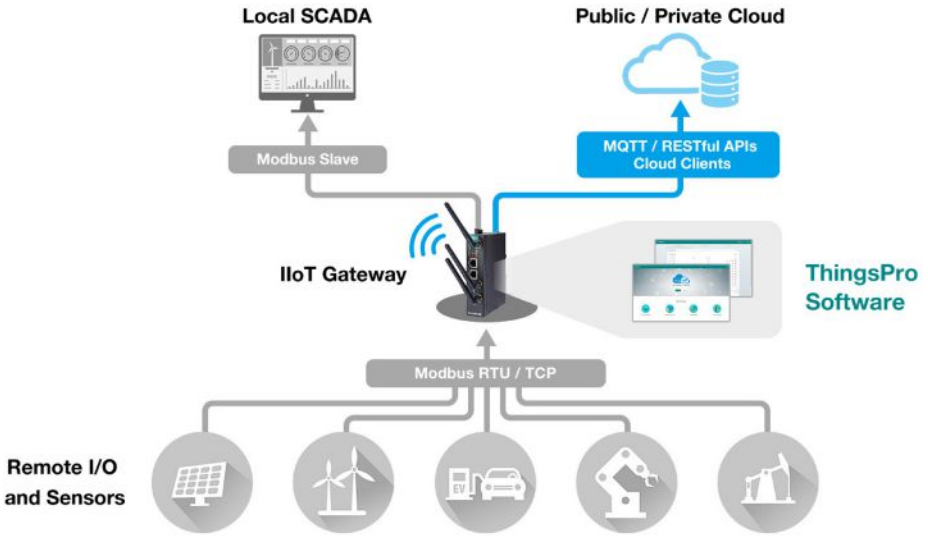
Easy-to-use GUI for data acquisition

A configurable easy-to-use GUI (graphical user interface) for data acquisition, which allows an IT expert to handle the popular Modbus protocols in industrial automation applications without the need for any additional programming will take the pressure off of the field engineers who can focus on the tasks that they are good at.

Seamless integration of data

Edge devices are deployed and used every day to fill the information gap in the field. These devices operate based on different Modbus protocols or may sometimes use proprietary protocols. The deployment of these edge devices is widening the boundaries of a traditional enterprise into spaces that were never before imagined. Centralized data management systems must be able to integrate disparate data types from these devices and add the relevant contextual dimension to the data to create a unified view of the operations for effective system management.

The volume of data that is generated by the edge devices is growing exponentially. Industrial IoT solutions must include a strategy to handle such large volumes of data. Industrial IoT applications should have the built-in ability to respond locally to a field alert and take corrective action at the device end to enable faster response time instead of transmitting data to a centralized data management system. The process of transmitting data to a centralized system for processing could take up to a few minutes, which could be too late if it involves data relating to critical industrial processes.



SOURCE: MOXA

Modern solutions combine the capabilities of a pure computing platform coupled with a data logger and LTE router.

Local intelligence & edge computing

One strategy to achieve faster response time is to deploy Big Data solutions, which are expensive and require skilled personnel. Alternatively, you can process data locally either in the IoT gateway or at the device-end and make decisions locally, which is much faster. Then, only critical data needs to be sent to the central system after data is processed locally. Solutions that support such local intelligence will also help in reducing the data load on an industrial network.

On-demand communication

An Industrial IoT Gateway is a critical component of an effective Industrial IoT solution. The gateway is used to mass-deploy devices at the field site, acquire data from these devices, and route this data on demand to the central system, to other devices, or to a remote site. However, the complexity of routing heterogeneous data in a network and the stability of the network link might hinder the progress of your solution deployment, and create bottlenecks for remote data transmission.

An IoT solution that can simplify data acquisition from devices that use the most popular Modbus protocols and route this data using built-in 4G LTE communication capability will enable efficient, on-demand transmission of data, and faster response times.

Developing future-proof solutions

Keeping in mind how rapidly the Industrial IoT field is changing, a scalable solution that can adopt and implement a new technology will give you good returns on your investment. For example, if your service provider decides to upgrade to a newer technology like 4G LTE, substantial changes in your network infrastructure might be required to maintain basic connectivity. Older communication standards such as 3G may no longer be supported and you will have to upgrade to the new technology.

As more and more service providers jump on the 4G LTE bandwagon, the sooner you adopt this new technology the better off your business will be. Rather than wait for the change, a better solution would be to proactively seek out systems and solutions that are future-proof or require minimum change to adopt or support newer technology.

Embracing new technologies has the potential to provide substantial gains and make your system work in more efficient ways than you might otherwise have imagined. Your Industrial IoT solutions can benefit immensely from the following new features:

- Built-in packet routing and logging service for wireless networks
- LTE management support for smooth deployment and higher maintainability of devices
- MQTT support for machine-to-machine communication and to enable remote devices to communicate directly with the cloud
- RESTful APIs for data integration with other systems

Meeting challenges head-on

To understand the changing landscape of the Industrial IoT world, let us consider the example of a power utility provider. To maintain the stability of a power grid, the provider must often isolate or cut off connections with the sections of the network where a surge or an abnormality is detected.

This means that the sensor deployed at the location will detect an issue and then use the WAN to send an alarm notification to the centralized SCADA system, which in turn sends a signal to the circuit breaker in the affected area to isolate the section of the transmission network.

This entire process could take up to 30 seconds, which is too slow in the case of a power transmission grid. To prevent the situation from getting out of hand, the problem area must be isolated immediately. Local intelligence in the edge device, in this case the sensor, is very critical so that a signal to trip the circuit breaker when a problem is detected can be processed and sent immediately from the sensor itself.

This case illustrates a clear need for an intelligent IoT gateway or an intelligent edge device for faster decision making. A centralized architecture where the data is sent to the SCADA system for processing does not provide the fast response time that is required.

The power utility provider is also responsible for providing backup power to the consumers affected by a power outage. This means that a change in the state of the power transmission system should immediately trigger the backup generator located at the consumer's site to kick in and provide backup power. Once the situation is rectified, the sensor deployed at the backup generator should sense the change in status and switch the power supply back to the grid. This complete solution can be easily implemented using an Industrial IoT system consisting of an Industrial IoT gateway and sensing devices.

IIoT gateway software solutions

IT experts who have limited knowledge of industrial automation can use advanced software to master data-oriented Industrial IoT applications. Moxa's ThingsPro software technology provides a platform that eases IIoT deployments, so that system integrators can focus on their core competency to deliver solutions and services faster with minimum effort. IIoT gateway solutions can offer:

- Easy-to-use configurable GUI for data acquisition with the most popular Modbus protocols and with LTE-enabled routing capability
- Future-proof technologies for local intelligence
- MQTT support for a lightweight, asynchronous data exchange protocol in heterogeneous applications
- RESTful APIs for gateway configuration that take advantage of HTTP methodologies provide application flexibility and insight into IIoT gateway.

By providing a solution that combines the capabilities of the computing platform coupled with a data logger and LTE router, advanced software can save valuable setup time. The technology does this by handling the Modbus data acquisition and wireless management requirements, especially LTE, while at the same time providing with the flexibility to program applications and extend the capabilities of the IIoT gateway.

Johnny T.L. Fang, Product Manager, ***Moxa.***

Plantwide Ethernet architecture boosts performance & uptime

Panduit implemented a plant-wide network technology upgrade in its Costa Rica facility to achieve optimized uptime and productivity. A single scalable architecture, using EtherNet/IP standard networking, provided the flexibility, visibility, and efficiency needed to create a competitive manufacturing environment.

PANDUIT'S COSTA RICA MANUFACTURING facility was experiencing various challenges relating to its industrial network. The company's manufacturing equipment was running on legacy PLCs, which caused reliability and uptime issues.

In addition, the plant's network architecture had outgrown its originally planned scale and was creating challenges with upgrades and maintenance. Finally, network security was a major concern due to dated network security equipment and unmonitored access to the network on the plant floor.

To resolve these challenges, Panduit decided to implement a network refresh and transition plan for the Costa Rica facility. The best way to achieve this was to use the best practices and guidelines set forth by Converged Plantwide Ethernet (CPwE) employing equipment from Panduit, Cisco, and Rockwell Automation.

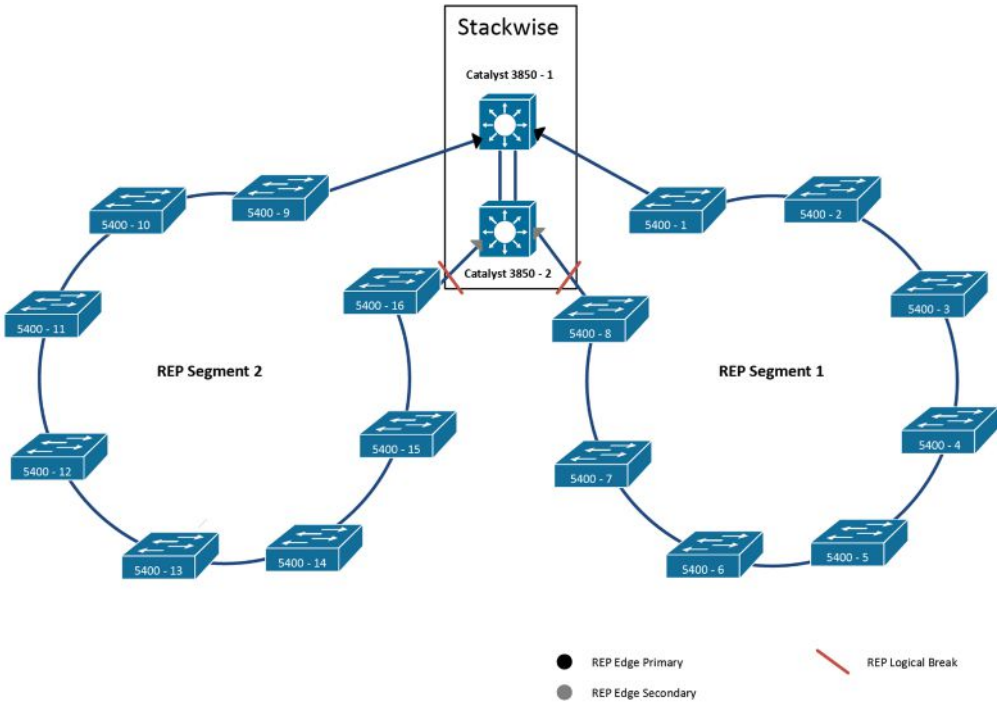
The Rockwell Automation Network and Security Services Group (NSS) was contracted to create the bill of materials for the network equipment and a transition plan required to best deploy CPwE. The Panduit team would implement the transition plan and integrate the new network equipment.

The transition plan would help the Panduit Costa Rica manufacturing facility achieve a more redundant and robust network infrastructure starting with the installation of brand new Allen-Bradley PLCs and network equipment.

As part of the network upgrade, the manufacturing equipment would be migrated off the old network and transferred to the new network.

This approach would separate the industrial network from the enterprise network to help protect the industrial network from downtime, while improving reliability in the process. It would also offer more scalability and maintainability.

Finally, hardened enclosures for the switches would provide improved physical security, while improved network architecture and equipment would provide upgraded logical security.



SOURCE: PANDUIT

To meet the demands of its network refresh and transition plan, the solution for the Costa Rica facility was to deploy a new Resilient Ethernet Protocol (REP) switch ring network.

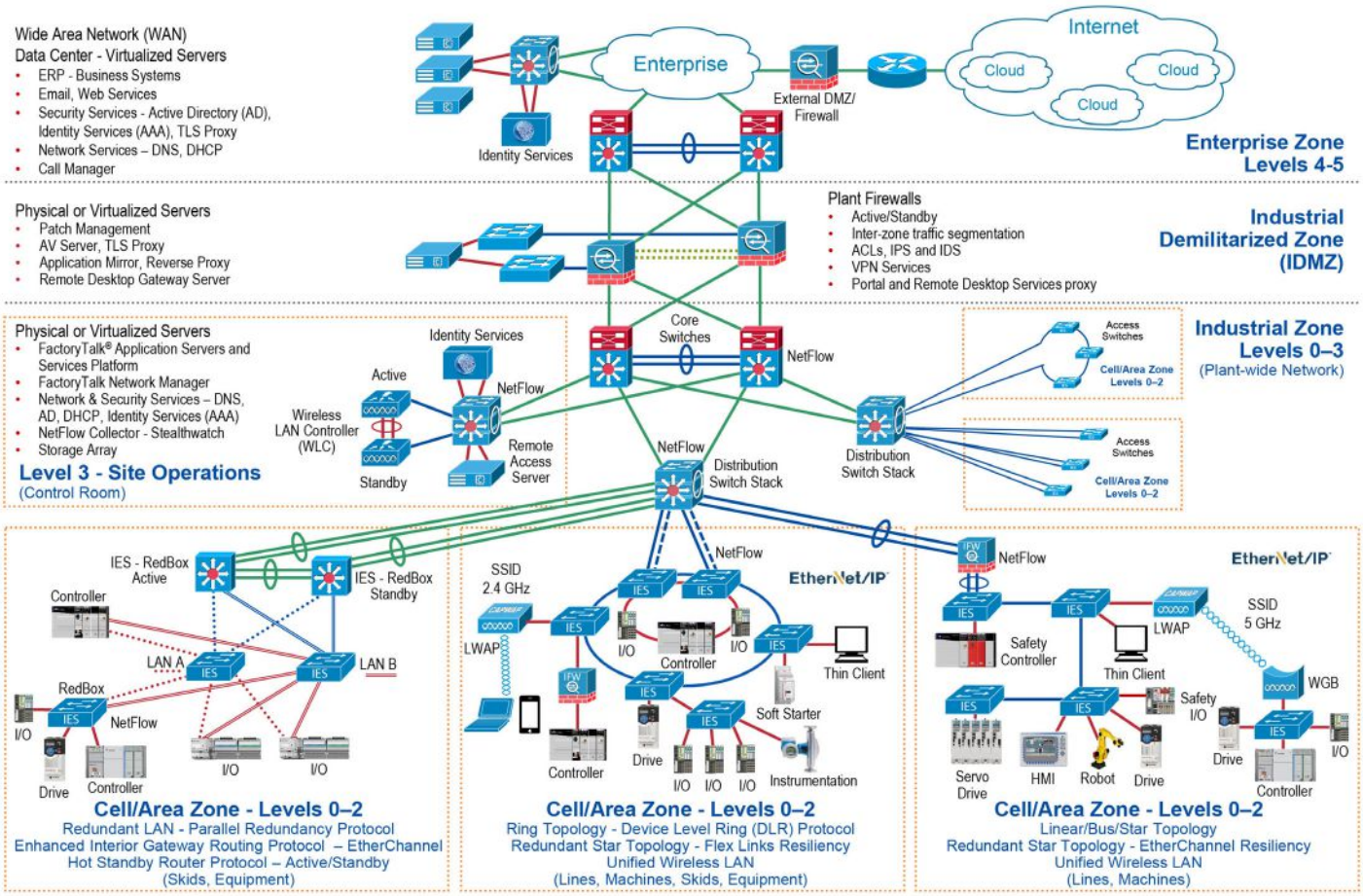
Strategic Objectives

The most important goal for this project was to deploy a secure and reliable industrial network to connect each machine/operation to the manufacturing execution system (MES) to gather data for the main production key performance indicators (KPIs). A dedicated, hardened, and secure network would demonstrate the value of the industrial network and it would allow Panduit to improve network uptime and production equipment availability.

Stratix 5400 Industrial Ethernet Switch.

Another essential goal was to provide a path for future network growth which would enable equipment expansions and enhanced data gathering to improve processes. This would enhance the company's ability to scale and upgrade the network, as needed, in the future. The improved data-gathering process allows for better and more consistent analysis of valuable manufacturing statistics.

"The CPwE deployment at our Costa Rica manufacturing facility has enabled a drastic improvement in our network reliability, scalability, and maintainability. This deployment is the template for all future network upgrades in our manufacturing facilities," said Mike Kimbrell, Manager IT, Panduit.



SOURCE: PANDUIT

Successful deployment of IIoT IACS application using a CPwE Architecture depended on a network infrastructure design that addressesd IACS application requirements.

Solution deployment

Panduit has a strong legacy when it comes to creating network and physical infrastructure solutions. In keeping with this standard, Panduit deployed a resilient plant-wide network architecture in its Costa Rica facility to increase overall plant uptime and productivity. The CPwE architecture provides standard network and security services to the applications, devices, and equipment in modern industrial automation and control system (IACS) applications and integrates them into the wider enterprise network.

Brought to market through an ecosystem of companies with experience in factory automation and networking, the CPwE architecture helps customers achieve the real-time communication and deterministic requirements of industrial control systems, including the reliability and resiliency required by these systems.

Successful deployment of IIoT IACS applications within CPwE Architectures depends on a network infrastructure design that addresses IACS application requirements. The content of CPwE, which is relevant to both OT and IT disciplines, consists of documented architectures and key tenets from OT and IT to help achieve reliable, secure and real-time communications to support IIoT IACS applications. CPwE key tenets include:

- *Smart IIoT devices*—controllers, I/O, drives, instrumentation, actuators, and analytics
- *Zoning (segmentation)*—smaller connected LANs, functional areas, and security groups
- *Managed infrastructure*—managed industrial Ethernet switches (IES) and industrial firewalls

SOURCE: PANDUIT

Panduit Pre-Configured IDF offered quick deployment and protection of the facility's rack-mount switches.

- *Resiliency*—robust physical layer and resilient or redundant topologies with resiliency protocols
- *Time-critical data*—data prioritization and time synchronization via CIP Sync protocol and IEEE-1588 Precision Time Protocol (PTP)
- *Wireless*—unified wireless LAN (WLAN) to enable mobility for personnel and equipment
- *Holistic defense-in-depth security*—multiple layers of diverse technologies for threat detection and prevention, implemented by different persona (e.g. OT and IT) and applied at different levels of the plant-wide IACS architecture
- *Convergence-ready*—seamless plant-wide integration by trusted partner applications

To meet the demands of its network refresh and transition plan, the solution for the Costa Rica facility was to deploy a new Resilient Ethernet Protocol (REP) switch ring network. Cisco Catalyst 3850 distribution switches and Allen-Bradley Stratix 5400 industrial Ethernet switches were used for the REP ring switches. The Switch Ready Network Zone System, Pre-Configured Industrial Distribution Frame (IDF), and fiber and copper connectivity and accessories from Panduit were also installed.

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SOURCE: PANDUIT

Switch Ready Network Zone System (PNZS) connects networking equipment to the plant floor. It includes copper and fiber connectivity, patching for the uplinks and downlinks, and a steel enclosure for reliability and improved security.

Two Cisco Catalyst 3850 switches were installed at the CPwE distribution layer. The Cisco Catalyst 3850 switch is the first stackable switching platform that enables wired plus wireless services on a single Cisco IOS XE software-based platform.

The single console port for Command-Line Interface (CLI) management reduces the number of touch points to manage for wired plus wireless services, which reduced the facility's network complexity, simplifying network operations, and lowering the TCO to manage the infrastructure.

Multiple Allen-Bradley Stratix 5400 Industrial Ethernet switches were installed to aggregate the IACS EtherNet/IP devices and to connect to the REP switch ring. The Stratix 5400 industrial Ethernet managed switches support Layer 2 and Layer 3 switching using a combination of Gigabit Ethernet (GE), Power over Ethernet (PoE), and GE fiber ports to help offer enhanced scalability. In addition, this industrial Ethernet switch offers support for dual media GE switch ring configurations, which enabled high performance network resiliency within the facility.

The Panduit Pre-Configured IDF was selected for quick deployment and protection of the facility's rack-mount Cisco StackWise Ethernet switches, which serve as the distribution switches. The IDF also helped achieve rapid and easy maintenance of network switch equipment.

Centrally locating the IDF, and therefore the switches, aided in establishing shorter fiber runs from the network core to the various Cell/Area Zones in the process areas. The facility used Panduit OS2 single-mode fiber patch cords and structured cabling. In addition, various cable managers were utilized to connect the Cisco distribution switches to the Allen-Bradley Stratix industrial Ethernet switches, which resulted in a well-managed, easy-to-maintain enclosure.

Tested and thermally verified by Panduit Laboratories, the IDF achieves 25% faster installation than a non-pre-configured IDF installation. The additional back-end space allows for 3X the cooling capacity over typical deployments for increased reliability. The optional AC units were used to ensure the optimal environmental parameters were maintained.

The Panduit Switch Ready Network Zone System (PNZS) allows for rapid deployment of the industrial networking equipment required to connect the plant floor. It includes copper and fiber connectivity, patching for the uplinks and downlinks, and a steel enclosure for reliability and improved security. It also includes power features to minimize engineering and installation time for faster implementation.

As an integral component of the end-to-end solution for industrial networks, the PNZS includes two industrial switches, 16 Category 6A STP copper patch cords and jacks, four MM LC fiber uplink patch cords with six adapters, redundant power supplies, and two Panduit maintenance-free 100W UPS devices.

The industrial network's backbone consists of OS2 single-mode fiber-optic cabling and enhanced Category 6A UTP copper cabling with Vari-MaTrix Technology.

Panduit OS2 single-mode fiber-optic cabling is an essential part of the Panduit end-to-end fiber-optic solution, designed to support today's data needs while meeting tomorrow's ever-advancing, advanced network requirements.

Panduit Category 6A UTP copper cabling with Vari-MaTrix Technology provides highly effective cable diameter and performance. The Vari-MaTrix tape minimizes the cable diameter and suppresses the effects of alien crosstalk while retaining UTP electromagnetic interference immunity.

This innovative cable design provides installation flexibility as cables are routed in tight bundles through pathways and spaces. In addition to the cabling, DIN Rail mounted patch panels were used for optimized cable management within the enclosures. The Panduit manufacturing team has observed a substantial increase in productivity through the enhanced performance of the new and improved industrial network. Upon the successful upgrade of the equipment and migration to the new network, outages (which were occurring far too often on the old network) have been completely eliminated.

In the previous six months before the network was upgraded, 17 outages had occurred. In the eight months since the migration, no network outages have been reported. This significant decrease in downtime has resulted in up to $500,000 cost savings per incident.

"The new CPwE network has provided us the stability and reliability that we need from our industrial network infrastructure to operate at full capacity. We have had no network issues since we migrated to the new network," said Elí Rodríguez, Senior Engineering Manager.

By using CPwE best practices, the Costa Rica facility now has a reliable, secure, and robust solution. Panduit's industrial physical infrastructure solutions aligned with CPwE guidelines greatly simplifies the design, implementation, and support of the new industrial networks.

This practice provides the best alternative with the lowest total cost of ownership. Collaboration helps customers address deployment complexities associated with plant-wide Industrial Ethernet and Industrial IoT Architectures. As a result, this allows customers to achieve a resilient, scalable network that supports proven and flexible logical CPwE architectures designed to optimize industrial network performance.

Application report by ***Panduit.***

Diagnostics for EtherNet/IP industrial control networks

The Standard Network Diagnostic Assembly is the first step in adding enhanced diagnostic capabilities to CIP devices. A standard structure provides a consisten set of diagnostic information in devices, with a goal of minimizing the messaging and user programming necessary to get the information to where it's needed.

AS THE NUMBER AND VARIETY OF NETWORKED devices continues to grow, and network installations gain complexity, there is a growing need for better diagnostics in industrial control applications.

It's well-known that the Common Industrial Protocol (CIP) has rich object models that provide information useful for many purposes, but the objects are typically organized by their functional role which results in the diagnostic data being spread throughout the various objects.

Clients can access this data through messages to the various objects, but it would be helpful if the diagnostic related data in each of those objects were accessible as a group and located at a well-known location in devices, in order to minimize the amount to messaging required to read them. Furthermore, it would be helpful if the content was discoverable by the client tool to account for the variability of device features.

This enables diagnostic analysis and prognostic systems to more easily utilize the data with minimal, if any setup and configuration by the user.

Big 12 Attributes and CIP Paths

Attribute	CIP Path (class/inst/attr)	Required?
Auto or Forced	F6/01/02, bits 2-4	Yes
CPU Utilization	05/01/11	No
Link Status	F6/01/02, bit 0	Yes
Port Speed	F6/01/01	Yes
Duplex	F6/01/02, bit 1	Yes
Ethernet Errors	F6/01/14	No
CIP Connections	05/01/05	No
TCP Connections	F5/01/16	No
HMI PPS	05/01/17	No
Connection Timeouts	05/01/08	No
Class 1/0 PPS	05/01/15	No
Missed I/O packets	05/01/18	No

SOURCE: ODVA

Enhanced standard diagnostics

Over the last several years, a roundtable of EtherNet/IP Implementers has been working on enhancing standard diagnostics for EtherNet/IP. The diagnostics working group within the roundtable has created a scope of work document that describes a framework for common diagnostics for EtherNet/IP devices and the work items needed to realize the framework.

The purpose of the scope of work document has been to:

1) Define common important terms and concepts related to EtherNet/IP diagnostics, to ensure a common understanding among project participants.
2) Define the essential problems that the diagnostic effort needs to solve, including specification of a set of high-level requirements that the diagnostic framework should meet.
3) Define use cases relevant to diagnostics.
4) Define the scope of the diagnostic effort.

This effort includes the definition of diagnostic structures for various object classes to create specification-controlled diagnostic content that client tools can access. These structures are then referenced in an Assembly object that is located at an assembly instance that is common to all devices.

This Standard Network Diagnostic Assembly with specification-controlled content means that tools can always go to a known object address inside a device to obtain a consistent set of diagnostic information, without needing to send numerous messages to different CIP paths within the device. This provides for consistent content, in different devices from different vendors, that's always at a common location.

The focus of the current work is to expose diagnostics related to the network health and device loading; also known as the Big 12 Network Diagnostics. However, this current work establishes the underpinnings that can support other types of diagnostic assemblies that can be utilized for more comprehensive diagnostics.

The need for diagnostics

There is a growing need for better diagnostics in industrial control applications. The IIoT phenomenon is bringing more and more devices to industrial networks. As the number and variety of devices grow, system complexity grows. As complexity grows, the need to more effectively manage these networks results in the need for information about the current operating state of the network. And when systems struggle to perform as they should, the diagnosis requires information from devices as well as the infrastructure that connects them.

It's well-known that the CIP Networks Library's rich object models provide information that is useful for many purposes beside the run-time exchange of control data. Specifically, many attributes of objects are reflective of device and/or system health. When analyzed in that context, this data provides insights into the device's current operation such as loading, whether its network interface is functioning properly, and indications of how the physical later is performing, etc.

By trending changes to these indicators over time, it's possible to discover potential system issues before the system degrades to the point of failure, thereby avoiding unplanned downtime. And when a system is experiencing problems, this information can

be utilized by the system troubleshooter to determine what's wrong and how to fix it.

Diagnostic challenges

There are several challenges with gathering diagnostic information in a control system. One is the amount of messaging needed. Today, diagnostic data is organized throughout various network related objects. This requires addressing different attributes in different objects with multiple messages. You must discretely read each one. For example, the data commonly referred to as The Big 12, is in ten different attributes of three different object classes. It requires 10 messages per device to retrieve them all.

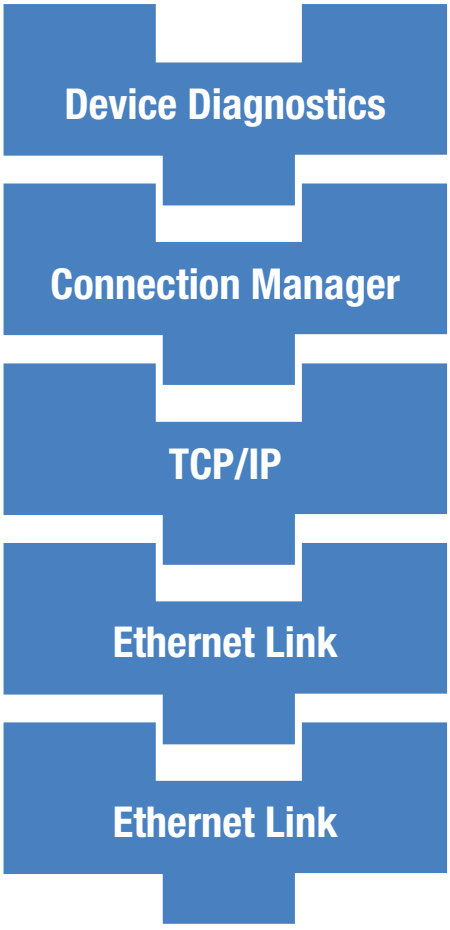
If you extend this across an entire system, it is easy to see that it will require a significant amount of traffic to gather all this information. So minimizing the required messaging is desirable.

Another challenge is variation between devices. Most of the system attributes are optional, which opens the door for different vendors to implement different subsets of these attributes. Knowing which devices implement which subset of the diagnostic attributes means clients need to know ahead of time, which attributes are supported and which aren't.

Furthermore, different features of devices such as number of ports, support for high-availability protocols, etc. have an impact on what network diagnostic data a device may have. User selections made when configuring a device can have similar impact. This requires clients to send unique message sets to different devices, which adds complexity, so organizing the data so its content is known is also desirable.

Customers are looking to spend less time dealing with network diagnostic data in control programs. A method that uses less messaging, is consistent across devices and where there's variations, clients can discover them more easily, is what they want. The work to create a Standard Network Diagnostic Assembly was originally developed by the Roundtable, and is now in the hands of several ODVA Special Interest Groups (SIGs). It addresses these usability features for network related diagnostics by making diagnostic data readily available in all devices that support it, at well-known locations, with content that is defined by the spec and discoverable.

Even though these concepts are being developed for network diagnostics today, they can be easily extended to other device, security and system diagnostics later. The concept is intended to provide the ability to create a scaled architecture where various object diagnostic data can be "plugged" together to create a diagnostic structure tailored to device's optional and varied features, as illustrated here. It's anticipated that future work will include definition of device level diagnostics that deal more with diagnosing the status of application-specific objects.



The Standard Network Diagnostic Assembly concept provides an ability to create a scaled architecture where object diagnostic data can be "plugged" together to create a diagnostic structure tailored to options and varied features.

Network diagnostic assembly

The goal for the Standard Network Diagnostic Assembly is to make it easier for diagnostic and prognostic analysis tools/systems to utilize data that is available in devices. It minimizes the traffic that's needed to read all the information. It provides consistency and where variability exists; it helps identify the uniqueness and simplifies the job of interpreting information. This minimizes user programming impact, application development complexity, and has a low impact on devices on the network.

One new item for CIP is the creation of assembly instances that are defined for all devices. These are intended to make it easier for clients to find diagnostic information in devices and to retrieve the information with one message request. There is a range of assembly object instances (currently reserved by CIP) being allocated for use as "globally defined" assemblies that can exist in any device, regardless of type. What's unique about these assembly reservations is that currently, assemblies in CIP are defined in Device Profiles, so this is the first profile-independent definition of assembly instances in CIP that have data applicable to any device.

The specification enhancements allocate 6 instances in the range of 0xD2-0xD7 for this purpose. These instances are being defined in Volume 1 of the CIP Networks Library, which is the volume that is common to all CIP network implementations. By doing this in the common volume, these assemblies can contain information about all network adaptations of CIP, and support devices like gateways and bridges.

The first instance in this range of assembly instances (instance 0xD2) is defined as the Standard Network Diagnostic Assembly. This assembly contains information about network health and device loading. Most of the diagnostic attributes used in this assembly come from the link objects associated with the network adaptations. For those familiar with the work that the Roundtable has been doing, this group of attributes for EtherNet/IP devices has been referred to anecdotally as "the Big 12 Diagnostic Attributes".

Some objects in the device that have useful diagnostic information are only present when optional network functionality like time synchronization and high-availability protocols are enabled, or when devices implement different network functionality. These have also been added to the assembly to expand the list beyond just the 12 items, along with rules for placement of these within the assembly.

In support of the objective of creating a pluggable diagnostics architecture, the specification establishes rules that deal with the variability of devices. This variability can be illustrated with a simple example. A device with multiple Ethernet ports with a configurable embedded switch, that is user configurable for DLR or two separate Ethernet ports. When configured for DLR, there will be one TCP/IP structure, two Ethernet Link structures and a DLR structure. When configured as two separate Ethernet ports there will be two TCP/IP structures, two Ethernet Link structures and no DLR structure.

Rule specifying the ordering of members, whether the various structures are required or optional, and how many instances are permitted are found in the definition of this assembly. Furthermore, the Member List (Assembly Instance Attribute #2) is limited, and the Member List is not settable like it is for Dynamic assemblies. These rules will permit clients to know what to expect in the assembly for any network configuration it encounters.

These rules for the Standard Network Diagnostic Assembly make it slightly different than most assemblies. They are similar to static assemblies, but have some characteristics of

SOURCE: ANALOG DEVICES

Member Content/Placement for the Standard Network Diagnostic Assembly

Object Class Diagnostic Structure	Placement in Assembly	Number of Instances Required
Member List Signature	1	1 indicates whether the Member List has changed
Ethernet Link	2	1 instance per EtherNet/IP capable port on the device
TCP/IP Interface	3	1 instance per EtherNet/IP port that has individually configured IP address settings
Connection Manager	4	1 instance
Device Level Ring	5	1 instance per pair of ports configured for DLR , omitted if no ports are configured for DLR operation.
Parallel Redundancy Protocol	6	1 instance per pair of ports configured for PRP, omitted if no ports are configured for PRP.
Time Sync	7	1 instance if the device is configured to support CIP Sync, omitted if the device is not configured to support CIP Sync.

dynamic assemblies as well. It is anticipated that a third type of assembly will be created in the specification to accommodate these differences. It's believed that this is necessary to permit the Conformance Test to develop the tests needed to verify the unique behavior combination.

The Member List Signature (Class 4, Instance Attribute #5) that appears in the first position of the member list. This is a new instance attribute that is being added to the Assembly object definition. The value of this attribute is managed by devices as a way to indicate that the member list has changed. The value is either calculated or predetermined by the device, based on the member list content. If upon reading this attribute a client sees that the value has changed, it knows it must read and process the member list before attempting to interpret the Data Attribute (Assembly Instance Attribute #3). If the value remains the same, then the Data Attribute can be read and interpreted as it was previously. As a part of the Member List, the Member List Signature will be the first item returned in the Data Attribute so that the client receives both the signature and the content, in context. Therefore, by simply reading the Data Attribute, a client can easily detect changes in device configuration that have impacted the content of the assembly.

Standardized diagnostic data

Diagnostic data comes from attributes of objects. Recall from earlier, that not all the attributes are required in product implementations. This means that product developers are free to independently decide which ones to use and how to group them, if they are grouped at all. This results in variability between devices, which makes it harder for clients/tools that want to make use of the information to interpret the content.

Consider two devices, both with a single Ethernet port, but differing with respect to which diagnostic attributes they provide to the network. If we provided a standard assembly but no content standardization, a client tool would have to know how to interpret the structure of data from each device independently. They would either require prior knowledge, possibly gained from EDS file constructs describing the structure, or by some means of querying the device for the necessary information.

EDS is a possibly useful solution to this, however the clients/tools that are harvesting this information today, typically do not have the necessary infrastructure to host EDS files for all the possible devices it may encounter. Many of the clients are envisioned to be handheld devices that would not have the capacity to accomplish this. To address this, the object definitions for some of the more popular network related objects in the CIP Networks Library are being updated to add a section for diagnostic structures. The structures will consist of the attributes from the class that are determined to be useful diagnostic information. Over time, it is envisioned that other objects will be updated with similar information. The determination of what is useful diagnostic information will be made by the SIGs that have responsibility for the object class.

The intent for the kind of information present in the diagnostic structures defined by the object classes is to convey several kinds of information about the device:

1) Values that, when they change, indicate there is a problem with the device that needs attention or that a previous problem has cleared or been corrected. For example, a Link Down indication for an Ethernet port, or the Connection Timeouts value.
2) Values that indicate the current device loading. So for example, things like the number of TCP connections in use, the number of CIP connections that are open, I/O packet rates, and CPU Utilization, just to name a few.
3) Values that are generally static like device settings, capabilities attributes, etc. and values that are constantly changing, like I/O packet counts, are not intended to be part of these structures.

An example that illustrates a typical structure is shown in below. This example comes from the Connection Manager object showing the items defined for that object class that meet the criteria for diagnostic information presented earlier.

Note the members are aligned so that 32-bit members align on 32-bit boundaries, and the overall structure is padded to a 32-bit boundary. This was discussed previously with respect to the overall assembly structure, but the alignment starts here in the structure definition.

Another important feature of diagnostic data is the ability for a device to convey information about the data that can be used to determine acceptable range, provide default values, scaling and help text. In CIP, this kind of "metadata" is provided for by using Parameter Object instances in the device. Parameter objects are designed to provide this kind of information about the attribute it refers to, so that clients can use this in creating user interfaces to the attribute value. EDS files can also provide this, but the desire is to not require EDS for this, as discussed earlier.

In order to accommodate this need, object classes implementing Connection Points will have available, a new CIP Common Service that will allow a client to obtain the list of EPATHs to the attributes contained in the structure. The service will return an array of EPATHs to these attributes. For devices that chose to implement Parameter Object instances for these items, the service will return EPATHs to the Parameter Object instances that are associated with the structure members. This permits the client to learn more about the attribute and to provide more user-pertinent information about them. This service will be

optional, as is the use of Parameter instances.

Consider an example, where an analytics client has rules for interpreting a value of the Link Down attribute of the Ethernet Link object. When it finds a non-zero value for this attribute it can provide the user with a text string that comes from the Parameter instance that refers to the Link Down attribute. This string might direct them to the potential causes and remedies of a Link Down situation.

The Connection Point section being added to objects in the CIP Networks Library is described in Volume 1, Chapter 4 where all the general CIP Object Model requirements are described. Locating it in this part of the specification will generalize the definition of the Connection Points section for use by any object in any volume, potentially for purposes other than just diagnostic information. It also allows a way to establish uniform rules for how the connection point content is maintained. The Connection Manager, TCP/IP Interface, Ethernet Link, Device Level Ring, Time Sync and Parallel Redundancy Protocol object classes are being modified with Connection Points specifically for diagnostic purposes.

These diagnostic structures will be assigned an identifier. That identifier will be referenced using a CIP construct called a Connection Point. The Connection Point is familiar to most as a way to identify Class 0/1 transport connections for I/O data, however, the specification doesn't limit their use to that purpose. Connection Points are being applied here as a way to address this structure of information in the Member List (Assembly Instance Attribute #2) of the Standard Network Diagnostic Assembly. The EPATHs in the Member List will contain Logical Segments for the Connection Points instead of separately listing the EPATHs to all the individual Class/Instance/Attributes that make up the structures.

Diagnostic data structures

With standard content comes the need to manage how the content can evolve over time, because it's unlikely that the content defined initially will remain unchanged forever. Given the long service life of industrial products, it is likely there will be a mixture of older and newer devices on networks, and mixtures of older and newer clients. The specification enhancements will establish rules for maintaining and modifying these structures that clients can apply when using the data. Future modifications to the specification must follow these rules in order to achieve forward/backward compatibility, and provide for future needs that are not necessarily known today. These rules are summarized here.

Clients must: (1) use the connection point and the size together, to determine the content of the structure; (2) interpret only up to the size they know when they encounter a connection point larger than they understand and; (3) expect and accommodate a mix of new/old servers.

These rules establish client behaviors, to allow for extending and modifying the structures over time, as the need arises.

Furthermore, future modifications to the structure definitions in the specifications must follow certain rules designed to aid in future extensibility. These rules are: (1) existing connection points can only be extended by adding members; (2) when a structure definition is extended, the size of previous version(s) must be maintained in the structure definition so that clients know all the valid size(s) for a given connection point; and (3) members of an existing connection point cannot be removed/replaced. If this is necessary, then a new structure with a new Connection ID must be defined.

These rules are designed to keep older clients and older devices viable, as these structures evolve. There are also rules for devices to follow when implementing these structures, to assure that clients can understand the content of the structures. These are: (1) if a device implements a structure, it implies that the device supports all members defined for that structure, even if the attributes themselves are defined as optional or conditional in the object definition; (2) implementations are not permitted to omit or replace with fill bytes, any member of the structure; and (3) implementations may not add any other members to the structure.

Diagnostic profiles

Something that is in the scope of the diagnostics working group in the Roundtable, but not part of the work to add the Standard Network Diagnostic Assembly, is the concept of Diagnostic Profiles that specify certain level(s) of required implementation of diagnostic capabilities. The profile(s) is designed to promote interoperability, by establishing basic levels of implementations for devices. The profile(s) will dictate what diagnostic content is required and what is optional in devices, which will guide product manufacturers toward implementing consistent features. This profile will also provide testing criteria for the Conformance Authority, which opens the door for ODVA to potentially verify the elevated level(s) of functionality.

It is anticipated that the Standard Network Diagnostic Assembly would be the base level of diagnostic profile with other levels developed later to include things like diagnostic event logging, product application diagnostics, user configurable diagnostic events, high/low water marks, logging, time stamping, etc.

Summary

The Standard Network Diagnostic Assembly is the first step in adding enhanced diagnostic capabilities to CIP devices that includes scalable diagnostic content that accommodates the feature variations in devices.

The Roundtable of EtherNet/IP Developers set out to define a standard network diagnostic structure that provides a consistent set of network diagnostic information in devices. The goal was to minimize the amount of messaging and user programming necessary to get the information to where it's needed. The structure defined is extensible to account for device variability, and is located at a well-known and consistent location in all devices, so tools know where to get it.

Raymond Romito, Business Development Manager, ***Rockwell Automation.***

Standardized Diagnostic Content for Objects

Attributes in Device 1	Attributes in Device 2
Auto or Forced	Auto or Forced
CPU Utilization	---
Link Status	Link Status
Port Speed	Port Speed
Duplex	Duplex
Ethernet Errors	---
CIP Connections	CIP Connections
TCP Connections	TCP Connections
---	HMI PPS
Connection Timeouts	Connection Timeouts
---	Class 1/0 PPS
---	Missed I/O packets

CAN bus deployment integrates industrial communications

CAN Bus provides both high-performance and high-security that can be used for common applications that require strict stability and safety, including the aviation industry, vehicular use, medical instruments, military industry, railways, robotics and critical control systems.

CAN IS A SERIAL BUS CONTROL PROTOCOL that features high flexibility and integration capabilities. Allowing workstations to be added to existing networks without needing to modify or adjust the hardware or software, it also provides high-level security and efficient control in real-time.

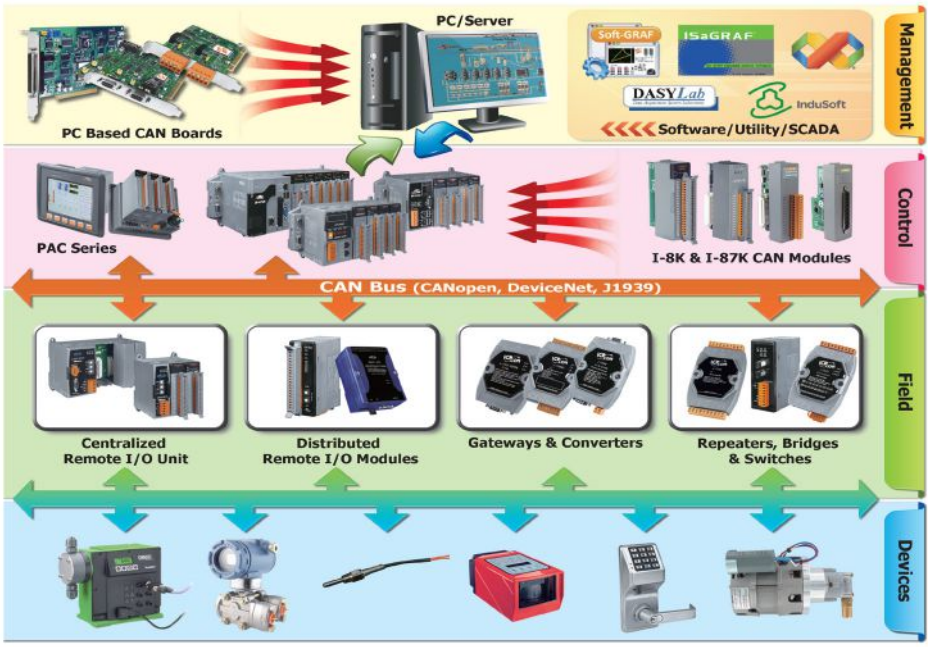
In the past, an RS-485 interface relied completely on the software mechanism. The determination of packet accuracy and prevention of packet collision was performed by the software program. In contrast, the CAN hardware features automatic error detection and priority determination. The security of network packets is checked by the hardware, which can complete multiple error checking operations in a very short time. Consequently, the transmission of a large number of network messages is more reliable and more efficient.

Multi-master support

The CAN Bus supports multi-master operation, making it the most efficient serial bus. Any device on the CAN network can actively send packets at any time. Such as the heartbeat packets from the device, real-time alarm packets, or other information.

This feature makes it more outstanding than other serial buses. CAN Bus utilization rate is very high, reducing unnecessary polling and removing the need to waste time waiting for acknowledgment packets, thereby speeding up the transmission of information and decreasing communication energy.

The CAN Bus is a serial communication bus system. That has high-level data integration capabilities, even in harsh environments that have extensive electrical noise interference. It also provides high fault tolerance and error correction abilities. The Bus itself features multi-master electrical characteristics, and its open architecture creates flexibility.



SOURCE: ICP DAS

A highly varied selection of CAN controllers, software and modules create solutions for a variety of application needs.

To keep pace with the ever-increasing sophistication of industrial technology and the pervasiveness of industrial automation, major equipment manufacturers and system integrators alike have adopted the CAN Bus as their core communication system. In the industrial sector, the CAN Bus is generally regarded as an integral component to the stability and security of any system.

In real industrial settings, a wide range of communications interfaces, including RS-232, RS-485, Ethernet, and CAN Bus, to name a few, are used by the majority of automation applications. To create a heterogeneous system, it is necessary to take into consideration the various interfaces, together with their distances from the Master device and the speed at which they operate, meaning that the combined communication performance and cost is difficult to estimate. To complicate matters further, integration issues and stability concerns are both very real and common. To resolve these difficulties, numerous types of converter and gateway devices are available on the market including those made by ICP DAS.

From its many years of experience, ICP DAS has produced hundreds of high-quality CAN Bus products. The CAN Bus converter can manage a range of transmission interfaces, meaning that more complex network structures are within easy reach. The ICP DAS CAN Bus converter serves as a solid foundation upon which many basic components can be built, including COM, USB, and Ethernet communications. ICP DAS has developed a series of DeviceNet/CANopen/J1939 products, including PCI interface cards, Fieldbus converters, PACs, gateways and remote I/O modules.

The technology provides complete hardware solutions to satisfy a wide variety of CAN-based applications that can effectively solve issues related to data acquisition and calculation, transmission distance extension, network topology limitations, communication interface transformation, and noise resistance.

ICP DAS also supplies a wide range of software tools, which can help you to develop

SOURCE: ICP DAS

Transparent communication functionality adds CAN communication functions to traditional UART devices.

SOURCE: ICP DAS

CAN communications over a local area network or the Internet creates support for remote monitoring and control.

complicated and customized control and monitoring systems more easily and quickly, including utility, APIs, demo programs, OPC, ActiveX, and third-party drivers. OEM/ODM services for specific projects help customers complete complex CAN-based projects.

CAN Bus to UART Converters

Technology benefits:

- Allows users to expand the communication functions of the CAN Bus on the host computer or PLC.
- Transparent communication functionality, adding CAN communication functions to traditional UART devices.
- Optical coupling isolation on the CAN side for protection.
- The I-7530-FT module is designed for the fault-tolerant CAN Bus (ISO 11898-3).
- The I-7530A-MR module supports Modbus RTU communication functions.

CAN Bus to Ethernet or Wi-Fi interface converters

Technology benefits:

- Provides multiple sockets to support the CAN Bus communication function in a local area network or the Internet, meaning that users can then perform remote monitoring and control.
- Supports transparent communication functionality, allowing the range of CAN communication to be extended.
- Module supports both the Modbus TCP and the Modbus RTU protocol.
- The ECAN-240 module contains two CAN communication ports, providing a wide variety of functions.
- Module is compatible with 802.11 b/g wireless transmission standards can transmit CAN data between the CAN network and the WLAN network.

USB to CAN Converters

Technology benefits:

- CAN device easily powered and controlled via USB on a PC for on-site usage.
- Optical coupling isolation on the CAN side for protection.
- Supplies APIs for use on various platforms to make secondary development easier and more efficient providing you with the flexibility to perform data collection and processing from the CAN Bus network.
- Module support for high-speed USB connections and two built-in CAN ports.
- Modules provide time-stamp functionality for each received CAN message, meaning that the time calculation for the CAN message will be more accurate.

CAN and Fiber Converter or Bridge

Technology benefits:

- Fiber optic communication is not only fast but also more resistant to interference from noise.
- Multimode fiber converter can be used in signal isolation and signal reconstruction applications.
- Optical coupling isolation on the CAN side for protection.
- A single-mode fiber bridge allows two CAN network operating at different Baud Rates to exchange data with each other, and extends the communication range of CAN Bus.
- Module support for up to 60 km of fiber, meaning that long-distance communication is no longer difficult.

The CAN Bus has been adopted in a wide range of industries, including aviation, electric vehicles, solar energy, wind power, elevator systems, building fire protection systems, environmental monitoring, warehouse automation, and redundant control systems.

CAN Bus Applications

Battery exchange station for electric motorcycles: The battery exchange station uses the PISO-CAN200U module to monitor the charging information, including the battery temperature, SOC, and charging current, etc., for all batteries. It can record the time the battery has been in use, as well as the number of charge/discharge cycles for each battery, and then calculate the remaining battery life and provide a battery health score, so that the motorcycle owner will only receive a battery that is in good health, rather than a battery that is about to fail or is in an unstable condition. Typically, the motorcycle owner will exchange batteries at the exchange station if the battery still has residual power. This system also offers a smart charge approach based on the actual amount of power consumed. Bad batteries can be directly recycled.

Production/inspection of LCD panels: LCD glass plays an essential role in the entire production process of LCD panels, and the yield of glass substrates is even more important. The design of this system focuses on checking whether the glass has bubbles or cracks. A robotic arm uses a Beckhoff PLC based on the DeviceNet communication interface together with a self-developed control program. The PISO-DNM100U controller is a perfect selection for use as a DeviceNet master device, utilizing only a small amount of CPU resources to achieve real-time control requirements, thereby improving product yield and system stability, together with excellent scalability.

ABS/ESP and Train-aided radar systems: The I-7540D-WF controller can be used in conjunction with ABS/ ESP system data and assisted driving radar functions. Mobile devices such as the iPad/iPhone (iOS), Android, and others can be used to connect to the system via Wi-Fi, and the controller will transform the information provided by the CAN Bus signals and forward the data to an ABS/ESP or assisted driving radar system.

IC Inspection Machines: An IC inspection process is necessary for good quality control. Though PLCs are cheap and stable, IC inspection is a difficult task for a PLC. If you use a camera on a PC in conjunction with a PISO-DNS100U to perform the IC inspection, you can then employ a PLC to control the mechanism used to reject defective ICs. After completing the inspection, the PC writes the result to the PISO-DNS100U. Because the PLC is used as a DeviceNet master, it can easily retrieve the information from the PISO-DNS100U via a DeviceNet network.

Energy Storage Systems: This system improves the usage efficiency of electrical power. During off-peak time for electricity use, unused electricity is stored in batteries. During peak time, these batteries then supply power to the electricity grid. In this system, two I-8120W modules are utilized, with a single VP-25W1 device inserted in each subsystem. The first is used to obtaining the status of the battery, and the other is used to transmit the data to the XP-8341 module, which then transmits the status information to the PC via the Ethernet and controls the charge time using a breaker.

*Technology report by **ICP DAS.***

Hybrid power systems rely on synergy of sun and wind

Belectric in Dresden, Germany, offers customers sophisticated hybrid power plants, leveraging its diverse expertise in solar generation, wind and PV energy storage. Systems are coordinated by an energy management system that uses advanced automation control technology and POWERLINK communication.

WHEN CLOUDS ROLL IN AND BLOCK THE SUN, the feed-in power of a photovoltaic system can drop by more than fifty percent. And when the air is calm, there's no wind power to be generated, no matter how urgently it is needed.

So what could be more natural than to combine the two systems in a way that each compensates for the other's weaknesses to feed our power grid a reliable supply? The developers at Belectric in Dresden, Germany, recognized this and now offer sophisticated hybrid power plants. Additional battery storage together with B&R automation technology and POWERLINK communication provide the required stability.

SOURCE: B&R

View of solar installation. Hybrid power plant also integrates a PV system and two battery storage units.

Sustainable energy supply

As sources of energy, the sun and wind are both a blessing and a curse. They are inexhaustible resources which, thanks to continuous technological advancements, now play a crucial role in providing the world with an environmentally sustainable supply of energy with an acceptable balance of cost and efficiency.

At the same time, however, they are highly volatile and not responsive to fluctuations in demand. For utility companies, this means considerable infrastructural investments to stabilize the grid.

In the event of an oversupply of feed-in power, generation plants must be throttled or even taken offline. This is frustrating for the operators of these plants, because if they don't feed anything in, they don't earn anything either.

In the opposite case, any energy deficits must be compensated for very quickly by what are called peaking power plants. These operate primarily with gas generators and sometimes take a few minutes to switch on, which can be problematic with increasing feed-in from photovoltaic systems in weak grids.

Hybrid power plant

Having recognized these problems, the developers at Belectric Solar & Battery implemented a very clever idea. "The basic idea was to combine our competencies in the fields of solar energy generation and energy storage and thus stabilize the power grid," reports Lars Fallant, who supervises implementation of battery projects. This is achieved by combining a variety of sources, such as wind and PV systems as well as combined heat and power units together with a high-performance battery storage system.

These systems are coordinated by an energy management system that uses B&R control technology and POWERLINK communication. In combination with local consumers, this results in a local power grid that, if appropriately designed, operates autonomously for long periods of time – storing excess energy and feeding it into the grid on demand.

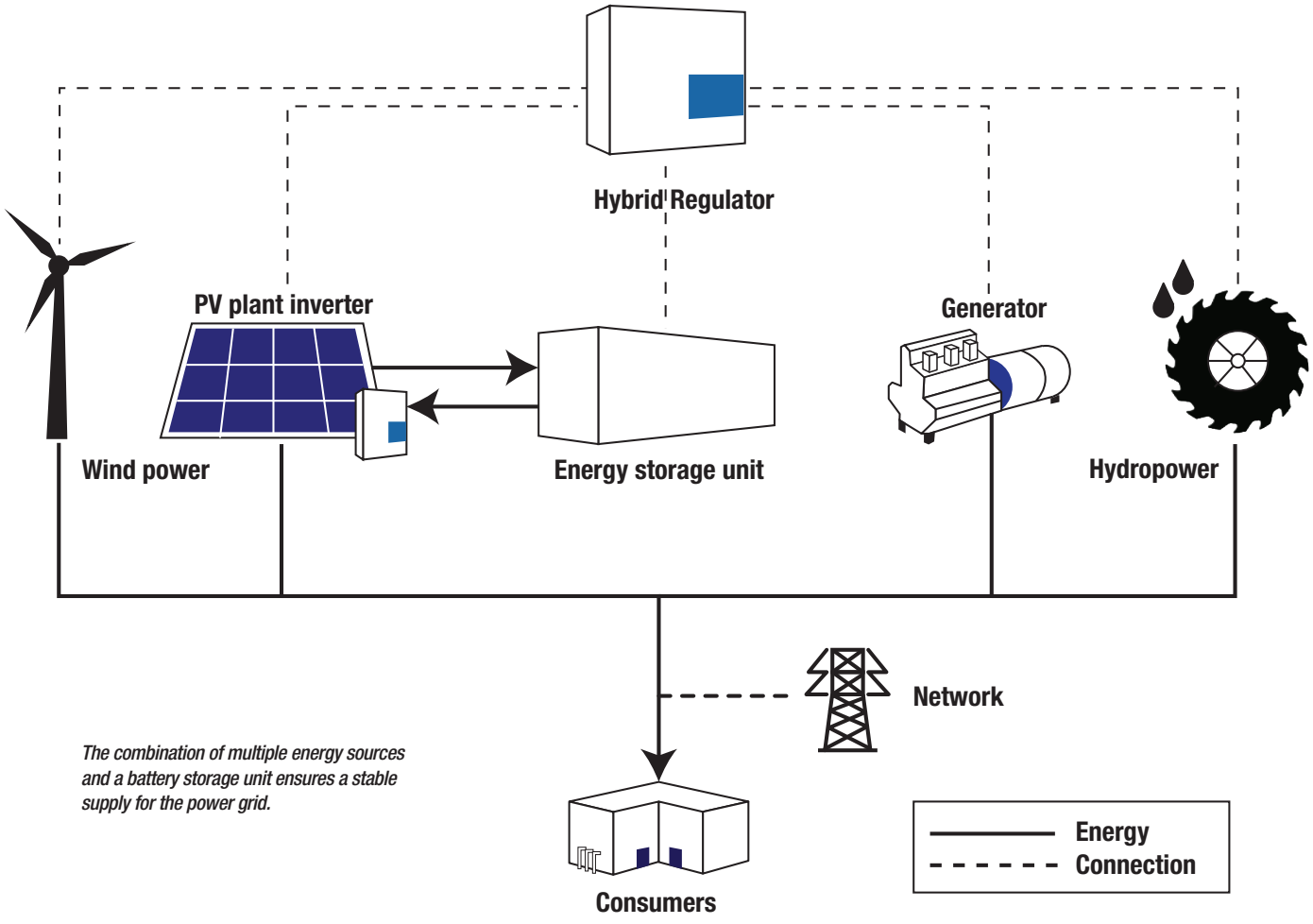
The PV plant of the future

This approach is vital to achieving sustainable energy targets, which is why eight partners – six companies and two research institutes – have joined forces to develop comprehensive technical solutions that equip inverters and other plant components to handle the heightened requirements.

It is no coincidence that Belectric's engineers are taking the lead in the research project to develop the photovoltaic plant of the future. "With this project, we also want to initiate the transition from generator-based to inverter-driven networks," explains Vincent Ackermann, who is responsible for the sale of battery storage systems.

Redundant control system

Even in the earliest stages of the project, it became clear that a standalone power plant is



SOURCE: B&R

The combination of multiple energy sources and a battery storage unit ensures a stable supply for the power grid.

very demanding on its control system. "With this approach, we are entering the field of system services," says Fallant. "Here, you need to switch to a redundant system within a few CPU cycles if the main controller fails.

When the hybrid system is responsible for the entire grid supply, every millisecond counts." At this point, the advantages of B&R's X20 controller range play a decisive role, because controller and network redundancy have long been part of their standard portfolio.

Integrated safety and security

It goes without saying that reliability and safety take high priority in the development of a power plant. On the one hand, the batteries must be safely ventilated and monitored, which requires safe control components for at least SIL 2. Furthermore, the fieldbus between the central and block controllers must be not only strictly deterministic, but also secure against external access. The developers found the components they needed for this in the B&R portfolio. Safety modules can be integrated into the functional system as required, and POWERLINK communication is fast, virtually jitter-free and – above all – secure.

Secure remote maintenance

"Our plants are completely autonomous and operate without on-site personnel," Fallant said, outlining another requirement. "That means we need to maintain a stable and, above all, secure data link to our plants." That's no problem with B&R's Secure Remote Maintenance solution, which is often used by Belectric.

SOURCE: B&R

Control cabinet for energy management and battery control system – featuring a controller, safety components and SiteManager.

Via an encrypted, certificate-protected VPN connection, data is transferred securely between a SiteManager unit at the plant (with an integrated firewall) and a GateManager unit at the operator's site. "This lets us forward all error messages directly to a service provider and access the system through a web-based HMI interface," Ackermann added.

94 MWh battery capacity installed

In addition to numerous battery projects implemented throughout Europe, one of the first hybrid plants is now up and running in Africa. There, Somaliland's ministry of information produces all the power it needs to operate its radio and TV station using a PV system with an output of 500 kWp and a 1,000 kWh battery. The auxiliary 300 kW diesel generator is used only at night and when the energy stored during the day is insufficient.

"With our next project, a combination of four 175 kW fast-charging columns with PV system and battery storage, we want to enhance the e-mobility infrastructure with a solution that reduces the load on grid connections," Ackermann added.

Application report by ***B&R Industrial Automation***.

More than 30 solar sites on one SCADA platform

New SCADA system developed at Ecoplexus provides better data access, improved efficiency, and lower costs. The company also now has a consistent "look and feel" for all its solar sites—in addition to lower costs, greater efficiency, more data, and improved data analysis.

SOLAR POWER IS GREAT FOR OUR PLANET. But it's not always as simple as one might think. For example, what if you're trying to manage more than 30 solar sites, all with different control systems and equipment? Ecoplexus, a leader in renewable energy, was in just that situation. But the company was committed to getting all its systems onto one platform. With the help of system integrator NLS Engineering, Ecoplexus was able to accomplish its goal. Now, the company has a consistent look and feel for all its sites—in addition to lower costs, greater efficiency, more data, and improved data analysis.

Ecoplexus provides a range of professional services for all stages from development to ownership. It has offices in the United States, Mexico, Japan, South Korea, and Vietnam, and its sites produce 365 MW of power. Another 420 MW are in construction or backlogged. Projects in development could add another 3,600 MW.

NLS Engineering has completed more than 1.5 GW of utility solar SCADA design, programming, and commissioning in the United States and Canada. The company focuses on supervisory control and data acquisition (SCADA) for renewable energy.

Ecoplexus needed a standardized, customizable SCADA system that could handle large solar and energy projects while also providing deep data acquisition and analysis. The company had a fairly tight timeline for bringing existing sites onto the single system, and it also needed the kind of data access that would appeal to potential buyers of its sites.

SOURCE: INDUCTIVE AUTOMATION

Ecoplexus has 35 systems in operation, and needed a way to monitor and operate those sites remotely.

NLS provided all this and more with Ignition by Inductive Automation. Ignition is an industrial application platform with tools for building solutions in SCADA, human-machine interface (HMI), and the Industrial Internet of Things (IIoT).

SOURCE: INDUCTIVE AUTOMATION

Previous data acquisition systems didn't provide the visibility, richness and robustness of the data needed.

"We have around 35 systems around the country," said John Morrison, senior vice president for U.S. operations for Ecoplexus. "We needed a way to monitor and operate those sites remotely, and Ignition is the tool that we use to do that. We just have to have data that other systems don't provide. We've had previous data acquisition systems, but they didn't give us the visibility we needed with the richness and robustness of the data necessary to really operate these farms well."

Unlimited licensing saves money

NLS Engineering brought in Ignition in part because of the software's unlimited licensing model; there are no extra costs for additional sites, tags, users, devices, or projects. And the software was easy to integrate with numerous disconnected sites.

"Before the project, Ecoplexus had various data systems from a wide variety of vendors," said Michael Crawford, vice president of operations at NLS Engineering. "There was no consistency or standardization from an operations platform, and their ability to produce financial and performance metrics for prospective asset buyers was limited. Ignition was a perfect fit for this project in every way. The unlimited licensing model removed all the cost barriers, and the underlying technology platform made it really easy for us to customize the system to their exact needs."

The Ecoplexus portfolio had included an assortment of data acquisition system (DAS) providers. Standardization had not been possible, and the systems were not designed for a large-scale solar enterprise. The systems didn't have control capabilities and didn't provide the kind of deep-dive data analysis that Ecoplexus was seeking. For potential buyers, more site-performance data was needed. Financial analysis was also a must. With previous providers, costs for adding control capabilities and greater access to data were prohibitive. Ignition's unlimited licensing and open architecture proved to be a big improvement on all fronts.

"There are quite a few benefits we've recognized since moving over to Ignition," said Christopher Thomas, solar operations monitoring manager for Ecoplexus. "It allows us to bring all our sites under one solution and provides a level of consistency that is conducive to our performance analytics — and even to our monitoring applications because there is consistency across the sites. So, operators know exactly where to look for items, or for tags, or for analysis."

"This software seamlessly lends itself to templating and driving consistency and standardization across all assets," said NLS' Crawford. However, the software also allowed customization where needed. For example, HMIs were changed to better identify issues that Exoplexus wanted to call out. Also, the team created Investor View, which presents data in a manner more suited to a non-technical public.

SOURCE: INDUCTIVE AUTOMATION

Bringing all the sites under one solution provides a level of consistency conducive to performance analytics.

More data = more opportunities

NLS used the software to collect and present data once every second, allowing for a level of analysis that was impossible with the previous system, which only presented data every 15 minutes. And the unlimited licensing means Ecoplexus owns the data from its sites, as opposed to paying recurring monitoring fees for a proprietary system.

"Ecoplexus needs to do financial analysis of all their sites, which is heavily reliant on data," said McKenzie Santin, associate director of energy at NLS. "In a lot of cases that's not data they were getting adequately from their previous systems, so we've allowed them, through the software, to receive much more data. And they can store it in much higher frequency and store many more data points. And Ignition actually costs far less than their previous solutions. Even though it stores more data, faster — and has more tags — it costs them less than their other solutions."

The software also presents greater opportunities for new connections. "We've been able to integrate artificial intelligence into Ignition much more easily than other systems," said Santin. "Since the code is much more open, we're able to pull in data from many different sources. We're able to use MQTT and a lot more IoT-focused technology."

The end result is greater efficiency and lower costs. "This project has been really good for Ecoplexus," said Santin. "It's allowed them to consolidate their many different systems and it's actually reduced their long-term O&M costs by a very significant amount."

NLS was just as pleased with the results as Ecoplexus. In fact, NLS used this project as a springboard for the creation of a new product, nextDAS, which it can provide to other customers. NextDAS is a powerful O&M platform for projects in solar, wind, and battery storage. It provides key metrics, site dashboards, live and historical data, alarm summaries, device status, weather data, and more. The web-based interface can be accessed from anywhere in the world, with both desktop computers and mobile devices. NextDAS is available from NLS Energy, a U.S.-based subsidiary of NLS Engineering.

"NLS was a really great partner in our implementation of Ignition," said Morrison. "We had close to 30 existing sites that needed to be converted and needed to be converted fairly quickly. They were able to bring the software up to speed, and then help us get those retrofit sites in place. And as we continue to build sites, we'll be bringing those new systems in too."

SOURCE: INDUCTIVE AUTOMATION

Ecoplexus consolidated systems and reduced long-term operating and maintenance costs by a significant amount.

Application story by ***Inductive Automation.***

Looking at the world of cloud vendors: industrial edition

Automation vendors in the data storage business have enjoyed an advantage for years because their components, sensors and software applications generated the data. Now, software-led disruption is bringing a new set of expectations for cost and interoperability to the market for cloud storage and analytics.

MARC ANDREESON, CO-FOUNDER OF NETSCAPE and the venture capital firm Andreesen-Horowitz, wrote an editorial in the Wall Street Journal in Aug 2011 titled "Why software is eating the world." Andreesen-Horowitz was an investor in Facebook, Slack and GoodStory Data, so the firm knows about software and disruption. Here is the thesis of the article:

"More and more major businesses and industries are being run on software and delivered as online services — from movies to agriculture to national defense. Many of the winners are Silicon Valley-style entrepreneurial technology companies that are invading and overturning established industry structures. Over the next 10 years, I expect many more industries to be disrupted by software, with new world-beating Silicon Valley companies doing the disruption in more cases than not."

However, in the intervening seven years the industrial world—contrary to Andreesen's expectation—has largely missed out on the software-eats-the-world model. There hasn't been a major disruption in the industrial software market like Blockbuster losing to Netflix, or Barnes and Noble losing to Amazon.

Not yet, anyway, but that will end, soon.

Beginning last summer, software disrupting established vendors is coming to the industrial market. Google, Amazon and Microsoft have each announced their intention to provide data storage and related services to the oil & gas and other process industries.

To be clear, I'm not referring to cloud-based DCS implementations for real-time control or futuristic visions. I am referring to cloud-based data storage, analytics and management services for manufacturing data. Cloud vendors claim aggregating data will make it more accessible to enable digital transformation and cross-plant analytics, unlocking improved outcomes in insights and production. And manufacturing data is an important business for them. Manufacturing—per McKinsey & Company's 2011 report on big data—generates twice as much data as the next largest industry vertical (government).

One can see the focus of the large software vendors on industrial data at industry trade shows. For the first time in 2019 Google, Amazon and Microsoft all had a significant presence at IHS's CERA Week event, and they are hiring employees with oil & gas expertise

SOURCE: SEEQ

Is software-led disruption is setting new expectations to the market for cloud storage & analytics.?

to add their roster of existing employees with experience at GE, AVEVA and other vendors.

So what will happen as software eats the industrial world? What the software platform companies want is to provide cloud-based storage for manufacturing data. It's a big business, because "data has gravity." Whoever stores data is able to provide ancillary services such as data management, security and business intelligence services. Therefore, automation vendors who hold customer data hostage and try to keep it from other vendors and analytics solutions will be put under pressure to change their business practices.

This is less strange than it sounds because proprietary hardware and software, and partner programs that lock out any potential competition, are the norm in the automation industry with its vertically- integrated offerings. There is a reason that ExxonMobil invested in Lockheed to drive an open control system initiatives: systems aren't open today!

What else does disruption mean? For decades, industrial automation vendors have dodged the massive price decreases associated with data creation, collection, storage and computing achieved in consumer and IT markets. Now, price competition is coming to industrial markets, just ask Amazon CEO Jeff Bezos, who notably quipped "your margin is my opportunity". As an example, Amazon has claimed their announced, but not delivered, Timestream time series data services offering will be one-tenth the price of existing offerings. And pricing will be visible to all customers like all AWS service pricing, bringing transparency as well as price competition to the industrial automation market.

Finally, disruption will impact the model for automation vendors with respect to expectations for interoperability and openness among systems. The software world thrives on "co-opetition," which is a polite way to say, "I hate you but we're going to work together." Consider that AWS claims to run many more Microsoft Windows Servers on AWS virtual machines than Microsoft does on Azure. So, despite the fact Amazon AWS competes with Azure, AWS supports Microsoft customers. Similarly, Microsoft competes with Oracle in the database business, but cooperates with them in competing against AWS. Politics makes strange bedfellows, but it's nothing compared to the oddities of co-opetition relationships in the software world.

As an example of the difference between the industrial automation and software markets when it comes to co-opetition, consider single-vendor user conferences. The last thing you'd expect to see at a Rockwell event is an AVEVA product booth, or a Rockwell booth at an AVEVA conference. After all, they compete.

But when you visit the Apple App Store, you'll find Apple competitors everywhere. Google's Maps competes with Apple's Map application, Microsoft's Office applications compete with Apple's application and Spotify's music service competes with iTunes.

That is co-opetition, with software companies deciding it's better to hold some of the business than lose all of it when a customer goes elsewhere for a better user experience. And again, this isn't a hardware or manufacturing application issue at this point, it's a software company proposal to move data to the cloud for improved access and insights.

Automation vendors have enjoyed an advantage for years in the data storage business because their components, sensors and software applications generated the data. Today we are in the early stages of software-led disruption to the established order, with software companies bringing a new set of expectations for cost and interoperability to the market for cloud storage and analytics. The disruption begins now, but it will trickle through industry for many years, with waves of customer acceptance and adoption of software-based offerings.

Michael Risse, CMO and Vice President, ***Seeq Corporation.***

Transforming data into machine performance insights

Plant manufacturer Scott Automation relied on power supply and data acquisition technology to upgrade its newest line of palletizers. Machine components that generate valuable data can be visualized using a warehouse management system to gain valuable insights into machine performance.

SCOTT AUTOMATION IS A MANUFACTURER of high quality automation systems, and its core expertise is high end palletizers which automatically compile packages on load carriers. In order to meet rapidly changing market requirements and customer expectations, Scott relied on data acquisition technology to help transform its latest development, the PAL 4.0 palletizer.

SOURCE: SIEMENS

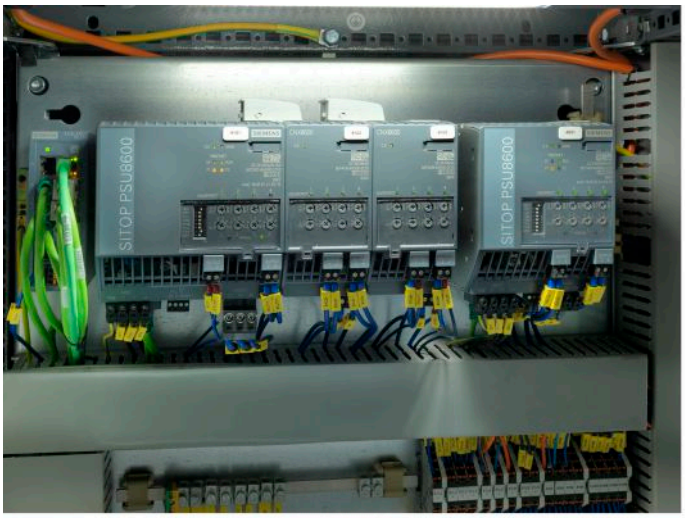
Scott Automation leveraged data acquisition technology in its latest line of palletizers.

Focus on digital transformation

The solution offers a higher degree of safety, flexibility and transparency, allowing Scott not only to capture the data generated by the plant but also to evaluate it and make it available for machine optimization. The power supply system from Siemens is also the only one of its kind to be completely integrated into the digital world of automation, fulfilling the company's aim of making its machines Industrie 4.0 ready.

"We're one of the few OEM (Original Equipment Manufacturer) companies worldwide that can offer reliable and safe, high capacity, multiline palletizing solutions," said Mathieu Vandevelde, Automation Engineer Manager at Scott. "With the PAL 4.0, we wanted to push the envelope even further in terms of flexibility and uptime."

In addition to this, Scott also wanted to make more use of the data produced by all the machine components. "Machine components can generate really valuable data. We were confident that, by visualizing that data and sending it to the warehouse management system, we'd gain valuable insights into the machine's performance," said Vandevelde. It quickly became clear that, above all, the power supply would be able to provide particularly important data which is why Scott decided to use Siemens Sitop PSU8600 power supplies.



SOURCE: SIEMENS

Integrating the power supply system into the digital world of automation allows Scott to make the plant Industrie 4.0 ready.

Two of the most important functions of the new technology are that Sitop supplies comprehensive diagnostic data and operational information from a wide range of sources via Profinet, the open Industrial Ethernet standard. In addition, the power supply system is completely integrated into the digital world of automation, supporting Scott in making its own plants Industrie 4.0 ready.

The Sitop PSU8600 is also completely integrated into the TIA (Totally Integrated Automation) Portal engineering framework. The data is therefore backed up and available on a central platform.

Big plans for the future

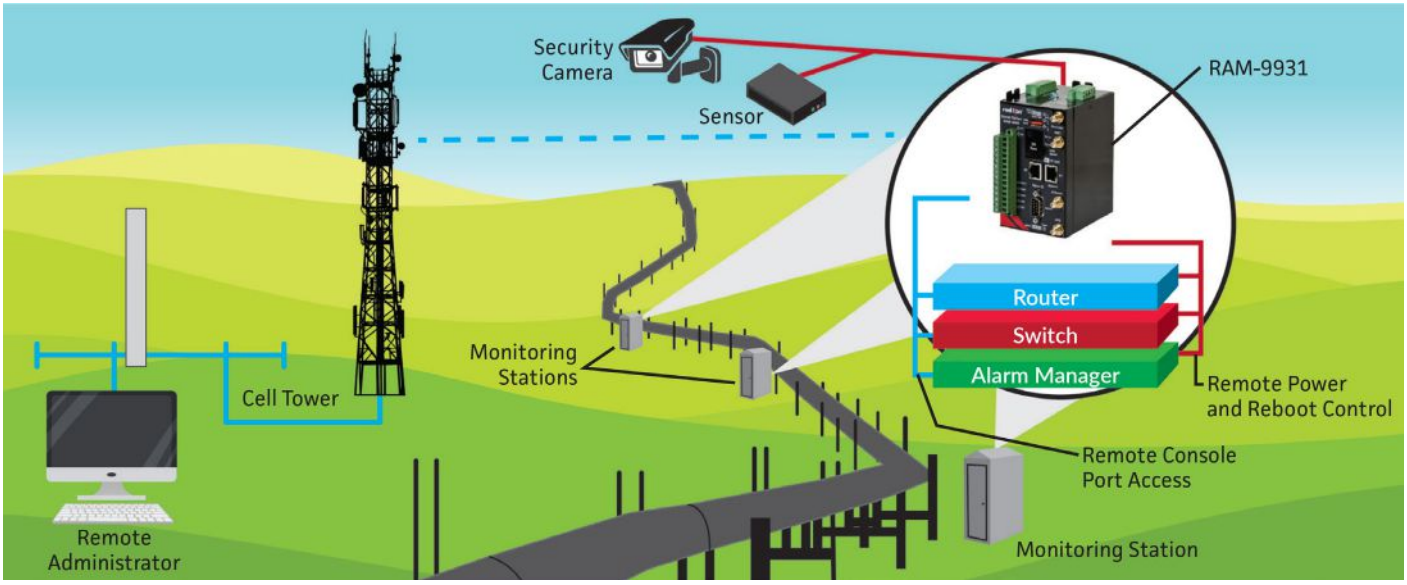
The Siemens technology also offers integrated safety functions and the option of programming the system remotely. In addition to the Sitop PSU8600, other operational components on the PAL 4.0 include a Human Machine Interface (HMI) panel Simatic HMI TP1200 Comfort Pro and other products from the Siemens portfolio.

"This project marks the first time we're using other components as well. The team has been very communicative, and we definitely look forward to integrating more Siemens components into our machines in the future," Vandevelde added.

Application story by ***Siemens.***

Overcoming an ineffective wireless radio infrastructure

A new remote communications system provides pipeline flow control and monitoring of municipal water supply and four pump stations. A combination of 4G LTE cellular communications, along with a multi-carrier cellular RTU with GPS and control, seamlessly monitors each RTU cabinet remotely.



SOURCE: RED LION CONTROLS

Illustration above shows modular cellular-based network with control at the edge. Equipment at remote sites connect to a cellular RTU, which has built-in processing capabilities. So if the network is unresponsive, the cellular RTU can still perform all control activities.

USE OF A MULTI-CARRIER CELLULAR RTU enabled a municipality operating an eleven mile pipeline to deploy a new system architecture for control and monitoring of its water treatment facility. A web-based event engine that can trigger I/O or send SMS messages based on real-time data for monitoring remote assets.

Definition of problem

Quantum specializes in delivering engineering and automation control system services for industrial and manufacturing facilities which often have challenges with geographically remote locations. No matter how remote, these industries depend on constant communication. For many years, the solution has been unlicensed wireless radio equipment either connected serially or via the Ethernet.

With the emergence of Ethernet-connected devices, certain wireless frequencies, including 900MHz radio communication, cannot support high-speed and high-bandwidth Ethernet traffic. These radios can only achieve a maximum data rate of 1024 Kbps, extremely slow compared to Wi-Fi (802.11) and 4G LTE data rates. Slow data rates can cause delayed communications, some which could be urgent like alarms, supervisory commands, and more. The challenge is complicated by repeater radios, inefficient PLC messaging schemes, flat networks and excessive polling rates.

This scenario is not ideal for critical applications that control and monitor equipment remotely. These limitations needed to be corrected by transitioning to 4G LTE or Wi-Fi wireless networks for a new, more robust wireless communication infrastructure.

For this specific project, a municipality operates an 11-mile pipeline, which crosses two other cities to deliver water to a treatment facility. Four pump station RTU cabinets sit along the pipeline, controlling and monitoring the flow of water.

To provide communications throughout the 11 miles, six 900MHz radios were in use to allow the individual RTU PLCs and water treatment plant to be in touch.

Since the initial communication process was put in place, urban growth has begun to affect the performance of the wireless carrier. Additional obstacles were also present, including a 650 ft. elevation difference between the first RTU and treatment facility.

Inconsistent and unreliable communication made it almost impossible to control the four pump stations remotely. The communication issues were critical enough that it represented a significant risk regarding water production and delivery. Quantum consulted with the city and recommended that the town move to a 4G LTE cellular network to communicate.

Communication solution

To enable the new communication system, Quantum leveraged the existing infrastructure while also infusing modern technology to solve the issues. This required the necessary 4G LTE equipment, working with a cellular provider, and deploying a new architecture.

Critical to this was the use of a multi-carrier cellular RTU with GPS and control. Red Lion supplied Quantum with a RAM 6000 cellular RTU. These RTUs have up to five Ethernet ports and a RS-232 serial port. The system uses a web-based event engine that can trigger built-in I/O or send SMS messages in response to real-time data. The device was built to perform advanced control and communications for monitoring remote assets.

Since Quantum implemented the new network, the city no longer has to worry about its aging and ineffective wireless radio infrastructure. They now have a dependable communication system that allows them to seamlessly monitor each RTU cabinet remotely. The city can now focus all its efforts on providing clean drinking water to its citizens.

*Application story by **Red Lion Controls.***

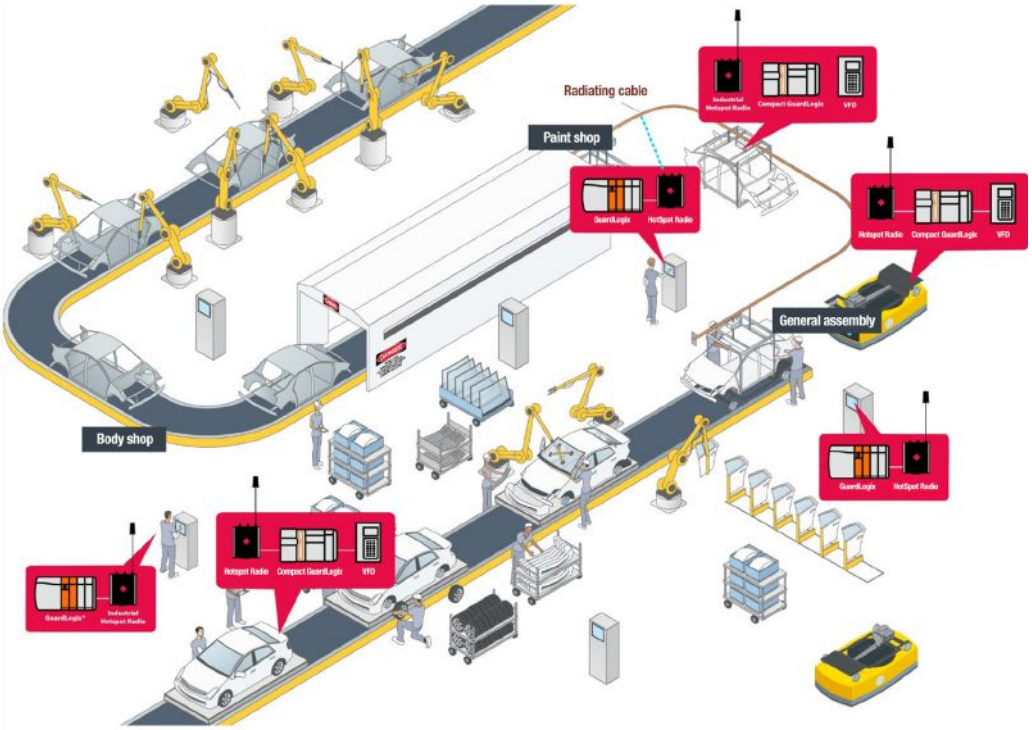
Fiat Chrysler conveyance system boosts production flexibility

A new conveyance system at Fiat Chrysler Automobiles utilizes a Compact GuardLogix controller, paired with an industrial hotspot radio to facilitates communication. The radios transmit control, safety, and diagnostic data from each carrier back to the traffic cop PLC, to ensure carriers are operating efficiently and effectively.

KEY TO ANY COMPANY'S SUCCESS is innovation and keeping up with the times. A major vertical that deals with this constantly is the automotive industry. Product needs abound from major sources. Consumers want the latest and greatest improvements to ensure value and safety, and having a great-looking vehicle is important for many people as well. Regulators around the world, meanwhile, can keep manufacturers very busy as they seek increased sustainability.

Multiply that constant innovation by 12 brands, and you get an idea of the lean manufacturing processes that Fiat Chrysler Automobiles (FCA) focuses on to ensure its long-term success. When vehicle models change each year, how do you stay on top of the trends while not losing sight of the bottom line?

In two of FCA's Midwest facilities, conveyance lines for three of the company's vehicles (Wrangler, Gladiator, and Ram) needed an upgrade to take stress off employees and better prepare for new models' requirements. The conveyance shepherding vehicles through the manufacturing process in General Assembly was the company's focus for the application.



SOURCE: PROSOFT

The new flexible conveyance system at Fiat Chrysler is ergonomically friendly for employee operators, and can be quickly adapted to new model changes.

"The top priorities in this project have been our employees and ensuring a flexible system as new models are designed," said Chen Subramanian, Facilities & Conveyors Group Manager at FCA. "Our workers were manufacturing at a high rate for long hours, and the movement was constant, including bending and twisting. Changes to our conveyance process previously were very costly and took a lot of time."

Those changes could occur for minor to major changes to FCA vehicle models – so they were frequent, to say the least, to allow the company to maintain its competitive edge.

FCA knew of an alternative conveyance system that would have required the company to cut the Power & Free conveyor track, then change and re-weld it. The process couldn't be done during production, and a common conveyance had to be used for all body styles, which meant the system's mechanical design would have been more complicated.

The manufacturer found a solution, starting with a Rockwell architecture; the pairing of GuardLogix and Compact GuardLogix controllers was a new (and ultimately successful) one for FCA.

Each carrier is outfitted with a Compact GuardLogix, which is paired with a ProSoft Technology Industrial Hotspot radio that facilitates communication between the carrier's processor and the GuardLogix that serves as the system-level PLC. The radios transmit control, safety, and diagnostic data from each carrier back to that traffic cop PLC, helping FCA ensure the carriers are operating efficiently and effectively.

Subramanian said that benefits of using ProSoft's radios included the solution's Ultra-Fast roaming time and its compatibility with the Rockwell equipment. He noted ProSoft's support assistance was a differentiator as well; a site survey and support during and after installation helped ensure the application's smooth performance.

This pairing has helped FCA revamp its conveyor system to be employee and innovation-friendly. From a technical standpoint, Subramanian said, the improvements have brought several benefits:

- A flexible conveyance system that is ergonomically friendly for employee operators
- The conveyance system can quickly adapt to new model changes, with FCA only paying the upfront cost once
- Changes are done in software and can be implemented based on the car model's body style

In addition, he estimates that, assuming changes every model year, adopting this system saves FCA approximately $300,000 to $400,000 per year in capital equipment spending.

In addition, the lower cost of maintenance and training saves the company at least 40 minutes of downtime per day – which adds up at 260 days per year.

Lauren Robeson Menting, ***Prosoft Technology.***

I/O modules

Opto 22: New I/O modules address the demands of specialty and low-cost applications, including dry contact monitoring, temperature control and mixed voltage.

GRV-IDCSW-12 (discrete input, 12 channels, DC contact switch status) monitors the open/closed status of dry contact switches, and provides the necessary excitation voltage to power the circuit. This module is designed for monitoring distributed IT equipment, benchtop analyzers, motor run/stop relays, or any device that offers only a dry contact for status.

GRV-IVI-12 (analog voltage input, 12 channels, ±1.25 to ±160 V, channel-to-channel isolation): With 12 isolated channels, each configurable to one of eight ranges from ±1.25 to ±160 V, this module eliminates the need to segregate I/O signals over multiple modules, providing cost and space reduction for mixed voltage applications.

GRV-IRTD-8 (analog input, 8 channels, temperature/RTD or resistor) increases options for accuracy and I/O density in temperature applications. It provides 8 channels for 2- and 3-wire RTD inputs, with a maximum range of –200 to 850°C. Users can take advantage of multiple fixed.

Motor controller integrates safety

Rockwell: Manufacturers can now install more of their control hardware on machines instead of in cabinets to simplify their production environments. The new Allen-Bradley ArmorStart ST distributed motor controllers with integrated safety can be mounted directly on a machine, allowing users to implement functional safety with fewer components.

The ArmorStart ST with integrated safety is the first networked safety enabled On-Machine solution designed to integrate into Allen-Bradley Logix controllers and programmed using Studio 5000 software. Using one network via EtherNet/IP and one software tool helps streamline light and heavy industry applications.

The ArmorStart ST motor controllers offer safety ratings of up to PLe/SIL3 and Cat 4. They also have built-in safe torque-off, which removes rotational power to the motor but not the drive. This can help keep workers safe and improve uptime by allowing for faster start-ups after safety demands are made. It can also reduce wear caused by repetitive start-ups.

RJ45/RJ45 Ethernet portfolio

Balluff: Offering a variety of industrial cable jacket types, a new RJ45/RJ45 Ethernet portfolio delivers increased durability for connectivity in manufacturing environments.

Balluff offers three main cable jackets: PVC (polyvinyl chloride) – the most common jacket type with high moisture resistance; PUR (polyurethane) – good resistance against abrasion, oil and ozone and; TPE (thermoplastic elastomer) – highly flexible and resistant to aging in sunlight, UV and ozone.

Additionally, the portfolio offers Ethernet in five different colors — red, orange, green, royal blue, and teal — to help maintenance and IT teams troubleshoot and diagnose network issues. The colored cables allow companies to create a reference for quick recognition of the connection type. For example, runs between managed and local unmanaged switches could use orange cables; teal cables could be used to connect field-level devices like sensors and I/O, while red cables could be used to connect robots in the work cell and the local switch.

With multiple colors and jacket materials, Balluff helps companies implement an Ethernet network to meet their reliable, real-time communication needs, while surviving the harsh conditions of an industrial environment.

Wireless communication devices

Beckhoff: A new IP 66-rated CU8210-M001 cabinet dome protects industrial WLAN and mobile communication components.

The new CU8210 series WLAN and mobile devices establish reliable wireless communication via the USB port of an Industrial PC. They also provide all necessary physical protection for components that

stick out of control cabinets. As a result, wide-ranging applications can benefit from reliable and powerful wireless connections to the machine controller without using attenuation-prone antenna cables. The C8210-M001 cabinet domes support efficient and globally usable wireless solutions for PC-based control technology when combined with the appropriate CU8210-D00x USB-2.0 sticks from Beckhoff for WLAN and 4G mobile communication.

Designed for industrial WLAN and mobile communication components, the cabinet dome boasts an IP 66 protection rating when installed. The components inside the housing dome, such as the USB-2.0 stick for wireless connection, are completely protected against physical contact, dust and moisture in industrial environments. The cabinet dome can therefore be mounted both in the panel of the control cabinet and also directly on the machine or outside of control cabinets.

WireNET portfolio

Belden: A new versatile portfolio is comprised of cables, connectivity and hardware for end-to-end Local Area Networks.

Applications include Ethernet BASE-T protocols from 1G to the upcoming 2.5G and 5G, and up to 10G; along with multimedia applications such as HDBaseT. Belden offers a networking solution for Category 5e/6/6A/7/7A UTP and shielded systems including a comprehensive cable managed OS2 and OM3/4 fiber portfolio.

The new WireNET portfolio covers a range of cables, connectivity and hardware that can

be combined to create complete Local Area Networks (LAN).

The WireNET solution is a complete package, built around the existing Belden cable portfolio, which encompasses both copper and fiber cables. In copper, Belden offers many systems with different performance levels to suit specific studio and/or office requirements. It includes both a complete UTP and shielded range of cables and connectivity.

CAT6A UTP includes tool-less jacks that offer quick and easy termination, while CAT6/5E UTP jacks use a standard 110 tool for 180 and 90 degree applications.

1U Desktop system

Advantech: The release of its latest 1U THIN barebone system offers eighth generation Intel Core processors up to 65W TDP – EPC-T2286.

This system supports i7/i5/i3 processors which bring enhanced performance over previous generations with up to six CPU cores and Intel's 9th generation graphics engine.

The EPC-T2286 powers up to two independently operated 60 Hz 4K displays via DisplayPort or HDMI and supports Wall/VESA/rack mounting for flexible easy installation.

Its compact 1U height is just 250 x 44.2 x 225 mm. It offers the high processing capability of a desktop CPU with up to six CPU cores to deliver high computing power and graphic performance. The H310 Express chipset supports Dual Channel DDR4 2666MHz memory (up to 32GB) in two SODIMM slots. Features include integrated Intel Gen 9 graphics (Display Port, HDMI), triple gigabit Ethernet w/ EtherCAT capability, 6 x serial ports (2x RS-232/422/485 by BOM option), and ESD level 4 protection compliance. All these features make EPCT2286 well suited to kiosk or automation applications needing a compact 1U height chassis.

Development software enhancements

Red Lion Controls: Crimson version 3.1 enhanced features and new functionality optimizes data intelligence and drives greater efficiencies on the plant floor.

Updates include enhancements to their Crimson development environment, including dynamic filtering of SQL queries and the release of a German language version of their award-winning software.

The increase in global use of Crimson-based products is a testament Crimson's ability to play a key part in delivering on the promise of the IIoT. In an effort to further optimize data intelligence, the latest version of Crimson has the ability to use expressions in filters for SQL queries. This allows operators to pull a subset of data from a SQL database based on dynamic search criteria. This new feature can deliver greater efficiencies and process control,shortening response time by accessing the right data faster – which is critical when troubleshooting production or operations workflow.

Electromagnetic flowmeter

Endress+Hauser: The new Picomag plug-and-play flowmeter measures flow of electrically conductive fluids, process temperature and conductivity. It enables easy commissioning with Bluetooth using the SmartBlue App and seamless integration with IO-Link technology.

Picomag can be installed into any pipe up to 2" in diameter, even in confined spaces. For this purpose, there are various process connection adapters available, such as NPT-thread, R-thread, internal thread, Tri-Clamp or Victaulic. Picomag is a cost-optimized solution for applications where the focus is on high repeatability (±0.2% o.f.s.) and reliable measured values – e.g. for correctly measuring water flows 198 gal/min or for minimizing energy costs in utility applications.

Picomag is suitable for process temperatures between 14 to 158 °F as well as for process pressures up to 232 psi. Picomag requires no inlet and outlet runs and can be mounted directly before or after a pipe bend.

Managed Ethernet switch

Abaco Systems: A new high performance Ethernet switch brings extended levels of capability to 6U VME systems.

The GBX25 Level 3 Managed 6U VME NETernity Ethernet Switch delivers new levels of simplicity in configuring 6U VME network support and handling almost any network configuration while delivering high performance. The GBX25 represents a switch solution for any user planning to create new systems based on the 6U VME architecture, or planning to refresh existing systems.

Typical applications for the GBX25 include mission computing; fire control; sensor/video aggregation and networking; and radar. It is also appropriate for industrial and automation applications.

For existing users of Abaco's GBX24 and RM921B, the GBX25 represents 100% pin-compatible technology, delivering a simple, cost-effective upgrade in capability and performance while guaranteeing long term availability. It also represents an enhancement for systems using Abaco's RM922, GBX16 and GBX16A switches.

Cybersecurity platform

Honeywell: The Forge Cybersecurity Platform resolves common security pain points for operational technology (OT) and Industrial Internet of Things (IIoT) to better protect customer sites from cyberthreats and rising security costs across the enterprise.

The platform improves cybersecurity performance at a single site or across an enterprise by increasing visibility of vulnerabilities and threats, mitigating risks, and improving cybersecurity management efficiency.

The new platform safely moves data from one site to another and uses operations data to strengthen endpoint and network security, and improves cybersecurity compliance. It gives customers tools to strengthen their cybersecurity operations and asset management, all through a single dashboard. In addition, multi-site, multi-vendor capabilities support an enterprise-wide solution with greater efficiencies and lower total cost of ownership regardless of the control system used.

Hardware-based IoT security

Microchip: With a minimum orderable quantity of 10 units, the new Trust Platform provides hardware-based secure key storage for low, mid and high-volume deployments.

The Trust Platform consists of a three-tier offering, providing out-of-the-box pre-provisioned, pre-configured or fully customizable secure elements, allowing developers to choose the platform best suited for their individual design. As the first solution to provide ready-to-go secure authentication for the mass market, the first tier Trust&GO provides zero-touch pre-provisioned secure elements with a Minimum Orderable Quantity (MOQ) as low as 10 units.

Device credentials are pre-programmed, shipped and locked inside the ATECC608A for automated cloud or LoRaWAN authentication onboarding. In parallel, corresponding certificates and public keys are delivered in a "manifest" file, which is downloadable via Microchip's purchasing e-commerce store and select distribution partners.

Industrial PCs for edge computing

Mitsubishi Electric Automation: MELIPC Series industrial-use computers are designed for data computing, edge computing, remote monitoring, and the integration of hardware and software technologies.

The MELIPC Series is targeted towards OEMs and end users running general manufacturing applications, and especially those who require a computing and data monitoring solution that takes up a limited amount of space with a small footprint. Most importantly, MELIPC is designed to enable Internet of Things (IoT) on factory floors that have not been introduced to it yet, or improve it where it is already enabled.

MELIPC releases with four initial models: MI1000, MI2000, MI3000, and MI5000. MI5000, the flagship product, combines real-time equipment control and information processing in one solution. MI3000 contains a touch screen LCD panel and pre-installed software that allows users to run it as if it were an HMI. The midrange MI2000 is designed for wide-ranged system expansion, and the compact, low-cost MI1000 enables companies to begin introducing IoT on their factory floors. All four models can be purchased standalone with Windows 10 IoT Enterprise 2016 installed, or can be purchased together with software as a comprehensive MELIPC data solution.

MI5000 includes two operating systems, VxWorks and Windows. It is compatible with the CC-Link IE Field industrial network, enabling high-speed data exchange at speeds of up to 1ms for real-time equipment control. It also uses Edgecross, an open software platform, to process and distribute data. All models in the MELIPC Series have Windows preinstalled and various software that allows for edge computing and high speed data transmission.

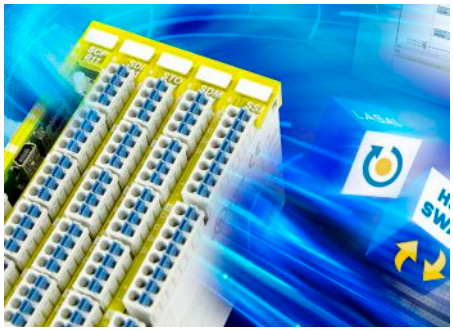
IIoT edge gateway

Moxa: The UC series IIoT Edge Gateways are Azure IoT Edge certified Arm-based computers. Integrating Azure IoT Edge with Moxa's IIoT gateways benefit customers, especially those operating on Linux platforms, in a number of ways. The benefits include secure remote connections to enable deployment in remote locations, connectivity to allow existing brownfield applications to share data with the cloud, and device management and product longevity to ensure users can deploy, scale, and maintain their IIoT applications.

The UC-8100A-ME-T computing platform is built around a Cortex-A8 processor and designed for embedded data acquisition applications. It has built-in remote communication capabilities and is Microsoft Azure-ready to facilitate data transfer from field devices to the cloud. The computer comes with dual RS-232/422/485 serial ports and dual 10/100 Mbps Ethernet ports, as well as a Mini PCIe socket to support cellular modules.

Due to these flexible interfacing options, this tiny embedded computer is a reliable and secure gateway for data acquisition and processing at field sites as well as a useful communications platform for many other large-scale deployments. Wide-temperature and LTE-enabled models are available.

Safety system



SIGMATEK:The S-DIAS Safety system equips the user with a high degree of freedom in designing the project for the safety concept and modular production machines or lines with optional modules such as loading and unloading units, as well as handling and transport systems.

Modular machine units are equipped with their own safety control and communicate with the higher-level control via VARAN industrial Ethernet. The new Hot-Swap feature ensures that the machine components with their Safety CPUs can be flexibly integrated into the system, logged out and logged back into the machine network at a different location. The primary central Safety control can manage up to 70 optional substations with emergency stop function.

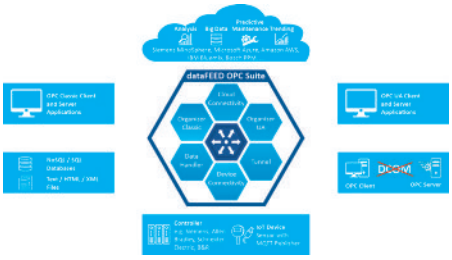
The overall safety program is created with all participating units in the machine network once and, like the modular machine or line, can then be combined as desired. Optional system modules with integrated emergency stop function can be therewith added to machines and systems or logged out of them during active operation without a restart. The connection dynamically is created using a simple function-oriented login mechanism – without a hardware switch.

Software-configurable I/O support

Analog Devices: The AD4110-1 Analog Front End with integrated 24-bit ADC for industrial process control systems is a universal input AFE that allows customers to design a "platform" input module that they can configure for multiple functions. This saves significant R&D cost, reduces time to market and requires less design resources.

The high voltage inputs of the AD4110-1 are fully software configurable for current or voltage signals, allowing direct interface to all standard industrial analog signal sources. One reference design replaces many, reducing module size and decreasing cost of ownership. Software-configurable I/O is a key factor in the implementation of Industry 4.0.

OPC UA store and forward solution



Softing: The new version V5.00 of dataFEED OPC Suite offers users an OPC UA Store And Forward Server. It automatically detects an interruption in the connection to an OPC UA Client and ensures the recording of the data to be transmitted for up to one hour. As soon as the OPC UA connection has been re-established, the data is transferred to the OPC UA Client with a correct time stamp.

The new Store and Forward functionality is fully integrated in dataFEED OPC Suite. It can be used with any OPC UA Client and does not require a special OPC UA Historical Access Client for data caching. Using Store and Forward does not affect the security features supported by the OPC UA technology; for example, this functionality can be combined with user authentication or data encryption.

Softing's dataFEED OPC Suite is a comprehensive complete package that covers communication via the OPC standard as well as the implementation of big data solutions and integration in IoT clouds.

Enhanced cybersecurity

Westermo: The release of WeOS 4.27.0 comes with enhanced features to increase network security. Allowing unused ports on a switch or router to be active and accessible presents a major security risk, as unauthorized users can breach the network via these ports. In most cases, unused ports are turned off but configuring this is a time-consuming and complicated task. In large networks with many switches, it is not uncommon for some ports to simply be left open by mistake.

In a previous WeOS release, the company introduced a feature that can be used to automatically shut down a port if it has been left unused for a certain period of time. Now that feature has been made even better, simpler and more secure.

In WeOS 4.27.0, a simple and intuitive configuration wizard makes it easy to configure automatic disabling of unused ports.

Bluetooth network analyzers

ABB: The company's first Bluetooth-equipped network analyzers offer accurate electrical measuring and power monitoring of all energy assets. The new M4M empowers digital transformation of buildings by leveraging the scalability of ABB's energy and asset management solutions.

As customers look to increase productivity and reduce energy consumption, ABB has developed its new M4M range of fully connected network analyzers for complete power quality analysis and accurate energy monitoring.

Designed with the end user in mind, M4M network analyzers gather information for the energy distribution system and connect them to the unique ABB Ability Electrical Distribution Control System, a cloud-based platform which gives users immediate access to actionable data on energy consumption and on-site power generation trends.

Industry 4.0 connectivity

HARTING: The Han 1A offers a compact, robust and universally deployable rectangular connector system for transmission in all lifelines of Industry 4.0 (data, power, signals). Smaller drives are becoming more common and require smaller interfaces. This new connector series reflects the trend with space optimized housings and inserts.

The Han 1 A is 30% smaller than Han 3 A, which was previously the smallest offering in the connector series.

Due to the modularity and a variety of different applications, the Han 1 A is suitable for all areas in which small drives, sensors and devices must be supplied. Individual components can be quickly assembled to form a ready-to-use connector. The portfolio also includes accessories such as fasteners for rapid wall mounting, strain relief or colorcoding pins.

Customers can combine insulating bodies, contacts, housings and interlocks to interfaces and achieve degrees of protection according to their requirements. An IP20 solution with only two components can be assembled for use in protected areas within industry.

Ethernet PoE+ switch

Planet Networking: Featuring plug and play features and designed to be installed in heavy industrial demanding environments, the IGS-504HPT is an industrial-grade, DIN-rail type unmanaged Gigabit Ethernet PoE+ switch with four 10/100/1000BASE-T ports featuring IEEE 802.3at PoE+ and one extra 10/100/1000BASE-T RJ45 copper interface for uplink connection.

The power system of the IGS-504HPT supports 12~56V DC power input for power redundancy and operational flexibility. It comes with a total power budget of up to 120 watts for different kinds of PoE applications and operating temperature ranging from -40 to 75 degrees C in a rugged IP40 metal housing.

To facilitate the 802.3at PoE+ usage with commonly used 12~48V DC power input for transportation and industrial-level applications, the IGS-504HPT adopts power boost technology to solve power source issue but does not require special power supplies. The IGS-504HPT provides an integrated power solution with a wide range of voltages (12~56V DC) for worldwide operability. It also provides dual-redundant, reversible polarity power supply inputs for high availability applications.

Complying with IEEE 802.3at Power over Ethernet Plus, it provides up to 36 watts of PoE output power to allow users to deploy standard and high powered devices simultaneously with no need of software configuration.

All-in-one controllers

OMRON: New CP2E Series all-in-one controller provides advanced control and IoT connectivity for compact machines. Performance of IoT-connected machines can be visualized through simple programming, helping improve productivity and quality of machines used in manufacturing and other industries.

As a result of rising labor costs and shortage of skilled workers, manufacturers increasingly need to streamline the process from machine setup to operation and maintenance. Even when they create compact machines on a tight budget, they want to utilize production data, visualize machine performance, and prevent sudden failure and stoppage. However, it is difficult to meet this demand because an expensive controller is needed to build an IoT network to leverage machine data.

The CP2E Series cost-effectively brings IoT to compact machines. In order to leverage machine data, the CP2E Series collects machine performance data and shares the necessary information with the host network. The pre-defined program data, function block, allows virtually anyone to set up machines that perform complex control, reducing the time required for programming, test, debugging, and maintenance. Moreover, the extended operating temperature range ensures reliable use in machines for non-manufacturing industries where the demand for use of controllers is increasing.

OPC UA over TSN

B&R Industrial Automation: A new machine switch for converged real-time networks can be used to set up networks using the vendor-agnostic communication solution OPC UA over TSN. Its design and form factor fit into the B&R portfolio for space-saving mounting in the control cabinet.

The TSN machine switch allows cycle times under 50 µs. It offers four real-time capable TSN ports and one standard Ethernet port to connect a display, for example. The switch also opens up the possibility of star, tree or ring topologies in addition to daisy-chaining. Multiple switches can be cascaded in order to reach remote cabinets or implement large, complex real-time networks. Non-TSN nodes can also be incorporated in the network via the switch. Implementing modular machine concepts is now faster and easier than ever.

The switch is completely integrated in B&R's Automation Studio engineering environment. Configuration occurs automatically. The device fully supports a centralized approach to hardware and software management. Application development and machine-specific configurations can be performed either offline or online. The TSN switch can also be used as a conventional unmanaged switch for non-real-time networks. No special configuration is required.

Since the TSN machine switch is designed in the X20 form factor, it takes up minimal space in the control cabinet, mounted right alongside the X20 control and I/O system. The switch can be mounted in two different positions, depending on the cable outlet. This allows it to be installed in tight spaces.

Industrial wireless network solution

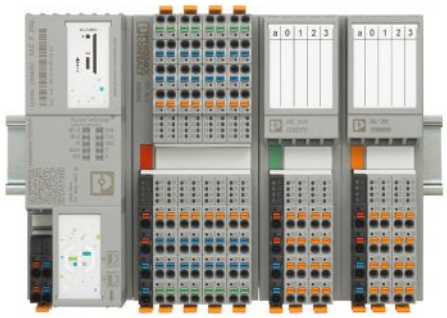
Emerson: A next generation wireless access point, integrating the Emerson Wireless 1410S Gateway and the Cisco Catalyst IW6300 heavy duty series access point, delivers IIoT connectivity in a single solution.

The solution combines the latest in wireless technology with advanced WirelessHART sensor technology, delivering reliable and highly secure data, even in the harshest industrial environments.

To help enable new digital transformation strategies, this industrial networking solution combines Emerson's expertise in industrial automation and applications with Cisco's innovations in networking, cybersecurity and IT infrastructure. Driven by the demand for greater productivity, lower maintenance costs and improved worker safety, industrial manufacturers are accelerating investment in robust IoT sensor networks combined with scalable operational analytics tools to improve organizational collaboration and decision making. In these environments, network performance and security are critical for success.

This next-generation wireless access point provides enhanced wi-fi bandwidth necessary for real-time safety monitoring, including Emerson's Location Awareness and wireless video.

PLCnext technology



Phoenix Contact: New PLCnext Technology combines the openness of smart devices with the reliability of a traditional PLC. It also gives developers a control platform that combines the advantages of IEC 61131 programming options with the flexibility of open-source languages like Linux.

PLCnext is a completely open platform. Users can directly access the core of the product via Linux. This gives them the freedom to leverage the open-source community or develop their own Linux-based applications on an industrially hardened control platform.

At the same time, PLCnext enhances IEC 61131 PLC programming and makes it possible to program industrial controllers using high-level languages for real-time performance and data.

PLCnext Technology is IIoT-ready. It has complete integration with Phoenix Contact Proficloud, for easy access to dashboard data and alarms using time series data. PLCnext can also connect to common IoT plaforms, such as Amazon Web Services, Microsoft Azure, Google IoT and more.

PLCnext Engineer, the software for the platform, provides an intuitive development environment with IEC 61131 and HTML5 visualization, allowing seamless integration with high-level languages including C, C++, C#, MATLAB, and more. This makes it possible to achieve real-time control with advanced computation and modern visualization using HTML5 and adaptive response.

Has technology design become too slick and stylish?

The work of Apple designer Sir Jonathan Ive has dramatically changed the look of electronic devices. Computers, television sets, stereo systems and even watches have become stylish glass and metal slabs. Some feel that the contemporary look is a bit too slick and stylish, and are looking for alternatives.

ONE CAN HARDLY OVERESTIMATE, the influence that Sir Jonathan Ive has had on design in the 21st century.

Until the beginning of our millenium, electronic devices proudly displayed their technical nature. They came equipped with colorful status lamps, switches, dials, slide controls, knobs – the more, the better. With the Mac PCs, Ive did away with all that, reducing the computer to a smooth, elegant structure. He later applied the same design principles to mp3 players, cell phones, watches and more.

Soon enough, other companies followed. Today we are used to electronic devices being thin slabs of glass and metal, that blend almost invisibly into our living rooms.

But don't we wish sometimes that our electronic home equipment would display its technical nature in a more self-confident way?

PHOTO: APPLE

High tech audio systems

PHOTO: NAIM AUDIO

Home stereo systems are a good example. A premium music streaming platform like the Naim Mu-so delivers crystal clear sound out of a very compact package. At first glance, one wouldn't even recognize the small, brushed aluminum box as an all-in-one audio system. *What HiFi?* magazine was impressed that the Mu-so "drives all songs with a sure-footed sense of rhythm, rich detail and lashings of deep, rumbling bass".

By comparison, the McIntosh MA352 Integrated Amplifier is quite a different animal. Its design proudly shows all the advanced technology that it contains. Its preamplifier section is powered by two pairs of 12AX7A and 12AT7 vacuum tubes. The output stage is a direct coupled solid state amplifier. As one can guess by the prominent heat sinks on the sides, it delivers serious power. Up to 320 Watts per channel should be enough to properly drive virtually any set of loudspeakers.

PHOTO: MCINTOSH

If that is still not enough, a stereo preamplifier output is available for connecting even higher-powered amplifiers, e. g. a pair of McIntosh's MC1.25KW 1,200 Watt single channel models. The stainless steel chassis with mirror-like finish is complemented by blue output meters, control knobs, an illuminated logo, and a black glass front panel with LED backlighting.

www.mcintoshlabs.com

The McIntosh amplifier would go very well with a pair of speakers that are the exact

PHOTO: BOWERS & WILKINS

opposite of unobtrusive design. The Bowers & Wilkins Nautilus look like something straight out of Captain Nemo's submarine. These speakers were revolutionary when they were launched almost a quarter century ago, and they still look so today. The manufacturer insists that the form strictly follows function, as only the long, tapered damping tubes allow the drive units to work optimally by gently absorbing stray energy.

If you want your pair of Nautilus speakers to really stand out, Bowers & Wilkins can paint them any color you specify – for a small surcharge on the US$ 60,000 list price.

www.bowerswilkins.com

The invisible TV

PHOTO: SONY

Following the "less is more" design principle, Sony has come up with a TV that does away with distinct elements like speakers or a bezel. The One Slate concept uses new sound technology that generates sound through vibrations in the display itself. The whole structure is kept with just a primary display slate and a support slate on the back. A design approach that aims to make the TV disappear as much as possible.

What a contrast to the classic Brionvega Algol. This portable television was designed in 1964 by Marco Zanuso and Richard Sapper. The Algol became an instant classic and sold very well throughout the 60s and 70s.

After quite a few ups and downs over the next two decades, Brionvega went out of business in 1997. Fortunately, the company was resurrected ten years later and today continues to produce its iconic products, including the Algol.

PHOTO: BRIONVEGA

It doesn't have a 4k Ultra HD OLED display, integrated subwoofers or Smart TV functionality, but doesn't it look cute? Just like designer Marco Zanuso described it: "A little dog looking up at his master."

brionvega.it

Wearable electronics

PHOTO: MISFIT

The trend towards minimalistic design has meanwhile also extended to smart watches and other wearables.

One example of this trend is the Misfit Ray fitness tracker. Paired with the Misfit app, it provides fitness and sleep tracking, including steps taken, distance traveled, calories burned, activity tagging, and sleep duration and quality. It also features vibration alerts for alarms, calls, texts, and movement reminders.

Yet all this functionality is hidden in a tubular, rose gold anodized aluminum body. On the outside it looks just like a fashionable bracelet.

www.misfit.com

While the Misfit Ray certainly appeals to users who appreciate its minimalistic aesthetic, other people want to have the high tech on their wrists clearly visible. Mechanical wristwatches always have been and still are a preferred choice for this.

One man who has taken this idea to the extreme, is Maximilian Büsser. In 2005 he started his company MB&F to produce not just watches, but horological machines, as he calls them. These wearable machines reinterpret traditional, high-quality watchmaking into three-dimensional kinetic sculptures.

Their Horological Machine No2 revolutionized the world of Haute Horlogerie with its twin dials and the 349-component movement.

The horological engine was developed by award-winning watchmaker Jean-Marc Wiederrecht. It uses his patented asymmetrical-tooth gear wheels for the highly energy-efficient jump hour/retrograde mechanism. The watch is unique in that it combines instantaneous jump hour, concentric retrograde minutes, retrograde date, bi-hemisphere moon phase and automatic winding.

This masterpiece of mechanical engineering is not hidden within a metal housing, but sits in a crystal-clear sapphire case.

Synthetic sapphire watchcases are extremely difficult to machine. The complex, three-dimensional form of the Horological Machine No2, with its bevels, mounting holes and porthole cut-outs requires 55 hours of milling, drilling and polishing.

The clearly visible mechanics and the retro-futuristic appearance make the Horological Machine No2 the exact opposite of the minimalistic design pioneered by Sir Jonathan Ive.

www.mbandf.com

Leopold Ploner

PHOTO: MB&F

Exceptional Performance and Reliability

NT328G LAYER 3 SWITCH

Designed for use in harsh industrial environments, the NT328G Layer 3 rackmount industrial Ethernet switch, offers 28 high-speed ports (24-Gigabit, 4-10 Gigabit) to meet the performance requirements of bandwidth intensive applications. Robust feature set includes wire-speed switching performance, network redundancy, advanced security, policy-based traffic control and easy-to-use configuration and management.

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