4.2020 Issue 117
ISSN 1470-5745

industrial ethernet book

The Journal of Industrial Networking and IoT

Industrial 5G targeting factory automation 8

ADI Chronous™

INDUSTRY-LEADING SCALABLE ETHERNET. TIMED TO PERFECTION.

ANALOG.COM/CHRONOUS

We Turn Your Vision of Connected Factories into Reality.
Analog Devices´ new ADI Chronous™ family of compatible and interoperable industrial ethernet connectivity products enable best-in-class industrial automation solutions for the connected factory of tomorrow. From complete Time Sensitive Networking solutions for high-performance motion control to innovative 10Base-T1L concepts for robust field instrument connectivity – our market-leading and industry-first ethernet portfolio of software and hardware are scalable and timed to perfection. Designed from ADI's rich factory expertise and system design knowledge, ADI Chronous ethernet solutions pave the way for intelligent industrial connectivity to turn your vision of the connected factory into reality.

Emergence of 5G technology

At the recent ODVA technical conference, one of the most engaging presentations and lively panel discussions focused on 5G technology and its path to acceptance and deployment in factory automation and manufacturing environments.

One observation is that Industrial 5G is arriving with one of the largest marketing pushes ever with the large telecommunications companies specifically targeting industrial automation. In virtually every manufacturing company of any size, someone is assigned to develop their 5G vision. While wireless has been available for a long time, and applied in numerous industrial automation applications, it has not become ubiquitous. 5G is offering potential new solutions, but it remains to be seen how long before solutions are ready for widespread adoption

In the 5G feature story starting on page 8, you can read about both the evolution of this technology and how it is moving rapidly forward.

The authors of this article have made a series of conclusions that "5G will implement a wide range of technical enhancements over 4G. These enhancements improve on prior wireless solutions and may open new market areas including industrial automation."

And beyond that they also say: "5G has already emerged. Capabilities are limited, but enhancement will continue. For the first time, we have a substantial set of industrial automation players pushing for a common wireless standard – 5G. Since 3G, the 3GPP standards have included: packet switched Internet Protocol, Ethernet connectivity, and quality of service, matching EtherNet/IP needs. Paradigm shifts may be either an opportunity or a threat."

Siemens and Qualcomm Technologies, Inc. have also implemented the first private 5G standalone (SA) network in a real industrial environment using the 3.7-3.8 GHz band. Both companies have joined forces in this project. Siemens is providing the actual industrial test conditions and end devices such as Simatic control systems and IO devices and Qualcomm Technologies is supplying the 5G test network and the relevant test equipment. The 5G network has been installed in Siemens' Automotive Showroom and Test Center in Nuremberg.

The takeaway on 5G is not "if" but "when" the technology will be widely deployed to offer new solutions for industrial automation and manufacturing. A significant factor will be testing and performance results at end user manufacturing companies but there is a strong push to provide solutions first for use in remote monitoring before the exploration of potential control applications.

Al Presher

Contents

Industrial Ethernet Book

The next issue of Industrial Ethernet Book will be published in **May 2020**
Deadline for editorial: April 3, 2020 **Deadline for artwork:** April 24, 2020

Product & Sources Listing

All Industrial Ethernet product manufacturers (not resellers) are entitled to free of charge entries in the Product locator and Supplier directory sections of the Industrial Ethernet Book. If you are not currently listed in the directory, please complete the registration form at **www.iebmedia.com/buyersguide/** to submit your company details.

Update your own products

If you wish to amend your existing information, login to the Editor section **www.iebmedia.com/buyersguide/register.htm** and modify your entry.

Do you want to receive issues of Industrial Ethernet Book? Call, mail or e-mail your details, or subscribe at **www.iebmedia.com/service/**

Editor: Al Presher, editor@iebmedia.com
Contributing Editor: Leopold Ploner, info@iebmedia.com
Advertising: info@iebmedia.com
Tel.: +49-8192-994-9928 · Fax: +49-8192-994-8876
Online Editor: Adela Ploner, info@iebmedia.com
Circulation: subscriptions@iebmedia.com

Published by IEB MEDIA
IEB Media, Bahnhofstrasse 12, 86938 Schondorf am Ammersee, Germany
ISSN 1470-5745

PEFC™
PEFC/04-31-1873

International IEC 63171-6 standard for Single Pair Ethernet

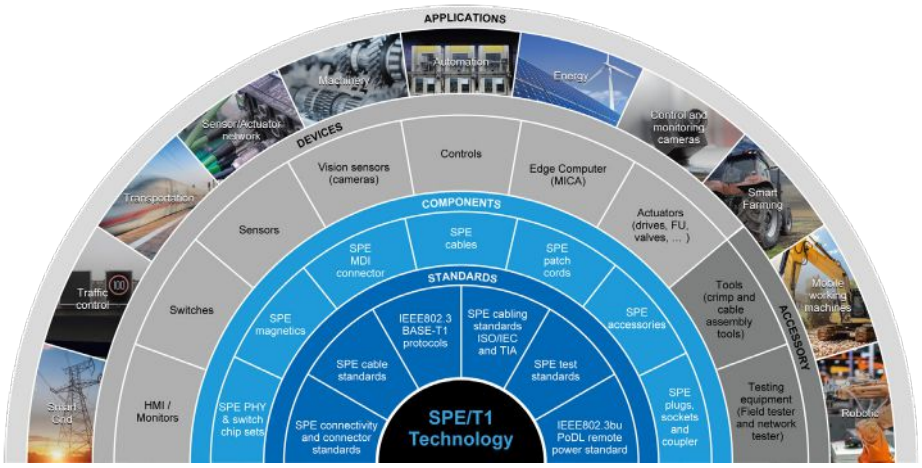
The T1 Industrial Style interface introduced by HARTING in 2016 has been the official SPE interface for industrial applications since January 23, 2020. This sets complete standards for IIoT networks based on SPE.

THE IEC SC 48B STANDARDS COMMITTEE FOR Copper Connectors published IEC 63171-6 on January 23, 2020. It describes the T1 Industrial Style SPE plug-in face and is the common strong connection for the SPE Partner Network and its members. T1 Industrial is the future interface for single pair Ethernet applications in industry. This standard is supported and integrated by the SPE relevant standards ISO/IEC 11801-3, ANSI TIA 1005-x and IEEE802.3cg.

The IEC standardisation committee SC 48B published IEC 63171-6 as an international standard for Ethernet interfaces using only single pair wires. The T1 Industrial Style mating face described in the standard was included in standardisation by HARTING in 2016 and is now the internationally standardised default interface for SPE networks in M3I3C3E3 environments (industry).

IEC 63171-6 is included as a complete standard document with all specifications and test parameters in ISO/IEC 11801-3 for cabling and represents the specified standard interface. It is still possible, however, to use cabling components other than in IEC 63171-6, but these are not compliant with the standard and may pose a risk of functional loss.

For this reason, ISO/IEC JTC 1/SC 25/WG 3 started an international selection process in 2018, at the request of IEEE 802.3, which gives a recommendation for a SPE Media Dependent Interface (MDI). As a result of this choice of over 20 national standardisation bodies, a mating face has prevailed for industrial applications.



SOURCE: SPE

Single Pair Ethernet Ecosystem.

For industry and industry-related applications (M2I2C2E2 and M3I3C3E3), the mating face is set according to IEC 63171-6. This mating face is based on the proposal from HARTING T1 Industrial.

This result has been confirmed by TIA TR-42 and IEEE802.3cg. The T1 Industrial plug-in face supported by the SPE Partner Network in accordance with IEC 63171-6 is the standard interface for a standardised M3I3C3E3 end-to-end connection in single-pair Ethernet networks.

The founding members of the SPE partner network (HARTING, TE Connectivity, HIROSE, LEONI, Murrelektronik, Würth Electronic and softing IT network) as well as the companies igus, DEHN, HELUKABEL, Molex, Amphenol ICC, Lütze, ESCHA, Perinet, EKF and Zheijang which joined after the SPS 2019, support this common standard IEC 63171-6. Single pair Ethernet is the infrastructure basis that makes IIoT and Industry 4.0 possible.

View details on website at: https://single-pair-ethernet.com/en

*News from **SPE Industrial Partner Network**.*

5G in Manufacturing Will Reach US$10.8 Billion by 2030

THE MARKET FOR 5G CELLULAR CONNECTIONS in manufacturing is expected to reach US$10.8 billion by 2030, at a Compound Annual Growth Rate (CAGR) of 187%, according to the global tech market advisory firm, ABI Research.

"But, to capture the value at stake, ecosystem stakeholders will first need to evaluate how to measure the impact of 5G and edge deployments," said Don Alusha, Senior Analyst at ABI Research.

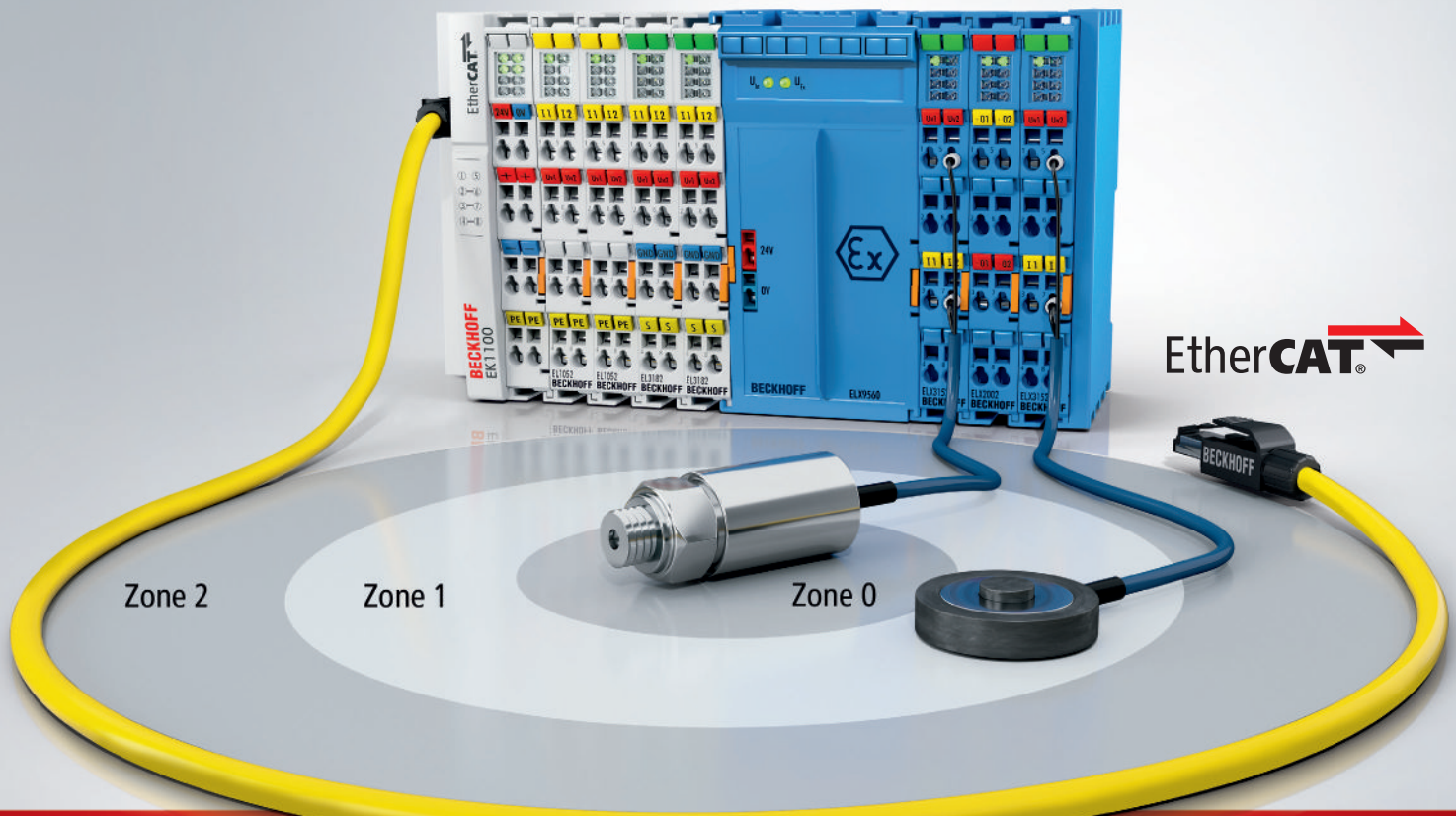
The current Industry 4.0 digitalization discourse centers around conventional financial metrics (e.g., return on investment, net profit, and cash flow) as the yardstick to measure 5G and edge computing effectiveness. But these metrics are financial measurements to gauge profit and do not lend themselves to the factory floor. "Therefore, Industry 4.0 ecosystem entities must consider an alternative set of measurements that look at how 5G and edge deployments aid manufacturing establish operational rules to run a plant. They are throughput, inventory and operational expense for the incoming flow of capital, for capital located inside, and for capital going out, respectively," Alusha explained.

These three measurements enable Industry 4.0 partners (e.g., ABB, Bosch, Siemens) to institute a direct connection between the 5G's utility and what takes place on the factory floor. In turn, they will be able to use that connection to find a logical relationship between daily plant operations and the overall company's performance. Only then, will Industry 4.0 verticals have a basis for knowing the real benefit of 5G and edge computing. "Furthermore, equally important is the ability to measure risk when looking to adopt 5G and edge technology assets. Discussions on new technology adoption have always been based on an assessment of risk and reward. If the reward is truly compelling, adopters will take the risk. 5G and edge offer unprecedented commercial opportunities, but they inherently constitute new technologies and therefore there is a risk attached," said Alusha.

These findings are from ABI Research's 5G and Edge Networks in Manufacturing application analysis report. This report is part of the company's 5G Core & Edge Networks research service.

*News report from **ABI Research**.*

Automation and process technology in a single system: with PC-based Control



www.beckhoff.com/process

With a comprehensive range of components for explosion protection and the common interfaces in TwinCAT, Beckhoff offers the possibility to integrate automation and process technology in a system without barriers into Zone 0/20. The range extends from the narrow, intrinsically safe EtherCAT Terminals from the ELX series and the high-grade Control Panels and Panel PCs from the CPX series through to EtherCAT, the fast process technology fieldbus, and the TwinCAT control software with specific process technology interfaces. This allows users to directly connect intrinsically safe field devices and to realise integrated control architectures with barrier-free process technology.

TwinCAT 3: with process technology interfaces

Complete EX range: from Panels and Panel PCs to the I/Os

HANNOVER MESSE

Hall 9, Booth F06

New Automation Technology **BECKHOFF**

Industrial Internet Consortium details upcoming priorities

IIC announces new LTE for metro testbed, a working agreement with the 5G Alliance for Connected Industries and Automation and software best practices for developing and deploying IIoT solutions.

THE INDUSTRIAL INTERNET CONSORTIUM has announced a series of initiatives including a new LTE for metro testbed, a working agreement with the 5G Alliance for Connected Industries and Automation (5G-ACIA) and a compilation of testbed that offers best practices for developing and deploying IIoT solutions.

LTE for metro testbed

The first testbed for the rail transportation industry, the LTE for Metro Testbed shows the feasibility of adapting LTE for Metro technologies for the urban rail sector.

"The LTE for Metro Testbed will serve as a benchmark and technical resource for future urban rail communications," said Dr. Richard Soley, Executive Director, IIC. "The testbed is part of the IIC Intelligent Transport Systems (ITS) initiative, in which IIC members are working on best practices and technologies to help guide the transportation industry."

Within metro systems, multiple types of wireless communication services are used for train control, and for management between devices on a moving train and facilities on the ground. The services include Communication Based Train Control (CBTC), Passenger Information System (PIS), CCTV monitoring, trunking communication and Train Control and Monitoring Systems (TCMS). Multiple wireless technologies support the different services. To guarantee critical service, two WiFi-based networks carry critical and noncritical services respectively, operating with vendor-specific extensions. They are not standardized or interoperable.

The IIC LTE for Metro Testbed plans to replace existing non-standard networks with a standard single-technology-based network. LTE for Metro technology features high bandwidth, great mobility and multi-service Quality of Service (QoS) capabilities, making it a prevailing trend for train-to-ground wireless communications. LTE for Metro technology has been tailored to metro railway requirements and meets the needs of the urban rail industry for service functions, performance and reliability.

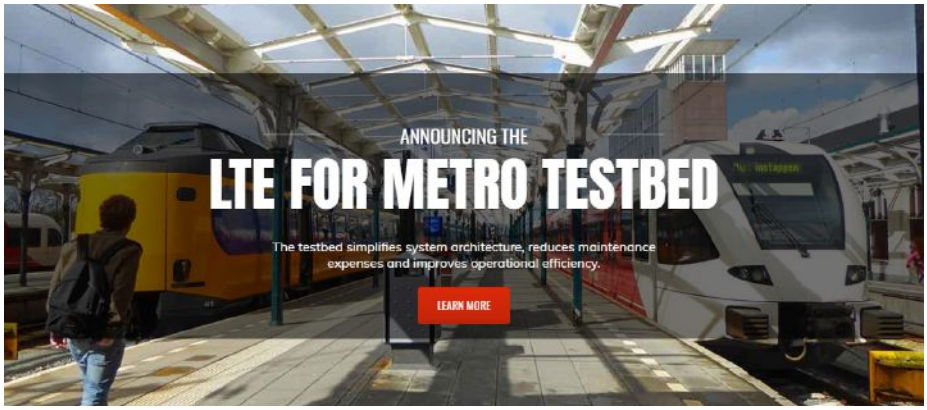
IIC and 5G-ACIA

Under its new agreement, the IIC and 5G-ACIA will work together to align efforts to enable interoperability, prevent fragmentation, and in particular to maximize synergies of 5G for the Industrial Internet.

Areas of alignment and harmonization include use cases and scenarios, requirement modelling and specification, networking best practices and architecture patterns, technology co-existence and interworking, connectivity and communications security. Joint activities will happen between the organizations on leadership level to ensure complementary approach and identify synergies, as well as on concrete deliverables targeting the mentioned areas of mutual interest.

"5G represents a key technology for the factory of the future and for achieving unprecedented levels of flexibility, versatility and productivity," adds Andreas Müller, Bosch, and Chairman of 5G-ACIA. "We are excited to work more closely together with the IIC and to make sure that the different building blocks coming out of the two organizations seamlessly fit together. Only through such concerted actions it will be possible to unlock the full potential that 5G can bring to the factory floor."

"Networking is a key enabler of Industrial IoT, and with the emergence of 5G, we have a versatile platform to support many industrial use cases," said Jan Höller, Ericsson, and IIC Liaison Officer to 5G-ACIA.



SOURCE: IIC

The testbed will establish and validate a profile for the use of LTE (Long-Term Evolution) in mission critical metro environments, so as to support the multiple types of services (critical and non-critical) in a metro system, replacing the existing non-standard multiple types of Wi-Fi networks.

Software best practices

A new report written for developers, owner-operators and decision makers, addresses various aspects of creating, acquiring and protecting software for IIoT systems. It also provides practical and actionable best practices for recognizing, addressing, managing and mitigating risks and their sources, and includes numerous use cases.

"You cannot talk about the trustworthiness of today's systems without an in-depth understanding of the trustworthiness of the software in these systems," said Mark Hermeling, one of the authors of the report and Senior Director of Product Marketing at GrammaTech, Inc.

"This concisely lays out the topics to consider when reasoning about the trustworthiness of software, during the entire lifecycle of the system, from inception to disposal," he added.

"Systems depend on software to function in potentially hostile environments that are inherently untrustworthy," said Simon Rix, one of the authors and Security Evangelist from Irdeto. "As a security practitioner, I like the practical nature of this as it presents techniques and methodologies to ensure that software is protected and not a target of attacks, thereby enabling successful business objectives in hostile, untrustworthy environments."

"Software is an essential part of almost all modern systems," said Frederick Hirsch from Fujitsu, and co-chair of the IIC Trustworthiness Task Group. "Ensuring that software is trustworthy is essential to assuring the trustworthiness of these systems, to make them appropriately secure, safe, reliable, resilient and privacy protecting."

*News by **Industrial Internet Consortium**.*

Exceptional Performance and Reliability

NT328G LAYER 3 GIGABIT SWITCH

Designed for use in harsh industrial environments, the NT328G Layer 3 Gigabit 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.

WWW.REDLION.NET

Designed to comply with IEC 61850-3

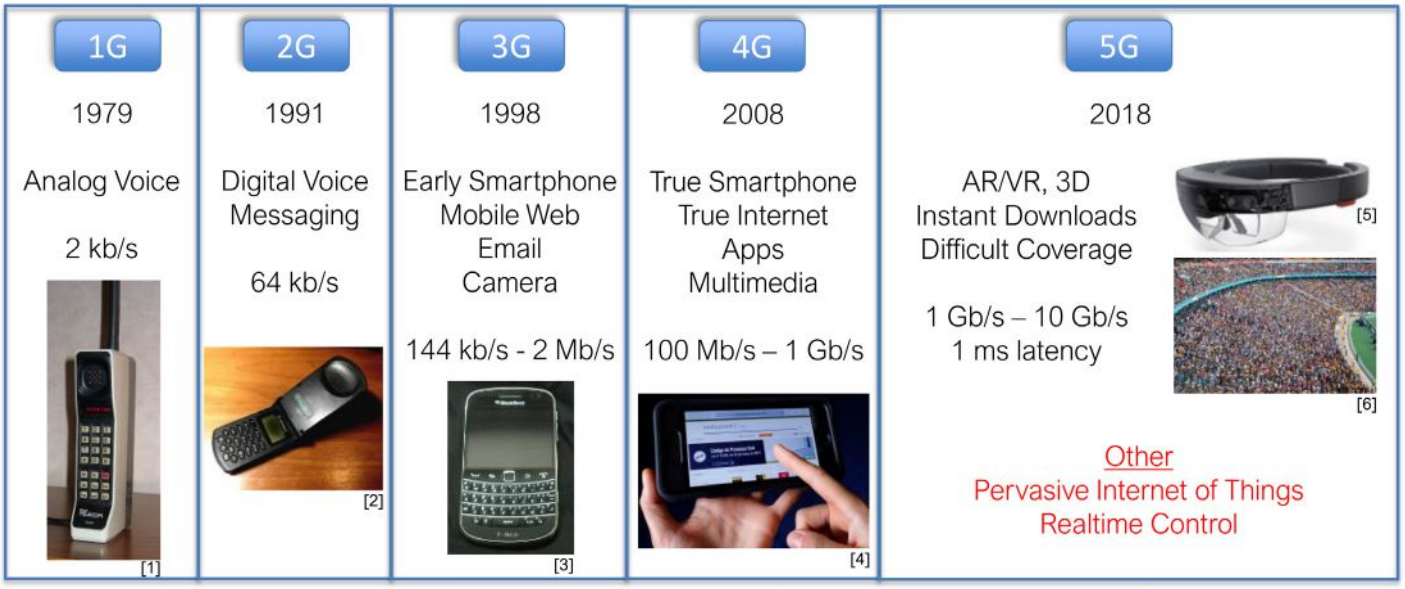
EUROPE
+31 (0) 33 4723-225 | europe@redlion.net

AMERICAS
+1 (717) 767-6511 | info@redlion.net

EXCELLENCE. REDEFINED.

Industrial 5G technology offers potential wireless standard

5G implements technical enhancements over 4G, and is specifically targeting industrial automation. 5G as a technology has already emerged and, even though capabilities are limited, enhancements will continue to be backed by a set of industrial automation players pushing for a common wireless standard.



SOURCE: ODVA

Mobile phone generations. New cell phone generations have emerged about every 10 years.

5G IS AN UPGRADE TO THE CELLULAR SYSTEM that is not the same as prior generations, where the upgrade focused almost exclusively on improved rates for cell phones. Along with improved rate, enhancements include higher device density, lower latency, increased reliability, and a push for private deployment that all combine to target a wider range of applications.

Expected usage includes Ultra Reliable Low Latency Communication (URLLC) for real time control, enhanced Mobile Broadband (eMBB) for uses including augmented and virtual reality, and enhanced/massive Machine Type Communications (eMTC) for wide-area (usually battery powered) wireless.

Not only did the cellular industry target industrial automation in their IMT-2020 vision, but there is a coordinated effort called 5G-ACIA to rally industrial automation behind 5G and to influence the 5G standards to meet industrial automation use cases and requirements.

The 5G standards from 3GPP are delivered in a series of releases. Earlier releases had already included Ethernet bridging, IP routing, and DSCP-based QoS – valuable features to carry EtherNet/IP traffic.

Release 15 is moving into the market, bringing many of the stated enhancements. Release 16 is in development and goes even further with the addition of TSN capability. Various visions include the replacement of wired switches and the enablement of collaborative mobile manufacturing platforms.

New 5G generation

New cell phone generations have emerged about every 10 years. The bandwidth of 1G was just adequate for analog voice. The increased 2G bandwidth enabled digital voice and messaging. The increased bandwidth of 3G, along with platform improvements, enabled transmission of pictures, optimized Web pages, and email.

The increase in the platform capability eventually drove the first smart phone. With 4G, we entered the true smartphone era. High resolution screens allowed true internet access by apps. The higher bandwidth enabled the first multimedia streaming. Through all of this, the primary focus was on the improvement of cell phones.

With 5G, cell phone advancements are still important. The large density of cell phones at ballgames, airports, and other public venues presents a challenge to the cellular infrastructure. Users demand high-quality multimedia, regardless of the setting.

In combination with higher rates, 5G brings dramatic latency reduction to enable new capabilities. Mobile interfaces become wearable and immersive. Augmented Reality (AR) and Virtual Reality (VR) depend not only on high rates, they but they must move large amounts of data with low latency, or risk making users nauseated.

Showing larger aspirations, 5G proposes to utilize its low latency for real-time control applications, including those in industrial automation.

On another front, 5G is pushing to be the dominant force in low-power wireless devices. While 4G brought features for Low Power Wide Area Network (LPWAN), 5G improves cellular's competitiveness.

Much of the extended focus is on devices other than traditional cellphones, the so-called Internet of Things (IoT). While each person may carry a single (relatively expensive) cell phone, they may wear multiple (relatively less expensive) devices. They may also utilize a dramatically larger number of devices in their homes, cars, and workplaces, as well as in public settings.

5G feature set

The vision documents for each future generation of mobile telecommunications have been emerging from a single source. Under the United Nations (UN) is the global-scope International Telecommunication Union (ITU). One part of the ITU is the

C_ber Securi_y

AI 05-19000L1

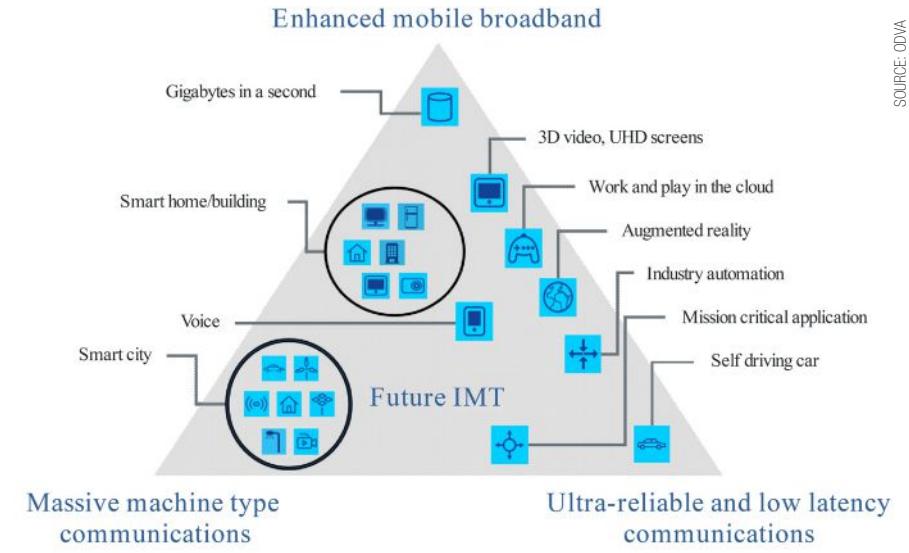
Incomplete security?

Our 360° cybersecurity solutions protect your industrial network!

Industrial control and automation systems are increasingly exposed to cyber risks and unintentional changes due to the growing networking of these systems and their connection to the Internet. By means of secure products, services, and industrial solutions, Phoenix Contact helps you protect your systems and safeguard your know-how. Don't hesitate to contact us for more information and advice.

For additional information call +49 5235 3-00 or visit **phoenixcontact.com**

PHOENIX CONTACT
INSPIRING INNOVATIONS



SOURCE: ODVA

5G triangle from IMT-2020.

Radio Communication Sector (ITU-R). An initiative of ITU-R, named International Mobile Telecommunications (IMT), develops the vision documents.

5G is the third cellular generation based on these documents. The 3G vision document was completed in 1998, under the name of "IMT-2000". The 4G vision document was completed in 2008, under the name of "IMT-Advanced". The 5G vision document was developed between 2015 and 2018, under the name "IMT- 2020".

5G Triangle

IMT-2020 includes a usage scenario triangle. IMT proposed three broad usage categories on the vertices of the triangle: "Ultra Reliable Low Latency Communication" (URLLC) for real time control, "enhanced Mobile Broadband" (eMBB) for uses including augmented and virtual reality, and "enhanced/massive Machine Type Communications" (eMTC) for wide-area (usually battery powered) wireless.

The three corners of the triangle are roughly related to three aspects of improvement in 5G: increased rate, reduced latency, and LPWAN capability.

Within the triangle are more specific usage scenarios. These fall in place by their relationship to the broader categories. Industrial Automation is shown to rely more on high reliability and low latency, and less on high data rate or wide geographic spread.

5G Spider diagram

IMT-2020 also includes spider diagrams for making comparisons which proposes eight technical metrics for improvement over IMT-Advanced (4G). These enhancements combine to target a wide range of usage scenarios.

While there is a 20x increase in the peak data rate, other metrics are worth noting. Low latency of 1 ms (10x improvement) is an enabler for AR/VR applications. It is also an enabler for motion control, but only when combined with high reliability.

Data rates of 100 Mb/s at each automation device would match today's typical expectation for wired Ethernet. A capacity of 10 Mb/s/m2 may begin to enable wireless in each sensor, not just for limited usage, especially if there can be 1 M devices/km2.

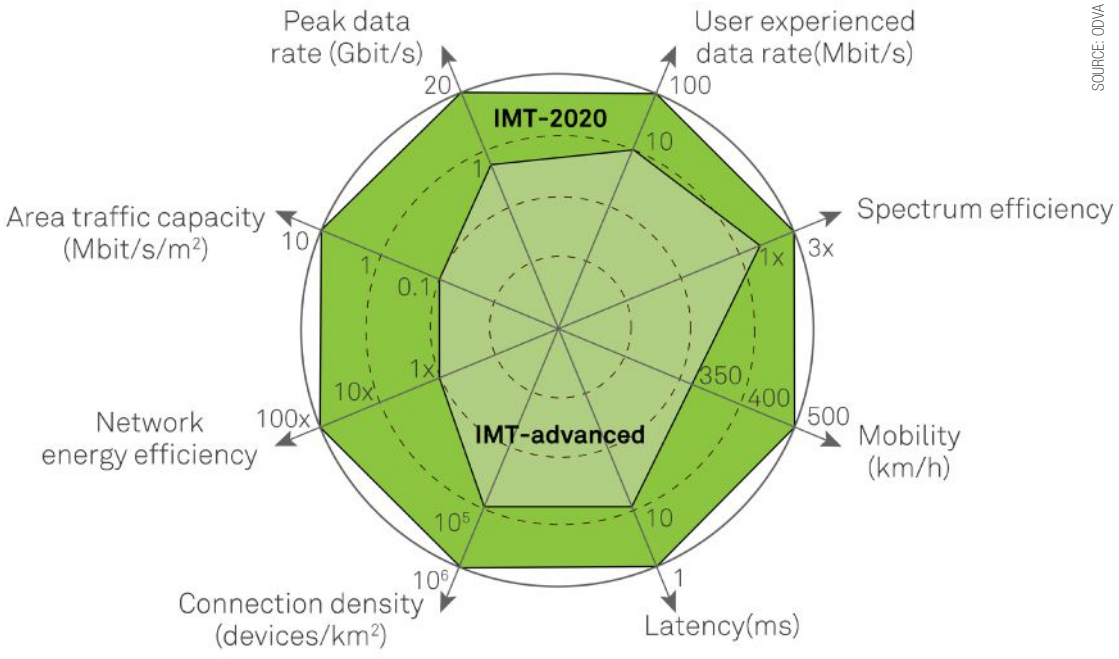
5G Standards development

The Third Generation Partnership Project (3GPP) is the organization where 5G specifications are created and maintained. The specifications are publicly available – free of charge. 3GPP was established in 1998 for the development of 3G cellular.

It was established as an international collaboration of telecommunication standards development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC). 3GPP was so successful that they have continued to develop standards for subsequent generations of cellular beyond 3G. Still, the name was preserved.

3GPP is divided into Technical Specification Groups (TSG), each working on a specific aspect of the technology. The Radio Access Networks (RAN) group develops radio specifications from layer 1 through layer 3 for the base station and the user equipment. Core Network and Terminals (CT) group develops the specifications for the layer 3 protocols (session control, mobility, etc.) between the core network nodes, and the interconnection with external networks. Services & System Aspects (SA) develops the specifications for the overall architecture and the services.

Importantly, TC WG3 develops specifications for "interworking" – the connection of the 5G realm to the rest of the world. In 4G/LTE, they created the "Evolved Packet Core" (EPC), which provided an Internet Protocol (IP) packet switching basis for subsequent cellular.



SOURCE: ODVA

5G spider diagram from IMT-2020.

3GPP releases

The 5G standards from 3GPP are delivered in "releases". A release is a formal specification development process – focused on agreed "work items" (features). A series of releases defines

HIROSE ELECTRIC EUROPE B.V.

ix Industrial™

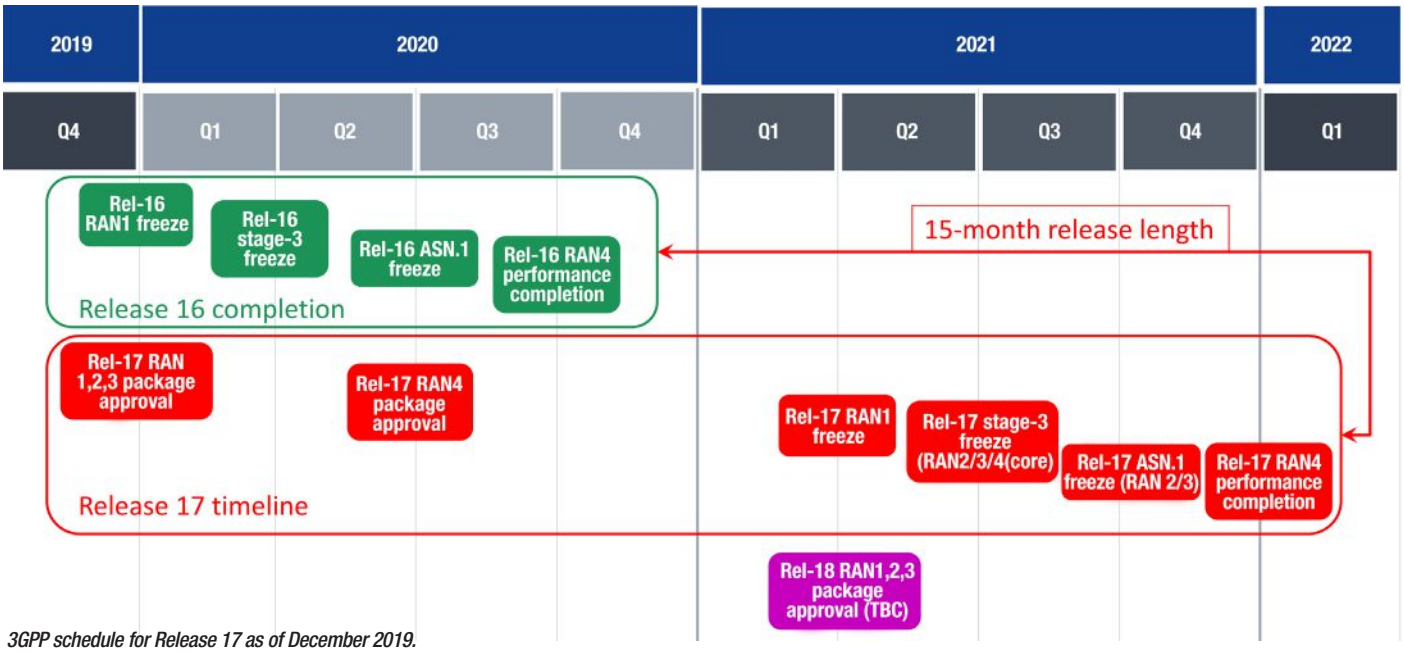
Buy Online on SINBON webshop https://ix.sinbon.eu/

Ethernet communication between electronic equipment has increased with Industry 4.0 which brings efficiency of manufacturing with ICT technology. In response to this increasing demand HIROSE had standardized a new miniaturized Ethernet mating interface in compliance with IEC/PAS 61076-3-124. The ix Industrial™ socket size is reduced by 75% compared to the existing RJ45 modular connectors, and offers ideal space saving cabling for applications with miniaturized requirements.

- **Compact: 75% smaller in size than a RJ45**
- **Robust: 5000 mating cycles**
- **High-speed: Ethernet 1Gbps/10Gbps**
- **High EMC resistance**
- **Complies with IEC/PAS61076-3-124**

► Security System ► Transportation ► Data Center ► Robotics ► Communications ► Factory Automation

www.hirose.com/eu - eu.info.3d@hirose-gl.com



SOURCE: ODVA

3GPP schedule for Release 17 as of December 2019.

a cellular generation introduction and its enhancement and maintenance. The time to complete a typical release is variable. The releases overlap to reduce the time.

Release 15 is currently moving into the market, bringing many wireless enhancements. It is called 5G NR (New Radio). Two versions are defined. The Non-Standalone (NSA) version leverages the legacy LTE "control plane" to establish connectivity, to roam, and for other related management. The NSA data utilizes the 5G "data plane" for the application traffic. The full native version is Standalone (SA), which uses both control and data plane from 5G. This requires more extensive changes in the core.

Note that the NSA roaming is based on the slower LTE procedures. Control loops operating at 1 ms latency should expect some longer latency where they have to roam. Release 16 is (as of March 2020) in development. It brings the addition of TSN capability. This addition is made to cater to industrial automation use case requirements.

5G-ACIA

Not only did the cellular industry target industrial automation in their IMT-2020 vision, but there is a coordinated effort called 5G-ACIA (5G Alliance for Connected Industries and Automation) with the purpose of rallying industrial automation behind 5G and to influence the 5G standards to meet industrial automation use cases and requirements.

5G-ACIA is a subgroup of ZVEI (a German Electrical and Electronic Manufacturers' Association). 5G-ACIA was established with the sole purpose of promoting 5G evolution to meet industrial automation needs. It is in part an outgrowth of the German government promotion of Industrie 4.0, which points to 5G as a key enabler in the digitization of industrial automation. Further German government influence led to lightly licensed industrial bandwidth, and German manufacturer commitment to 5G in factories (Volkswagen and Audi in particular).

The membership of 5G-ACIA includes industrial automation leaders as well as telecommunication industry participants at all levels (operators, equipment providers, chip-level providers, etc.). The overlap of the two sets of participants results in the ability for industrial requirements to be brought back into 3GPP. These were brought into the 3GPP releases, along with the key performance indicators, to influence the specification enhancement process.

Note that some of the 5G use cases require 99.9999% (Six-Nines) reliability in packet delivery. This is equivalent to wired Ethernet reliability. This represents a Packet Error Ratio (PER) of 1 in 1 million or 10^{-6}. Assuming an average packet length of 1000 bits, this represents a Bit Error Ratio (BER) of 10^{-9}.

System architecture & interworking

At a high level, the 5G System architecture (5GS) includes three main components: the 5G Radio Access Network (5G (R)AN), the 5G Core (5GC), and the User Equipment (UE). The UE is typically a cell phone, but it can be any 5G enabled device. The 5G RAN includes a base station (known in 5G as a "gNodeB") and the antennas, providing the wireless access point for the User Equipment.

The 5GC includes a Service-Based Architecture (SBA) with functional modules. These include the Access and Mobility Management Function (AMF), controlling access to the system, and facilitating mobility/roaming.

A primary function of 5G is to convey information between the wireless UE and non-5G Data Networks (DN) – e.g., the Internet. This is known in the 5G specifications as "interworking". The DN is most typically a routed network using Internet Protocol (IP), or an Ethernet network.

The User Plane Function (UPF) acts as a decoupled data plane, forwarding, filtering, and converting packets. The Session Management Function (SMF) acts as the control plane to configure the UPF, creating sessions between UE and DN.

Two important interworking methods are in place: (1) an Internet Protocol (IP) routing method; and (2) an Ethernet bridging method. The two methods include related services, including linkage to outside security. The User Plane Function (UPF) plays a key role in data movement.

The IP routing includes use of IPv4 or IPv6 and DSCP-based QoS, with the SMF acting as DHCP client/server, as well as linkage to RADIUS/AAA and other security services.

The Ethernet bridging utilizes the User Plane Function (UPF) to strip and add Ethernet headers on ingress and egress, stores Media Access Control (MAC) addresses for bridging decisions, and acts as an Address Resolution Protocol (ARP) proxy.

Note that the UE may also include routing or bridging function internally. This allows compliant design of an adapter to a wired subnet or the creation of a fully embedded wireless solution.These 5G interworking specifications are valuable features to carry EtherNet/IP traffic. Early testing by Rockwell Automation indicates that unmodified EtherNet/IP protocols can run over 5G.

Spectrum

5G spectrum is only roughly harmonized on a worldwide basis. Most of the spectrum is currently licensed (under control of the operators). Unlicensed and flexibly licensed

SOURCE: ODVA

Use case (high level)		Availability	Cycle time	Typical payload size	# of devices	Typical service area
Motion control	Printing machine	>99.9999%	< 2 ms	20 bytes	>100	100 m x 100 m x 30 m
	Machine tool	>99.9999%	< 0.5 ms	50 bytes	~20	15 m x 15 m x 3 m
	Packaging machine	>99.9999%	< 1 ms	40 bytes	~50	10 m x 5 m x 3 m
Mobile robots	Cooperative motion control	>99.9999%	1 ms	40-250 bytes	100	< 1 km²
	Video-operated remote control	>99.9999%	10 – 100 ms	15 – 150 kbytes	100	< 1 km²
Mobile control panels with safety functions	Assembly robots or milling machines	>99.9999%	4-8 ms	40-250 bytes	4	10 m x 10 m
	Mobile cranes	>99.9999%	12 ms	40-250 bytes	2	40 m x 60 m
Process automation (process monitoring)		>99.99%	> 50 ms	Varies	10000 devices per km²	

bands exist and are growing in availability. The US promotes 3.5-3.7 GHz (CBRS band) with a license database to reserve exclusive use of channels within a limited geography. Germany introduced 3.7-3.8 GHz with company licensing. Unlicensed spectrum generally requires Listen Before Talk (LBT), impacting determinism.

In Release 15, 3GPP specified two broad frequency bands: FR1 (410 MHz to 7.125 GHz) and FR2 (24.5 GHz to 52.6 GHz). Technical differences are specified for radios that are designed for each band.

The cellular industry created a further logical division into three functionally different layers: (1) The "low-band", below 1 GHz, applying only Frequency Division Duplexing (FDD), and known as the "coverage layer" due to better propagation characteristics; (2) The "high-band", above 24 GHz, applying only Time Division Duplexing (TDD), and known as the "Super Data Layer" due to high data rates; and (3) the "mid-band", between 1 and 6 GHz, applying mostly TDD, and known as the "Coverage/Capacity Layer" as it is a compromise between the other two bands.

The low-band services provide for remote rural coverage as well as LPWAN. Standard cell phone usage falls into the mid-band. Applications demanding the highest rates and lowest latency will utilize the high band. Coverage is then more difficult due to the poor propagation characteristics of the mmWave signals (blocked by most everything, including windows). On the other hand, the poor propagation facilitates channel reuse by blocking the signal at a facility boundary.

Non-Public Networks (NPN)

New deployment models are emerging with 5G. Previously, cellular systems were totally controlled by the Mobile Network Operators (MNOs). End users could develop the UE, adding Subscriber Interface Modules (SIMs) to bring them into a Public system. 5G brings options for Non-Public Networks (NPN) to the end users.

Several NPN models exist, starting with a full stand-alone NPN, where the end user owns all the equipment, the control plane or 5G core (5GC), the data plane (UPF), the Radio Access Network (RAN), and the private spectrum. In hybrid models, only some portions are private.

Based on market studies, cellular participants estimate that NPN deployment will lead to 3x increase in the number of base stations that are deployed. This is high motivation for equipment vendors. The bulk of the estimate is for industrial automation deployment.

Local equipment can improve URLLC performance, closing the loop closer to the equipment. The easy containment and high rates of mmWave may also be of benefit.

Challenges exist in achieving the NPN vision. The traditional cellular system is comprised of a large set of specialized equipment. The size and cost must be reduced and ease-of-use improved dramatically to enable practical use by the average industrial automation site. One positive trend is the emergence of "small cells". This brings more bandwidth to smaller areas. The equipment must then be small and economical.

Another challenge is that private spectrum is difficult to procure. Since operators may benefit by NPN participation through sub-licensing spectrum, selling equipment, or providing installation/management services, this cooperation may be key to providing adequate bandwidth and avoiding interference between sites. 5G's "slicing" technology allows operators to partition their 5G network into virtual networks (both the RAN and the 5GC), coordinating between industrial automation sites, and providing Service Level Agreements (SLAs) to each site.

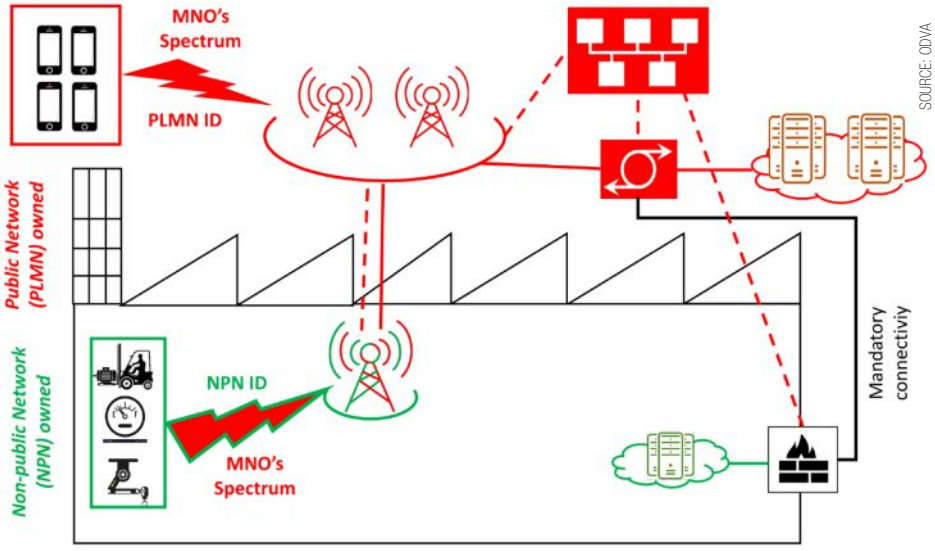
Frame structure

5G communication is based on a standard frame structure. 5G repeats a fixed 10 ms radio "frame". The frame contains 10 fixed "subframes" of 1 ms each. This fixed frame structure provides the basic timing, matching the legacy LTE fixed frame structure.

Within a subframe, there are a variable number of "slots". The slot length, and number of slots in a subframe depend on the "subcarrier spacing" (SCS). Small SCS (i.e., 15 kHz) has less bandwidth and is extended in time to increase the energy, large SCS (i.e., 120 kHz) has more bandwidth and the slot can be shorter in time (125 us).

Each carrier may be modulated using Quadrature Amplitude Modulation to carry up to 256-QAM (8 bits per symbol). A variable number of subcarriers (up to a maximum bandwidth) are modulated simultaneously to form a symbol using Orthogonal Frequency Division Multiplexing (OFDM). A slot (usually) consists of 14 symbols.

Considering the frame in frequency and



System diagram for standalone Non-Public Networks (NPN).

time, it composes a resource grid. Blocks of user data can be packed into the grid by a scheduler using Orthogonal Frequency Division Multiple Access (OFDMA).

The 5G frame can mix upstream and downstream traffic within slots. Each symbol may be assigned as uplink, downlink, or flexible, following a set of predefined slot formats. Some formats have more downstream symbols, some more upstream, and some alternate for sub-slot turnaround and reduced latencies.

Note that the same basic frame structure can be used for all purposes. While this section described TDD, where transmission and reception occur on a single channel, the same basic frame structure applies to FDD, where there is continuous transmission and reception on separate channels. The same frame structure also supports unlicensed band usage, where the start of a slot is sacrificed for the Listen Before Talk (LBT) procedure. There may also be "mini-slots", with a small number of symbols and a flexible start time. This allows low latency for URLLC transmission.

Fading

Wireless channels are not constant, but experience impairments. The fluctuation of the signal strength at the receiver is known as "fading".

Fading can be broken down into types. Some classifications consider "path loss" as a type of "large scale fading" based on transmit distance, which can be compensated by increased signal. Another type is "small scale fading", where the signal fluctuates rapidly over short time and distance – making it hard to compensate. Changes may be induced not just by motion of the transmitter and receiver, but by changes in the surrounding environment (e.g., moving metallic objects).

Statistical models are developed for the fading channels. Radios can be designed against the statistical models, but the real channel may vary in dynamic ways. Rapid channel measurement can enable compensation. Depending on relative motion, the channel can only be assumed to meet the measurement for a fixed time period (the "coherence time"), then it must be re-measured.

Some impairments such as "fast fading" can be compensated by retransmission, as the fading only lasts for a short period. This and related techniques can add unpredictable latency, contrary to URLLC goals. Fading can change faster than adaptations are made. The result is additional retransmissions to compensate for the unreliable channel, leading to unpredictable latency.

Channel hardening

Considering a channel between a transmitter and a receiver, the gain may vary (in time and frequency) due to fading. Decreasing the variation is known as "channel hardening". If the variation is adequately reduced, the channel behaves deterministically – as if there is no fading.

Channel hardening can be achieved by applying "spatial diversity". If the number of antennas is increased between the transmitter and the receiver, each with a slightly different path with regard to the fading, by combining the antenna signals we approach an average channel gain (over a large enough period, we can average out the fading) for the instantaneous value.

There are now several practical implications. The signal is improved across both time and frequency. Latency is lower and transmissions can be scheduled.

An additional benefit is the ability to utilize (only) uplink pilots for channel estimation. By utilizing TDD, reciprocity can be applied. The upstream and downstream channel can be estimated to be the same. A single upstream pilot from a UE arrives to multiple antennas at a base station. The large number of antennas is used for channel hardening. The base station can compensate for the channel in both directions, by combining the multiple receive signals and by manipulating the multiple transmit signals.

Massive MIMO

"MIMO" (Multiple In Multiple Out) is a technique that combines multiple antennas (in the same channel) for various improvements. Much like some directional antennas, "beamforming" uses multiple antennas with the same data stream to increase the gain and to steer the signal, improving distance and decreasing some interference. Spatial multiplexing sends different data streams from the multiple antennas to increase throughput.

5G brings "massive" to MIMO, deploying a very large number of antennas attached to the base station (ideally 100's). This can bring benefits to even unmodified UE. Some argue that this is the single improvement that makes 5G worthwhile.

In an example MIMO system, the large antenna array targets multiple users. The large number of transmit and receive chains are coordinated at a system level. An 8 x 8 array (64 dual-polarized antennas) is typical. The array transmission and reception can be configured to form multi-antenna beams to multiple users. The benefits include full cell capacity for each user, high reliability, and low latency – based on channel hardening and rapid channel estimation.

Coordinated multi-point

The massive MIMO technique can be extended by spreading the antennas across a site. This technique is known as Coordinated Multi-Point (CoMP), or as "distributed MIMO". CoMP bring the same general improvements – an increase in the capacity within the site and/or low latency with increased reliability. It can also further harden the channel by increasing the antenna diversity.

As explained by Qualcomm, blockage and reflections from fast moving metal objects within industrial automation can cause sudden drops in signal strength. It is implied that (CoMP) can maintain reliable operation and low latency under such conditions. Note that the distributed antennas must be tightly coordinated. A CoMP server tunes the signals from each antenna set. Note that CoMP is not a new technique. It was applied to LTE in 2009.

Low power wireless

5G promises improvements in low power wireless. LTE-M, NB-IoT and EC-GSM-IoT are specified. While these low power radios are not new, there have been enhancements.

It has been shown that all three technologies can achieve battery life longer than 10 years with two AA batteries totaling 5 Wh. This requires a daily report consisting of a 200 byte

message at data rates < 1 kb/s and latency approaching 10 seconds, with 164 dB MCL.

The Maximum Coupling Loss (MCL) is a channel-independent measure to describe the expected wireless system coverage. While nodes could transmit > 10 km under ideal conditions, citywide coverage is a primary target, with interstation distance in the range of 250 m to 2 km. Deeply embedded nodes are the challenge, where in parking garages for example, we may lose 50 dB through concrete walls. In order to work under these lossy conditions, redundant transmissions are applied – reducing battery life.

Release 15 continued adding improvements to help meet increased performance requirements relative to LTE (4G). The number of messages needed to participate in the network were reduced. Small cells, located closer to UE, allowed the reduction of transmit power. A small Wake Up Signal (WUS) was introduced. A battery-efficient security technique (BEST) was added – in-part as a confidence builder for IoT proliferation.

Active transmission uses the most power. LTE-M and NB-IoT radios have 164 dB MCL and transmit at 14, 20, or 23 dBm. Each halving of the distance can gain back 6 dB. Mesh techniques are also considered for better coverage and to reduce distances. "Generalized" beamforming is another technique that can be applied. Each doubling of the antennas can add 3 dB of gain. In one study, 200 antennas demonstrated 28 dBi. Reductions of transmit signal power do not translate in a linear fashion, but chipsets are improving each generation to be more efficient by utilizing more efficient power amplifiers.

5G IoT radios are under continuous improvement, driven by a huge technical community.

5G industry vision

5G is arriving with one of the largest marketing pushes ever. In virtually every manufacturing company of any size, someone is assigned to develop their 5G vision. While wireless has been available for a long time, and applied in numerous industrial automation applications, it has not become ubiquitous. 5G may bring some new vision, or at least may deliver better capabilities to meet unsatisfied visions.

As stated by the 3GPP Chair from Nokia, Release 16 pursues Ethernet replacement in the factory. This includes the addition of TSN.

One vision is the replacement of wired switches with 5G wireless. Supervisory control may be a good candidate due to the lower rates to interlock and coordinate across equipment, and the larger distances of cable runs. This includes the IT/OT boundary and MES connections.

Another vision is the enablement of lean collaborative mobile manufacturing systems. Besides replacing Ethernet between fixed machines/cells/lines (which has benefit), wireless untethers the equipment. While the mobile equipment may just move materials (AGVs), mobile platforms can also carry parts-in-process to fixed application platforms. Each part can be different. Process reconfiguration can be rapid.

Conclusions

5G will implement a wide range of technical enhancements over 4G. These enhancements improve on prior wireless solutions and may open new market areas including industrial automation.

5G has already emerged; capabilities are limited, but enhancement will continue. For the first time, we have a substantial set of industrial automation players pushing for a common wireless standard – 5G.

Since 3G, the 3GPP standards have included: packet switched Internet Protocol, Ethernet connectivity, and quality of service matching EtherNet/IP needs. Paradigm shifts may be either an opportunity or a threat.

David Brandt, Engineering Fellow and Scott Griffiths, Senior Network Engineer, ***Rockwell Automation.***

Simplify Machine IP Integration

IP Routers

Maintain your factory-set IP addresses when integrating with the customer's IP network by using a Skorpion IP Router.

- **Reduce installation time**
- **Eliminate IP conflicts**
- **Easily comply with your customer's IP requirements**
- **Eliminate site visits with secure remote access**

CONTEMPORARY CONTROLS®

Learn more at www.ccontrols.com/machine

IIoT in automation from machines to the cloud and back

Use of digitalization offers new possibilities for optimizing manufacturing processes by leveraging data analytics through cloud-based systems. New communication methods for automation systems via standards-based open protocols such as MQTT is helping users fully integrate components regardless of manufacturer.

ADVANCING DIGITALIZATION OFFERS NEW possibilities for optimizing production processes. Use of state-of-the-art components to connect a controller to a cloud system can increase productivity and thanks to extended maintenance intervals provide for an uninterrupted production, leading to a significant competitive advantage for the enterprise.

Digitalization is changing today's production and business processes of modern companies more and more. The increasing availability of data and advanced Industrial Internet of Things systems provide greater opportunities to optimize the production process throughout the entire chain by skillfully analyzing the data. In doing so, the maintenance intervals of the machines used can be extended and unplanned downtime be avoided.

After connecting a machine to a cloud system, for example, data on the motion sequence can be transmitted to it and comprehensively analyzed there. In case of deviations from the set point, the failure of the machine can be predicted from the absolute deviation as well as from the rate of change.

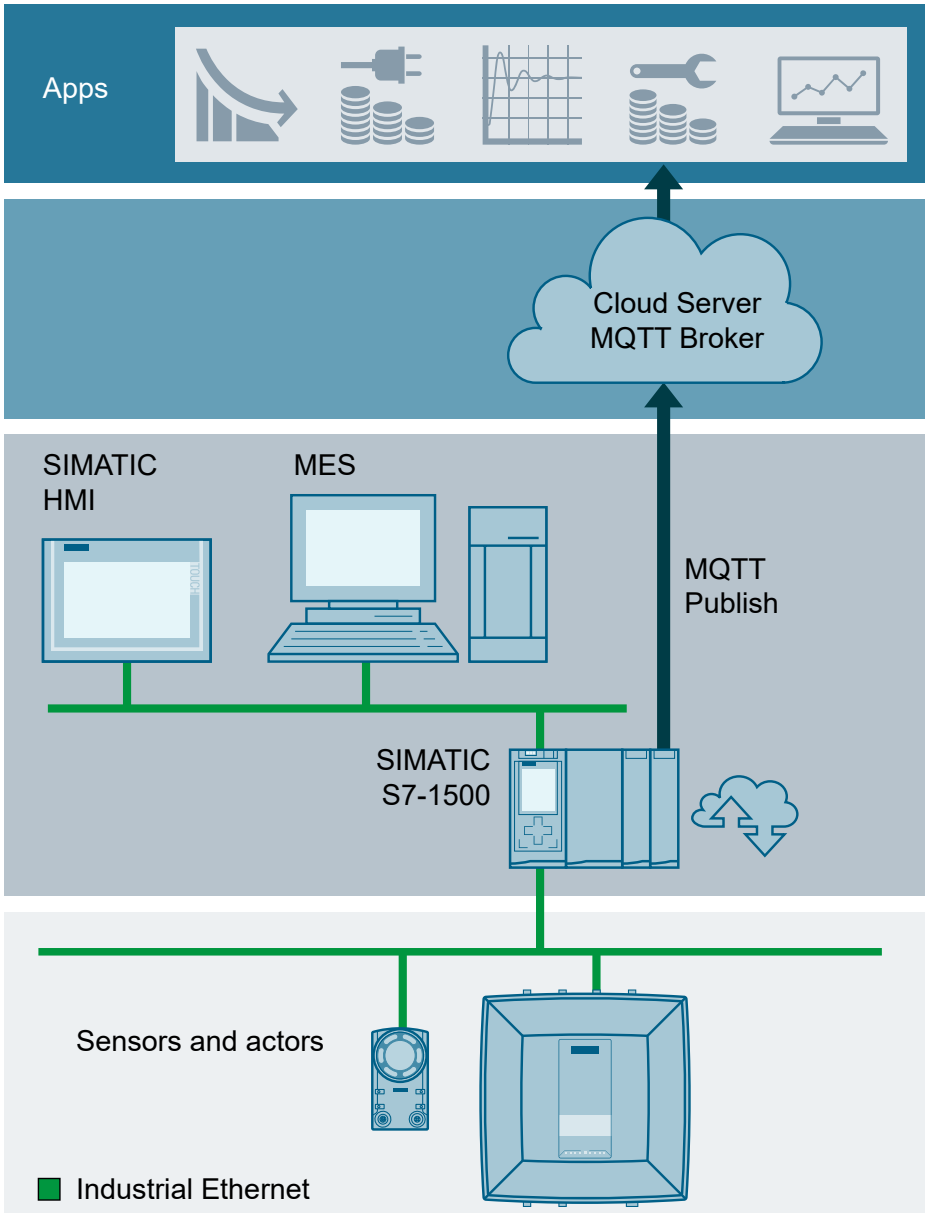
As a result, maintenance intervals based on the analysis result from the data can be planned dynamically and precisely. This approach is called predictive maintenance and represents a major use case for using cloud-based systems.

Use of MQTT

For the integration into modern cloud-based systems, the open standard protocol MQTT (Message Queuing Telemetry Transport) is often used. It is a simple protocol based on the client/server principle, where the participants (clients) communicate as MQTT Publisher or MQTT Subscriber via an MQTT Broker (server). Devices only wanting to send data to a cloud system use the MQTT Publish function.

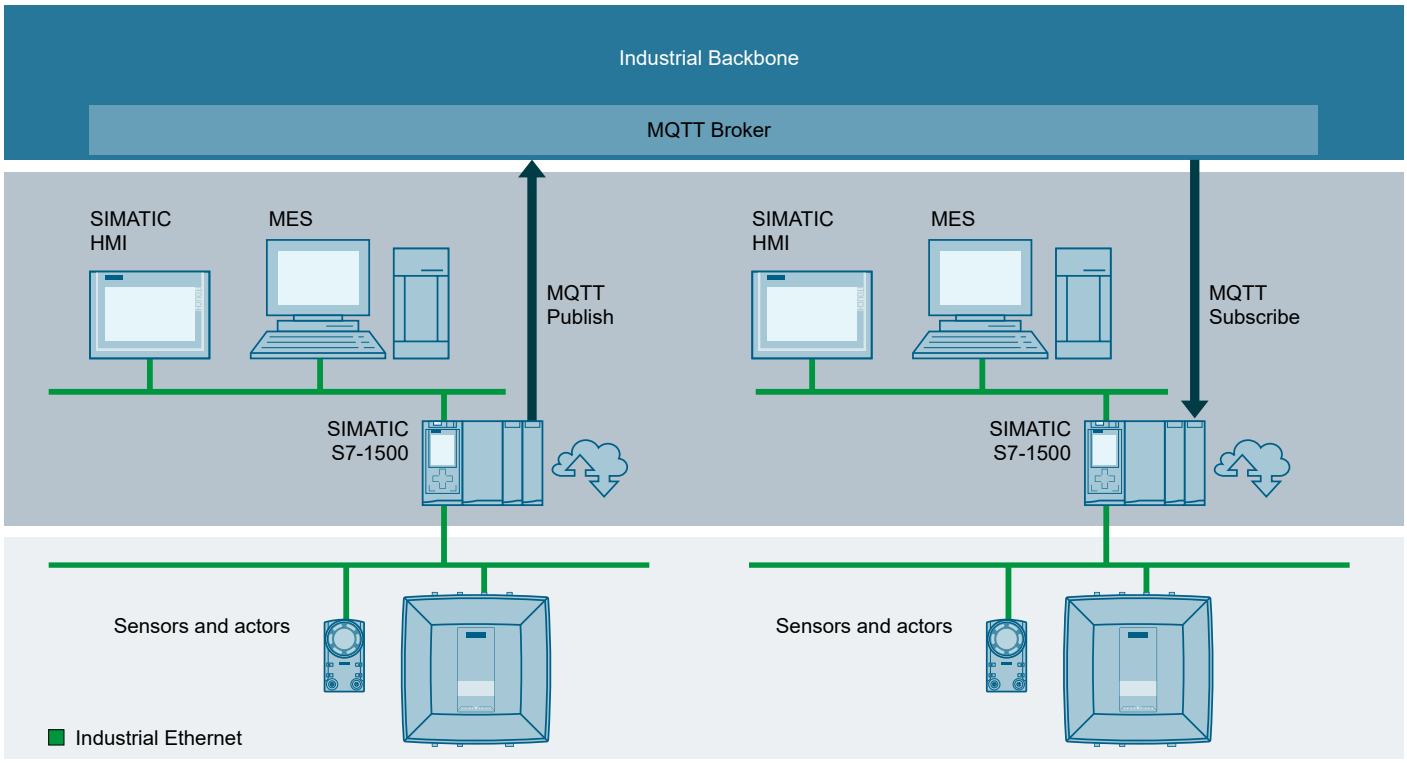
In the context of digitalization in the company, the opportunity presents itself to employ a system such as MindSphere, the cloud-based, open IoT operating system from Siemens, which makes it possible to analyze data from a machine by means of special apps in order to determine the optimal maintenance time for the machine. However, it is very important for the user to identify in advance the data to be transmitted to the cloud system. It is advisable to proceed frugally here, since an optimal data selection not only leads to better clarity in the cloud system, but also optimizes the data load in the network. In addition, the data volume in the cloud system is reduced (saving money).

The heart of a machine from which data is to be transmitted to a cloud system frequently consists of an automation system of the type SIMATIC S7-1500, which ensures the proper process sequence within the machine. By using appropriate sensors to record, e.g., temperature, vibration, or rotational speed of axles and motors, deviations can be determined over a longer period and downtime be planned much more precisely, or unplanned downtime be detected earlier.



Data transmission communicates from an automation system to a cloud system for the further analysis.

SOURCE: SIEMENS



Communication with MQTT Publish and MQTT Subscribe in the Industrial Backbone for the communication between machines.

Communication processors

A new communications processor CP 1545-1 is available for integration into the modular automation system SIMATIC S7-1500. Via the MQTT protocol, the MQTT Publish function can be used to transmit selected data from the automation system to the cloud system.

After entering the access details for the cloud system in the configuration software TIA Portal, the data to be transmitted is also selected there using data points. Besides the name of the selected data point, other attributes are defined, such as timestamp, data type, status, or limits.

The transmission of data via MQTT additionally requires the entry of a name for a topic to which the data points are assigned. By means of topics in the MQTT protocol, the user structures the data to be transmitted according to the desired topic.

When using multiple topics, it is therefore possible to assign the data to be transmitted according to the different function of the data points. An example would be machine1/TemperatureSensor2. Of course, this structure must also be mapped in the cloud system for the data to be processed correctly.

For the transmission of the data to the cloud system, the user also defines corresponding trigger conditions. Thus, data can be transmitted either via a time trigger (e.g., once a day or cyclically) or according to a threshold trigger (e.g., value lies outside a defined range).

It is of course also important for the operation of this solution that user already thinks in advance about the necessary security. This also depends on the cloud platform used and on the locally installed (on-premise) or Internet-based solutions.

Since MQTT can be encrypted using Transport Layer Security (TLS), the CP 1545-1 already provides the first component for comprehensive security, which can be easily activated for the module in the configuration software TIA Portal.

To protect the cell, the integrated firewall of the CP 1545-1 can be used in addition. Since the user is responsible for the security of the installed solution, it is generally recommended that a holistic security concept be implemented in which the functions mentioned are only one component.

SOURCE: SIEMENS

SIMATIC communications processor and controller.

If the user is now able to send data to a cloud system and analyze it there with the help of apps, the idea of wanting to use the analysis result to send data to the machine according to the instructions of the user inevitably comes up. This can, if it is determined in the context of predictive maintenance that increased wear has occurred, serve to put the machine, for example, in an emergency state to protect the components.

If a cloud system is able to send data to a machine, the CP 1545-1 in the SIMATIC S7-1500 automation system is already prepared for this. For instance, it can already send data via MQTT Publish to an MQTT Broker installed in the Industrial Backbone or receive data from an MQTT Broker it via MQTT Subscribe.

Conclusion

Advancing digitalization offers new possibilities for optimizing production processes by skillfully leveraging data analytics through cloud-based systems, creating a competitive advantage for the enterprise. New ways of communication for automation systems via standards-based open protocols such as MQTT help users to fully integrate components regardless of manufacturer.

In the future, the possibilities of receiving data in the systems could further simplify the processes. The technical requirements are already provided by some products today, such as the SIMATIC CP 1545-1 communications processor.

Axel Schröter, Product Manager, ***Siemens.***

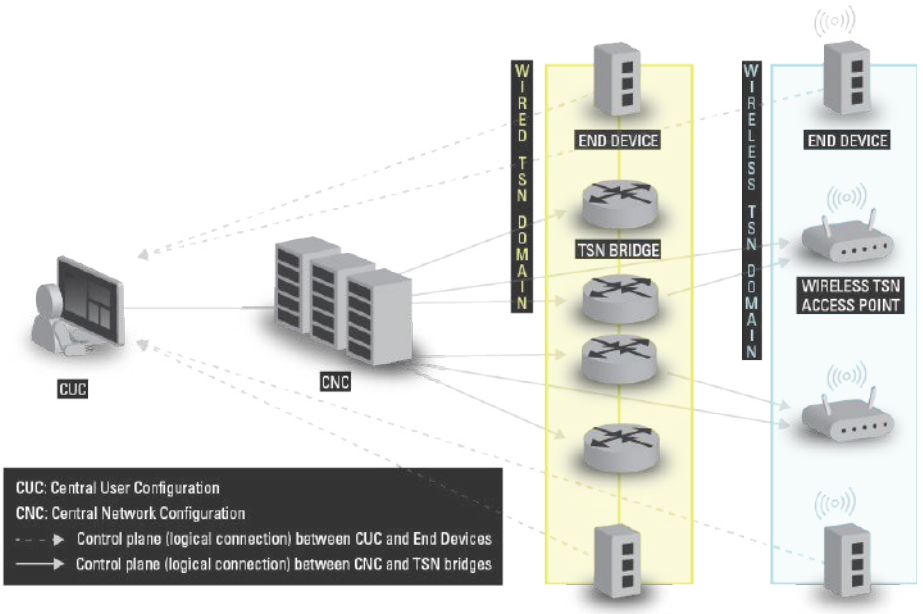
Wireless TSN use cases and standards challenges

Most Time Sensitive Networking (TSN) standards developed so far are solutions based on Ethernet technology. However, given the nature of wireless communications, enabling TSN capabilities that maintain interoperability and compatibility with existing wired TSN standards is challenging.

RECENT ADVANCES IN 5G AND IEEE 802.11 wireless connectivity technologies in providing low latency and high reliability have generated significant interest in extending Time Sensitive Networking (TSN) capabilities over wireless.

Wireless communication systems are beneficial for many obvious reasons, including enabling flexibility and reducing wiring costs as well as enabling mobility. However, given the stochastic nature of wireless communications, enabling wireless TSN capabilities that are interoperable and compatible with existing wired TSN standards is challenging.

Although a few IEEE 802.1 standards exist for wireless, most implementations, market-specific profiling, interoperability testing and certification efforts have focused on Ethernet as the main transport media. As TSN-enabled devices and networks start to be deployed, enabling extensions of similar capabilities over wireless is a natural next step.



SOURCE: AVNU

Example of a Wireless TSN domain in centralized TSN operation model.

Wireless TSN – what it means

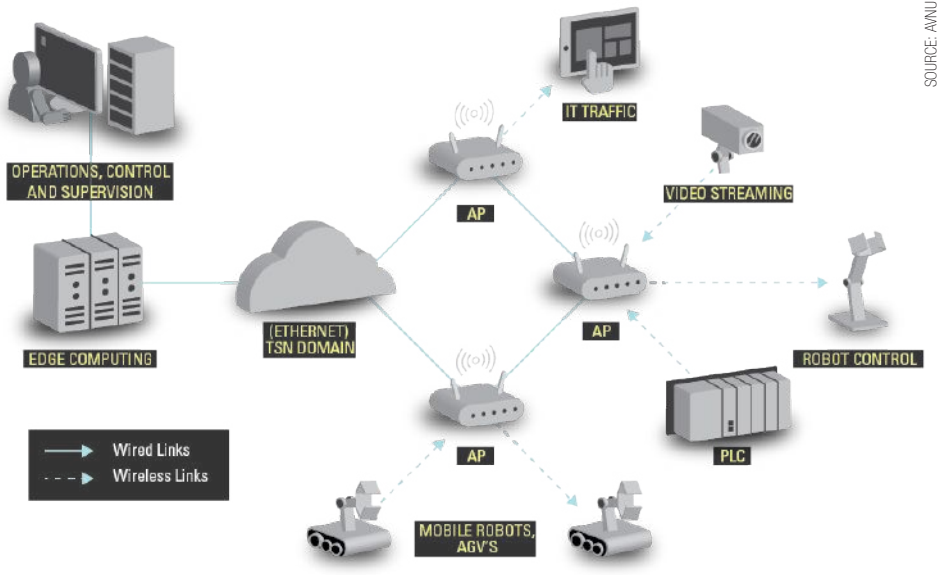
It is envisioned that TSN-enabled networks will extend from wired (Ethernet) to wireless domains. The term "Wireless TSN", then, is used to refer to a wireless network that extends IEEE 802.1 TSN capabilities over wireless media.

The graphic above illustrates the concept of a Wireless TSN domain extending a wired TSN-enabled network; The Wireless TSN links can enable wireless access to end devices and connect wired TSN networks, as illustrated in the graphic. The architecture in this graphic is an example of a centralized TSN-enabled network deployment for industrial systems.

Not every wireless technology is capable of supporting time sensitive networking features. Therefore, given the recent advances and features available in IEEE 802.11/Wi-Fi and 5G standards, only these two technologies are considered as candidates to enable TSN-grade performance.

In order to leverage the IEEE 802.1 TSN standards and ecosystem developed around them, it is important to enable seamless operation and interoperability from wired to wireless TSN domains. Some of the challenges associated with mapping TSN capabilities to wireless include fundamental differences between wireless and wired communications, the variable capacity of wireless links and the Packet Error Rate (PER) being typically higher in wireless.

The broadcast nature of the wireless medium is another important aspect to be considered. On one hand, it may open up the possibility to reach more devices with a single transmission. On the other hand, it is more susceptible to interference. Therefore, coordinated medium access is very important as well as resilience to interference.



SOURCE: AVNU

Wireless use cases in industrial environments.

Wireless TSN benefits

The industrial market has the most diverse set of use cases and requirements for wireless TSN and has received significant interest. It has motivated the development of the 5G Ultra-Reliable Low Latency Communications (URLLC) mode, with several industrial use cases having already been captured in detail by 3GPP, 5G ACIA, and IEEE 802.11 standard groups.

Closed loop control is one of the most widely applicable use cases given its generic control loop model (input + compute + actuation), but specific latency and reliability requirements varies significantly depending on the application.

Mobile robots are also an important use case as wireless is fundamental for mobility, flexibility and reconfigurability of tasks and routes. Mobile robots' latency and reliability requirements are compatible with capabilities of the latest wireless technologies.

Wireless use cases

Use cases related to control of Power Grid components have also been described in the IETF DetNet group. One unique aspect to be considered in some electrical power grid systems is the required coverage area, which may vary from local (e.g. substation) to wide areas (distribution and transmission). Industrial control systems require the highest level of determinism and reliability and rely exclusively on IEEE 802.1Qbv for scheduling.

Other use cases that require TSN-enabled networks, such as automotive and transportation applications, may also benefit from wireless. For instance, the wiring harness within vehicles, airplanes, and trains add significant production costs. If wireless technologies can provide the required time-sensitive media performance, it would bring value to such systems.

However, due to stringent latency, safety requirements and regulations, use cases that have safety critical requirements are beyond the scope of this document and the current wireless standards in 802.11 and 5G. Use cases that require under 100 microsecond level cycle times are also considered out of scope for wireless. Such use cases may be considered in the future as wireless technologies evolve.

What's next for Wireless TSN

Given the benefits and advances in wireless connectivity technologies, it is a natural step to consider the extension of TSN capabilities to wireless media.

It is envisioned that the transition to wireless will be gradual. Initially, a wired TSN-enabled network will be extended to the wireless domain in order to support the use-cases where wireless provides clear benefits.

Existing wireless capabilities can support proof of concepts in the area of time synchronization and time-aware scheduling over wired and wireless domains and further work to define wireless specific test procedures is recommended. Configuration and management of wireless TSN capabilities is another area that can be further developed within the scope of Avnu. Areas for further work from a wireless standards standpoint have also been identified, which can be useful for groups like IEEE 802.11 and 3GPP.

Although most of the TSN standards and solutions developed so far are based on Ethernet, some of the fundamental TSN capabilities, such as 802.1AS-based time distribution, have already been extended to operate over 802.11 and integration with 5G standards is also being developed.

These existing standards and potential standards gaps are areas that to be addressed before widespread Wireless TSN implementation, along with the work needed to integrate wireless and wired TSN standards in the future.

*Technical report by **Avnu**.*

The IoT Enablement Company

As a pioneer in connected applications, Eurotech provides best-in-class, proven building blocks for open, standard-based Internet of Things solutions for your Industry 4.0.

www.eurotech.com

EUROTECH
Imagine. Build. Succeed.

Durable cables aid in production of biscuits and breads

A leading manufacturer of furnaces for biscuit and bread production designed new cabling systems and connections for its newest production lines. These systems are capable of producing around 4,000 kilograms of biscuits per hour: 24 hours a day, seven days a week.

POWERFUL SYSTEMS FOR MANUFACTURING biscuits and bread are provided by the Italian company, Polin, a manufacturer of furnaces for biscuit production. For its connection solutions, the long-established company in Verona, Italy is relying on a complete package of industrial data transmission solutions.

Thousands of delicious confectionery products are kneaded, stamped, baked, cooled and packed every hour in a biscuit factory. Wide conveyor belts transport the baked goods from station to station. In biscuit production, for example, they are taken to rollers that thin the dough and then finally to stackers in which the finished biscuits are stacked one after another. In the meantime, they are baked in ovens that are as long as an underground train.

These ovens accommodate thousands of biscuits at a time and, afterwards, the biscuits all come out perfectly cooked. A lot of experience is required for a perfect synchronisation – something that Ing. Polin E C. S.p.A., manufacturer of industrial bakery equipment, can claim to have.

Founded in 1929 in Verona, Italy, the company built tunnel ovens as early as the 1930s. Today, the ovens and machines from Verona are in demand around the world in the production of biscuits, bread and sweet baked goods due to their high quality and efficiency. Polin designs and produces tailored solutions that offer high productivity, operational continuity, as well as time and cost optimisation.

4,000 kilograms of biscuits/hour

The systems from Verona are also in demand in Asia. Recently, Polin built a production line that produces around 4,000 kilograms of biscuits per hour: 24 hours a day, seven days a week.

Even for a company with as much experience as Polin, this was challenging. To meet the challenge, Polin is only using particularly powerful and robust components. For example, for the automation side, the company is relying on the expertise of Automation System Srl, which is also based in Verona and has been designing and producing software and hardware solutions for industrial automation since 1999, including for Polin's baking systems.

SOURCE: LAPP

The Italian company Polin, manufacturer of furnaces for biscuit production, relies on effective connection solutions.

Complete system solutions

Automation System recommended working with LAPP on the connection systems. Together these automation experts designed the cabling system and the connections for the new production line.

It consists of three parts: 60 metres of cable are inserted in the machine that shapes the biscuits from the dough, 104 metres of cable are used in the oven and 150 metres of cable are installed in the cooling system. LAPP succeeded in satisfying all customer requirements.

Alongside ÖLFLEX control cables and pre-wired ÖLFLEX CONNECT servomotor cables, LAPP supplied a complete package of industrial data transmission solutions. The package comprises the following components: ETHERLINE Cat.5 data transmission cables for industrial networking of PROFINET applications, the associated EPIC DATA RJ45 and M12 industrial connectors, ETHERLINE

SOURCE: LAPP

A system stopping and tonnes of dough or burnt biscuits having to be thrown away is not an option.

In addition to numerous LAPP data lines and power cables, ETHERLINE ACCESS switches were also used.

patch cables and the ETHERLINE ACCESS U05T and U08T industrial switches.

Longevity, shortened delivery

"We recommended LAPP as a supplier because we were convinced that its quality and broad product range would certainly meet the special requirements Polin had for this project," Massimo Urbani, owner of Automation System said.

LAPP technology offers both high quality and longevity. A cable defect leading to a system stoppage, and tonnes of dough or burnt biscuits having to be thrown away was not an option. Furthermore, technology options were able to offer convincing solutions for all the required components including industrial data transmission –all from a single source and with a high level of product and solution expertise.

"The extensive consultation given when selecting suitable components gives us real added value," said Urbani. Another advantage was being able to make online purchases with very short delivery times. This shortened the time before a new system is launched on the market. Extensive certifications (IEC/EN, UL/UR, CSA, EAC) also guarantee immediate operational capability in various applications in the food and beverage industry.

"Our experts' close collaboration with our customers and partners is a basic principle for LAPP. Their satisfaction is the top priority," Marco Artoli, Product Manager at LAPP Italia, reveals the secret to success. "The search for outstanding quality was what connected Polin, Automation System and LAPP in this challenging project, and our complete solutions in the field of industrial communication impressed the customers."

In addition to numerous data lines and power cables, ETHERLINE ACCESS switches were also used in the application.

Application article by ***LAPP.***

WHILE OTHERS THINK ABOUT THE IIOT

… we are already there.

Networks and computers for a smarter industry.

- Powerful computers designed for your needs
- Secure and reliable networks – anywhere, anytime
- Vertical integration from SCADA to field device

www.moxa.com

MOXA
Reliable Networks ▲ Sincere Service

Ethernet Advanced Physical Layer for process control

Focus on an Ethernet-based single network vision includes one common communication technology for all automation levels. Ethernet technology is key to accessing data from smart instruments. In combination with PA-DIM, which is currently in development, new possibilities for future digital services can be achieved.

INDUSTRIAL ETHERNET IS MAINLY USED IN factory automation, and only partly in process automation. However, Ethernet in the field would provide higher data transmission speed, ease-of-use and interoperability. In addition, smart instruments with Industrial Ethernet are vital for Industrie 4.0 and IIoT use cases. By these advantages the value generated by the process plant is increased.

Smart instruments which are already on the market today, are not suitable for use in all areas of process control, e.g. in explosion hazardous areas or where separate power is not available. Main issues occur with the physical layer which does not fulfill all requirements of process industries: long distance, power supply and communication via the same 2-wires and intrinsic safety.

To solve these problems, the user organizations PI (Profibus & Profinet International), FieldComm Group and ODVA cooperate with major device vendors to work on the Ethernet Advanced Physical Layer (APL). As Ethernet-APL effects the physical layer (layer 1), the integration of the specification is neutral to communication protocols. This integration in the respective IP-based protocol standards is foreseen in 2020. Afterwards, devices for the complete network infrastructure are expected.

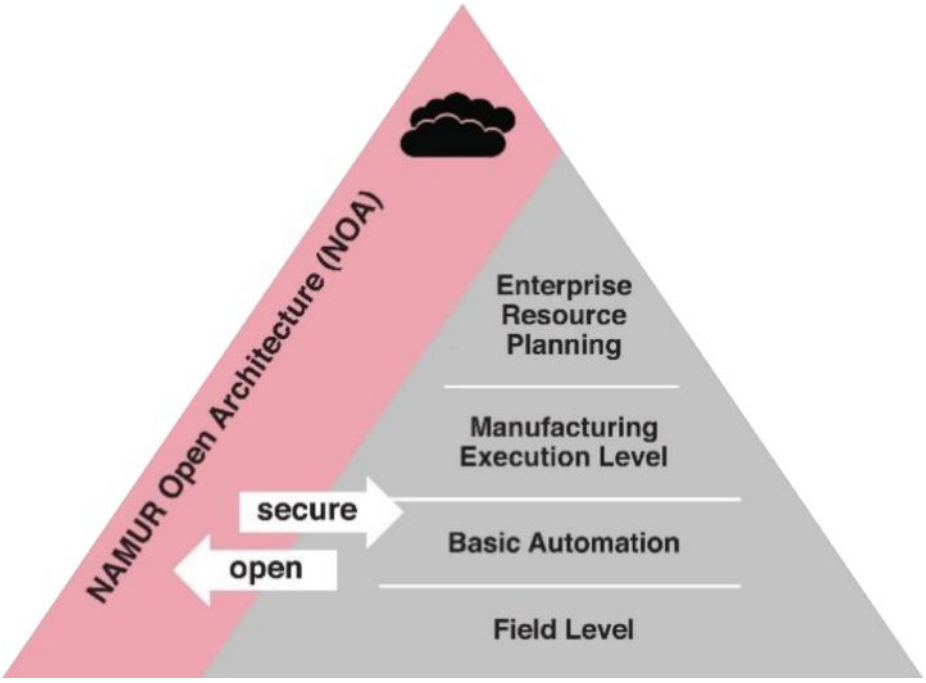
Based on the diversity of the mentioned organizations, the large number of industry partners who contribute to the Ethernet-APL project, the resulting IEEE and IEC standards and on a focus on customer needs, this technology will achieve major advantages for the process industry.

Single network vision

Focus on an Ethernet-based single network vision in an industrial plant includes one common communication technology for all automation levels.

The thinking starts with the evolution of communication protocols to get an understanding for the logical next step – Ethernet-based communication in process automation.

The article presents all relevant details that are necessary to achieve this vision, from organizational setup to technical insights and finally the expected timeline. As the technical specifications are not finalized yet, the technical details are not part of the article but only the reference to the respective specifications.



SOURCE: ODVA

Ethernet-APL enables access to data which is dormant at the field level today.

Based on first customer experiences gathered during a pilot test in a chemical plant, the advantages of the technology are proven. Finally, an outlook shows related topics such as impacts on safety applications or the Process Automation Device Information Model.

Process control technologies

By standardizing the HART protocol in the 1980s, the first step of digitalization was done. With this protocol, which can easily be introduced for plants with pre-existing 4-20 mA analog wiring and technology, it is possible to unlock data of smart instruments. The technology is still wide-spread in process automation.

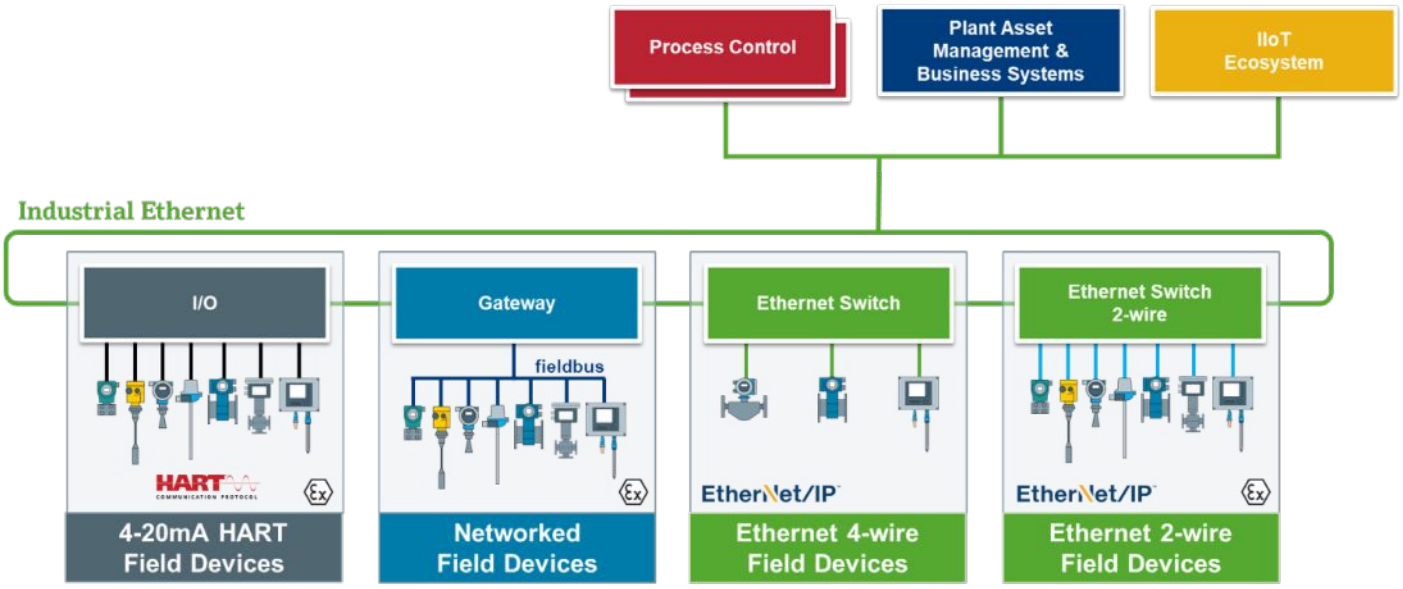
In the 2000s, fieldbus protocols like PROFIBUS PA or FOUNDATION Fieldbus were introduced which provide faster data transmission rates, more standardized functions for diagnostics or device exchange. Both, 4-20 mA including HART systems and fieldbus systems satisfy the harsh requirements of process industry such as power over the cable which reduces the wiring in a plant or usage in hazardous areas.

However, fieldbus systems were not able to replace traditional HART systems which might have various reasons, e.g. do process control systems only use the process values but not the comprehensive diagnostic and parameterization possibilities.

In traditional infrastructures, the data is locked in the field and control level (OT = operational technology) which are based on these traditional communication technologies and is separated from upper management levels (IT = informational technology) which are typically Ethernet-based.

By using Ethernet technology based on current IEEE Ethernet specifications and in combination with Industrial Ethernet protocols like EtherNet/IP, more transmission speed and bandwidth was achieved. However, this physical layer has limitations such as 4-wire Ethernet cables, less cable lengths and it is not suited for installation in explosion hazardous areas.

Driven by future system concepts with data-intensive applications like the Industrial Internet of Things, Industrie 4.0 and the NAMUR Open Architecture, the requirements



Overview of topology concepts.

and communication technologies might change. All these future concepts require data from the smart instruments with no need for interpretation and transformation of the data between the automation levels.

In factory automation, the barrier of consistent communication between IT and OT was already overcome since some years, based on existing Ethernet technology.

In process automation, there are requirements which are not covered by Ethernet specifications yet. These gaps were identified and shall be solved by a new Physical Layer for Ethernet.

Barriers in process automation

In the process industry, aspects like topology (trunk/spur installation), two-wire technology (communication and power supply over the same cable), long distances and intrinsic safety, in particular, are paramount. "Long distances" refers to cable lengths of several hundred meters, with spans even up to 1,000 m having to be overcome.

Since the supplying of power to field devices over the same 2-wire cable used for data communication has proven itself in previous fieldbus installations, this feature should not be left out. The installation of Ethernet-capable field devices in explosion hazardous areas rounds out the requirements of the process industry.

For future system concepts with IIoT use cases, requirements came up as described by the single network vision. Standard Ethernet technology based on IEEE 100BASE-TX and traditional systems with 4-20mA including HART or fieldbus infrastructure do not fulfill all these requirements.

To solve all these requirements and support the Single Network Vision in process plants, the Ethernet-APL project was established.

Ethernet-APL organization

The industry organizations FieldComm Group, ODVA and PROFIBUS & PROFINET International cooperate on the Ethernet-APL project. Industry partners in this project are leading companies in process automation: ABB, Emerson Process Management, Endress+Hauser, Krohne, Pepperl+Fuchs, Phoenix Contact, R. Stahl, Rockwell Automation, Samson, Siemens, Vega and Yokogawa. In total, three organizations and 12 industry partners working on Advanced Physical Layer for Ethernet.

Addressing the barriers

The requirements of process industry, even for future system concepts are identified and clear. To fulfill all requirements, several specifications need to be enhanced. The request was addressed to the appropriate organizations.

IEEE 802.3cg

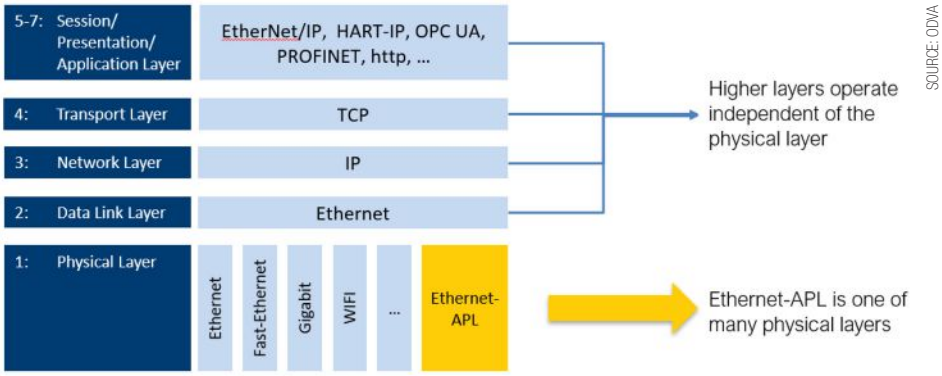
Main aspect to fulfill these requirements is a new physical layer based on Ethernet technology. Therefore, the request was raised at IEEE 802.3 to work on a specification for 2-wire Ethernet with 10Mbit/s to achieve long-reach applications and power and data over the same twisted-pair Ethernet cable.

In 2016, the IEEE Standards Association approved the IEEE 802.3cg project. The specification was finalized end of 2019 and released beginning of 2020. Based on this specification, manufacturers of PHY chips can start to produce the required Ethernet PHY.

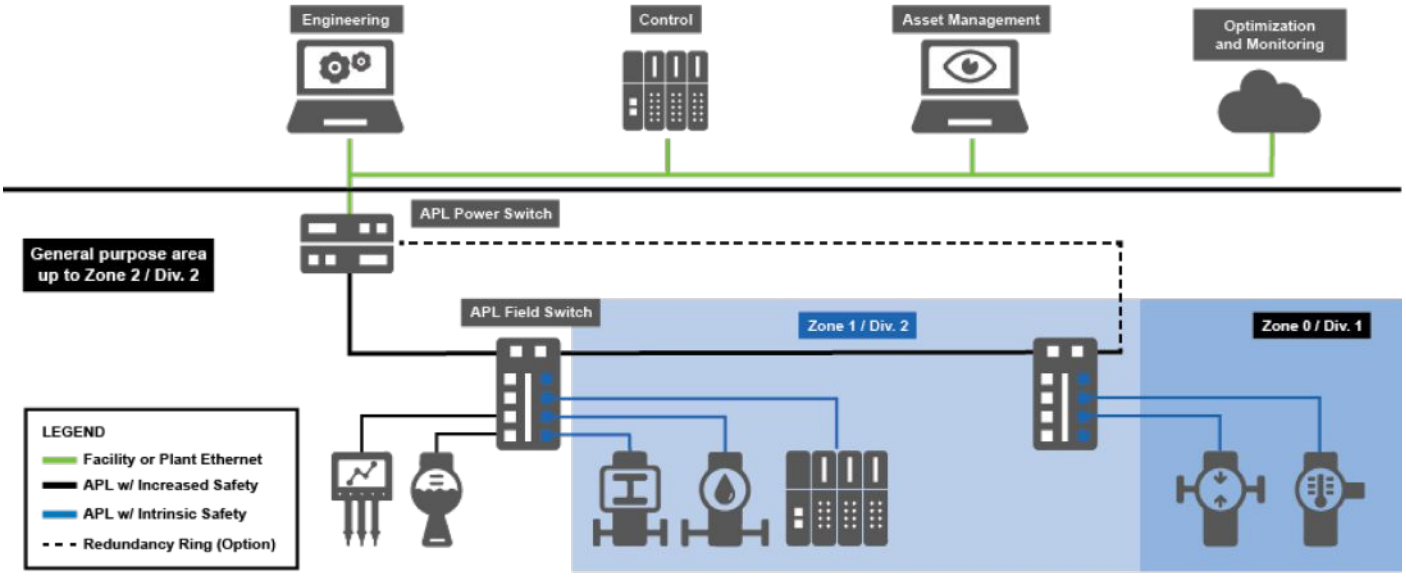
IEC 60079

To fulfill the requirement of intrinsic safety for loop-powered and separate powered devices in hazardous areas up to Zone 0 / Class 1 Division 1, IEC PT 60079-47 project team within technical committee IEC SC 31G is working on a technical specification for the 2-Wire Intrinsically Safe Ethernet (2-WISE) in IEC 60079. The focus is to create a concept for ignition protection.

In the meantime, the working group agreed that the principals defined in Fieldbus Intrinsically Safe Concept (FISCO) are also suitable for the 2-WISE technical specification, including some adaptions for the new physical layer. The perception is supported by successful tests executed at DEKRA Testing and Certification GmbH. The final technical specification (IEC TS 60079-47) is expected by the end of 2021.



ISO OSI model shows independency of Ethernet-APL from higher layers.



SOURCE: ODVA

Example of well-known trunk & spur topology.

Finally, the Ethernet-APL definitions must be considered in the relevant specifications of the organizations FCG, ODVA and PI. These adaptions are expected to be finalized by the end of 2020.

Basic definitions for Ethernet-APL

ISO OSI model: As named, the Ethernet Advanced Physical Layer is an additional physical layer based on IEEE 802.3cg. Therefore, the Industrial Ethernet protocols like EtherNet/IP are independent of this enhancement as they operate independent of the physical layer.

Topologies: By Ethernet-APL, already established topologies can be realized. This includes the proven trunk-and-spur topology of fieldbus infrastructures with the ability to power up to 50 field devices with up to 500mW each. The installation of both APL field switches and APL field devices in hazardous areas with intrinsic safety is ensured.

Advantages from a customer point of view: Ethernet-APL provides many advantages for planners, engineers and maintenance staff.

Reduction of system design and integration time: By having one pervasive communication technology between field level and control level, gateways and proxies that convert different communication protocols are not required in an Ethernet-APL system infrastructure. Due to power supply output up to 60W, more devices per power supply can be added which leads to fewer segments. The well-known trunk & spur topology can be adapted by Ethernet-APL systems. In addition, pre-existing installations can be replaced easily by re-using fieldbus cables. In total, the complexity of the system design is reduced.

Reduction of startup efforts

During installation of an Ethernet-APL infrastructure, less installation errors might occur due to polarity independence and the common trunk & spur topology.

After installation, test efforts are lower as the physical layer in an Ethernet-APL infrastructure is always the same. Same applies due to power and data on the same cable which occurs in the minimal amount of wiring.

Even for training purposes, the effort decreases as there is only one communication in all network levels. By standard means for IP based communication which is supported by auto-instantiation, the vertical integration of OT in IT can be done easily.

By high data transmission rates which is up to 300x faster than traditional systems, fast device configuration is supported.

Timeline

As already described, all relevant specifications are expected to be finalized and released by the end of 2020. The objective is to demonstrate Ethernet-APL with real products of the complete network infrastructure at Achema fair (Frankfurt, Germany) in June 2021.

First customer experiences

In 2019, the Ethernet-APL technology was evaluated in a chemical plant in Germany based on first prototypes. Focus of the evaluation project were the already described requirements of process industry:

- One Ethernet protocol for all applications
- Robust Ethernet communication over all automation levels
- Data communication and power supply over the same 2-wire cable (reuse of fieldbus cable)
- Usage in hazardous areas
- Parallel data access for IIoT use cases according to NAMUR architecture: The evaluation project was executed in a realistic set-up including a control room and a field.

First results of the experiences were presented during the NAMUR General Assembly in November 2019. Summarized, the evaluation was successful, and the technology offers the advantages that were expected.

Further customer evaluation projects will provide an ability both to receive feedback for the technology and for creating more awareness, evaluation projects based on prototypes are planned by industry partners with suitable customers in different industries.

Digitalization in safety applications

With Ethernet-APL, the vision of a single network for all automation levels becomes reality. But what about safety applications?

The number of safety-related measuring points is increasing which enforces this question. In terms of the single network vision, also safety applications shall be ready for digitalization. By considering the safety protocol CIP Safety for EtherNet/IP, exactly this use case fulfilled.

Process Automation – DIM

Ethernet technology will be the key to get access to data from smart instruments. In combination with PA-DIM, which is currently in development, new possibilities for future digital services are achieved.

PA-DIM offers the realization of these digital services as it is defined independently of manufacturers, protocols and platforms. This device information model is based on OPC-UA and is transferred based on TCP via Ethernet.

Basically, PA-DIM consists of a unified device information model which defines the semantic of data to avoid the interpretation of data.

Benedikt Spielmann, Innovation Technology Manager, ***Endress+Hauser Digital Solutions.***


1,100* Exhibitors & 85,000* Visitors Under One Roof!

29th Japan IT Week Spring

Japan's Largest IT Show

Dates: **April. 8 [Wed] – 10 [Fri], 2020**

Venue: **Tokyo Big Sight, Japan**

Organiser: **Reed Exhibitions Japan Ltd.**

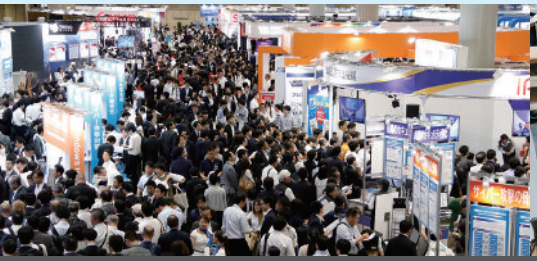
Web: **https://www.japan-it-spring.jp/en-gb.html**

Consists of 10 IT Exhibitions

- 29th Software & Apps Development
- 25th Sales Automation & CRM Expo
- 23rd Embedded & Edge Computing Expo
- 22nd Data Center & Storage Expo
- 17th Information Security Expo
- 14th Web & Digital Marketing Expo
- 11th Cloud & BPR Expo
- 9th IoT & 5G Solutions Expo
- 8th Advanced E-Commerce & Retail Expo
- 3rd AI & Business Automation Expo

Visit and Find the Best IT Solutions at this Show !

Website>>

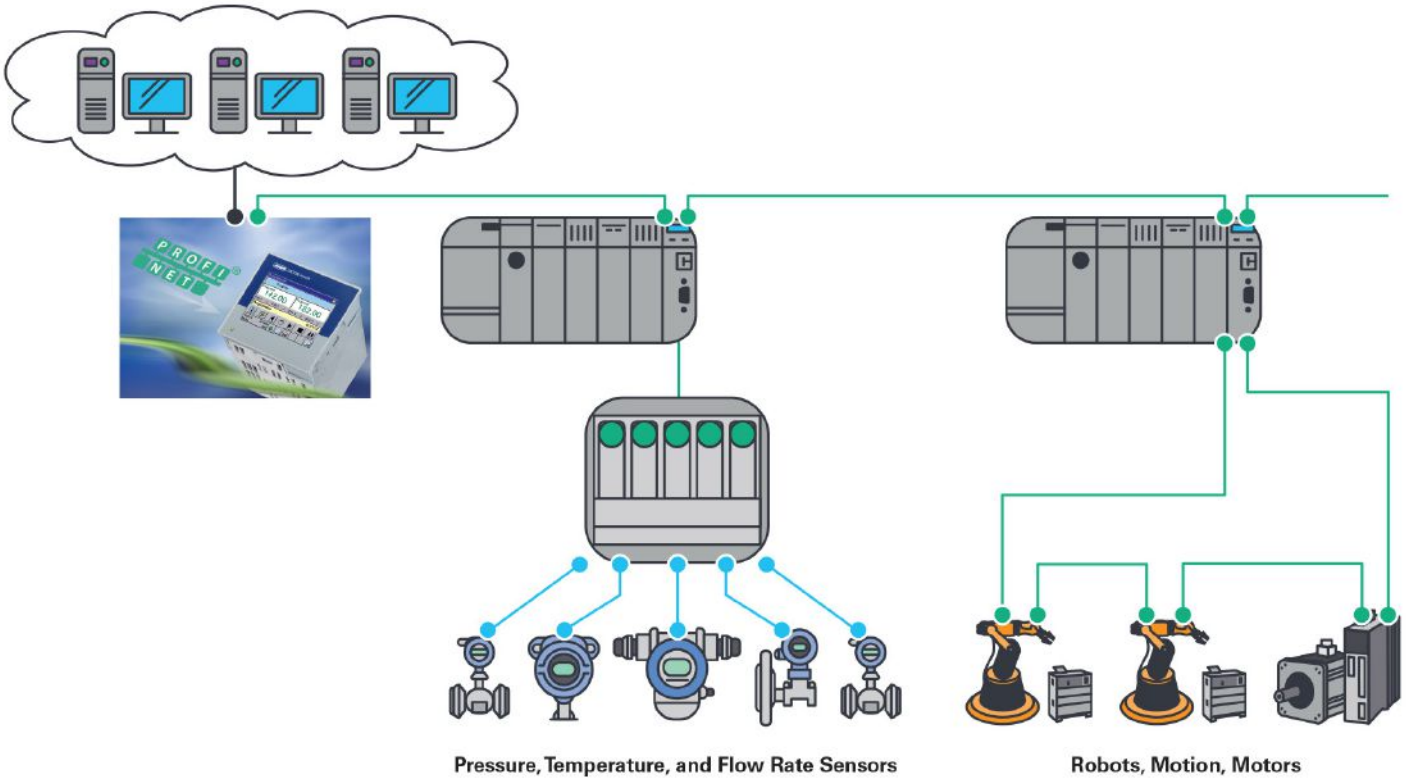



Organised by Reed Exhibitions®

Organiser: Reed Exhibitions Japan Ltd.
Japan IT Week Show Management
TEL: +81-3-3349-8504 Email: itweek-osaka@reedexpo.co.jp
A division of Reed Business Registered in England, Number 678540
*expected

Industry 4.0 communications for process automation

Digitization is shifting toward the sensor in the era of Industry 4.0 process automation. Implementation of smart sensors that can be integrated anywhere in a complex network allows them to pass on the digital form of recorded physical quantities over the network, versus digitizing analog signals transmitted to a controller.



SOURCE: ANALOG DEVICES

An application example of the various participants in a networked factory.

THE SHIFT TOWARD DIGITIZATION DRIVEN by Industry 4.0 and the Industrial Internet of Things (IIoT) can be seen in industrial automation technology. The production floor is changing. Individual production sites are being networked; they communicate with one another and between different company divisions or even across company boundaries.

The effectiveness of overall production can be significantly increased through condition monitoring and optimization of mechanical installations and technical systems. However, this requires constant communication between all participants in the enterprise, whether human or machine, to exchange countless volumes of data and a wide variety of parameters.

Shifting toward the sensor

in the era of Industry 4.0, digitization is shifting toward the sensor. Where connectivity was once handled relatively simply, the analog sensor signals from the various systems were transmitted to a central controller and digitized there.

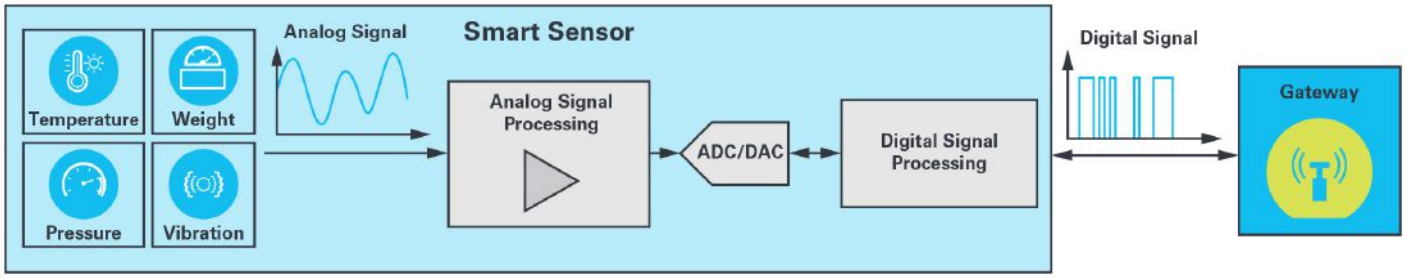
The implementation of so-called smart, intelligent sensors that can be integrated anywhere in a complex network allows them to pass on the digital form of the recorded physical quantities over the network. Apart from the actual measurement parameter sensing, this intelligent sensor unites a major part of the signal conditioning and processing in one housing.

Furthermore, the smart sensors are often already equipped with a bus interface. Through the digitization of the measured parameters, significantly more data can be transmitted and at a faster speed. Another advantage lies in the more robust signal transmission. Through the digital signal transmission, signal changes and interference can be lessened or even completely prevented.

In addition, in the ideal case, the bus-enabled sensors can be connected to the network via plug and play, meaning they are automatically detected by the control unit. If one sensor fails, the others continue to function.

However, all of this requires an omnipresent, highly reliable, and real-time-capable network extending from the individual sensors and actuators to the machines and finally to the complete systems. Ethernet—especially Industrial Ethernet—has emerged as a key set of communication standards. Compared with previous field buses, Industrial Ethernet provides decisive advantages such as efficient and synchronous transmission of larger data volumes on a shared transmission medium. In addition, Industrial Ethernet offers the possibility to create the entire communication on a uniform basis, which complements the classical Ethernet with real-time extensions for determinism.

It was precisely for this type of application that Analog Devices launched a real-time Ethernet multiprotocol (REM) switch chip technology, the fido5000. The technology



SOURCE: ANALOG DEVICES

Transformation from a simple analog sensor to a smart sensor. A smart analog sensor includes the complete signal chain and the processing unit.

features two TSN-enabled Ethernet ports to implement line, ring, star, and redundant star network topologies.

In addition, any host processor can be connected with the switch chip through its configurable memory bus interface. The flexibility of the fido5000 REM switch allows developers to future-proof their designs despite constantly evolving standards because it supports every current Industrial Ethernet protocol.

Among others, these advantages were realized by the JUMO Group. JUMO develops and manufactures products and system solutions for measurement, control, and analysis of physical and chemical quantities for a wide variety of industries, including food, air conditioning, mechanical engineering, chemical and pharmaceutical, packaging, and water and wastewater. Everywhere in these industries, a variety of process data must be communicated over large networks and the reason it is used in one of the latest JUMO designs, the DICON touch.

Control technology

DICON touch technology offers a two-channel process and program controller that can be visualized via a TFT color graphics screen and can be operated intuitively by touch.

Besides providing the RS-422/RS-485 MODBUS RTU, Ethernet, and PROFIBUS DP interfaces that were previously available, DICON touch technology also makes it possible to connect and communicate with a PROFINET controller. This is enabled by its integrated fido5000 2-port switch, which allows simple network topologies to be established. The network application has integrated features that include evaluation of registration data, setup configuration, and web server functionality for online visualization, which are available along with the PROFINET real-time data exchange. Conformity to the PROFINET standard and compatibility with applications from various manufacturers are guaranteed through certification.

ADI and JUMO have a longstanding partnership. Through the acquisition of Innovasic in 2016, ADI was able to expand its Industrial Ethernet portfolio. This makes it possible for ADI to offer its customers access to a series of Industrial Ethernet applications—a fact that has already been demonstrated in the cooperation with JUMO and that has positively influenced the relationship between the two companies. With JUMO, ADI moved beyond being a supplier of individual components and into the role of being a true design partner. "With Analog Devices, we gained a competent partner that has supported us extremely professionally in developing the PROFINET interface for our multichannel process and program controller JUMO DICON touch," said Klaus Otto, product manager at JUMO GmbH.

Specifically in the development of the DICON touch, ADI has a solution for the requirement of designing all devices based on the Ethernet protocol PROFINET. The challenge was to develop a device that was as universal as possible to offer customers a large number of possibilities.

The DICON touch was to be developed as a modular, powerful concept: with a simple plug-in card and an integrated PHY for standard Ethernet or, alternatively, with an extended plug-in card with PROFINET functionality. "In the development, we placed special focus on an individual PROFINET solution that was not yet available on the market with such a functional range," said Otto.

In addition to the fido5000 REM switch chip, the integrated RapID platform was used in the development of the DICON touch. It demonstrates a complete solution based on the fido5000 as an embedded design. It combines the fido5000 switch chip, a communication processor, JTAG interface, and PHYs, as well as different memories like Flash, SDRAM, and EEPROM, all on one board. The next generation of this RapID platform will include a more powerful and power-saving ARM Cortex-M4 processor as a communication processor, on which additional processes can be implemented depending on the requirements.

For the development of the DICON touch, the properties of the existing RapID platform, like the availability of common pre-certified Industrial Ethernet protocols, were very much in JUMO's interests. The possibility of downloading all relevant information onto the RapID platform, including circuit diagrams and layout data, reduced system development time considerably. Another interesting feature of the RapID platform, which is also on the DICON touch, is the dynamic, integrated web server that can be used to read or change network parameters as well as input and output data in a very simple way. Also, it is possible to configure the PHY via RMII and I²C interfaces. In addition, the PROFINET module can be updated on startup because the firmware is mirrored on the DICON touch.

Thus, the RapID platform's flexible configuration for the DICON touch also enables firmware updates and network access. There were also no limits placed on creativity in the development of the DICON touch. For example, the standard blinking LEDs, an important feature of PROFINET, were not implemented on the electronics. Instead, the complete LCD display of the DICON touch will blink.

Cybersecurity also played a key role in the development of the DICON touch. Cybersecurity for industrial controllers cannot be addressed with a one-size-fits-all solution. Instead, a far-reaching approach must be taken based on the risk assessment for the system.

As part of its security strategy, there is a concentrated effort to making Ethernet components as secure as possible. Current Industrial Ethernet and TSN solutions are thereby one focus of security developments. The fido5000-based RapID platform was supplemented with security features that offer key management, secure boot, secure updates, and secure memory access to protect against cyberattacks.

Conclusion

With the fido5000 family and the RapID platform, ADI offers its partners a solution for applications so that they will be able to meet future requirements such as real-time capability, reliability, security, etc. In this context, ADI offers its customers not just the pure product but also the possibility of cooperation or support for their development.

The advantages of such cooperation have been demonstrated by the example of the new JUMO DICON touch process controller. The project's success yielded a secure, reliable, and forward-looking solution that was jointly developed within a manageable amount of time.

Thomas Brand, Field Applications Engineer ***Analog Devices.***

IoT-capable press lines harness open control technology

Implementing Industrie 4.0 and Internet of Things (IoT) concepts is leading to a huge increase in the volumes of data in manufacturing plants. PC-based control technology forms a potent solution for processing this data, as manufacturers seek to meet the demands of optimizing manufacturing quality and efficiency.

SOURCE: AIDA ENGINEERING

Tandem press line from Aida Engineering in an automotive production facility.

THE DEMAND TO OPTIMIZE MANUFACTURING quality and efficiency while implementing Industrie 4.0 and Internet of Things (IoT) concepts is leading to a huge increase in the volumes of data in manufacturing plants. Considering its performance and compatibility with the IT world, PC-based control technology forms the ideal basis for processing this data.

Press manufacturer Aida Engineering, based in Kanagawa, Japan, recognized that advantage at a very early stage. It has therefore relied for many years on PC-based control from Beckhoff and on the globally established EtherCAT standard for its press solutions, e.g. for the automotive industry.

The largest servo presses from Aida can exert more than 3,000 tons of pressure on the raw material. Designed for high-volume series production, they are used in the most diverse industries.

These include the automotive industry, in particular, with its special requirements. Here, the formed parts must be increasingly lighter to produce vehicles with a lower weight and thus lower fuel consumption. The sturdiness of the parts must not suffer in the process, however, to ensure that the occupants of a vehicle are still protected as well as possible in the event of an impact.

In order to meet these requirements, the use of sheet steel with a high tensile strength has become established in the automotive industry.

The Aida servo presses enable very precise machining of this demanding high-strength material through exact speed control. In addition, complex designs are implemented in the manufacturing of vehicle bodies, especially in Europe. Aida designed a tandem version of the servo press specifically for such applications. This version can even form complex geometries in a short time.

PC-based control technology

Aida uses Industrial PCs (IPCs), TwinCAT 3 automation software and EtherCAT I/O terminals from Beckhoff to control its servo presses in the mid and high performance ranges.

The transfer units that connect several presses are also controlled by PC-based control. According to Sotoyuki Kaneko, head of Aida's System Control Department, this control platform has also been tried and tested in vehicle manufacturing for the European market with their high metal forming requirements. In this demanding environment, it is not uncommon to use large tandem lines of servo presses with six different process steps.

The prerequisites for the smooth operation of such a large-scale plant are optimum control and precise synchronization of the numerous presses and transfer units that carry out the

individual process steps.

According to Sotoyuki Kaneko, EtherCAT has proven to be the best solution for the implementation of the Aida system on account of its precise synchronization and high-performance data transmission capabilities even over long distances: "In 2000, our group's Electronic Development Department began work on a next-generation motion controller, which was intended to replace the internally developed controllers we had used up to that point in time. The fundamental decision to use a PC-based control system was taken at the same time. The optical fiber-based Lightbus was the established Beckhoff fieldbus at that time. I can still remember very well how excited company founder Hans Beckhoff was when he informed us that the introduction of the new fieldbus standard EtherCAT was imminent. Then EtherCAT came onto the market as an open fieldbus, supporting extremely fast speeds, precise synchronization and long-distance data transmission up to 100 m via a standard Ethernet cable. That met all the requirements for the Aida presses, so we chose EtherCAT."

Besides that, Sotoyuki Kaneko says that there were obvious benefits in replacing previous internally-developed controllers with Beckhoff components as the standard control platform for Aida presses: "If we had continued to develop the control systems ourselves, we would also have had to develop all the I/O terminals connected to the system. In view of the enormous number of I/O terminals required for the wide variety of individual customer specifications, this would have been virtually impossible for us. Beckhoff offers not only a wide range of IPCs, but also the widest variety of I/O terminals for all necessary signal types. The huge product range, extensive engineering expertise and global distribution network were important reasons why we opted for Beckhoff."

He adds that another crucial factor was the flexibility of the control platform. The IPC concept perfectly suited Aida's design philosophy because all necessary control functions could be integrated with the highly flexible TwinCAT automation software.

SOURCE: AIDA ENGINEERING

The individual processes within the Aida press lines are controlled by an Industrial PC with TwinCAT software as well as various EtherCAT terminals.

Fast control and configuration

In the servo-based tandem lines each of the machining processes is controlled by an IPC as the EtherCAT master. These communicate in turn with each other via EL669x bridge terminals. A further high-performance Industrial PC serves as a higher-level controller with the EtherCAT "master clock", which ensures seamless synchronization of all presses and transfer units.

In the tandem line, a robot handles the transfer of workpieces from one process to the next. The appropriate distance between the robot and the forming tool is the most important factor in achieving high productivity and efficiency: the smaller the distance, the more products the press can process. If the distance is too small, however, this may cause disruptions that can increase the risk of system failures.

For this purpose, Aida developed a TwinCAT-based solution featuring an ultra-fast control cycle, optimum synchronization and minimized robot distance with a high level of production reliability. In this way, the servo tandem line achieves 20 strokes per minute and approximately 50 % more efficiency than the predecessor series as a result.

Also integrated in the servo tandem line is the Aida Digital Motion System (ADMS) software, which allows operators to freely and conveniently configure press motion parameters for each line. ADMS is able to determine the optimal process control simply on the basis of the form data entered for the sheet metal part. The motion sequences can be fine-tuned on the user interface on site. Apart from that, the motion controller can be adjusted in advance using an offline 3D simulator. As EtherCAT slaves, I/O terminals collect a multitude of data such as the tool position, information about the servomotor for positioning the handling robot as well as sensor data. Based on the control data processed by TwinCAT in real time, ADMS simulates the motion sequences and generates corresponding path control data. Sotoyuki Kaneko explains: "The system benefits from the fact that TwinCAT can integrate the most diverse data into the runtime environment and send real-time feedback to the PLC and motion controllers."

PC-based IoT control

By its own account, Aida is one of the pioneers in the development of IoT systems and, according to Sotoyuki Kaneko, EtherCAT components are strong innovation catalysts in this field, too. One example of this is the Aicare system (Aida Information Care), based on Microsoft Azure. Aicare monitors and visualizes important press data such as product quality, operating parameters and maintenance information.

Multiple data sets have to be acquired synchronously and in succession to analyze the quality of the formed parts. Aicare does this with the help of EtherCAT distributed clocks. As all data are given a timestamp and clearly identifiable in this way, the formed part quality achieved with each stroke can easily be analyzed in retrospect. In this context, a machine learning process (Support Vector Machine) is used, which according to Kaneko was easy to implement using PC-based control.

Operational data, including data on temperatures and energy consumption, are securely sent to Azure cloud services and can also be viewed on the Aicare web page. Authorized persons automatically receive any alarms and error messages. Regarding these features, Sotoyuki Kaneko concludes: "Aicare benefits enormously from real-time communication with EtherCAT and from PC-based control, because these technologies enable simple integration with cloud services such as Azure and the use of advanced IoT technology."

Technology report by ***Beckhoff Automation.***

Predictive maintenance relies on effective data collection

Predictive maintenance has the potential to open up new service models for machine builders. Using machine data, it is possible to more precisely forecast maintenance cycles. Machine builders can offer customers custom tailored service that keeps machines in the field in optimal condition at all times.

WHEN A MACHINE FAILS OR IS STOPPED FOR maintenance, it comes with a hefty price tag. And that's not just the cost of repair work and replacement parts, but rather the revenue that is lost every minute that a line is not productive. By helping to detect impending damage before it occurs, an investment in predictive maintenance can really pay off. In addition to preventing revenue loss, predictive maintenance extends the life of the machine and even opens up new business models.

In continuous web machines like those used in printing and packaging, a sheet of material is guided through a labyrinth of rollers. A mechanical imbalance or increased bearing friction in one of those rollers could introduce uncontrolled oscillations that interfere with web tension throughout the machine. This has a negative effect on product quality and could even lead to an outright machine failure.

An effective way to keep this from happening is with a predictive maintenance system, which is able to detect potential faults before they occur. Imbalances or worn bearings are identified in time to plan the necessary repairs before the roller fails and brings the machine to a halt. After all: only if machinery and equipment is functioning properly is it possible to meet financial targets.

SOURCE: B&R

Predictive maintenance provides comprehensive insight into the health of a machine and forecasts the probability of component failure, helping to identify damage before it becomes critical.

Avoid downtime

A predictive maintenance solution relies on a variety of data collected from the machine. This data is collected through a process of continuous condition monitoring, then analyzed and evaluated so that the predictive maintenance system can calculate the precise probability of certain events occurring.

"Not only does predictive maintenance save costs, it also helps maximize productivity – because you're replacing components before they would begin to impact the machine's performance," said Martin Staudecker, software development expert in the area of closed-loop control at B&R.

Predictive maintenance can do much more, however, than simply monitor the behavior of a single roller. It provides comprehensive insight into the health of the entire machine and forecasts the probability of component failure. Motor speed, noise level and temperature can all be recorded, and any unusual vibrations or mechanical imbalances can be detected in their earliest stages. It's also possible to perform detailed vibration analysis of specific components that are prone to wear.

Intelligent analysis algorithms

To make a reliable statement about the condition of a machine, the first step is to collect as much data as possible and evaluate it using intelligent analysis algorithms.

The more data the system has to work with, the better it is able to detect impending faults before they occur. "That means, however, that you need to find a system that can store and analyze such enormous volumes of data,"

Staudecker added.

In addition to condition data from the machine itself, predictive maintenance can also make use of parameters from the surrounding environment, such as temperature and humidity. This data must also be incorporated into the analysis in order to maximize the reliability of its predictions.

B&R's predictive maintenance utilizes special I/O modules for condition monitoring, paired with sophisticated analysis algorithms from its mapp technology toolkit. The easy-to-configure condition monitoring modules pinpoint areas were service may be needed.

These modules offer unique vibration analysis capabilities. Data received from the condition monitoring modules can easily be prepared and utilized to optimize existing processes. As part of B&R's X20 controller family, these modules are fully compatible with any machine control topology.

Results-oriented data processing

The collected data is evaluated using the sophisticated analysis algorithms of the mapp Control software package.

"High performance, results-oriented data processing is the key to effective analysis," noted Staudecker. "And that's exactly what mapp Control makes possible." The bulk of the analytics can be performed directly on the controller. That greatly reduces the volume of data to be transferred, since it's only the results that need to be passed on.

Auto-tuning for fault prediction

Another way to detect faults early is using tuning procedures. Staudecker explained that "mapp Control includes model-based tuning methods that identify system behavior then create a suitable controller on that basis."

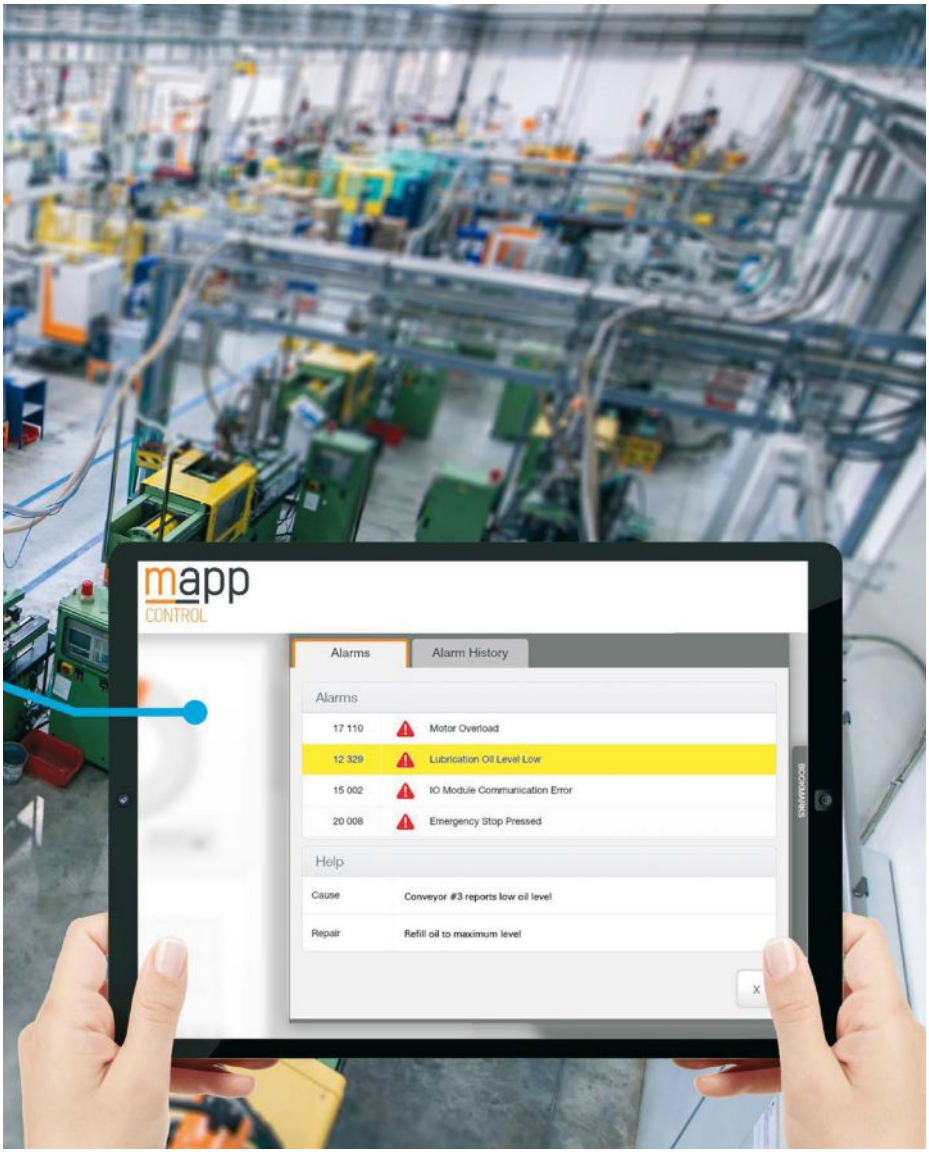
When tuning is performed at regular intervals, not only are the control parameters kept up to date, but any changes in system behavior are brought to light.

Based on deviations in static properties, system dynamics or resonant frequencies, it is possible to draw conclusions about developments in the machine process, leaks or worn components.

Detect wear

Predictive maintenance allows operators to replace worn components when it is most convenient, rather than interrupting ongoing production. Over time, mechanical wear gradually takes its toll on components such as hydraulic valves, which has a negative impact on the control of hydraulic axes.

The mapp Hydraulics package includes a software component for early detection of this type of wear. "The component automatically measures the valve's characteristic curve, which describes the relationship between valve opening and oil flow rate," explains Staudecker. "Not only does that let us know when there is wear, it also optimizes control performance."



SOURCE: B&R

To make a reliable statement about the condition of a machine, the first step is to collect as much data as possible and evaluate it using intelligent analysis algorithms.

Heating current monitoring

Particularly with highly complex machines like those in the plastics industry, the quality of the finished product relies on perfect execution of each step in the process. One sub-process typically involved in plastics production is extrusion. A faulty heating element in an extruder could bring down an entire production line, causing large amounts of waste and immense costs.

"Using software components from B&R to implement predictive maintenance helps keep the machine in optimal condition and maximizes the long-term productivity of the entire system," said Staudecker. B&R's mapp Temperature package compares heating currents against reference values at freely configurable intervals. This makes it easy to notice changes in the heating circuit that indicate the first signs of damage in heating elements or relays.

New business models

Predictive maintenance also opens up potential new business models for machine builders, particularly in the area of service. By using machine data collected over longer periods of time, for example, it is possible to more precisely forecast maintenance cycles. Machine builders can offer their customers custom tailored service that keeps machines in the field in optimal condition at all times.

"The data can also be used to optimize the design of the machine itself," Staudecker said. With predictive maintenance, machine builders can offer a comprehensive service package while at the same time making effectively targeted improvements to their machines.

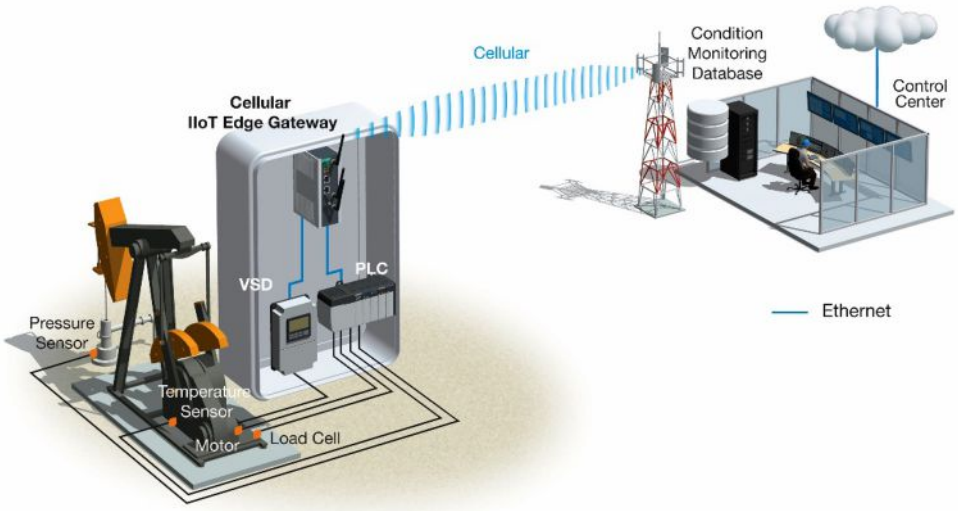
*Application report by **B&R Automation.***

How Industrial Linux enables distributed IIoT applications

Distributed IIoT applications require robust, secure operating systems to preprocess mission-critical information before transmitting to the cloud. Capable of addressing development, remote maintenance, data protection and support, Industrial Linux distributions have become popular edge gateway operating systems.

DISTRIBUTED APPLICATIONS are on the cutting edge of the Industrial Internet of Things (IIoT). By leveraging the latest advances in edge computing, that is, deploying edge gateways to collect and preprocess data from numerous sensors and other devices spread across many different field locations before transmitting mission-critical information to the cloud, distributed IIoT applications bring the benefits of IoT to the remotest regions on earth.

Besides satisfying industrial-grade hardware specifications, edge gateways used in distributed IIoT applications also demand a robust yet lightweight and highly customizable operating system for bespoke IIoT application development. This article discusses the role of edge computing in distributed IIoT applications, identifies the major challenges to implementing distributed IIoT applications, and explains how adopting an industrial Linux operating system can overcome these issues.



SOURCE MOXA

IIoT edge gateways need to perform several different functions and process large amounts of data from many different sensors and actuators at each oil well in real time.

Edge of the IIoT

In recent years, growing investments in industrial markets have spurred rapid expansion in "Internet of Things" (IoT) application development. The Industrial Internet of Things (IIoT) promises to revolutionize global manufacturing by leveraging data from interconnected smart sensors, industrial equipment, and analysis tools to improve production processes. Although many IIoT applications adopt a centralized architecture where communication devices connect to a central node (for example, smart factories that connect all the PLCs, actuators, and other industrial equipment to a central SCADA system through communication gateways and industrial Ethernet switches), distributed IIoT applications are on the rise.

In a distributed IIoT application, sensors and equipment deployed across a wide area connect to one of many edge gateways located throughout the entire network. Each edge gateway acts as a data concentrator, protocol converter, and data preprocessing device for all the sensors and equipment that connect to it. The edge gateway then transmits all of the preprocessed information from the edge system (comprised of the gateway and connected sensors and equipment) to a public or private cloud for big data analysis. Typical distributed IIoT applications include smart cities such as smart meters and street lighting management, renewable energy such as solar or wind farm monitoring, and oil and gas.

The critical role served by edge gateways in distributed IIoT applications also illustrates the importance of edge computing, which essentially moves IoT data processing and actuation from the cloud to the edge of the network. By introducing a layer of gateways between the IoT devices (edge systems) and the cloud to preprocess the data, edge computing reduces latency for real-time applications, efficiently utilizes bandwidth and storage resources, enhances scalability, reduces costs and energy consumption, and improves privacy control.

Besides sufficient processing power and industrial-grade hardware requirements, edge gateways in distributed IIoT applications also need a robust, secure operation system. IoT developers value operating systems that include common features and enable them to concentrate on business outcomes.

In 2019, the most popular OS for IoT gateways was clearly Linux, with 76% of IoT developers using a Linux distribution for edge system development, compared to only 52% of IoT developers using a Windows platform. To understand why Linux distributions are such a popular option for IoT edge gateways, let's examine the specific challenges faced by a typical distributed IIoT application and how the edge gateway OS can help.

Challenges of a Distributed IIoT

Distributed IIoT applications face unique challenges that need to be considered when choosing the development platform for the edge gateway. Consider the classic example of a digital oil field, which is usually located far from civilization and includes many oil wells scattered over thousands of acres to pump underground petroleum to the surface. In order to provide predictive maintenance, real-time monitoring, alarm notifications, and other add-on value in a digital oil field application, all the information from numerous oil wells, pipelines, and other processing facilities needs to be collected and transferred to a public or private cloud server for big data analysis.

Due to the highly remote and distributed nature of oil field applications, wired communication is often difficult to deploy and maintain. Instead, digital oil fields often use cellular communications, or another

wireless technology, by installing an edge gateway along with I/O, PLCs, and other devices in an explosion-proof cabinet at each remote site. To ensure reliability in harsh oil field environments, the gateway should also have a wide operating temperature range and explosion-proof certification.

Besides the aforementioned mission-critical hardware requirements, edge gateways in digital oil fields and other distributed IIoT applications also require an operating system that addresses the following challenges.

Application development

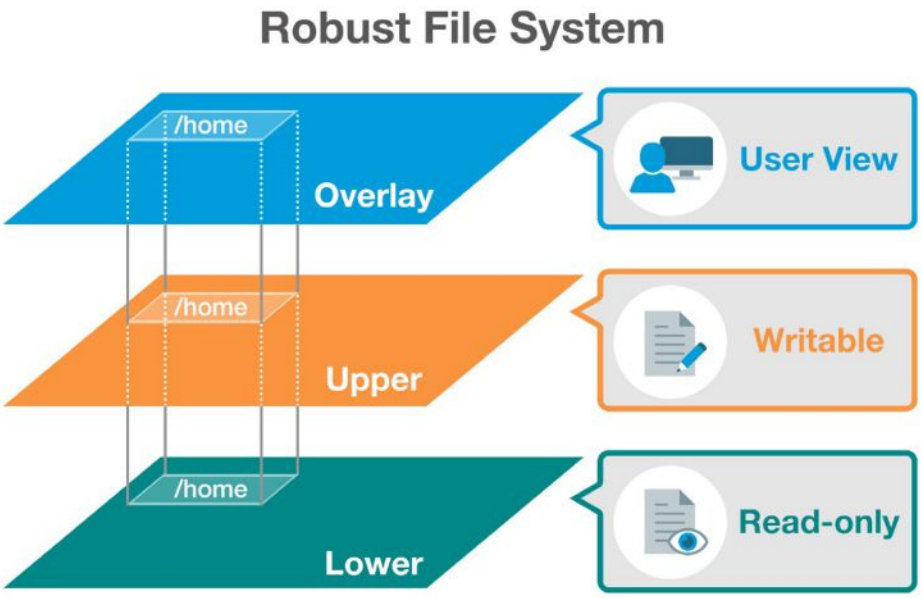
IIoT edge gateways need to perform several different functions and process large amounts of data from many different sensors and actuators at each oil well in real time. Since most gateways are only designed to process incoming data before transmitting the information to more powerful servers in a remote data center or the cloud, a real-time operating system (RTOS) is usually embedded on the microcontroller unit (MCU).

However, the traditional embedded RTOS is usually designed for a single purpose, which makes it difficult to simultaneously perform multiple functions in real time. In addition, a simple RTOS is unable to support machine learning, containers, and other new technologies. Ultimately, these limitations will delay time-to-market and increase overall development costs.

System stability

Since edge gateways need to process mission-critical data at each remote site, the gateway operating system needs to be incredibly stable because a system crash could easily endanger production or even human life.

In general, there should be zero tolerance for system crashes or damages resulting from adding, modifying, or deleting files on the gateway. If an exception occurs or a software application freezes the system, maintenance engineers should be able to roll back the operating system to the last working version.



SOURCE: MOXA

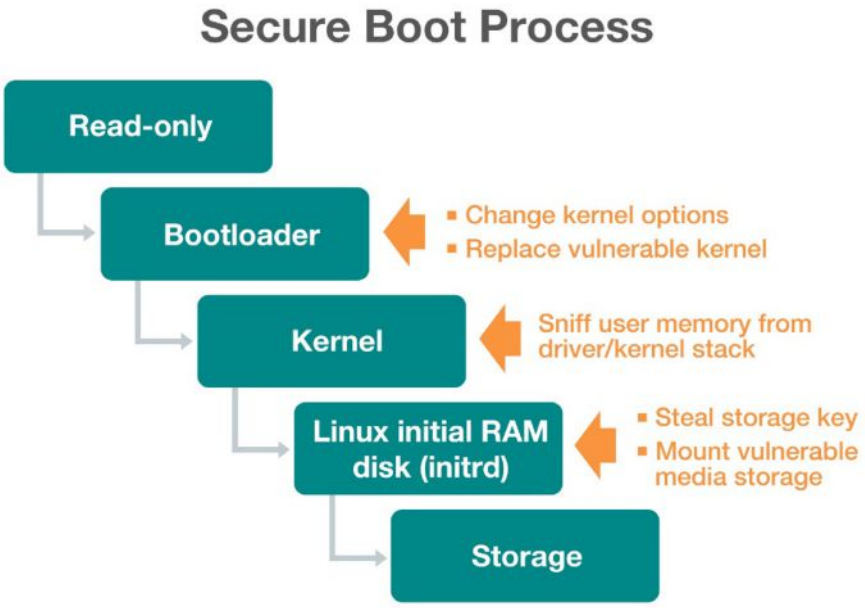
Industrial Linux platforms have three system layers: the bootloader, kernel, and file system.

Remote maintenance

All operating systems require periodic firmware updates and vulnerability patches. However, updating the firmware on so many gateways in such a remote and highly distributed application presents another challenge for digital oil fields. How is a maintenance engineer supposed to update the firmware on so many different devices in so many different locations? Physically travelling to each remote site is incredibly time-consuming and costly given the size of most oil fields. Moreover, how does a maintenance engineer ensure that the entire digital oil field system remains online and running if a single firmware update fails at one remote site?

Data protection

All the oil well data stored on each gateway also need to be protected because the information is highly sensitive and confidential. Even if an intruder is able to steal the storage media, such as a flash drive or SD card, from the gateway, the data should be protected from unauthorized access through reverse engineering. Furthermore, the gateway operating system software should be protected and validated for the integrity. For example, if it is possible to bypass the normal boot-up process and replace the operating software, the gateway can be commandeered by unauthorized personnel and compromise the entire oil field system.



SOURCE: MOXA

The figure above shows a thread model for a typical secure boot process.

Future support

Most operating systems are only supported by vendors for several years. However, unlike commercial applications in offices that upgrade to a new version of an operating system every couple of years, industrial applications like digital oil fields generally need to use the same platform for 10 years or possibly longer. After all, industrial applications run highly specialized programs for complex processes that require a great deal of time to implement and deploy. What's more, these programs may not even be fully compatible with new operating system versions.

Industrial Linux distributions

Fortunately, new industrial Linux platforms can address the previously discussed challenges plaguing distributed IIoT applications by providing an open software platform specifically designed for industrial

	Former Embedded OS	Modern Embedded OS
OS Type	RTOS/Embedded	General Linux
Toolchain	Cross-compiler	Normal toolchain
System Functionality	Single-purpose	Multi-purpose
Storage	Constrained SRAM, flash	256 MB RAM, 2 GB SD
Remote Updates	Few updates	Constant updates
Network Connection	Offline	Connected
Development Effort	Expensive and custom software development	Low-cost and simplified software development

SOURCE: MOXA

automation. However, industrial Linux distributions also vary substantially. As a result, it is important to choose an industrial Linux distribution that genuinely satisfies the following requirements for edge gateways in distributed IIoT applications.

Fast time to market

Due to the drastic drop in silicon costs in recent years and technological advancements enabling smaller chips to perform increasingly powerful computations, embedded operating systems for gateways are no longer limited to a single purpose or a simple RTOS. In fact, modern embedded systems are capable of running multipurpose Linux operating systems on edge devices, including IIoT gateways. The ability to support multipurpose functions enables IoT developers to focus on business outcomes and bring applications to the market even faster. In addition, choosing an industrial Linux operating system based on Debian, the most popular Linux distribution for IoT developers, can also speed up time-to-market by providing a familiar platform for developers to start adding on value.

Dual system design

Industrial Linux platforms have three system layers: the bootloader, kernel, and file system. The most frequently changed layer during application development and operation is the file system. To prevent system crashes, the industrial Linux OS should provide a mechanism to prevent the file system from crashing and allow administrators to roll back the system to a previous version. More specifically, the robust file system should support the following:

- Firmware downgrades, in addition to upgrades
- Overlay File System (OverlayFS) to prevent system crashes caused by unexpected power loss during firmware upgrades/downgrades, or when restoring the system to default settings
- File system recovery if firmware upgrades/downgrades fail

The industrial Linux OS should also incorporate a dual system design that retains the last working version of the bootloader or kernel if a bootloader/kernel upgrade fails. For example, administrators may need to upgrade the bootloader or kernel to patch a security issue or fix a bug. However, if the bootloader or kernel upgrade fails, the entire system will not be able to boot up, bringing the entire industrial system to a halt.

Over-the-air software updates

Because edge gateways are located at remote sites, it is difficult for administrators to upgrade the application and system software in the field. Remote firmware upgrades over cellular, Wi- Fi, or another type of wireless network provide the most practical way to overcome this issue. Debian systems in particular support a simple software upgrade mechanism called APT. APT, which stands for Advanced Package Tool, has a central repository of over 25,000 software packages ready for remote download and installation.

Developers can even package their own security patches, bug fixes, or new application software in the APT format and provide the APT package to a central server, such as the device management server, to perform firmware upgrades over the air. To ensure that the APT package is genuine and comes from the original vendor, the device should also have a mechanism for validating and authorizing the APT server.

Built-in cybersecurity

The industrial Linux platform should have a built-in secure boot process to protect mission- critical data. By anchoring each boot process to the hardware root of trust (RoT), industrial Linux platforms can prevent the trusted computing base (TCB)—that is, the bootloader or kernel—from unauthorized access, thereby protecting the gateway from data theft or brute force attacks.

Secure boot requires a CPU that supports either IBM eFuse or Intel Boot Guard technology. Both of these technologies essentially hard-code critical programming logic onto a chip that cannot be modified after manufacturing. Generally, the following OS boot processes are anchored to the hardware:

1. The CPU loads the bootloader
2. The bootloader loads the kernel
3. The kernel loads the mini root file system (initrd/intramfs)
4. The mini root file system mounts rootFS (ext4/raid disk)

In order to protect each thread from unauthorized code injections or sniffing, asymmetric cryptography and signature verification should also take place as each process is executed.

Besides storage protection during the OS boot process, secure boot should also include library protection for application software and binary data.

For example, if an attacker physically steals the gateway from a remote site, he or she should still be unable to access mission-critical information because all the data and libraries have also been asymmetrically encrypted.

Long-term Linux support

One of biggest concerns developers have about using a Linux distribution is the maintenance and support period. As with standard Linux operating systems, industrial Linux platforms are also open-source and may only be maintained by the original developers for about two years.

For industrial applications, however, upgrading or migrating platforms after two years is unacceptable. Ideally, IIoT application developers should work with a software vendor that provides long-term support for their industrial Linux platform, such as the 10-year support offered by Moxa Industrial Linux, to extend the period of software maintenance and adjust the type and frequency of software updates (patches) to reduce risk, expense, and disruption to software deployment.

Conclusion

Distributed IIoT applications, such as digital oil fields, require robust and secure operating systems for edge gateways to preprocess mission-critical information before transmitting data to the cloud.

Capable of addressing the application development, remote maintenance, data protection, and future support challenges affecting distributed IIoT environments, it is no wonder industrial Linux distributions have become the most popular edge gateway operating systems among IoT developers.

Whether you choose MIL or another industrial Linux distribution, it is important that your edge gateway operating system enables fast time-to-market, includes robust file systems and dual system design, supports simple and secure updates over the air, has built-in industrial-grade cybersecurity, and provides long-term support.

Ryan Teng, Project Manager, ***Moxa.***

How to optimize networks for extreme conditions

From remote oil rigs to electrical substations, industry runs on data. Interruptions to flow of information can create unexpected downtime and result in costly outages. This article explores ways to optimize networks for maximum uptime in the face of challenging and varied environmental operating conditions.

COMMERCIAL-GRADE ETHERNET SWITCHES have proven to be especially vulnerable in industrial environments because they are not engineered to withstand the fluctuating temperatures, humidity, vibration, dust and other conditions common to remote environments. Just as ice formation can stop the flow of a river, extreme temperatures can stop the flow of data from remote operations. Because modern facilities and control systems run on information, even brief interruptions to data flow can introduce significant risk to operations.

Commercial-grade Ethernet switches have proven to be vulnerable because they are not engineered to withstand the fluctuating temperatures, humidity, vibration, dust and other conditions common to remote environments. Instead of routing data, these switches often experience failures such as shutdowns when faced with extreme conditions. Designed for climate-controlled data centers and wiring closets, these switches should not be used outdoors.

Extreme conditions don't need to make the network go down. Today, thousands of industrial-grade Ethernet switches are performing reliably in remote locations. Keeping switches and systems functioning requires an understanding of how extreme conditions affect performance, knowledge of the different types of switches and their limitations, and an understanding of features required to mitigate changing conditions.

Extreme conditions impact

As an Ethernet switch approaches the limits of its operating temperature, it starts slowing down and may drop packets. When an Ethernet switch gets too cold or hot, components simply fail to function. Data can't be communicated or stored, blocking visibility into operations and hampers control systems. The value of the data managed by Ethernet switches in remote environments is not only the data itself, but the crucial role it plays in supporting automated network systems. Interrupted flow of data may cause networking equipment, control software, and even security and safety systems to shut down unexpectedly.

Network failures pose a significant threat to safety, productivity and profitability. System crashes can create a dangerous lack of visibility into operations and can shut down safety systems. They also create a financial liability, since emergency repairs cost much more than planned preventive maintenance, especially in remote locations. Failures also carry a high productivity price. The costs could be even higher at offshore rigs, wind farms, pipelines and other work environments where skilled maintenance technicians and spare parts may be miles away. Failures are problematic, but they are also highly preventable. Network failures are extremely rare when the Ethernet switch is properly matched to the operating environment. Making the match requires an understanding of two types of switches— commercial and industrial—and the limitations of each.

Specifications	Typical Commercial Switch with Fan Cooling	Typical Industrial Switch
Operating Temperature	0º to 45ºC	up to -40º to 85ºC
Vibration/Shock	1/5G	5/10G to 50/200G
ESD/Overvoltage Protection	2KV	4KV to 16KV
MTBF Hours	25K	200K-2M

SOURCE: RED LION CONTROLS

Commercial-grade switches

Commercial-grade Ethernet switches are typically used in climate-controlled environments such as offices where there is little exposure to temperature extremes, shock, vibration and electrical noise that can impact performance. Commercial switches are typically rated to operate in temperatures ranging from 0° to 45°C (32° to 113°F), which is an important consideration when selecting switches for remote operations. They also usually require on-board fans.

Industrial-Grade switches

Industrial-grade Ethernet switches reliably perform in temperatures ranging from -40° to 85°C (-40° to 185°F), which means they work in extreme environments difficult for people to access. Industrial switches are an essential part of automated control systems. The chart above presents a comparison of the specifications of both commercial and industrial switches. Industrial switches, for example, are capable of operating for 20 to 30 years in the field, while the MTBF (Mean Time Between Failure) for commercial switches is often less than 3 three years.

Preventing problems

Many industrial switches offer diagnostic capabilities that help prevent downtime by proactively issuing alerts before falling temperatures and other extreme conditions can cause a problem.

One optional feature is for the switch to regularly send packets of diagnostic data that can be integrated into a management system or viewed on a human machine interface (HMI). The person or system responsible for monitoring the switch can view port-by-port data flow to easily see the slowdowns that may indicate an impending problem. More advanced switches offer embedded browser functionality that provides more powerful diagnostic capabilities and enables remote troubleshooting.

Data can be viewed and processed in real time, and also shared with databases and other applications for analysis and maintenance planning. These capabilities are native to many industrial switches. Similar functionality is available for commercial switches, but complex configuration and programming is required.

Use of industrial switches

While organizations can't depend on good weather and perfect environmental conditions, they can rely on high performance and increased uptime when the proper industrial-grade Ethernet switches and other components are selected for the job.

The key is to use rugged products that are engineered for the environment and can be managed remotely and proactively to prevent problems, regardless of operating conditions. Industrial Ethernet switches are engineered to get the job done even when conditions are uncomfortable for workers and unmanageable for commercial-grade products.

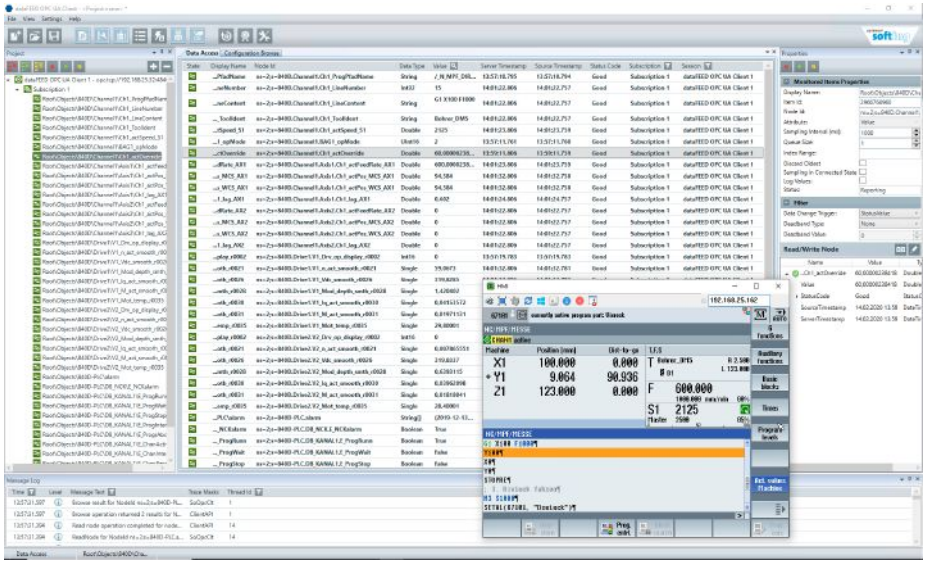
Application report by ***Red Lion Controls****.*

Using OPC UA and MQTT to access CNC controller data

Use of a gateway along with OPC UA and MQTT, can provide access to S7 controller machine tool data. This allows important spindle and axis data, such as torque and power consumption, to be read out, processed and become available for condition monitoring, predictive maintenance, and data logging or analysis tasks.

TO FULLY IMPLEMENT INDUSTRIE 4.0 applications in the future, the internal data of CNC controllers needs to be available in a digitalized way. Since many machine tools, however, already have been developed years ago, these controllers often do not provide any open and standardized interface for data integration. But now, new gateway technology opens the door to external access to SIMATIC S7 controllers, as well as NC and drive data of the SINUMERIK 840D solution line.

The SINUMERIK 840D CNC controller from Siemens has been available on the market for about 25 years and is used in many machine tools for implementing milling, turning, grinding, nibbling and punching technologies. However, when checking the requirements for a future use, it turns out that only the data from the integrated SIMATIC S7 controller can be re-used outside the machine tool, while the NC and drive data is not accessible by external applications. Thus, the CNC controller prevents the integration in an overall application by not providing open and standardized communication capabilities.

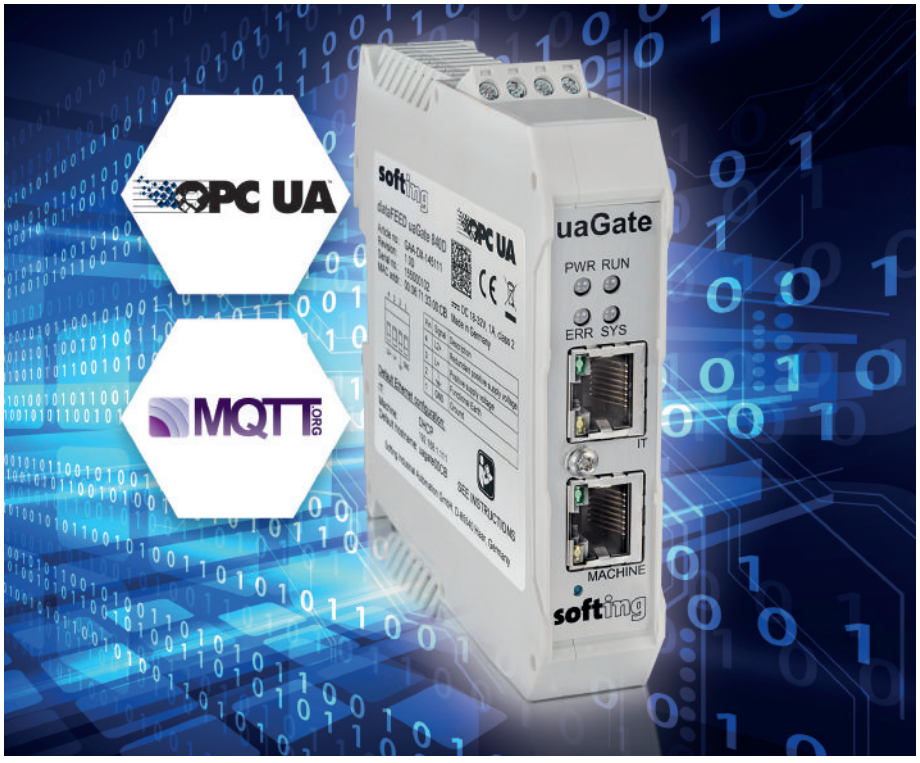


SOURCE: SOFTING

Use of the uaGate 840D gateway allows access to the complete set of SINUMERIK 840D data and alarms.

Access to controller data

The uaGate 840D gateway from Softing is dealing with this challenge and, for the first time, provides access to the complete machine tool data. This allows important spindle and axis data, such as torque and power consumption, to be read out and processed using the OPC UA and MQTT communication technologies.



SOURCE: SOFTING

Access to the data in the SINUMERIK 840D sl CNC controller via the standards OPC UA and MQTT.

Together with the associated alarms, this data for instance becomes available for condition monitoring, predictive maintenance, data logging or analysis tasks. In addition, this gateway allows to generally integrate the SINUMERIK 840D sl CNC controller into Industrie 4.0 applications. This solution works with newer and older SINUMERIK 840D Solution Line versions using the NCU Type 7x0.3 and a software version newer than V4.3.

Pre-configured symbol file

For using uaGate 840D the gateway just needs to be connected to a free Ethernet slot – either X120 (operator panel) or X130 (company network). Once the gateway has been integrated into the network, commissioning the gateway becomes very easy by making use of the symbol files already pre-configured in the firmware upon delivery. The symbol files take care of establishing two connections, one to the NC section including drive data, axis data, program data, tool data and specific NC alarms and one to the PLC section of the integrated SIMATIC S7-300 controller with its DB data, alarms and messages.

As a result, data including spindle speed,

override, actual distance and remaining distance of four axes, as well as temperature, torque, and power consumption of the four motors connected to the drive modules are immediately accessible using the OPC UA standard.

The uaGate 840D gateway solution also provides an effective tool for downloading symbol files from STEP7 and TIA Portal projects referring to the S7-300 controller integrated in SINUMERIK 840D. Once downloaded and adapted according to individual needs, customers can import these symbols into the uaGate 840D gateway.

The NC variables can be loaded into the gateway using the Siemens tool NC-Var-Selektor available as part of the Sinumerik Toolbox. As a result, the controller data as well as the NC and drive data is accessible immediately via OPC UA without requiring any modifications in the SINUMERIK 840D CNC controller.

By default, the uaGate 840D creates an ability to read and write variables in the integrated SIMATIC S7-300 controller, however customers have the chance to define these as read-only, if required. The variables of NC part configuration are defined as read-only for precautionary reasons.

Range of applications

The uaGate 840D can be used in a variety of different applications. One application is the acquisition of operating data. Here, users determine which data on the workpiece or tool is read from the machine tool and collected at what time. The recorded data can then be used for visualization purposes or for evaluations. For predictive maintenance, high frequency data like positions, currents and control deviations are monitored.

Users thereby evaluate the tool quality and tool wear by minimizing scrap, increasing tool life and ensuring higher overall product quality. Plus, the service life of tools is maximized. One customer reports: “We have successfully installed the gateway in our gear cutting machine for analyzing data such as rolling force. This enables us to estimate the hardness of the components and to create specific maintenance and inspection measures for the machines. Thus, in the end we can reduce machine failures.”

Machine tool manufacturers are also using the collected data for determining an optimal choice of tools: “It is not uncommon that 500 tools and more are used in a modern production line, resulting in an almost infinite number of different sorting options. When re-sorting the tools to the optimal positions, we can significantly reduce waiting times in the production process.” Customers, in addition, use the tool and machine data provided by uaGate 840D to improve tool installation and calibration.

SOURCE: SOFTING

The uaGate 840D gateway can be connected directly to the SINUMERIK 840D sl CNC controller without requiring a system adaptation and any additional licenses.

Advantages of gateway solution

Using the uaGate 840D gateway provides significant advantages for customers. First, the uaGate 840D can process up to 20,000 symbols in total. It also provides read optimization to summarize drive data and to read the values of several drives simultaneously using just one request, resulting in higher performance. Furthermore, the gaeway supports subscribing to all the drive data, alarms and values from the PLC and NC area.

The gateway is backwards compatible up to software version V4.3, which is beneficial to customers, since users are often cautious to migrate to a newer software version due to possible problems arising during production or to reduce potential liability and warranty issues. When using the gateway, customers can access the complete alarm list including the individual active/inactive time stamps.

Plus, the gateway provides convenient browsing of the complete integrated namespace and subscription by any OPC UA Client. Finally, the pre-configured symbol files allow for a fast start-up configuration and the MQTT interface makes uaGate 840D a solution for integrating Industrie 4.0 and cloud applications.

Comprehensive solution

As a result, the gateway offers easy access to the SIMATIC S7 controller as well as NC and drive data. Product manager Sebastian Schenk gives a short overview of the uaGate 840D development: "In the past, we often received inquiries as to whether we could not use our knowledge of Siemens and the OPC UA standard for a product for SINUMERIK 840D integration. In fact, we have managed to develop this gateway in a very short time.

This offers customers a simple and practical solution for implementing Industrie 4.0 applications. Especially, the included pre-configured symbol files support to setup the data exchange with just a few clicks. And we are not at the end of our development efforts: Based on specific customer requests we are currently performing first tests for accessing the data in SINUMERIK 840D pl CNC controllers as well."

*Application report by **Softing.***

Analog Devices: Accelerating the Path to Industry 4.0

Stay ahead of what's possible with innovative solutions that solve the most complex, important, and impactful industrial automation challenges.

ANALOG DEVICES (ADI) IS A GLOBAL leader in the design and manufacturing of analog, mixed signal, and DSP integrated circuits. We intelligently bridge the physical and digital worlds with a cutting-edge portfolio of technologies that sense, measure, interpret, connect, power, and secure.

ADI is, however, not a typical semiconductor company. It pushes the boundaries of silicon technology, investing heavily in software, systems expertise, and domain knowledge within its key markets such as industrial automation.

The combination of this knowledge with that unmatched set of analog-to-digital capabilities enables ADI to approach challenges at the system-level and help its customers get to market faster, create and capture more value, and make sound investments with a roadmap to tomorrow.

Industry-leading, scalable Ethernet

We turn your vision of connected factories into reality. ADI Chronous™, Analog Devices´ family of compatible and interoperable Industrial Ethernet connectivity products, enables best-in-class industrial automation solutions for the connected factory of tomorrow. From complete Time Sensitive Networking solutions for high-performance motion control in factory automation to innovative 10Base-T1L concepts for robust field instrument connectivity in process control – our market-leading Ethernet portfolio of combined software and hardware solutions are scalable and timed to perfection.

ADI Chronous encompasses a range of advanced Industrial Ethernet technologies from real-time Ethernet switches to physical transceivers and network interface solutions that include protocol stacks. Designed to support scalable and flexible system development, the ADI Chronous portfolio offers multiple port count, low power consumption, and flexible bandwidth. Being multiprotocol, these solutions are compatible with the majority of existing industrial protocols while also providing the ability to future-proof for TSN networks.

ADI Chronous solutions are designed and verified for robust operation in harsh industrial environments and offer effective security at each node point within a system. Our suite of Industrial Ethernet products includes technologies, solutions, software, and security capabilities designed to connect the real world to factory networks and beyond to the cloud.

Why ADI?

Our long and rich industrial expertise and system design knowledge coupled with advanced technologies deliver seamless and secure connectivity across the automation network, turning your vision of the connected factory into reality.

ADI ensures your time-critical automation and control data is delivered perfectly on time, every time. Get to market fast by using ADI's complete solutions that provide predictable, trusted results you can depend on every time.

For deterministic, verified robust, scalable and flexible solutions that simplify system design and reduce the development burden, look no further than Analog Devices.

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

ADI Chronous™
SCALABLE ETHERNET TIMED TO PERFECTION

Analog Devices
Email: EMEAMarketing@analog.com
Phone: +49 89 769030
analog.com/chronous

Beckhoff – New Automation Technology

Beckhoff implements open automation systems based on PC Control technology. The product range covers Industrial PCs, I/O and Fieldbus Components, Drive Technology and automation software. Products that can be used as separate components or integrated into a complete and seamless control system are available for all industries.

THE BECKHOFF NEW AUTOMATION TECHNOLOGY philosophy represents universal and open control and automation solutions that are used worldwide in a wide variety of different applications, ranging from CNC-controlled machine tools to intelligent building automation.

Worldwide presence on all continents

The central divisions of Beckhoff, such as development, production, administration, distribution, marketing, support and service are located at the Beckhoff Automation GmbH & Co. KG headquarters in Verl, Germany. Rapidly growing presence in the international market is taking place through subsidiaries and branch offices. Through worldwide cooperation with partners, Beckhoff is represented in 75 countries.

Innovative products and a full range of services

Since the foundation of the company in 1980, continuous development of innovative products and solutions using PC-based control technology has been the basis for the continued success of Beckhoff.

Many automation technology standards that are taken for granted today were conceptualised by Beckhoff at an early stage and successfully introduced to the market.

Beckhoff | The Automation Company

Beckhoff offers comprehensive system solutions in different performance classes for all areas of automation. Beckhoff control technology is scalable – from high-performance Industrial PCs to mini PLCs – and can be adapted precisely to the respective application.

TwinCAT automation software integrates real-time control with PLC, NC and CNC functions in a single package.

All Beckhoff controllers are programmed using TwinCAT in accordance with the globally-recognised IEC 61131-3 programming standard. With TwinCAT 3 C/C++ and MATLAB®/Simulink® are available as programming languages in addition to IEC 61131-3.

Beckhoff | The IPC Company

Beckhoff supplies the right Industrial PC for every application. High-quality components based on open standards and the rugged construction of the device housings mean that the Industrial PCs are ideally equipped for all control requirements.

Embedded PCs make modular Industrial PC technology available in miniature format for DIN rail mounting. In addition to their application in automation, Beckhoff Industrial PCs are also ideally suited to other kinds of tasks – wherever reliable and robust PC technology is required.

Beckhoff | The I/O Company

Beckhoff has the right technology for every signal and every fieldbus. Beckhoff supplies a complete range of Fieldbus Components for all common I/Os and over 15 major fieldbus systems. With the Bus Terminals in protection class IP 20, and the Fieldbus Box modules in IP 67, a complete range is available for all important signal types and fieldbus systems.

In addition to conventional bus systems, Beckhoff offers a complete EtherCAT I/O range for the high-speed Ethernet fieldbus based on EtherCAT Terminals, the EtherCAT Box and the EtherCAT Plug-in Modules.

Beckhoff | The Motion Company

In combination with the motion control solutions offered by the TwinCAT automation software, Beckhoff Drive Technology represents an advanced and complete drive system. PC-based control technology from Beckhoff is ideally suited for single and multiple axis positioning tasks with highly dynamic requirements.

The AX5000 Servo Drive series and the AX8000 multi-axis servo system with high-performance EtherCAT system communication offer maximum performance and dynamics. Servomotors with One Cable Technology, which combines power and feedback system in a standard motor cable, reduce material and commissioning costs.

The drive system XTS (eXtended Transport System) replaces classic mechanical systems by innovative mechatronics. It enables individual product transport applications with a continuous flow of material.

BECKHOFF

Beckhoff Automation GmbH & Co. KG
Email: info@beckhoff.com
Phone: +49 5246 963-0
www.beckhoff.com

Contemporary Controls: Innovative Machine Integration

Contemporary Controls develops, manufactures and markets innovative networking and control products to the benefit of our automation customers worldwide. We are committed to delivering products and services that meet customer requirements and expectations through our continuous improvement efforts.

CONTEMPORARY CONTROLS DESIGNS AND manufactures the system building blocks for networking, integrating and controlling automation processes where performance and reliability are important.

Our products are built upon open technologies such as ARCNET, BACnet®, Controller Area Network (CAN), Ethernet, Modbus®, Niagara Framework®, and Sedona – typically found in the building, energy, and industrial automation industries.

Innovative Machine Integration

Contemporary Controls' designs and manufactures IP routers that quickly and effectively integrate machines to a customer's existing IP infrastructure, benefiting both customer and machine builder alike.

Modern machines are comprised of various complex subsystems that communicate via the Internet Protocol (IP) – the backbone of the Internet.

The machine builder pre-defines each subsystem IP address and the range of addresses devoted to each machine. This addressing convention may conflict with the addressing policies of the customer potentially jeopardizing a speedy integration of the machine or machines to the plant.

Cost-Effective, Trusted IP Routers

Contemporary Controls' Skorpion series of IP routers eases the integration of new machines into the existing network.

Each machine consisting of multiple IP devices connects to the LAN side while keeping the same IP settings for the devices and the application, lowering installation cost and eliminating troubleshooting. The IP address for the WAN port on the IP router is the only setting that requires modification allowing multiple machines to reuse the same configuration on the LAN side.

Skorpion routers have been successfully used in Robotics, Automated Guided Vehicles (AGVs), Packaging, Scientific Equipment to name a few applications.

Quick Diagnostics with Secure Remote Access

Skorpion IP routers also supports Virtual Private Network (VPN) functionality. This can be enabled to allow secure remote access to the machine at the site for remote diagnostics and troubleshooting, using both wired and cellular VPN routers. This allows remote access to the machine over the internet and through the plant network for servicing.

Rugged Ethernet Switches

Whatever the Ethernet infrastructure need, a solution is available from CTRLink products. For simple systems, plug-and-play unmanaged switches provide a cost-effective method for expanding Ethernet networks.

For troubleshooting, diagnostic switches allow a network sniffer to attach to an unused port on a switch and observe all traffic on the network. Managed switches provide SNMP, VLAN and RSTP.

40 years of experience

With more than 40 years of experience, Contemporary Controls has been a leader in innovative solutions for industrial automation.

Contemporary Controls' CTRLink products are designed for unattended operation in environments not conducive to office-grade equipment. The products provide convenient DIN-rail mounting in control panels, 24VAC/DC power, UL 508, improved EMC compliance and reliability.

Contemporary Controls' repeating hub, switches, media converters and IP routers adhere to IEEE 802.3 standards and more. Specialty regulatory needs are addressed in selected models.

Our customers

Contemporary Controls' customers are systems integrators, contractors and OEMs seeking simple, reliable networking and control products from a dependable source.

With headquarters based in the US, Contemporary Controls also has operations in the UK, Germany and China and is well suited to fulfil your application needs worldwide.

CONTEMPORARY CONTROLS®

Contemporary Controls
Email: info@ccontrols.com
Phone: +1-630-963-7070
www.ccontrols.com

Enabling intelligent and autonomous factories

Eurotech provides advanced computing and AI capabilities at the edge with compact, rugged and fanless systems with global industry and environmental certifications for a faster deployment and to reduce time to market. They meet the requirements of global applications and are fully customizable for scalability and integration with existing systems.

EUROTECH IS A MULTINATIONAL company that designs, develops and supplies edge computers and enables Internet of Things (IoT) solutions – complete with services, software and hardware – to system integrators and enterprises.

Customers have access to IoT building blocks and software platforms, Edge Gateways to enable asset monitoring and High Performance Edge Computers (HPEC) designed for Artificial Intelligence (AI) applications. To enable end-to-end solutions, Eurotech has activated partnerships with leading companies in their field of action, thus creating a global ecosystem that allows it to create "best in class" solutions for the Industrial Internet of Things.

Eurotech provides advanced computing and AI capabilities at the edge with compact, rugged and fanless systems with global industry and environmental certifications for a faster deployment and to reduce time to market. They provide soldered-down components and are designed to ensure sustained and reliable operations in harsh environmental conditions, typical of industrial and embedded applications with long lifecycles.

They meet the requirements of demanding applications globally and are fully customizable for maximum scalability and integration with existing systems.

High Performance Edge Computing (HPEC)

Eurotech brings supercomputing performances to the edge with its HPEC (High Performance Edge Computers). They feature server-class CPUs and GPUs to provide unmatched edge computing capabilities, thus enabling data-intensive industrial applications at the edge such as collaborative robotics, artificial vision and predictive maintenance. This enables the transition to an autonomous, intelligent factory.

Bringing HPC capabilities to the field allows a faster, real-time management of huge amounts of data. This allows training and inference to happen directly at the edge, by applying AI algorithms for deep learning.

High Performance Edge Computers enable server-class capabilities in the field for AI and other data-intensive applications

An innovative, direct hot water liquid cooling allows maximum performance density, making these systems ideal for stationary and mobile applications where space is at a premium.

Moreover, this cooling solution allows sustained operations with a very low power consumption.

Everyware IoT – Edge-to-Cloud IoT building blocks

Eurotech provides Industrial IoT components to enable end-to-end solutions and collect and manage data from the edge to the cloud.

Under the brand name of Everyware IoT, the company integrates hardware and software building blocks and services to simplify and accelerate IoT adoption and enable the enterprise digital transformation.

With Everyware IoT, customers have access to Multi-service IoT Edge Gateways for any industry vertical, an open edge framework and a modular cloud infrastructure to connect data collected by field devices to business analytics and enterprise IT applications.

Based on open source and standards, Everyware IoT reduces the risks and costs of IoT project deployment.

Multi-service IIoT Edge Gateways

Eurotech's Multi-service IIoT Edge Gateways are a family of intelligent devices that offer a wide range of performance, networking and ruggedness options in order to best fit today's IoT applications.

Eurotech's Multi-service IIoT Edge Gateways are certified for various industry verticals including Industrial, Automotive, and Railway and are globally certified for cellular connectivity.

With the Multi-service IoT Edge Gateway approach, Eurotech enables a faster and easier development of Industrial IoT and edge computing applications

EUROTECH

EUROTECH S.p.A.
Email: welcome@eurotech.com
Phone: +39 0433 485411
www.eurotech.com

An international leader in connector technology

HIROSE Electric is a world-class Japanese manufacturer of high quality connectors that are sold across all global markets in the electronics industry. Since the establishment of Hirose in 1937, an excellent reputation has been built through the production of technically advanced connectors that incorporate the latest cutting-edge technology.

SINCE THE BIRTH OF HIROSE in 1937, the company has developed and introduced thousands of new connectors, for numerous applications.

Hirose first appeared on the international stage in 1968 and has crafted a network of sales offices, agents and production facilities around the world. The company continues to broaden the scope of its business activities, keeping pace with market advances and satisfying the changing connector needs of companies in Europe, Asia and North America.

Hirose's vigorous international strategy rests on three pillars: strong capital investment, a highly skilled labour force, and close contact with the product development divisions of client manufacturers throughout the world.

Progress in connector technology

With the technical knowledge gained from this contact, backed by the company's own human and financial resources, Hirose is dedicated both to meeting connector demand world-wide and to contributing meaningfully to progress in connector technology.

As a result, the functions and performance of Hirose connectors are more diversified and sophisticated to satisfy the growing demand for smaller, highly innovative connectors that provide superior connectivity.

Such innovations include; enhanced locking mechanisms, ultra low height profiles, high retention forces, user friendly assembly, high speed transmission, high contact reliability and many others. Hirose complies with ISO9001, ISO14001, ISO/TS16949, ISO/IEC17025.

50,000 variations

A wide product portfolio of over 50,000 connectors variations are available. These include wire-to-board, board-to-board, circular, memory, interface, FFC/FPC, coaxial connectors and others, which are suitable for a wide range of applications such as; factory automation, industrial machinery, LED lighting, broadcasting, measurement & control, security devices, instrumentation, consumer electronics, automotive, telecom/datacom, computing and many more.

The ix Industrial is a new standard miniaturized Ethernet mating interface in compliance with IEC/PAS 61076-3-124, which is reduced by 75% compared to the existing RJ45 modular connectors.

A new Ethernet connector standard

One example of Hirose's innovative approach is the new ix Industrial. In response to the challenging and increasing demand for global digitalization technology, Hirose has standardized a new miniaturized Ethernet mating interface in compliance with IEC/PAS 61076-3-124. The ix Industrial socket size is reduced by 75% compared to the existing RJ45 modular connectors, and offers ideal space saving cabling for applications with miniaturized requirements.

The Hirose Yokohama Center integrates a technical network that horizontally links the sectors of engineering, production technologies, and quality assurance.

The receptacles enable parallel 10mm pitch mounting, ideal for daisy-chaining applications, which contributes to unit size reduction.

The unique shell design offers maximum stability on the PCB, increases locking strength and provides durable cable connection of the plug. Thanks to this rugged design, the ix Industrial supports 5,000 mating cycles. It also features an optimized shielding design that guarantees high EMC resistance to secure safe data transmission. The ix Industrial works with Cat.6A high-speed Ethernet for 1Gbps/10Gbps/s data transmission.

These features make the ix Industrial an ideal solution for demanding factory automation and robotics, data center, security system, and transportation applications.

HIROSE ELECTRIC EUROPE B.V.

Hirose Electric Europe B.V.
Email: eu.info.3d@hirose-gl.com
Phone: +31-20-6557467
www.hirose.com/eu

Perfection often evolves out of sight.

Moxa was founded in 1987. Since then, we have constantly expanded - both geographically and technologically – and today we are one of the leading global manufacturers of industrial networking technology.

OUR INTERNATIONAL CLIENTS READ like a "Who's Who" of the transport, energy, production, shipping, as well as oil and gas industries. On both the technical and the entrepreneurial front we embrace the philosophy of reliability and sincerity.

"Reliable Networks. Sincere Service" is thus simultaneously the approach we take and the aim of our endeavours.

Moxa Europe

Since the foundation of our Moxa Europe headquarters in Unterschleißheim near Munich, Germany, in 2007, we have been growing steadily both in terms of resources and revenue. Today, we have more than 70 experts in four different locations, and the European success story is reflected in our consistent growth.

Experts in the IIoT and Industrial Cloud Computing

Moxa offers proven solutions that allow customers to take advantage of the Industrial Internet of Things (IIoT) for industrial applications. Our solutions help to ease device connectivity and network deployment, leaving customers to focus resources on infrastructure design and software development.

Edge Gateways and Devices

Moxa´s UC-8112-ME-T-LX is a communication-centric RISC computing platform, designed for embedded data acquisition applications with Microsoft Azure IoT Edge pre-installed.

The versatile communication capabilities including two RS-232/422/485 serial ports and dual 10/100 Mbps Ethernet ports, Wireless Enable Solution with wide-temperature design, guarantee that the ARM Cortex 7-based LTE-enabled computers are suitable for harsh-environment applications.

Shaping the Future Now

Moxa has always been a forerunner in industrial networking and computing. In close cooperation with our customers and partners we are shaping the future of industrial automation day by day. This includes the further development of current industry topics like "Industrie 4.0",

Moxa's IIoT Edge Gateway integrates Moxa's industrial protocol expertise, offers 10-year long-term Linux support, and facilitates optimized device management for large-scale deployments.

"Big Data", "Industrial Internet of Things", and "Industrial Cloud". Therefore, we are member of the relevant industry committees and associations, such as IEEE, CIRM, Cigré, or the Industrial Internet Consortium, the OPC UA Consortium and S2R (Shift to Rail).

Thus we ensure that we create innovative products which guarantee that our European customers and partners receive the right products and solutions for their specific requirements.

Rugged Cloud Servers

An essential ingredient for cloud connectivity is high computing performance. Moxa's DA-820 series delivers superior processing power with reliability and efficiency that meet the demands of distributed, high-availability cloud applications in any harsh environments.

Defend Your Industrial Networks

Moxa´s solutions help mitigate cyber-threat risks.

Originally, industrial control system (ICS) networks were physically isolated and almost immune to cyber attacks. Recently, however, there has been a rise in the sophistication of cyber attacks, which has prompted everyone from IT to OT personnel to create solutions that enhance industrial cyber security. With over 30 years of experience in industrial networking, Moxa draws on this expertise to help customers build secure networks by offering protection for PLCs, SCADA systems, factory networks, and remote access.

Activate Your IIoT With Us

With rapid globalization and information digitalization, industrial operators have begun to adopt IIoT applications for enhanced operational efficiency and maximum profits.

We at Moxa, an industrial-leading connectivity solution provider, are here to provide you practical technologies to realize IIoT connectivity.

MOXA®

Reliable Networks ▲ Sincere Service

Moxa
Email: europe@moxa.com
Phone: +49-89-3700-399-0
www.moxa.com

Phoenix Contact: Automation for the future

Phoenix Contact is the worldwide market leader of components, systems and solutions in the area of electrical engineering, electronics and automation. The product range comprises components and system solutions for energy supply including wind and solar, device and machine engineering as well as control cabinet engineering.

TODAY, THE FAMILY-OWNED COMPANY employs 17,600 people worldwide and had an turnover of 2.48 billion Euros in 2019. The corporate headquarters is located in Blomberg in North Rhine-Westphalia. The Phoenix Contact Group has eighteen companies in Germany, as well as more than 55 sales subsidiaries. Internationally Phoenix Contact is on site in more than 100 countries.

Phoenix Contact produces with a high vertical range of manufacture all over the world. Besides screws, plastic and metal parts, highly automated assembly machines are also built in-house.

Wide product range

A diverse product range of modular terminal blocks and special-purpose terminals, printed circuit terminal blocks and plug connectors, cable connection technology and installation accessory offers innovative components.

Electronic interfaces and power supplies, automation systems on the basis of Ethernet and Wireless, safety solutions for man, machine and data, surge protection systems as well as software programs and tools provide installers and operators of systems as well as device manufacturers with comprehensive systems. The automotive, renewable energy and infrastructure markets are supported with holistic solution concepts including engineering and training services and further service features according to their specific demands.

Product innovations and specific solutions for individual customer requests are developed at the locations in Germany, China and the United States. Numerous patents underline the fact that many developments from Phoenix Contact are unique in their own.

In close cooperation with universities and science, future technologies like e-mobility and environmental technologies are explored and integrated into products, systems and solutions for the market.

Phoenix Contact supports the digital transformation with products, systems and solutions. Based on the experience in the in-house machine building, the company knows the requirements of the digitalization and integrated data flow from the engineering through the production and furthermore along the whole product life cycle.

360° Security

Phoenix Contact supports its customers throughout the entire process chain with standardized security. For risk assessment and threat analysis of existing or planned systems, individual service offers form the basis for implementing security concepts.

In addition, secure automation solutions are provided for various industries. Last but not least, the corresponding security components such as firewalls and secure controls of the company, which work in combination with the security functions of other components, contribute to the creation of secure networks. From the secure development process to the continuous vulnerability management of Phoenix Contact PSIRT (Product Security Incident Response Team), security is anchored in the complete life cycle of the products and solutions.

This wide-ranging competence of Phoenix Contact is also reflected in certifications: Phoenix Contact was one of the first companies in Germany to be certified by TÜV Süd according to the series of standards for IT security IEC 62443-4-1, -2-4 and -3-3.

These certifications underline Phoenix Contact's strategy of offering standardized security in products, industrial solutions and consulting services to enable future-proof operation of machines, systems and infrastructures.

Phoenix Contact GmbH & Co. KG
Email: info@phoenixcontact.com
Phone: +49 52 35 300
www.phoenixcontact.com

Anything IN. Anything OUT. Anywhere

FlexEdge™ brings industrial data together as never before to transform your operations. It doesn't just protect your investments. It enhances them.

RED LION'S FLEXEDGE™ Intelligent Edge Automation Platform brings industrial data together as never before to transform edge computing. FlexEdge™ provides a scalable solution to integrate complex multi-vendor environments into digital transformation strategies, while providing a futureproof solution for changing application needs.

One Platform. Limitless Potential.

Avoid costly and complex rip-and-replace scenarios by leveraging the FlexEdge™ sled architecture, designed to enable organizations to leverage new communications technologies as they become available.

Backward Compatible. Forward Thinking.

Regardless of the brand of PLC or other equipment specified, the FlexEdge™ platform, powered by the automation Software platform Crimson®, enables connectivity to virtually anything in your system with point-and-click simplicity. And the new equipment working with the existing infrastructure means capital budgets are kept in check.

Plug and play. And plug. And play.

The FlexEdge™ form factor adapts as applications needs change; effortlessly scale by adding up to ten hot-swappable I/O or PID modules. On-device wiring diagrams and removable wire clamp screw terminal blocks ease installation, while the at-a-glance module status indicator and individual channel LEDs improve troubleshooting and system testing.

Rugged Outside. Reliable Inside.

Rugged construction, a wide operating temperature range, industrial certifications and Red Lion's Crimson® software provide a dependable solution for control, networking and data visualization in even the harshest environments.

Squeeze every last drop from today's equipment. And tomorrow's.

Scan and Design your own ideal FlexEdge™ Solution by our FlexEdge™ Builder.

DA50N Secure Edge Networking Gateway
Red Lion's FlexEdge™ DA50N Secure Edge Networking Gateway offers reliable connectivity to deployed assets in both factory automation and remote applications. The DA50N features a wide operating temperature range and industrial certifications including UL Class 1, Div. II, and ATEX/IECEx approvals for reliable operations.

DA50D Advanced Protocol Converter with Modular Communication
The DA50D's modular design makes designing for compatibility with rapidly evolving communications standards as easy as replacing a field-installable sled. Regardless of the brand of PLC or other equipment specified, the FlexEdge™ platform, powered by Red Lion's Software Automation Platform Crimson®, enables connectivity to virtually anything in your system.

DA70D Intelligent Edge Controller with Scalable I/O
The modular design of the DA70D allows for up to three communications sleds to be added as requirements change or new communication standards emerge. Rugged, field-installable PID control and I/O modules ensure a solution that adapts to meet almost any industrial application need, while the diagnostic light ring offers at-a-glance insight into system operation. Regardless of the brand of PLC or other equipment specified, the FlexEdge™ platform, powered by Red Lion's Software Automation Platform Crimson®, enables connectivity to virtually anything in your system.

Select from our range of FlexEdge™ Communications Sleds, I/O Modules and PID Controllers for your individual applications.

About Red Lion

As a global expert in communication, monitoring and control for industrial automation and networking, Red Lion has been delivering innovative solutions for over forty years. Our automation, Ethernet and cellular M2M technology enables companies worldwide to gain real-time data visibility that drives productivity. Product brands include Red Lion, N-Tron and Sixnet. With headquarters in York, Pennsylvania, the company has offices across the Americas, Asia-Pacific and Europe. Red Lion is part of Spectris plc, the productivity-enhancing instrumentation and controls company.

RED LION™

a spectris company

Red Lion Controls
Email: info@redlion.net
Headquarters: +1 717 767 6511
Europe: +31 33 4723 225
Check for our global destinations on
www.redlion.net

Industrial microdrive

Yaskawa: The GA500 industrial microdrive is designed to meet RoHS2, providing a sustainable, environmentally friendly drive. Its TUV safety rating allows customers to meet stringent safety ratings for machines for the life of their equipment.

The GA500 also provides customers a wide range of flexibility. The drive is rated up to 40 HP and can be applied to 240 VAC single-phase, 240 VAC three-phase, or 480 VAC three-phase incoming power.

For customers that use DC as their power source, the drive is UL rated to accept DC as its primary power source. The GA500 can operate a variety of motors, including induction, permanent magnet (SPM and IPM), and synchronous reluctance (SynRM).

For customers that require network communications with their drives, the GA500 offers a variety of industrial protocols including EtherNet/IP, PROFINET, Modbus TCP/IP, and EtherCAT. Traditional fieldbus protocols like DeviceNet, PROFIBUS, and Modbus RTU (embedded) are also available.

Gigabit Ethernet switch

Abaco Systems: An upgrade to its NETernity SWE540A 6U OpenVPX VPX 40 Gigabit Ethernet switch offers the availability of a conduction-cooled variant, enabling the high speed deployment in a broader range of environments, including extreme heat and vibration.

Customers can standardize on a single switch, choosing the most appropriate ruggedization level according to the planned deployment.

The SWE540A offers the opportunity to create complete, 40 Gigabit-capable systems featuring the company's SBC627 6U VPX single board computer and DSP282A multiprocessor. The new version of the SWE540A also provides a straightforward upgrade opportunity for existing users of the conduction-cooled GBX460 10 Gigabit Ethernet switch, simplifying the transition from 10 Gigabit Ethernet to 40 Gigabit Ethernet.

Advanced features and capabilities offered by the SWE540A include data center bridging to accommodate data-intensive applications. Connectivity includes four QSFP+ (40GBASE-SR4/LR4) ports and two 1000BaseT ports to the front panel, and 40GBASE-KR4/10GBASE-KX4 with up to 39 rear I/O ports for data plane and control plane to the rear panel.

Edge automation platform

Red Lion Controls: The FlexEdge intelligent edge automation platform brings a new versatility to edge computing, while its ease of use makes productivity and efficiency gains from digital transformation initiatives accessible with point-and-click simplicity.

Its highly modular design and intuitive software enable quick, straightforward customization and deployment to applications without compromising rugged, reliable operation. The platform carries several certifications for oil and gas, water, wastewater, maritime, hazardous location, and factory automation applications.

Engineered for industrial customers with diverse needs who want to connect systems and process data at the edge, FlexEdge's modular architecture provides a variety of wireless and wired communication options which make it easy to configure the gateway to connect regardless of protocol or manufacturer.

FlexEdge offers a form factor and platform that adapts as application needs change. It's available with advanced networking functionality or advanced automation features including protocol conversion; virtual HMIs; an advanced web server with Bootstrap, JavaScript and CSS; data, security and event logging; and cloud connectivity.

EtherCAT communications

Deutschmann Automation: The UNIGATE IC2 EtherCAT provides a ready-to-use EtherCAT interface, which can be installed directly into a terminal device or sensor system. An integrated ARM Cortex-M4 processor ensures fast communication.

With the embedded solution UNIGATE IC2 EtherCAT, data can be processed at high speed and quickly transferred to the customer's application. A UART interface achieves baud rates of up to 7.5 MBaud. The SPI bus allows a transfer rate of 12 Mbit/s in master operation and 10 Mbit/s in slave operation. In addition, the all-in-one bus nodes support CANopen over EtherCAT (CoE).

The protocol connection between the UNIGATE IC2 module and the terminal device is implemented via a proprietary script, which is created in the script language developed by Deutschmann in-house. For programming the script, a free protocol developer tool is provided. Execution time of a script line is about 10 µs. With the UNIGATE IC2 embedded series, script execution time can be reduced by a factor of 50 to 80, compared to predecessor models from the UNIGATE IC series. Simple scripts can be executed in just a few microseconds.

Integrated servo drive

Beckhoff: The new AMI812x series of integrated servo drives expands its compact drive technology portfolio (up to 48 V DC) by adding extremely compact devices for distributed field installation. The integration of servomotor, output stage and fieldbus connection in a

space-saving design makes the drives suited for automation outside of control cabinets in the motion power range up to 400 W.

As an EtherCAT slave, the AMI812x drive can be placed directly on the machine without a control cabinet and without upstream I/O level, allowing for the implementation of highly compact machines without control cabinets. At market introduction, the AMI812x series includes three overall lengths in the F2 flange code with standstill torques from 0.5 to 1.1 Nm.

The AMI812x is optionally available with a multi-turn absolute encoder without battery backup and with a backlash-free holding brake. With an additional sealing ring, the servo drive achieves high IP 65 protection rating and is suitable for all installation positions. The STO safety function can be integrated as an option via the TwinSAFE Logic.

Distributed I/O

Opto 22: The new groov RIO, Ethernet-based input/output unit combines multi-signal, multifunction sensing with PoE-powered edge data processing for instant IIoT connections to real-world signals.

The groov RIO unit can quickly connect traditional wired switches and sensors directly to Ethernet networks, software applications, and cloud platforms without intermediary control or communication hardware, such as PLCs, PACs, or PCs.

The first shipping version of groov RIO is the GRV-R7-MM1001-10, a standalone, 10-channel, multi-signal, multifunction I/O unit for signals including thermocouples (TCs), integrated circuit temperature devices (ICTDs), voltage inputs, current inputs, millivolt inputs, discrete DC inputs, self-wetting discrete inputs, discrete DC sinking outputs, and Form C mechanical relays. In addition, two channels provide special features like pulse counting, on- and off-time totalization, software latching, frequency measurement, and more. GRV-R7-MM1001-10 is completely standalone and software-configurable through a browser-based interface.

Industrial Ethernet switch

Korenix: An industrial Gigabit Ethernet switch is equipped with 8 Gigabit port RJ-45, 2 Gigabit SFP and 2 SFP/ RJ-45 ports. The combo ports provide flexible combinations for different environments, and can also provide a high speed uplink to connect with higher level backbone switches. The switch is designed for smart city, surveillance and transportation market.

The JetNet 3212G-2C2F industrial full Gigabit 8 + 2G SFP +2G Combo DC Ethernet switch is specially designed for IP surveillance application that operate in extremely harsh environments. The switch meets the IEEE802.1P Class of Service (CoS) which allows the switch to prioritize traffic as well as perform dynamic multicast filtering. It also supports 10K bytes Jumbo frame transmission.

Controllers and couplers

WAGO: Two new Generation 2 PFC200 PLC controllers along with two new Generation 4 Ethernet based couplers have been added to its XTR line of products. These new devices are designed to work in the harshest environments and provide solid performance in extreme conditions.

The 750-8212/040-010 and 750-8213/040-010 XTR controllers have two configurable M12 Ethernet ports and an onboard SD card slot for additional data storage for program updates. The 750-8212/040-010 has one configurable RS232/485 port, while the 750-8213/040-010 comes equipped with one CANopen port to connect to engine parameters via J1939.

The 750-364/040-010 MODBUS TCP/UDP and 750-364/040-010 EtherNet/IP couplers each boast two M12 Ethernet ports with the rotary switches configuring the last byte of the IP addresses.

Managed Ethernet switches

Antaira Technologies: LMP-1002G-10G-SFP, LMP-1002G-10G-SFP-24, and LMX-1002G-10G-SFP 10 Gigabit managed switches are industrial-grade equipment that is Ethernet ready to fulfill various markets' edge-level networking applications in manufacturing automation, security surveillance, power/utility, water wastewater treatment plants, oil/gas/mining, and transportation. These devices support high-density Ethernet port connectivity, highbandwidth with 10 Gbps fiber ports, long distance data transmission, and an exceptional reliability factor.

The LMX-1002G-10G-SFP is well-suited for intelligent transportation systems. Often there may be 1000mbps fiber links in place that need more modern 10 gig speed links. The LMX-1002G-10G-SFP devices can support the existing link with 1000 Mbps SFPs installed and will run at 1000 Mbps speeds when faster SFPs are placed at both ends of the fiber. The link can be upgraded to 10 Gbps speeds. This makes migrating from a gigabit speed fiber back bone to 10 Gbps possible without changing out all the switches at one time.

Enhanced magnetic encoders

Balluff: Additions to its family of magnetic encoder systems meet IO-Link's smart sensor profile 2.0 specifications, adding four switching signal channels to the process data. Each channel uses IO-Link to program an on and off point for the encoder, allowing measurements to be limited to set ranges or windows.

An enhanced version of the encoder also adds condition monitoring functions to report signal quality and a low signal threshold to alert when maintenance may be needed.

Developed for measuring and positioning applications, Balluff magnetic encoders provide absolute measurement by traveling above a magnetically coded strip that can be up to 8 meters long, with an impressive read distance of 1.3 mm. Using IO-Link, they send digital measurement data to a network. They can also provide an optional analog real time sine-cosine signal for control applications.

Its most important features include a simple connection via IO-Link, Smart Sensor Profile 2.0 support, a read distance of 1.3 mm and an optional analog measurement output.

Multitenancy for cloud application

B&R Automation: Manufacturing OEMs can provide data and results from an Asset Performance Monitor to their customers, opening up new revenue streams. The cloud application also configures itself, regardless of the type and number of connected machines.

Asset Performance Monitor automatically recognizes assigned edge devices and the corresponding machines. The application collects available data via OPC UA. Thanks to OPC UA semantic descriptions and industry-specific standards like PackML and EUROMAP 77, Asset Performance Monitor knows how to prepare the data. Without any configuration, the user can view dashboards, reports and alarm overviews. Even small and midsized OEMs now have access to comprehensive IoT solutions.

B&R has made its Asset Performance Monitor multitenant. With the ability to process data from machines and sell the resulting data back to customers, OEMs can now implement new business models. The machine builder simply makes the corresponding settings in Asset Performance Monitor; no additional hardware or software is required.

The Asset Performance Monitor cloud application collects data such as performance metrics, energy consumption and production rates, and presents it in structured reports and dashboards. This makes it possible to reduce unplanned downtime as well as to detect production bottlenecks. Asset Performance Monitor is based on a flexible IoT platform that enables it to be expanded quickly and easily.

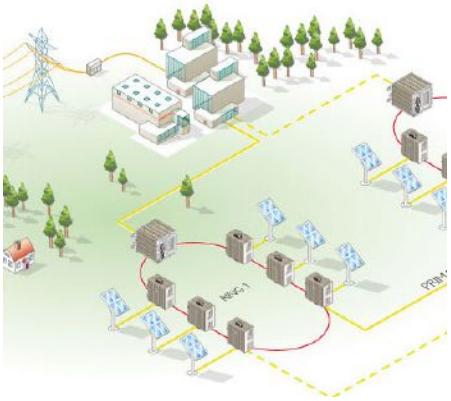
CIP safety absolute encoders

Rockwell Automation: New Allen-Bradley 843ES CIP Safety over EtherNet/IP absolute encoders can meet the needs of safety applications that require speed, direction or position-monitoring functions and, at the same time, help users be more productive.

The encoders are capable of up to, and including, SIL 3/PLe safety applications. The encoders can achieve this performance when used as part of an integrated safety system that includes an Allen-Bradley GuardLogix 5580 controller or Compact GuardLogix 5380 controller.

Users and machine builders can find the right 843ES CIP Safety Encoder for their needs with three configurable resolution options, solid and hollow shafts, and a range of flange options. With both safety and flexibility, the encoders can satisfy needs in a range of industries, including entertainment, material handling, mining and automotive manufacturing.

Edge networking software



Westermo: The release of WeOS 4.28 comes with extended network ring functionality and enhanced cybersecurity.

FRNT version 2 is Westermo's protocol for resilience in switched networks. Contributing to the robustness of the protocol is care when alternative paths are opened to make sure there is full connectivity but never any loops in a network.

With FRNT version 2, the foundation remains and added is the possibility to build more complex LAN structures. An example is a large distribution ring network where subrings can be added extend the LAN. This provides flexibility when building larger LAN structures in terms of distances and number of end devices, while retaining the reliable characteristics of FRNT.

Also new with the release of 4.28 is persistent port monitoring. It is a matter of fact that most attacks against networks today go completely unnoticed. It is very hard, after an attack, to determine that it has occurred and to analyse what has happened. With port monitoring enabled, users can listen to traffic, store it on a fileserver for later analysis, or do real-time surveillance by connecting an intrusion detection system (IDS).

Ethernet and PROFINET switches

Helmholz: New unmanaged Ethernet switches have a width of only 49 mm for the 5 port version, or 65 mm for 8 ports. Due to the compact design, the switches can be used for a variety of industrial applications. The compact design is suitable for installation on the DIN rail and can be easily integrated into networks. A tool-free push-in connection for the power supply supports installation.

One of the most important functions of a PROFINET switch is the prioritizing of PROFINET frames in the machine network. A managed switch can differentiate whether the frame is a web query, an FTP file transmission, a media stream, or a PROFINET frame. In the case of a high transmission load, important frames can be prioritized in order to prevent frame losses. This means the necessity for clear and unambiguous segmentation between Ethernet and PROFINET.

Loop-powered compact transmitter

Endress+Hauser: New two-wire loop-powered compact transmitters represent a new generation that surpasses previous radiometric instruments in terms of safety, compactness and user-friendliness and offers clear customer benefits.

Until now, the components of the detectors required more energy so that the direct connection to a control system (PLC) was not possible. Even conventional 2-wire devices could only be used with an external power

supply due to the separate transmitter system.

The Gammapilot FMG50 uses a unique, patented high-voltage generation and requires only a fraction of the energy of its predecessor to reach the same measurement performance. This offers valuable advantages over conventional 4-wire and 2-wire devices. As additional installations and wiring for a supply voltage are no longer needed, considerable cost savings are achieved over the entire life cycle of the measuring point.

Replacement is quick and easy and thanks to an exchangeable data module, there is no need for reparameterization or recalibration anymore. In addition, diagnostic functions and direct feedback on the device are available in the field.

With the latest generation of Gammapilot, operators communicate with the sensor using Bluetooth technology and the SmartBlue app.

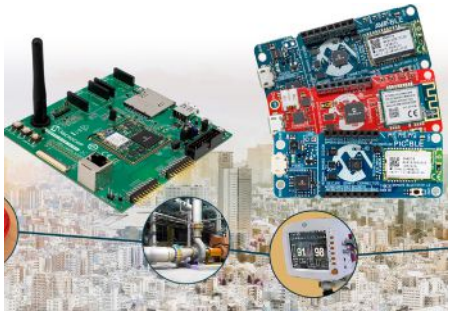
Visualization controller

Siemens: The Smart Infrastructure's compact visualization controller, designed to control standard rooms and complex building management functions in small and medium-sized commercial buildings, is now available with new V4 firmware. The updated IPCC combines more functionalities for customized system integration and installation as well as maximum building and data protection without having to rely on additional software.

Extended security measures, such as encrypted data transmission and presence simulation as well as other functional options such as individual scene settings, have also been implemented. In addition, new interfaces enable the control of SONOS loudspeakers and the Philips HUE lighting system. As part of the GAMMA instabus building control portfolio, a range of products based on the international KNX standard, the new IPCC visualization controller makes it possible to control KNX devices faster and more easily.

It provides intuitive operation and display of KNX systems on a customizable, fully graphical user interface for controlling standard room functions as well as complex building management functions from a central panel, PC or mobile device.

Embedded IoT solutions



Microchip: Developers can quickly, easily and securely connect to any cloud using Wi-Fi, Bluetooth and narrow band 5G technologies.

From small PIC and AVR microcontrollers (MCUs) for sensors and actuator devices, to the most sophisticated 32-bit MCU and microprocessor (MPU) gateway solutions for edge computing, the company is now making it possible for developers to connect to any major core and any major cloud, using Wi-Fi, Bluetooth or narrow band 5G technologies.

Two new PIC and AVR MCU development boards with a companion custom-built rapid prototyping tool developed in collaboration with Amazon Web Services (AWS), can help designers natively connect IoT sensor nodes to the AWS IoT Core service via Wi-Fi.

Smart grid gateways

HMS Networks: Ixxat SG-gateways enable data exchange between IEC61850 or IEC60870-5-104 based energy networks and common fieldbus and Industrial Ethernet systems. New functions include media breaker functionality and support for IEC60870-5-101, DNP3, OPC-UA and MQTT. User management has also been improved and a gateway version with an integrated Ethernet switch is available.

The energy sector is developing quickly, driven by the transformation to renewable energies, electromobility and the move from pure energy consumers to prosumers (producer and consumer). The changes result in high demands on communication within the energy distribution networks. Highly flexible and secure solutions are required to adapt the existing infrastructure to the new conditions, including mitigation of the increasing risk of cyber-attacks.

IIoT connectivity

Belden: New updates to the LioN-Power family offer versatility and cost-effectiveness. In addition to leveraging standardized protocols, new products feature user-friendly integration and configuration tools that eliminate the need for specialized programming skills. This makes it possible to implement predictive maintenance by transmitting diagnostic data of intelligent IO-link sensors and actuators before a failure happens.

Two LioN-Power IO-Link I/O hubs with 10 digital inputs and 6 digital outputs (10DI 6DO) and 16 universal usable inputs and outputs (16DIO). IO-Link devices, IO-Link Masters and I/O Hubs can now be easily connected to process up to 132 I/O signals per system.

This offers an effective way to update from passive to active systems or to collect many digital signals in distributed environments. Moreover, new IO-Link devices are designed to work seamlessly with the TMG IO-Link Device Tool as well as the TE concept tool in the future.

All LioN-Power System components are designed to operate in the harsh and confined environments typical for robotics, machine and material handling, automotive and food/beverage manufacturing, transportation and other industrial sectors.

Work out and exercise during coronavirus isolation

As the coronavirus continues to spread worldwide, people hesitate to go to the gym where they share equipment, locker rooms, and towels. But avoiding gym germs doesn't mean that you have to stop exercising. High-tech equipment allows you to work out from the comfort of your home.

TO TELL THE TRUTH, there are plenty of low-cost and no-cost options if you want to work out at home. You can do burpees, squats or lunges, and you can turn a broomstick with two jugs of water into a homemade barbell.

But you can also use the coronavirus as an excuse to get yourself the latest and fanciest fitness equipment. Here are some suggestions.

PHOTO: AMAZFIT

Peloton bike

Peloton was launched in 2012 to bring immersive and challenging workouts into people's lives in an accessible and efficient way. The Peloton bike promises to bring the community and excitement of boutique fitness into the home.

Essentially, it is a spin bike with a carbon and and aluminum frame and a weighted flywheel in the front. Weighing in at 135 pounds, it's a pretty solid construction. Affixed to the front of the bike is a 22-inch touchscreen with a camera, microphone and speakers. The display shows your stats like cadence, resistance, output, overall exertion level, and heart rate.

More importantly, it also enables you to participate in training classes that are streamed from Peloton's New York City studio. There are five live classes every day and you can view over 5,000 classes on-demand. These classes vary in terms of instructor, intensity, length, style, or music. We understand that it is not uncommon for several hundred people to be participating in a class at the same time.

Relative achievements of the participants are shown on a leaderboard on the display. This brings a competitive element to home work outs. On a normal stationary bike you pedal along lonely, while on the Peloton you are competing against other riders.

This means you have people to motivate you to go longer or sprint faster. A study published in the Journal of Social Sciences found that participants gravitate to the exercise behaviors of the people around them. So, working out with a group of ambitious, like-minded people makes it more likely to take advantage of your time on the bike.

www.onepeloton.com

PHOTO: PELOTON

Amazfit HomeStudio

The Amazfit HomeStudio takes a similar approach. You train at home, but you are not alone as you can join virtual classes.

The system's three major components are a 43-inch HD screen that acts as a smart mirror, a sound system with JBL surround-sound speakers, and a treadmill, which can reach speeds of up to 12mph. The belt is comprised of 55 rubber-coated aluminum slats, designed to provide a balance of comfort and support. For hill training, the belt can be set to an incline of up to seven degrees.

The smart mirror display includes a 3D time-of-flight camera. The Amazfit computer uses the camera images to analyze your posture and technique.

To join a training class, the smart mirror connects to an online library via Internet. There are currently 1,000 classes across a wide variety of exercises. These go beyond treadmill work outs and also include yoga, sculpt and stretching. The side rails of the treadmill are strong enough to serve as a bodyweight training barre.

amazfit.com

Mirror

If you like the idea of interactive work outs but don't want your living room to look like a gym, you may want to take a look at Mirror. Mirror is like Amazfit without the treadmill.

PHOTO: CURIOUSER PRODUCTS

The life size 40-inch full HD 1080p display with 178° wide viewing angle is mounted in a carbon steel frame, and indeed looks like a normal wall mirror when not in use. Under the shiny surface sits a Quad core processor, dual-band Wi-Fi, 2 x 10 watt stereo speakers, an omnidirectional microphone, and a 5 megapixel front-facing camera.

Dual-band 802.11 A/B/G/N Wi-Fi connects the Mirror to the Internet so you can attend one of more than 70 weekly live classes. Here you can join other Mirror members and get expert instruction and live feedback from certified instructors. You can also access a library of 10,000 on-demand classes or schedule one-on-one training sessions with a personal trainer.

The classes cover around 20 different genres from pilates and yoga to kickboxing and weight training.

www.mirror.co

Hydrow

PHOTO: HYDROW

Running, cycling or stretching are all fine, but maybe you are looking for a somewhat more exclusive work out?

There are no indoor polo or equestrian simulators on the market yet, but rowing is typically considered a rather elitist sport. The Hydrow rower promises an immersive experience that lets you feel the river and the power of a team.

You can imagine yourself as part of the Oxford or Cambridge crews competing in the legendary Boat Race on the river Thames, without leaving the comfort of your home. That home should be spacious, because at 86 x 25 x 4 inches the Hydrow is not exactly a compact machine.

A 10-roller system seat is mounted on a sleek aluminum frame. An industrial-grade webbed strap is connected to a computer-controlled electromagnetic drag mechanism. The structure is topped by a 22-inch HD touchscreen with front-facing speakers that project instructions, music, and the sound of every stroke, wave and splash.

There is a "just row" mode where you'll get a view of the water without any instruction, and there are hundreds of prerecorded workouts. The trainers are expert rowers, including Olympian Aquil Abdullah or US National team member Grace Luczak.

The live and on-demand rows are all filmed out on the open water. So while you may be sweating inside your apartment on a cold winter evening, at least the instructors had a beautiful day out on the water.

hydrow.com

Leopold Ploner

PHOTO: HYDROW

Service

industrial ethernet book

Reader Service Card

IEB issue 117 - April 2020

IMPORTANT: You must update your subscription annually to continue receiving your free copy of Industrial Ethernet Book magazine.

Return by mail to:
IEB Media
Bahnhofstr. 12
86938 Schondorf
Germany

Or use our online reader service at:
www.iebmedia.com/service

Please enter your contact details below:

Name: _____
Position: _____
Company: _____
Address: _____
_____
City: _____
State: _____
Zip Code: _____
Country: _____
Phone: _____
Email: _____

I want to:

☐ **Start** a new subscription
☐ **Update** my subscription
☐ **Digital** edition or ☐ **Print** edition
☐ **Change** my address
☐ **I do not want** to receive promotional emails from Industrial Ethernet Book
☐ I want to be **removed** from the subscription list

Signature: _____

Date: _____

Company Activity (select one)

☐ Aerospace/Defence
☐ Electronics Industrial/Consumer
☐ Instrumentation/Measurement/Control
☐ Manufacturing Automation
☐ Metal Processing
☐ Mining/Construction
☐ Oil & Gas/Chemical Industry
☐ Packaging/Textiles/Plastics
☐ Pharmaceutical/Medical/Food & Drink
☐ Power Generation/Water/Utilities
☐ Research/Scientific/Education
☐ System Integration/Design/Engineering
☐ Telecomms/Datacomms
☐ Transport/Automotive
☐ Other: _____

Job Activity (select one)

☐ Engineer - Instrumentation & Control
☐ Engineer - Works/Plant/Process/Test
☐ Engineer - Research/Development
☐ Designer - Systems/Hardware/Software
☐ Manager - Technical
☐ Manager - Commercial or Financial
☐ Manager - Plant & Process/Quality
☐ Scientific/Education/Market research
☐ Other: _____

IEB Media reserves the right to refuse an application for a free copy of Industrial Ethernet Book or the provision of information on any of the advertisers or articles