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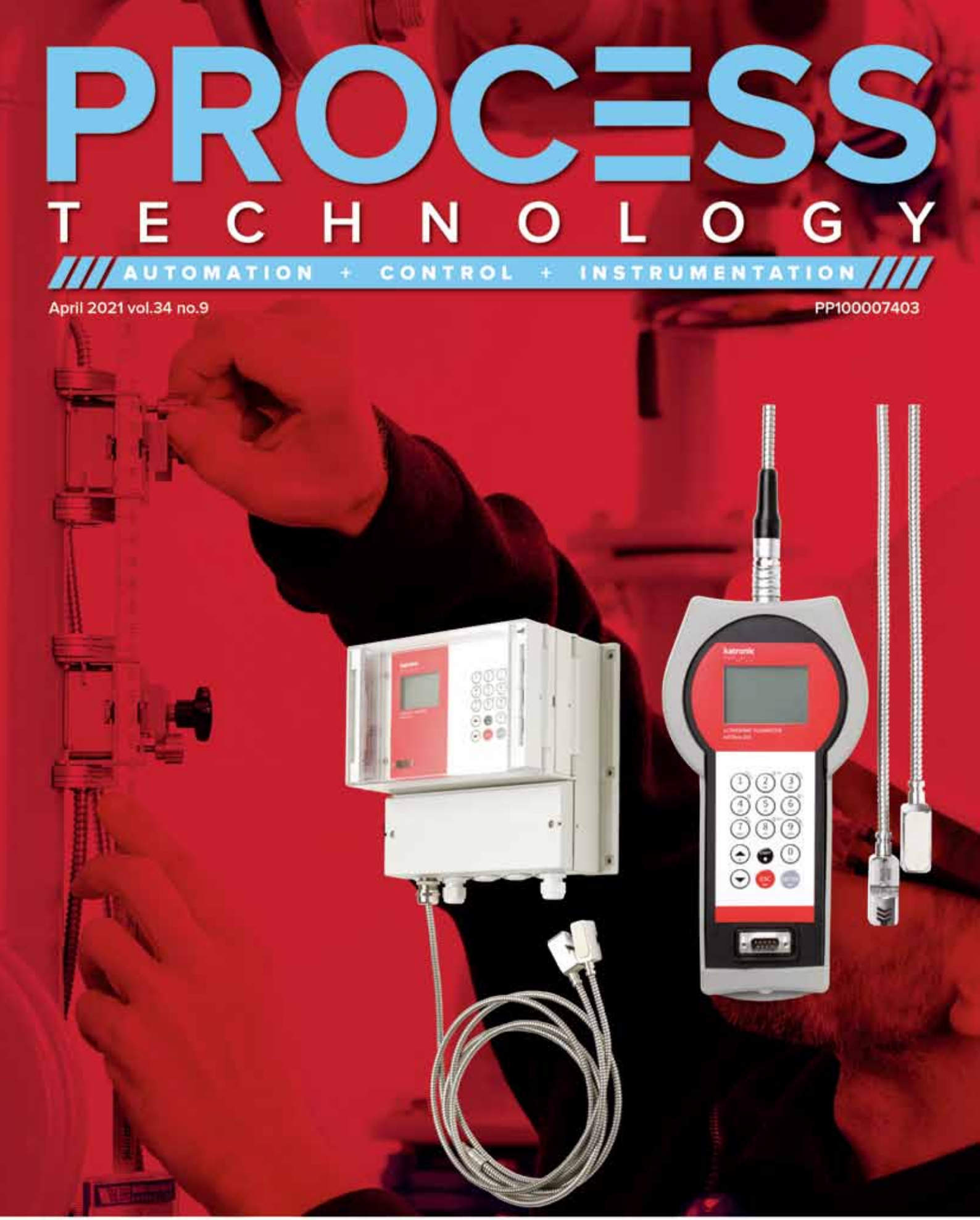

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ON THE COVER

Katronic has been providing reliable flow measurements to satisfied customers since 1996. The company's reputation has been built on offering accurate and intuitive clamp-on flow meters supported by market-leading customer service and technical support.

Katronic was established in the UK in 1996 as a distributor of process measurement instrumentation with a focus on ultrasonic technologies. Since then the company has evolved into being a highly-regarded manufacturer of its own brand of clamp-on flowmeters and works tirelessly to maintain an excellent reputation for quality products and market-leading customer service.

Katronic's commitment is shown in their mission statement:

"To provide innovative products and services that staff can be proud of and customers can trust. To foster relationships with customers, suppliers and colleagues that add benefit to all parties. To offer levels of support and flexibility that exceed those of our competitors."

The company believes that by adhering to its key values and by working hard it can ensure that the future of Katronic is a bright one. The company will be fostering new global partnerships to expand the sale of the flowmeters into new countries and industrial sectors. It will also be working to develop and release new products to add to the KATflow range and work tirelessly to make sure that Katronic's customers' experiences of working with Katronic are positive and fruitful, thus fostering a trusted relationship.

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DIGITISATION, DIGITALISATION AND DIGITAL TRANSFORMATION

WHAT DOES IT ALL MEAN?

Chris Hoey, Bürkert Fluid Control Systems

Digitisation, digitalisation and digital transformation represent three aspects of the application of digital technology in industrial businesses.

Early in any innovation wave, there tends to be a lot of hype and even more buzzwords. This leads to wild interpretations and claims with growing confusion in the market. That said, as this technology has not passed the maturity curve, there remains debate on definitions between institutions, vendors and even countries. Definitions for digitisation and digitalisation we can take directly from the Gartner IT Glossary[1], whereas digital transformation is more subjective, therefore, I offer my own perspective.

- **Digitisation** is the process of changing from analog to digital form, also known as digital enablement. Said another way, digitisation takes an analog process and changes it to a digital form without any different-in-kind changes to the process itself.
- **Digitalisation** is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.
- **Digital transformation** is understood as the transition stage between digitisation and digitalisation; however, it offers much more than that. It is where digital data and processes are combined and new models can be created that can substantially change the entire business.

A non-automation example

There was a time when music media was distributed on vinyl disks through bricks-and-mortar retail stores. We saw advancement into cassette tapes and eventually compact discs; however, you could say it was still a traditional model. It was not until music was widely available in mp3 format that you could say that the process was now digitised.

The 'big A company' then applied this digitised media to their business processes and was able to develop an end-to-end digital system that included marketing, purchasing, payment and delivery of media — then they even supplied the hardware to enjoy it. You could call this a fully digitalised system. It created value not just for the company, but also for its customers via flexibility and ease of use.

The digital transformation, however, is when other companies were able to analyse this process along with new developments, and design new business models that transformed not only their own companies, but also disrupted the entire industry. This, of course, was on-demand music streaming. While still an end-to-end digitalised system, the real value was created in the transformation.

Going back to process control...

Effectively digitisation took place way back in the 1980s, when PLC or DCS systems were implemented. However, like the example above, the traditional signals were converted from analog to digital, and after processing, returned back to analog for the final control element. We saved on individual controllers or relay logic and we were now able to collect and log data in our SCADA systems and even generate reports.

Over the next 35 years or so, not a lot changed. The controllers became more powerful, networks developed that saved cabling and installation time and some devices could even be set up in a digital manner. But under the surface, we were still performing digital control on converted analog signals. To explain this in more detail, let us create a small example that you would find in most processes.

Figure 1 shows the automation of a single heat exchanger including a temperature sensor, a modulating steam valve and a shutoff valve with feedback. These are connected to a modern PLC and SCADA system.

As you can see in this example, the field equipment is individually wired via 4-20 mA or 24 VDC signals to a distributed control panel that isolates and converts these signals into a network for the PLC. This example is not one from our history books; it still represents around 70% of today's installations. That said, it is a major advancement on the original centralised systems of previous years with their multi-core cables and massive panels.

To bring this 'digitised' system to a fully 'digitalised' system, we start with digital field equipment that no longer needs signal conversion, and we connect via a single distributed Ethernet cable right back to the PLC. This is shown in Figure 2.

As is clearly visible, the wiring complexity is drastically simplified and there is no distributed I/O panel required at all. The entire system can be wired without any terminations at all or even the need for a screwdriver. The time and investment to design, build, install and commission this

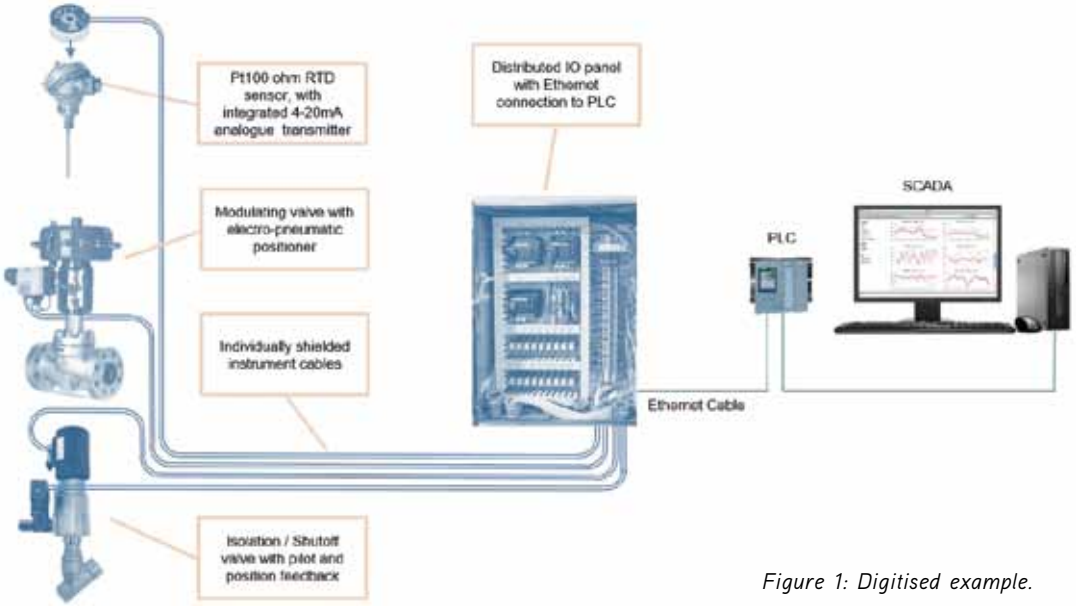

Figure 1: Digitised example.

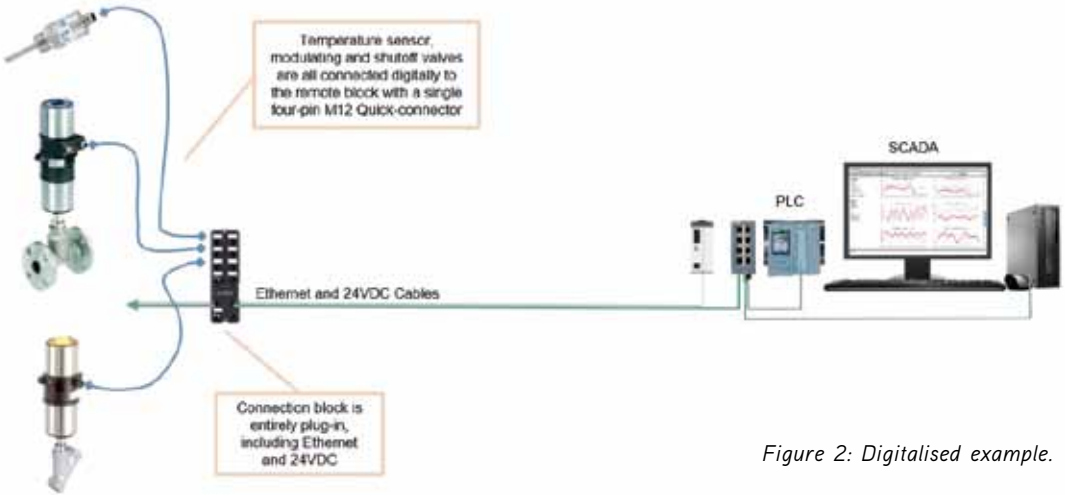

Figure 2: Digitalised example.

system is drastically less. The additional cost of the smart field equipment is more than covered in the total cost savings, and they deliver higher accuracy and responsiveness overall. Reverting to our digitalisation definition, value is created through design simplicity and increased accuracy, as well as the savings in installation and running cost.

While the above example is a strong enough argument on its own to generate a change in the industry, we are yet to consider the 'transformation' part. A fully digitalised installation offers a lot more than just upfront cost savings.

The new wave of digital field equipment is also compliant with the latest demands of Industry 4.0 or IIoT.

As well as the process signals needed for control (cyclic data), they offer bidirectional device management information (acyclic data) including asset management and advanced diagnostics (see Figure 3). This data seamlessly integrates into your control system, engineering workstation or even directly to cloud-based systems.

System capabilities

Continuing with the above application example, let us consider just the shutoff valve. In the original system, we would know what signal we were sending it and thanks to integrated feedback loops, we would know whether it is open or closed. If we send it a signal and it doesn't transition in the allotted time, we generate an alarm. At this point the operator jumps into action and a service engineer is notified to rectify the fault. Around 30% of a service engineer's time will go into nothing more than collecting information — what type of valve, what is wrong with it, who made it, how old it is, when it was last checked, plus other diagnostic data.

Consider now a digitally connected valve which has been included in a diagnostic page in the site SCADA system. Immediately the service engineer can see the valve number and type, he can see the voltage supply as well as temperature, the stroke length, cycle time and number of operations performed. He can also see how long the valve has been installed and how many operations it has performed. In addition, if replacements are required, he has the ID number, hardware and software versions at hand.

But that is only after the failure event. As you can see in Figure 4, tolerances can be set on a number of operating parameters

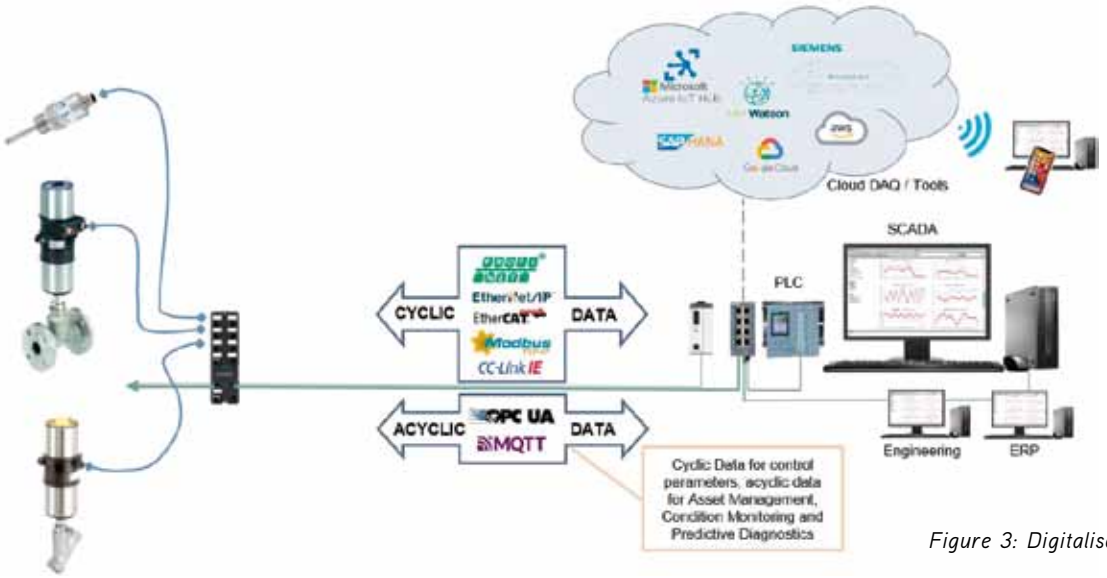

Figure 3: Digitalised connectivity.

that will enable a notification prior to a failure. Perhaps the voltage is low due to added load, or a kinked air tube causes a longer operation time. Such warnings can help avoid process downtime happening in the first place.

The next level is that all the process and diagnostic data is uploaded to a cloud server. From there AI algorithms can be implemented that will analyse the data and report by exception on any change in the operational status in your plant. In other words, it would determine valve opening time post signal and if this did not happen, it would alert you with that detail. Therefore, you could have very powerful diagnostic tools overseeing the operation of your plant, without the need for programming. An example of this is a current feature in the latest Apple watch, which will, without any pre-programming, dial an ambulance and provide your location data should you suffer a significant fall or impact.

Eventually the market will move towards digital twins or cyber-physical systems. In these systems you will have complete status and diagnostic information on components and even complete systems constantly available in the cloud — like Facebook for hardware. From there you will be able to do analysis without even being onsite.

Is this digital transformation?

Technically, only you can answer this question, as it relates particularly to your own business and the daily operational issues that are relevant to you. Perhaps you have 2000 such valves and sensors onsite; perhaps you have limited service personnel; perhaps you are operating this site from 3000 km away; perhaps you are manufacturing a highly expensive or toxic ingredient and cannot afford failure. The digitalised system simply delivers a set of tools along with advanced capabilities; it is really up to you how these tools are used to solve your particular business challenges.

Imagine a dairy that is suffering issues with final product contamination. This may be happening due to a random set of circumstances, a deep programming bug, a working but incorrectly specified product or something as simple as water hammer. If the contamination is high, huge amounts of final product are wasted as well as downtime for CIP cleaning and the like. In the worst case the contamination is not detected and this leads to a product recall that can cost many millions of dollars and loss of brand trust. The 'digitalised' dairy could set up a small diagnostic tool to monitor all the relevant variables, process pressure, valve parameters including seat position in 0.01 mm increments, relevant pumps, pipe vibration analysis, etc. While this does not sound too difficult, consider the process may have a vast number of valves, pumps and sensors, and the need for cyclic and acyclic data. Thanks to the digitalised plant, this could be performed online, in parallel to normal plant operation, with analysis done in a diagnostic terminal, edge controller or even the cloud.

Is it for my business?

For many the hype has served to confuse the market and potentially delay implementation. In my mind, it is a stepped process or transformation journey, and let's face it, when we approach a set of stairs, we do not start our ascent at the top stair. It all starts with getting the backbone in place and generating the data that you will use. Therefore, it must start in the field, as without the right interface to the process, no PLC, edge or cloud system will deliver meaningful results. Having these digitally connected devices installed is the first step; you can then take your time to plan your next. The cost savings that are evident in this first step serve as a great incentive to get you on our way.

Good luck with your digital transformation.

**Chris Hoey is the Managing Director for Bürkert Australia and Regional Coach of Asia-Pacific. While holding a diverse international management portfolio, Chris remains hands-on and strives to be part of developing applications of new technologies to meet current and future challenges. With over 30 years of experience, his enthusiasm for industry evolution and solution development is second to none and is a key influence within the business in seeking new modernisms and efficient processes for Bürkert customers.*

Reference

1. Gartner IT Glossary, ‹‹https://www.gartner.com/en/information-technology/glossary››, accessed 22/02/2021

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NEW PRODUCTS

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The AZM40 by Schmersal is said to be the smallest electronic solenoid interlock in the world with dimensions of 119.5 x 40 x 20 mm. It is designed to be suitable for small safety doors and flaps that do not close at 90° or those that open upwards to a 45° angle, due to its 180° flexible actuator.

Despite its compact size, the AZM40 has a 2 kN interlocking force, in addition to its integrated RFID technology for increased tamper protection. Even in the event of a power failure, the AZM40 retains its current position to ensure safe operation whatever the status of the machine, and remains safely locked. Another advantage of the bistable principle is the consistently low energy consumption, as the interlock only requires power when the door is to be locked or unlocked. It features optimised symmetrical mounting on 40 mm profiles that can be bolted on either side, with LEDs visible from three sides.

For applications with personnel protection (interlock monitored), the safety outputs area switched on when the safety door is closed and the interlock locked. The AZMB40B model (actuator monitored) can be used for applications with process protection. In this variant, the safety outputs are actuated as soon as the safety door is closed.

Control Logic Pty Ltd
www.controllogic.com.au

HAZARDOUS AREA PRESSURE SWITCH/GAUGE

The Dwyer Series AT-3000MR/MRS ATEX/IECEx approved Photohelic switch/gauge incorporates a flameproof aluminium enclosure with texture epoxy coating that protects the device for use in hazardous areas commonly found in process or industrial applications.

The switch/gauge is designed for monitoring pressure, vacuum and differential pressure. Solid-state switches allow for switching in high cycle rate applications while extending the life of the sensor. These instruments can be installed in various process or HVAC applications globally because of the numerous pressure ranges and units available.

Well suited for industrial applications, the Series AT-3000MR/MRS also features a standard windowed enclosure cover that allows users the ability to visually verify changes in the process. Easy-to-adjust setpoint indicators are controlled by knobs located on the gauge face, accessible by opening the case after de-energising the instrument.

Dwyer Instruments (Aust) Pty Ltd
www.dwyer-inst.com.au

PRESET FLUID REGULATOR

In applications where health standards are rigorous, the use of lead-free materials is an increasing priority. The Protect-Air EcoReg preset fluid regulator is made of the synthetic material Grivory GV-5 FWA and high-quality stainless steel, making it suitable for applications in areas such as drinking water, the food industry and medical industry. Grivory GV-5 FWA conforms to the DIN 50930-6 / FDA/EU drinking water directives and is FDA certified.

Drinking water is considered the most vital element for life next to air/oxygen. Since there is no alternative to this finite resource, protecting and securing the standard and quality of drinking water is a top priority for engineers, planners and technicians as well as system operators.

The EcoReg fluid regulator is an independent diaphragm pressure regulator that can be installed in all fluid systems. It ensures a constant and precise output pressure independent from the input pressure. The pressure value is factory set and cannot be changed, ensuring that no-one can manipulate the specified pressure.

Particularly important for liquid dosing machinery, the EcoReg inline fluid regulator can protect all downstream installations, devices and components by ensuring the correct operating pressure and preventing expensive loss of production.

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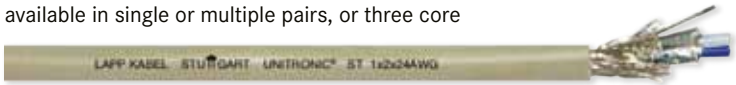

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The Pepperl+Fuchs Bebco EPS 7500 Series purge and pressurisation system is a solution that enables conventional electrical equipment to be used in hazardous areas. Devices that require protection are installed in an enclosure with a pressure that is higher than that of the surrounding hazardous atmosphere. It is designed for use in Class I and II/Div. 2 and Zone 2/22 hazardous locations, and comes with NEC, CEC, ATEX and IECEx third-party certifications.

The 7500 series uses a universal AC/DC power supply and is available for panel mounting and external mounting. The large multi-feature touch display provides clear status information to monitor conditions in the compact housing and allows quick adjustments to any situation.

The Bebco EPS 7500 Series is designed to be easy to operate and with its automatic and manual mode it offers a high level of protection for electrical equipment in the oil and gas or offshore industries.

Pepperl+Fuchs (Aust) Pty Ltd
www.pepperl-fuchs.com

PANEL PC

Interworld Electronics has released the Aplex ARCHMI-932AP rugged industrial all-in-one HMI computer that is housed in a fanless aluminium case providing IP-66 front panel protection.

The ARCHMI-932AP is supplied with an internal 32″ 1920x1080 resolution LCD with a projected capacitive touch screen making it suitable for HMI control and display applications.

The ARCHMI-932AP supports Intel 6th Gen Core i3/i5 processors with 16 GB of DDR4 2133 MHz memory. An easily accessible 2.5″ hard drive bay is provided for operating system and data storage. Rear I/O connections include two COM ports, two USB 3.0 type A ports, two Gigabit Ethernet ports and audio out. Optional I/O expansion boards can be installed to further extend the ARCHMI-932AP functionality.

Requiring a 9–36 VDC power source, the ARCHMI-932AP can operate in temperatures ranging from 0–50°C. It can be panel or VESA 200x200 mounted, allowing the panel PC to be ergonomically positioned for operator convenience.

For applications requiring a smaller screen sizes, the ARCHMI-9xxA Series is available with a 12.1″, 15″, 17″ and 19″ 3:4 ratio LCD screens and 15.6″, 18.5″ and 21.5″ 16:9 ratio Full HD LCD screens.

Interworld Electronics and Computer Industries
www.ieci.com.au

INDUSTRIAL 5G ROUTER STARTER KIT

HMS Networks has released what it says is the first commercially available industrial 5G router optimised for industrial private networks. The Wireless Router 5G supports Ericsson Industry Connect 5G networks and allows users to get started with 5G in their own location. HMS also offers a ready-made starter kit for test and evaluation of typical industrial use cases.

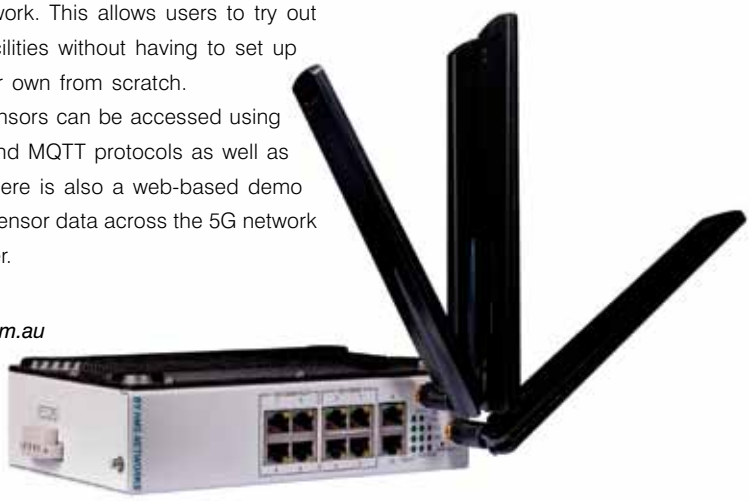
The Wireless Router 5G has been developed by HMS Networks' technology initiative HMS Labs and allows early adopters of 5G to try out the technology.

With 5G in a factory, users benefit from a wireless network that is fit for industrial demands in terms of communication speeds and security, along with the flexibility that comes with wireless.

The Wireless Router 5G has been tested with the Ericsson Industry Connect 5G solution in standalone operation using band n78. It enables users to create a robust cellular connection in an industrial production environment. Supporting 4G and 5G cellular technology, it is a suitable communication solution for automated guided vehicles and other industrial machines.

The starter kit includes the Wireless Router 5G and two industrial IO-Link sensors sending data across the 5G network. This allows users to try out 5G in their own facilities without having to set up applications of their own from scratch.

Data from the sensors can be accessed using the Modbus TCP and MQTT protocols as well as in JSON format. There is also a web-based demo ready to show the sensor data across the 5G network in a regular browser.



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FLUID CONTROL SYSTEMS

FLOW COMPUTER FOR CUSTODY TRANSFER

Accurate measurement is crucial to custody transfer. Minor errors can potentially create high financial impact, but precision can be hard to maintain when operating in harsh field conditions. The ABB Flow-X gas and liquid flow computer has been improved to meet the Class 1 Division 2 and ATEX/IECEx Zone 2 certification, which extends operating temperature range from -40 to +75°C and 5% to 95% humidity.

Its analog inputs provide an accuracy of 0.008% and make the Flow-X series a high-accuracy flow computer for hazardous areas that complies with the stringent standards for custody transfer and legal metrology for the control room and the field.

Flow-X is also a useful automation platform used for measurement and control of gas and liquid pipelines, LACT units and truck and rail loading and offloading systems. Its complete control functionality eliminates the need for any programming, an additional PLC or a sampler controller. Besides the typical proving, batching and PID control functions, Flow-X also provides configurable valve, sampler, LACT and liquid (un)loading control. It doesn't require additional purging, Ex enclosures or junction boxes.

Rigorously tested for immunity for radiated and conducted electromechanical disturbances, it also incorporates role-based access control and secure communication to prevent unauthorised access and data tampering.

A multilingual user interface provides a guided set-up and configuration of the flow metering system. Its traceability is fully compliant with API MPMS Chapters 21.1 and 21.2, including as-found/as-left verifications.

ABB Australia Pty Ltd
www.abbaustralia.com.au

LASER LEVEL TRANSMITTERS

Hawk Measurement Systems has released the OptioLaser L100 and L200 laser level transmitters. They are suitable for level, distance and position measurement of solid and liquid surfaces. What makes these lasers different is the very narrow beam that can measure long and short distances at virtually any angle. The OptioLaser L100/L200 is completely stainless steel and rugged for use in harsh environments.

The OptioLaser sensors can measure anything from a flat metal plate on the side of any overhead crane, to the top of material stored in a silo. They are useful for long- and short-range applications where the unit needs to see through a narrow opening or tube. These sensors are already being used in areas such as blocked chute detection, materials handling, positioning, plastic pellet silos, conveyor belt edge control, ore pass levels and bin levels.

The OptioLaser L100/L200 laser level transmitters are fully programmable and include simple-to-use software. They can be configured for either distance or level measurement and are a suitable solution for a wide range of industrial applications such as plastics, mining, aggregates, water and wastewater, oil and gas, pulp and paper, pharma, food and beverages, and chemicals and petrochemicals.

Hawk Measurement Systems Pty Ltd
www.hawkmeasure.com

IP67 HMIs

Turck's TXF700 series now offers a HMI range with complete all-round IP67 protection for use at temperatures between -20 and +55°C. With its high degree of protection, this HMI platform allows for flexible and slim mounting since, unlike previous solutions, it no longer requires installation inside protective housings or control cabinets.

The high brightness TFT displays are protected by a glass front and feature a capacitive touch screen supporting multi-touch capability and gesture control. This enables the latest operating concepts from the world of smartphones and tablets to be brought into the rugged environments of industrial automation. The TXF700 HMIs are available in display sizes from 5″ to 21.5″ and with a resolution of up to 1920x1080 pixels.

The TXF700 can be used in simple visualisation applications but also, if required, as an IIoT gateway or edge controller with Turck's TX VisuPro. Besides the conventional HMI protocols for connecting to controllers, TX VisuPro also supports MQTT or OPC-UA as server and client. The TXF700 HMIs can communicate simultaneously with up to eight protocols. This gateway function therefore also enables data to be exchanged between different controllers or terminal devices.

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Beamex MC6-T

New revolutionary temperature calibrator

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The Beamex MC6-T is an extremely versatile portable automated temperature calibration system. It combines a state-of-the-art temperature dry-block with Beamex MC6 multifunction process calibrator and communicator technology.

With the ability to generate temperature as well as measure and simulate temperature and electrical signals, it offers a really unique combination of functionality. In addition to temperature calibration abilities, the MC6-T also offers electrical and pressure calibration capability, all in one device.

It offers versatility, that no other temperature calibrator can match.

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INDUSTRIAL NETWORK INFRASTRUCTURE

YOUR FUTURE BUSINESS FOUNDATION — PART 2

Taking advantage of performance enhancements from new technologies

In Part 1 of this article the various aspects of migrating to, and managing, an industrial Ethernet infrastructure were discussed. And like any other critical business and plant infrastructure, it is important to look forward to emerging technologies in order to prepare for future technologies that may further enhance performace, reliability and productivity.

Network planning next two years

Networks continue to evolve over time. Plotting the evolutionary path for the business network requires insight into future trends and possibilities. This section offers insight via identification and discussion of important technologies. The time domain for these technologies is within the next two years.

Power over Ethernet

Power over Ethernet (PoE) is an Ethernet-compatible technology created to enable Voice over IP (VoIP) telephony. DC power, at a nominal voltage of 48 VDC, is carried on one or more pairs in the Ethernet cable along with the transmitted signal. PoE-powered devices (PD) negotiate with the power source (typically a network switch) to ensure appropriate power is delivered. Businesses soon realised the potential of network supplied power. PoE now powers IP cameras, wireless access points, badge readers and access gateways, and office lighting (Figure 1).

Today, PoE in industrial networks performs identical tasks to those it performs in enterprise networks today. These tasks include powering shop floor phones, wireless access points and IP cameras. PoE holds a bright future as the standards community expands its capabilities.

PoE is a key technology for the future of industrial networks because, with the advent of IEEE 802.3bt, conspicuous amounts of power can be delivered along the Ethernet connection to a device. With 71 W available at the end of an Ethernet cable, device manufacturers can be very creative. This 'one wire ideal' allows device power and communications in a single connection, simplifying all phases of the device lifecycle. In doing so, PoE alters the DC power infrastructure of control systems.

Legacy protocols are serial communications to the device at a very modest data rate. No device power is delivered by the connection. Therefore, local DC power supplies are required near the device to meet its power requirements. Behind the DC power supply are many AC components (eg, transformer, connection wires, circuit protection, etc) to convert machine mains power to a usable input

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to the DC power supply. When this supporting infrastructure can be eliminated, control system DC power infrastructure is simplified and costs become lower.

PoE negotiates with the device at start-up to determine the appropriate power level to deliver. There is no need for preconfiguration of each circuit in a standards-compliant installation. Additionally, since device power is controlled by PoE-enabled ports in the switch above it, toggling device power can be done via network switch commands, simplifying service procedures.

PoE should figure prominently in new network installation to simplify powering needed by devices like cameras and wireless access points. The transformative effect on the DC power infrastructure, while quite feasible, is going to take longer to become a reality.

Single pair Ethernet

Work is underway in IEEE 802.3 to create standards for Single pair Ethernet (SPE). Many variants are proposed from short reach (15 to 40 m at 1 Gbps transmission speed) to extreme lengths (up to a kilometre at 10 Mbps transmission speed), all over a shielded twisted pair cable. For industrial network applications, the variant to watch is IEEE 802.3cg, the 1 km at 10 Mbps variant. All variants of SPE are considering a methodology for power delivery like PoE called Power over Data Line (PoDL), IEEE P802.3bu.

Single pair Ethernet drives 'Ethernet-to-the-edge' and is a vital portion of legacy protocol migration plans. For 802.3cg, its 10 Mbps transmission speed provides more than enough bandwidth for end device and sensor data rates. For industrial networks:

- The reach objective of up to 1 km is ideal for plants with a large footprint, (eg, oil and gas, petrochemical, etc).
- Power delivery via the Ethernet connection achieves the aforementioned 'one wire ideal' where device power and communications are enabled by a single connection.
- SPE, being standard, unmodified Ethernet, supports purpose-built Ethernet forms like EtherNet/IP and Profinet without issue.
- Conductor wire gauge for SPE will need to be at least 18 AWG to achieve the 1 km reach objective; a latent benefit of this cable construction is the ability to drive higher current levels than 4-pair cable, making LED lighting installations more effective.
- SPE media should be easily field terminable; this aspect can reduce pre-terminated cordset inventories and address slack management issues.

Single pair Ethernet will rise to prominence by taking Ethernet to the edge of industrial networks. Device manufacturers and network switch manufacturers are closely monitoring and contributing to the creation of IEEE standards that enable this future concept.

Power over Data Line

Power over Data Line (PoDL) is governed by IEEE standard 802.3bu. The PoDL acronym is frequently pronounced "poodle" in conversation. It represents a necessary adaptation of PoE. A reasonable question is "why can't we just use PoE on SPE?" The reason is PoE requires at least two pairs to work. This is because there is an electrical connection between pair centre taps (Figure 2a).

Since SPE has only one pair, the PoE circuit (above) does not work. However, a simpler circuit with a lowpass/highpass band splitting filter network works with SPE (Figure 2b).

Using PoDL Class 8 and Class 9, PD power can be 30 W or 50 W respectively at 100 m. New classes are required to accom-

Property	PoE IEEE 802.3af	PoE+ IEEE 802.3at	4PPoE IEEE 802.3bt	PoE++ IEEE 802.3bt
PSE Power	15.4 W	30.0 W	60 W	100 W
PD Power	12.95 W	25.5 W	51 W	71 W
Power Management	Power class levels, negotiated at initial connection or 0.1W steps negotiated continuously			

Table 1: Power over Ethernet power levels.

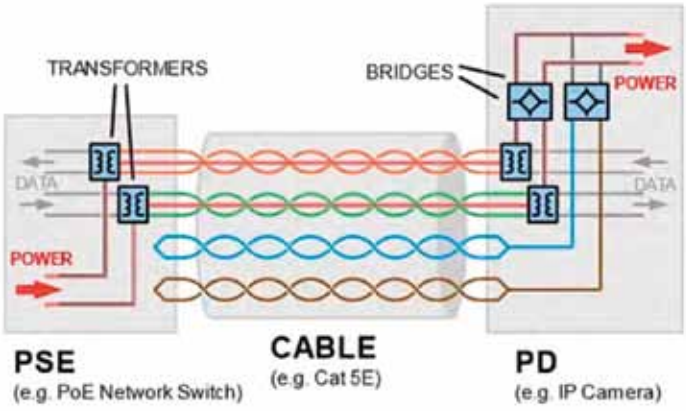

Figure 1: PoE general layout.

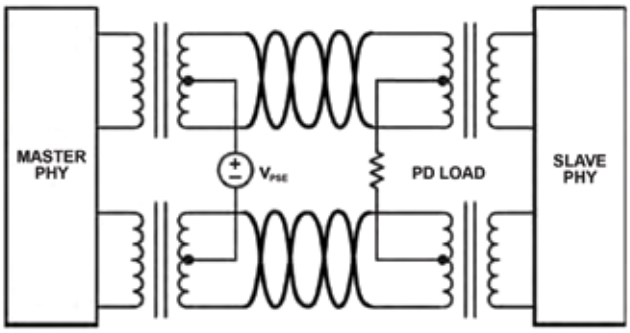

Figure 2a: Example circuits for PoE

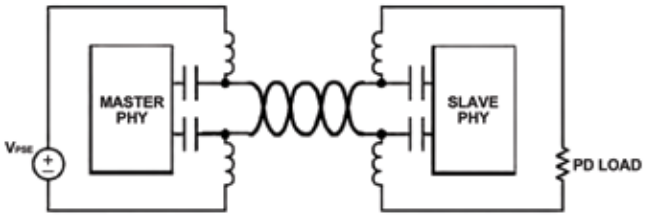

Figure 2b: Example circuits for PoDL.

modate the expected higher loop resistance of 1000 m links seen in 802.3cg.

PoDL and SPE go hand in hand as technologies to watch and include in legacy protocol migration plans.

Wireless sensor networks

Wireless sensor networks are gaining popularity as businesses seek solutions that improve decision speed and quality. Wireless networks can be implemented quickly, speeding the availability of additional knowledge to achieve these goals.

Speed and reliability, however, are not yet at the same level as wired connections. Critical control connections will remain wired for the foreseeable future. Nevertheless, wireless connections provide a fast and cost-effective means to collect additional data to propel analytics efforts, study new facets of an existing process, etc.

There are many wireless sensor networks worthy of consideration but two stand out for industrial applications. These are:

- Wireless Mesh
- LPWAN

Most wireless mesh networks used for wireless sensor applications are based on IEEE 802.15.4. This is the technical standard which defines the operation of low-rate wireless personal area networks (LR-WPANs). Wireless mesh networks have a unique feature that make them a provocative choice for industrial data collection; they are self-healing. If a wireless sensing node is blocked from communicating directly with the sensor gateway, it will 'hop' to an adjacent node to get back to the gateway. This feature is superb for industrial applications given the dynamic environment with material handling equipment and other large metallic structures often in motion. For example, the chances of a forklift mast blocking transmission at some point in the day is easily an even odds bet.

Low-power wide-area network (LPWAN) is another technology worthy of note for industrial applications. LPWAN protocols are well suited for use in industrial settings. These networks are nominally 900 MHz, a frequency range that performs well in highly metallic environments.

LoRaWAN is intended for wireless battery-operated nodes in a regional, national or global network. It targets key requirements needed for the Internet of Things (IoT) like low data rate, low cost and long battery life while delivering vital features such as secure bidirectional communication, location and mobility services.

End devices using LoRaWAN can choose from three device classes, allowing different device behaviour depending upon optimisation needs:

- Class A — battery-powered node. Class A operation optimises communications to conserve battery power at the node.
- Class B — low latency needed. Class B devices open extra receive windows at scheduled times to optimise communications but with shorter battery lifespan.
- Class C — no latency. Class C devices have nearly continuously open receive windows reducing latency to its practical minimum.

More information can be found at www.LoRa-Alliance.org.

LoRaWAN presents performance advantages for wireless sensing networks in industrial environments and is already gaining popularity for many IoT applications. This is a wireless network to watch and include in your future network planning.

Network planning beyond two years

Industrial network evolution includes a strong influence of better IT/OT collaboration. As these two very capable groups act in concert to improve business outcomes, some advanced IT practices will find their way into industrial networks. One of these is time-sensitive networking (TSN).

Time-sensitive networking

TSN gets a lot of attention from automation experts due in part to the increased interest in the Industrial Internet of Things (IIoT). Some of the data collected by IIoT sensor networks is not inherently time sensitive. However, some data is mission critical and time sensitive and must be shared with strict latency and reliability

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requirements. Further, all data is enriched by adding accurate time context as it allows correlation and analytics to excel. Therefore, TSN is an important technology both within the control loop and outside the loop in IIoT applications.

There are four key benefits that TSN applied to industrial networking provides:

- **Bandwidth:** Machine vision, 3D scanning and power analysis applications running on an industrial network create large datasets which can strain available bandwidth, but proprietary Ethernet derivatives that are used in industrial control today are limited to 100 Mb of bandwidth and half-duplex communication. TSN supports standard Ethernet in full duplex with higher bandwidth options such as 1 Gb, 10 Gb and even a projected 400 Gb version.
- **Security:** TSN embraces top-tier Ethernet security provisions: segmentation, performance protection and temporal composability add multiple levels of defence to the security framework.
- **Interoperability**: TSN integrates existing brownfield applications and standard IT traffic by using standard Ethernet components. It inherits many existing Ethernet features like HTTP interfaces and web services, and these features enable remote diagnostics, remote visualisation and repair capabilities common to IIoT systems.
- **Latency and synchronisation:** TSN prioritises low-latency communications to provide fast response and closed loop control applications. It can achieve deterministic transfer times in the order of tens of microseconds and time synchronisation between nodes down to tens of nanoseconds. TSN provides automated configurations for high reliability data paths where packets are duplicated and merged to provide lossless path redundancy, and in doing so, it ensures reliable delivery of time-sensitive traffic.

TSN provides network designers with tools to ensure that critical traffic is received in a timely and reliable manner. It also frees up congestion to allow non-critical traffic to be converged onto the network and move as 'best effort' traffic. This is an essential distinction in that almost all traffic is best effort. Wire speed and limiting traffic to only critical message streams is used to make the network function correctly.

There are two groups to monitor regarding TSN. These are:

- IEEE 802.1 Time Sensitive Networking Task Group, www.ieee802.org
- AVnu Alliance, www.avnu.org

IEEE 802 has united several domain experts under the auspices to 802.1 to create a suite of TSN specifications that are without equal. The group has led application needs from audio/visual, automotive, industrial automation and consumer realms in creating these specifications.

The AVnu Alliance focuses on the creation of an interoperable ecosystem through solution certification. Member companies include National Instruments, Broadcom, Cisco and Intel, to name but a few. The AVnu Alliance website presents superb resources to help companies understand and adopt these powerful concepts.

Conclusion

The industrial network infrastructure is a valuable business asset. Investments in legacy industrial networks require a clear migration path to optimise return on assets while not missing out on performance enhancements from new technologies. A robust, well-executed physical layer is foundational to this asset continuing to deliver value. Rapidly emerging technology advances such as the Internet of Things, wireless sensor networks, Power over Ethernet and time-sensitive networking can further leverage your network with a little education and planning.

Panduit International Ltd
www.panduit.com

Intelligent wastewater management for tanneries in India

India is not only the second biggest producer of footwear and leather garments in the world, it also accounts for around 13% of the world's leather production of hides and skins. Over 50% of tanneries in India are located in India's southernmost state of Tamil Nadu. The industry is highly water-intensive — even a small tannery with a capacity to process 3–4 tonnes of hides and skins a day uses up over 100,000 litres of water a day, which is the daily household requirement of at least 2500 people.

Due to the poor water resources compounded with the increasing population, pollution and the lack of efficient water management, the state of Tamil Nadu has been facing severe water stress for many years. To help resolve this, a non-profit company — Chennai Environmental Management Company of Tanners — was formed to carry out the Zero Liquid Discharge (ZLD) project announced by the state government, and six common effluent treatment plants (CETPs) were established in Tamil Nadu to help tanneries that were not able to install expensive water treatment facilities.

The existing CETPs are now facing problems that require upgrades or improvements. One of the six CETPS — Ranipet Tannery Effluent Treatment Company Ltd (Ranitec) — approached the Water Technology Research Division of the Industrial Technology Research Institute (ITRI) in Taiwan and Advantech, seeking solutions to improve their outdated facilities and reduce operating costs.

As a result, the ITRI helped the biggest CETP in Tamil Nadu to upgrade its system to reduce total operation cost and energy consumption, as well as increase water recovery rates.

Ranitec, as a benchmark plant, is the largest CETP in Tamil Nadu for the tannery and leather industry. Although pre-treatment facilities were constructed in both Ranitec and member tanneries' sites, pre-treated wastewater still has high suspended solid (SS), biological oxygen demand (BOD) and chemical oxygen demand (COD) values, which resulted in several issues: ultrafiltration and reverse osmosis membrane fouling, low water recovery rates and high energy consumption, as well as a large amount of dry solid waste after the final mechanical vapour recompression (MVR) process. Membrane fouling requires intense cleaning or membrane replacement and increases the operating costs.

Ranitec has been operating for over two decades, and the accumulated amount of mixed solids, which cannot be recycled or reused, was getting out of control and far from the ZLD project's goal.

To address the above issues, ITRI proposed a pilot project using its patented BioNET biological polishing system, combined with its membrane bioreactor (MBR) and electrodialysis (EDR) systems.

The BioNET reactor contains porous compressible carriers that offer large surface areas for the interception of suspended solids and the growth of microorganisms. After implementing ITRI's water treatment solutions, the BioNET technology and MBR reduced ammonia use by up to 96%, and both BOD and COD were also greatly reduced from the wastewater — making the condensate reusable and improving water recovery rates, as well as extending the lifespan of ultrafiltration and reverse osmosis membranes. The EDR system also minimised the inlet volume of brine to the MVR, decreased energy consumption and increased the water recovery rate. After going through the membrane bioreactor, BioNET and EDR, the volume of the concentrated wastewater has decreased by about 100 tonnes per day and made it more efficient to treat in the final MVR process, which easily saved Ranitec operating costs of around US$1000 per day.

In order to remotely monitor ITRI's wastewater treatment solutions and collect data from sensors, ITRI introduced Advantech's hardware and water treatment industrial app. Chih Huang, AIoT Engineer at the Water Technology Research Division of ITRI, commented that ITRI and Advantech's wastewater management solution has been used in several projects over the years. By leveraging ITRI's water treatment expertise and Advantech's experience in industrial applications, the wastewater solution was successfully replicated for Ranitec's project.

The BioNET, MBR and EDR systems' PLCs were connected with Advantech's ECU series industrial edge computing gateway units. The data captured from the PLCs is sent to a WISE-PaaS platform, allowing ITRI to easily conduct monitoring of all data remotely at its office in Taiwan. Ranitec also has WISE-PaaS access for real-time monitoring of water quality and volume, equipment operating status and other related information for efficiency optimisation. After the pilot project, an AI engine was developed to further optimise ITRI and Advantech's wastewater treatment solution.

Stepping into the IoT era, water and wastewater treatment will not only need automatic monitoring and control, but also the capabilities offered by cloud services. Advantech said its WISE-PaaS platform, with its functions and tools based on an open architecture, not only fulfils the existing system requirements but also takes future expansion into consideration.

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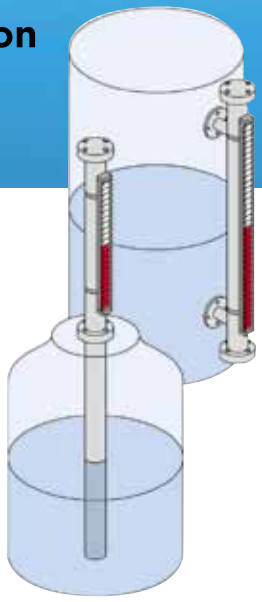

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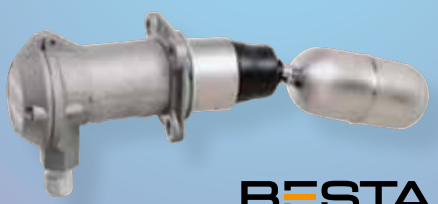

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EDGE IoT COMPUTER

Powered by a 9th generation Intel Atom E3940 quad-core processor, the Advantech UNO-137 is an industrial-grade IoT edge computer. Compliant with IEC-61010 safety standards, the device has a rugged design including a wide operating temperature (-40 to 70°C), wide input voltage (10–36 VDC), isolated DIO/COM and TPM 2.0 hardware-based security, making it suitable for industrial-grade equipment and control cabinet applications.

The UNO-137 can be easily integrated with edge software to support various industrial applications. For example, for machine monitoring, the built-in digital I/O can be used directly or connected with USB I/O modules. The inclusion of DAQNavi software facilitates failure prediction and prevention. The UNO-137 can also be equipped with an additional fieldbus iDoor module loaded with CODESYS software to realise real-time, PC-based soft logic control. For remote asset management, the device supports Wi-Fi, LTE and 5G connectivity. The integration of Advantech's WISE-DeviceOn software is said to further enable flexible device management.

To ensure easy deployment for diverse IIoT operations, the UNO-137 features a modular design. The base unit has two expansion slots (one mPCIe and one M.2) for integrating various expansion modules. It has also been optimised for DIN rail mounting with the provision of a sliding hook that snaps into place as well as a user-friendly release latch that allows quick disassembly.

Advantech Australia Pty Ltd
www.advantech.net.au

DIGITAL PRESSURE GAUGE

The Vaetrix ETG series digital pressure gauge utilises digital technology to more accurately provide pressure measurement. All MEMS pressure sensors are fully temperature compensated throughout the operating range and the interface design and intuitive menu structure make the gauge easy to use. The display offers 240x120 tri-colour backlit graphics with true-type fonts and 1.5 cm digits. There are no cryptic symbols or abbreviations — users can press the arrow keys to navigate the menu and select their choice.

The gauges feature dual sensor technology to measure absolute and gauge pressure with one device, high and low alarm settings with icon and red backlight indication, a dedicated interface for leak test and min/max function and a snapshot feature to capture pressure readings with date and time.

Ranges available (psi) are 15, 30, 100, 300, 500, 1K, 3K, 5K and 10K (isolated, gas and liquids). Other pressure units are also available. Accuracy is ±0.05%, ±0.1% or ±0.25% of FS. The gauges are powered by three AA alkaline batteries (LR6) handheld, with more than 1200 h of typical use and a low battery indication at 3.7 V. Data logging supports up to 64,000 readings with data management software. Intrinsically safe and ambient temperature options are available.

Operating temperature ranges of the ETG series pressure gauges are -10 to 50°C and -23 to 65°C and the pressure connection is ¼″ MNPT in 316 stainless steel, while the enclosure is corrosion-resistant aluminium, powder coated and sealed to IP64.

Slentech Pty Ltd
www.slentech.com.au

WINDOWS-BASED PAC

The Win-GRAF WP-9x28-CE7 series is the latest Windows CE 7.0-based programmable automation controller from ICP DAS. Each WP-9000-CE7 is equipped with a Cortex-A8 (1 GHz) CPU running a Windows CE 7.0 operating system, a range of input/output ports (VGA, USB, Ethernet, RS-232/485) and two, four or eight expansion I/O slots that can be used to integrate high-performance I-9K (parallel-type) and I-97K (serial-type) series I/O modules.

The benefits of running Windows CE 7.0 on a WinPAC device include hard real-time capability, achievable deterministic control and a PC-like windowing display and operating environment.

The PACs can run Win-GRAF (IEC 61131-3 Standard) software to develop logic control applications, and also support Microsoft Visual Studio 2008 software (VB .NET, C#) to develop HMI and data management applications that can exchange data with Win-GRAF applications.

ICP Electronics Australia Pty Ltd

www.icp-australia.com.au

TELEMETRY LOAD SHACKLES

The Interface WTSSHK-B-HL range of telemetry load shackles is manufactured using the GN rope H10 shackle. Suitable for use in a wide range of industrial and marine heavy lift weighing applications, these load shackles provide a robust and effective method of measuring large tensile loads. They are particularly suited to offshore applications, as they include 3.1 material certification as standard and the proof load test.

The telemetry housing is manufactured from tough high performance polyamide resin making it strong yet light, resulting in a better balanced load shackle. Two clips enable users to open the housing to access and change the two AAA batteries, while the internal electronics underneath remain completely sealed, including the antenna to ensure maximum protection from damage. The built-in radio telemetry electronics operates on the 2.4 GHz licence-free frequency.

The WTSSHK-B can also supply as standard with a handheld battery-powered display that can toggle between MT or lbs, or alternatively, for multi-shackle applications, a single display can address up to 12 shackles for individual monitoring, or for summation/weighing applications.

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COMPACT BOOSTERS

Kaeser Compressors has announced its latest generation of boosters, which cover the 7.5 to 22 kW drive power range. The CN C series booster models are said to be energy-efficient, complete and compact turnkey systems that are suitable wherever high-pressure compressed air is required, such as PET bottle production, process air applications and nitrogen generation.

The series produces flow rates from 0.8 to 8 m^3/min, initial pressure from 3 to 13 bar and final pressure from 10 to 45 bar.

All application-relevant components are provided and configured ex works for delivery of a complete turnkey system that is ready for immediate operation. With a footprint of 1.9 m^2, they are compact and keep the space requirement to a minimum. They are also built within a sound enclosure that keeps sound pressure levels down to as little as 71 dB(A).

The boosters feature separate cooling airflows for the compressor block, drive motor and control cabinet, which are taken in through openings in the right-hand side of the enclosure. Once they have been used for cooling, the streams are combined, then blown up and out through the exhaust air outlet in the top of the enclosure. This design prevents cool inlet air from mixing with warm exhaust air for enhanced efficiency.

Kaeser Compressors Australia
au.kaeser.com

LED INDICATOR LIGHT FOR Ex ZONES

The QUADRO LED-RGB-3G/3D light from Pfannenberg is deigned to create an efficient alternative to conventional signal towers in Ex Zones 2 and 22.

Equipped with LED technology, the RGB light offers flexible and versatile signalling options and operating modes for industrial applications in the field of indication and warning. A wide range of RGB colours can be selected and the desired status can be visualised with one device. LED technology offers many advantages, including brightness, light colours and time sequences to allow various combinations for application needs.

The lights are suitable for both indoor and outdoor areas wherever gases, fine dust and other explosive materials are around, and could include machine and plant operations, refineries, pharmaceutical and chemical industries, woodworking, paint shops and industrial bakeries.

Control Logic Pty Ltd
www.controllogic.com.au

PROFINET POWER HUBS

Pepperl+Fuchs Profinet proxy technologies provide standardised and digital communication to field instrumentation with Profibus PA.

The FieldConnex Profinet power hub enables users to integrate process variables, configuration and diagnostics data into the controller and asset management application of their choice. Significant time savings through a high degree of automation help with achieving return on investment during installation and commissioning.

The Profinet gateway connects instrumentation from any vendor to any controller or DCS. Easy DCS integration via manufactured cables reduces wiring and makes factory acceptance testing run smoothly. The company says this allows users to exercise freedom of choice and reduce systematic risk, enabling them to maintain highest levels of availability and safety in their plant.

Pepperl+Fuchs (Aust) Pty Ltd

www.pepperl-fuchs.com

INDUSOFT-BASED VIEWPAC

The VP-x239-CE7 series from ICP DAS is a WinCE-based series of InduSoft PACs. The ViewPAC combines a WinPAC, a graphic display and keypad into one unit. It is equipped with a Cortex-A8 CPU (1 GHz) running the Windows CE .NET 7.0 operating system, various communications (USB, Ethernet, RS-232/485), three slots to expand with I/O modules, a 5.7″ TFT LCD and a rubber keypad.

Its operating system, Windows CE .NET 7.0, has many advantages, including hard real-time capability, small core size, fast boot speed, interrupt handling at a deeper level, achievable deterministic control and low cost. InduSoft Web Studio Runtime is pre-installed.

InduSoft Web Studio is an integrated collection of automation tools that includes all the building blocks needed to develop modern HMIs, SCADA systems, embedded instrumentation and control applications. Compared to traditional IPC and PLC solutions, ViewPAC reduces overall system cost and space, and gives the features of both an IPC and PLC.

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Modern wastewater uses the cloud

Formally organised in 1834, Waterford Township is located geographically in the centre of Oakland County, Michigan, USA, and is home to over 72,000 residents. It is known regionally for its 34 lakes, from which it earns its name.

In the public utilities industry, however, Waterford is known for its leadership and persistent innovation in water and wastewater management.

With 600 km of water main and 592 km of sewer, water management in Waterford is no small task. The Department of Public Works (DPW) operates and maintains 19 production wells, 3 storage tanks, 11 treatment plants and 63 sewer lift stations. To run all this, it invested years ago in integrating its core applications, including geographic information systems (GIS), asset management systems (AMS), enterprise content management (ECM) and SCADA, all of them sharing data to enable seamless operations.

That system has delivered much value over the years, but nothing lasts forever. And in the last few years, Russell Williams, director of public works, and Frank Fisher, engineering superintendent, started on a project to upgrade core infrastructure. It was an opportunity, not just to avoid obsolescence, but to improve scalability and fault tolerance.

"We attended a conference in Chicago about the release of Opto22's EPIC in 2018," Williams said. "We were talking about it on the ride back and said, 'If this does what it's supposed to, then it changes the whole layout of everything.'" They were particularly intrigued by MQTT and the way its report-by-exception behaviour promised to improve the efficiency and stability of their infrastructure.

At the time, Waterford's system used a polling program to request updates from a network of Opto 22 M4 RTUs that communicated through licensed RF transmitters. DPW had already begun replacing these with SNAP-PAC-S2 controllers and industrial cellular modems that communicated through a private internet tunnel. But with MQTT on groov EPIC, they saw the potential to reduce the complexity of the system further.

"We have many lift stations that will spend most of their time sitting," Williams explained. "So why transfer data all the time?" And with no dependence on a central polling program, they could eliminate a potential point of systemic failure.

"It just looks too simple. You've got to question it," Williams recalled. But, willing to test the premise, Williams and Fisher purchased three groov EPIC units to play with over the summer, and soon they had the evidence in hand.

"We disconnected a controller and within a millisecond the system reported the failure. It really is that easy: change a variable and it shows up in the broker, then on your mobile phone," Fisher said.

Waterford DPW has since begun rolling out groov EPIC controllers. Since the groov EPIC can communicate directly with cloud-based systems, Waterford chose to host its MQTT broker (Ignition from Inductive Automation) on Amazon Web Services (AWS). Each EPIC uses a CA-signed client SSL certificate to establish a secure broker connection over a cellular modem configured to block any traffic not originating from a trusted IP address. Additionally, with MQTT's device-originating connections, the groov EPIC's device firewall in each lift station can be closed entirely to outside connections.

With that foundation, Waterford DPW made other infrastructure changes that have put it at the forefront of municipal utilities management. For instance, their Ignition MQTT server is hosted in an Ohio, USA, data centre, but if there are any issues, in 30 minutes Fisher can have the entire system up and running on a snapshot of the same server hosted in an Oregon data centre.

In time, they will likely set up full server redundancy. Meanwhile, they continue to run the legacy SCADA system (on upgraded hardware) in parallel from the local department office. It still manages about a third of the system and will stay up until they have fully migrated to Ignition.

Williams recognises that Waterford is leading digital transformation in the public sector. "I was at a FEMA training not that long ago, and they were adamant about not having an internet connection on your SCADA system," he said. "But everything we are looking at will be more secure than we could do from the office, because then you make a building a single point of failure."

With data coming across much faster, and groov EPIC providing spare data processing capacity, Williams and Fisher expect to dramatically increase the connectivity of the system. By integrating residential meter data, for instance, they could help the system stay balanced against demand. And if they can talk other agencies and neighbouring counties into sharing data, they see the potential to build an advanced warning system that would improve their reaction time to system disturbances.

At this point, Waterford DPW has converted 36 lift stations and four treatment plants to the new system, with more to come throughout 2021.

Systems 22 Pty Ltd

www.systems22.com.au

LONG-LIFE ELECTRIC LINEAR ACTUATOR

Thomson Industries has launched the Electrak LL electric linear actuator, a long-life, high-duty-cycle component designed to work in harsh conditions and offer high environmental protection.

With increased UV resistance capabilities, a long-life ball screw and nut assembly, and a long-life manual override design, the Electrak LL actuator is built to last more than 10 times longer than previous models.

The load-bearing design of the Electrak LL electric actuator features two bearings to handle bidirectional load, as well as a built-in, brushless motor and motor drive system. The system provides constant speed regardless of the load and delivers the safety functionalities of the Thomson Electronic Monitoring Package. Eliminating the need for standalone controls, these integrated features provide constant monitoring of critical parameters such as end of stroke, voltage, current and temperature.

The actuator can withstand temperatures from -40 to +85°C and is CE and RoHS compliant, making it easier for operators to interact with and control operations, and providing a better user experience in all environments. Its coated, painted and sealed housing is rated to IP69K (static) and IP66 (dynamic) standards, meaning it resists corrosion from UV radiation, water jets, high-temperature/high-pressure washdowns and other forces.

Long-life actuators such as the Electrak LL are valuable on the plant floor for high-duty cycle applications such as material handling and logistics operations.

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NEW PRODUCTS

CATEGORY 2 SAFETY RELAY MODULE

IDEC Corporation has announced the HR5S safety relay module, designed specifically to meet ISO 13849 Category 2 requirements. If designers are using a system with Safety Category 3 or 4, then redundant safety inputs, controllers and outputs must be provided. Now when the machine risk is relatively low, designers can opt for a more streamlined safety implementation by using Category 2 instead of a more rigorous safety implementation.

HR5S safety relays are available in three configurations for a range of applications. The Simple type can be used for applications up to PLc, while Standard and Off-Delay types work for designs up to PLd and add failure detection features. While most Category 3 and higher relays consume 45 mm of installation width, the HR5S is only 22.5 mm wide and can be mounted on DIN rails or a backpanel surface.

Push-in terminals are used for ease of installation and vibration resistance, accepting solid wires up to 16 AWG or stranded wires up to 18 AWG with ferrules. Inputs are rated for 24 VDC, and outputs are rated up to 250 VAC, 3 A. The HR5S safety relay modules comply with many standards including EN ISO 13849-1:2015 and UL 508.

HR5S safety relays make it easier for machine builders to apply approved safety designs in additional applications, for new systems and also for retrofit cases. In addition to these opportunities, Category 2 designs and safety relays can be used to warn users of impending issues instead of automatically stopping equipment.

IDEC Australia Pty Ltd
www.idec.com/australia

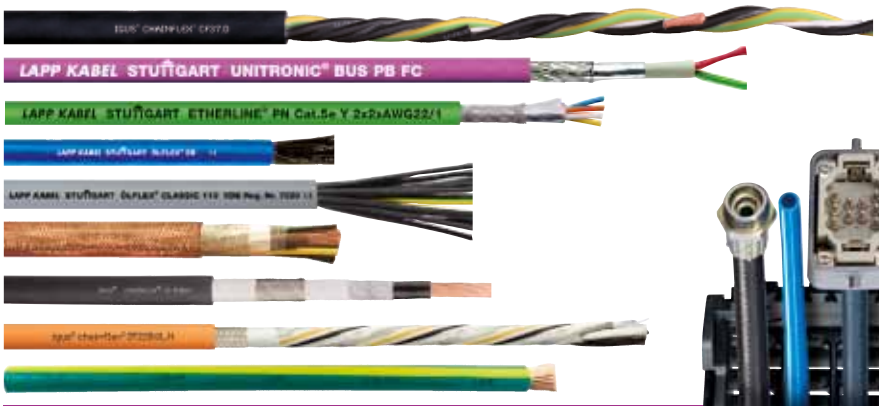
RUGGED TABLET

The RuggON Rextorm PX501 rugged tablet is integrated with advanced touch technology, allowing the user to avoid unintended touches including hand palm, water mist and rain drops. Paired with an IP54 digitiser pen or 2 mm hard tip stylus, the product is said to ensure accurate touchscreen interaction and a sensible writing experience. Combined with the hard Gorilla Glass and glove touch function, it is intended to be a dedicated device for mobile workers, resisting external damage and fulfilling in-field needs.

The product comes with a high-resolution WUXGA (1920 x 1200), 1000-nit, high-brightness, sunlight-readable display. A hyper dimming option adapts to low ambient light conditions while increasing viewing performance.

The rugged Rextorm series come with a wide range of I/O ports and expansion options, meeting the various requirements of different applications including fingerprint readers, smart card readers, UHF RFID, and integrated 2D barcode readers. The optional OCR capabilities allow for passport scanning and identity detection. Equipped with the latest and complete communication technology, mobile workers can experience precise positioning, fast processing, broad coverage and stable data transfer even around buildings or trees. The seamless connection can be enhanced through the switchable dual pass-through connector.

Metromatics Pty Ltd
www.metromatics.com.au



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Harnessed solutions are also available

MAGNETIC LINEAR ENCODER

The BML absolute magnetic encoder in the SGA series is suitable for applications where high absolute accuracy of position and end-of-travel is required. The linear measuring system is suitable for both long measuring lengths up to 48 m as well as for applications which require high precision.

Diagnostics functions are designed to ensure reliable operation and efficient maintenance. With its Drive-Cliq interface, the Balluff measuring system can also be integrated into Siemens controller environments, and Siemens has certified the system allowing for plug-and-play installation: the controller automatically detects the sensor and its basic settings. The sensor also offers flexibility, since leaving and reengaging with the tape is permissible.

Since the system works magnetically, it is also insensitive to temperature change, dirt (such as from dust and oil) or wear. The read distance of 1.3 mm makes installation easier, and in practical operation continuous plausibility checking ensures high reliability since the system consistently checks the measurement quality.

Automatic condition monitoring checks the signal quality and, using the controller, the user can evaluate the function reserve.

The BML absolute encooder offers an accuracy of up to ±12 μm and a resolution of 1 μm and is also to retrofit.

Balluff Pty Ltd
www.balluff.com.au

INDUSTRIAL PCs

Emerson's RXi2-BP range of expandable industrial computers are said to offer a number of processor choices, increased and faster storage, improved graphics and enhanced security features.

The system utilises the latest AMD Ryzen family processors and supports up to 16 GB of ECC RAM; four to six Gigabit Ethernet interfaces; and industrial-grade, high-speed SSD storage.

The IPC is designed to deliver compact, rugged, mid- to high-range performance computing capabilities to run HMI, historian and analytics applications at the machine to enable improved real-time control of operations and better integration into plant-wide systems.

The company says all aspects of the device have been engineered for operation in harsh environments and feature high-quality industrial components, a rugged design and fanless operation.

Control Logic Pty Ltd
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GETTING STARTED WITH DIGITAL TWINS

THE WHAT, WHY AND HOW FOR PROCESS ENGINEERING

Branko Dijkstra, Principal Technical Consultant, MathWorks Australia

One of the primary catalysts for engineering and design teams to be able to actualise the benefits of Industry 4.0 has been the emergence of digital twins.

After many years of excitement and discussion around Industry 4.0, manufacturing, energy and transportation, companies are increasingly realising the benefits of Industry 4.0 applications. One of the primary catalysts for engineering and design teams to be able to actualise these benefits for their companies has been the emergence of digital twins.

What is a digital twin?

A digital twin is a real-time digital representation of a real-world physical asset in operation that reflects the asset's current condition and provides relevant historical data. Companies can leverage digital twins to analyse the real-time performance, optimise the operation, predict future behaviour or refine control of its assets, such as pumps, engines, power plants, manufacturing lines or fleets of vehicles.

Why use a digital twin?

There are numerous ways engineering teams can design and deploy digital twins to deliver value to their companies and optimise future operations.

Asset history

Digital twins capture the physical asset's history — being updated periodically to represent the real asset's current state. Over time, these past states become the asset's history. The type of information included in this history differs, based on how the digital twin is being used and what is captured in the current state. For example, a digital twin used for fault classification will capture a history that includes a specific pump's operational data from its healthy and faulty state. In the future, engineers can then compare the operational data from that pump to the digital twin histories of

other pumps to understand how they behaved under similar faults and predict the effect on the fleet's efficiency.

Maintenance strategies

The ability to monitor a whole fleet of assets using digital twins brings advantages to planning operational events and improving maintenance strategies.

For example, when a specific pump is nearing failure, the digital twin can assess how this will affect the efficiency of the fleet and potential costs. This informs the company when making the decision between ordering a new part and waiting for it to arrive or paying more for expedited shipping to get the part as soon as possible.

Simulating future scenarios

Companies can use digital twins to simulate future scenarios to see how factors such as weather, fleet size or different operating conditions affect performance. This approach helps manage assets and optimise operations by informing maintenance schedules or flagging expected failures in advance.

Digital twins can be leveraged by companies for a variety of applications, including anomaly detection, operations optimisation and predictive maintenance.

Anomaly detection

The digital twin models run in parallel to the real assets and flag operational behaviour that deviates from expected behaviour in real time. For example, a petroleum company may stream sensor data from offshore oil rigs that operate continuously, while the digital twin model looks for anomalies in the operational behaviour to flag potential equipment damage.

Operations optimisation

Companies can apply variables such as weather, fleet size, energy costs or performance factors to trigger hundreds or thousands of simulations to evaluate readiness or necessary adjustments to current system setpoints. This approach makes it possible to optimise system operations to mitigate risk, reduce cost or gain system efficiencies.

Predictive maintenance

In industrial automation and machinery applications, companies can use digital twin models to determine remaining useful life and the most opportune time to service or replace equipment.

In a characteristic smart connected system topology as shown in Figure 1, the digital twins could be executed on the smart asset, at the edge or on the IT/OT layers depending on the required response time of the application. For example, predictive maintenance, a common Industry 4.0 application, generally requires making real-time or time-sensitive decisions — meaning the digital twin should be integrated directly with the asset or at the edge.

How does a digital twin work?

An IoT application drives what needs to be modelled as part of a digital twin. A digital twin model will include the required components, behaviours and dynamics of the IoT asset. Modelling methods generally can be grouped into two types: first principles or physics-based methods (eg, mechanical modelling) and data-driven methods (eg, deep learning). A digital twin can also be a composite of various modelled behaviours and modelling methods and is likely to be elaborated on over time as more uses are identified.

The models must be kept up to date and tuned to the assets that are in operation, which typically involves direct streaming of data from the assets into algorithms that tune the digital twin. This makes it possible to consider aspects like asset environment, age and configuration.

Once the digital twin is available and up to date, it can be used any number of ways to predict future behaviour, refine the control or optimise operation of the asset. Some examples include simulating sensors that are not present on the real asset, simulating future scenarios to inform current and future operations or using

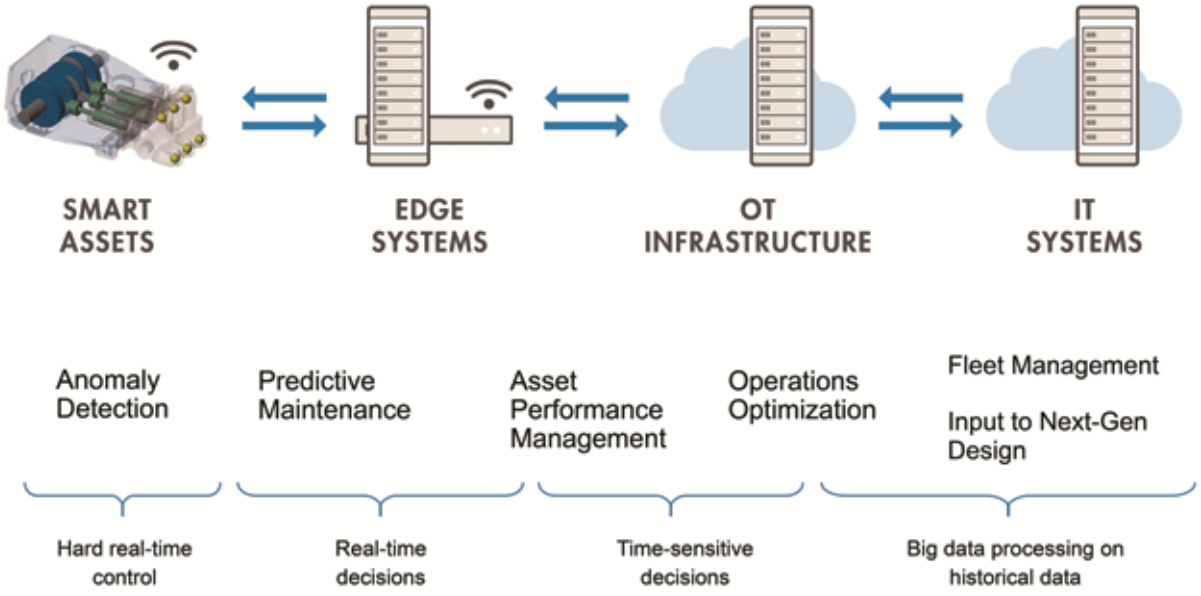

Figure 1: A characteristic smart connected system topology showing where digital twins should be deployed.

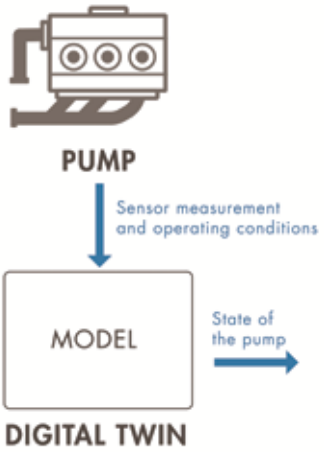

Figure 2: Sensor measurements and operating conditions are sent from the pump to the model and the model outputs the current state of the pump.

the digital twin to extract the current operational state by sending in current real inputs.

How to build a digital twin

Engineers will be increasingly asked to develop digital twins for their company given the above benefits. Here are two methods design teams must keep in mind as they prepare, build and apply their digital twin models.

Data-driven model

A company looking to optimise maintenance schedules by estimating remaining useful life (RUL) will use a data-driven model, as the type of the data from the asset will determine which model teams will be using. Similarity models can be used if the company has complete histories from similar machines. If only failure data is available, then survival models can be used, and if failure data is not available, but the safety threshold is known, a degradation model can be used. If failure data is not available but a safety threshold is known, degradation models can be used to estimate RUL. In this RUL scenario, the degradation model is constantly updated using the data from the asset measured by different sensors — such as pressure, flow and vibration in the case of a pump.

Physics-based model

If a company wants to simulate future scenarios and monitor how the fleet will behave under those scenarios it would use a physics-based model, which is created by connecting mechanical and hydraulic components. This model is fed with data from an asset, and its parameters are estimated and tuned with this incoming data to keep the model up to date. Engineers can then inject different types of faults and simulate the pump's behaviour under different fault conditions.

How to apply digital twins

Design teams need to create a unique digital twin for every individual asset. This means that for each asset at a different location, teams must create a unique digital twin that has been initialised with the specific asset's parameters. The total number of unique twins will depend on the application. If teams are modelling a system of systems, they may or may not need a twin for each system of components depending on the required level of precision. For example, if the intention is to run failure prediction and fault classification, design teams need to create different models that serve these different purposes.

Delivering value with digital twins

The flexibility and various potential benefits of digital twins make them a top priority for companies transitioning to Industry 4.0. Having an up-to-date representation of real operating assets lets engineering and design teams unlock insights in data to optimise, improve efficiencies, automate and evaluate future performance — all delivering cost savings and shorter development timelines.

MathWorks Australia
au.mathworks.com

DATA ACQUISITION DEVICE

The ICP DAS PET-7H24M is a high-speed data acquisition device with a built-in Ethernet communication port for data transfer over a network and includes four high-speed 24-bit differential analog input channels (with 128 kHz sample and hold for all four channels), two analog output channels, three digital input channels, four digital output channels and one encoder input channel.

The module provides a programmable input range on all analog channels, and the digital output has short-circuit and overload protection. The encoder input channel can be configured in quadrant, pulse/direction or CW/CCW input mode.

The PET-7H24M also provides 4 kV ESD protection as well as 2500 VDC intra-module isolation. The 24-bit ADC includes built-in Sinc3 filtering to adjust the appropriate sampling rate and filter out modulator and signal noise. The PET-7H24M is suitable for a wide range of mobile/portable measurement applications.

ICP Electronics Australia Pty Ltd

www.icp-australia.com.au

DIGITAL PANEL METER

Lumel's N21 digital panel meter is designed for the visualisation of industrial processes, and features a universal input, universal power supply and universal OLED display, making it a versatile display, suitable for use in many applications.

It offers a universal measuring input for standard process signals and temperature sensors and a normally open relay alarm output. It can be powered from a universal power supply from 24 V up to 230 V, AC or DC, and can provide an auxiliary 24 VDC power supply for loop-powered sensors.

The N21's universal OLED display can be oriented horizontally or vertically and is user-programmable by using the appropriate firmware. Configuration is via a mini-USB connection with free software, and includes the selection of measured value, rescaling of indications, accuracy of measured value (decimal point), alarm output mode, measurement averaging time, firmware update and engineering units

The N21 panel meter has a protection grade of IP65 and external dimensions of 48 x 96 x 64 mm.

Pacific Automation

www.pacificautomation.com.au

T-JUNCTION BOX FOR POWER AND SIGNALS

The ILME CYG 9KAXI3 T-junction box is a ready-to-use customisable solution for industrial applications requiring the distribution of power and control signals.

The pre-assembled system includes three compact bulkhead mounting housings with stainless steel locking lever and anti-ageing gasket (CKAX 03 I) mounted on a robust UV-resistant aluminium distribution box (APV 9), offering a construction suitable for outdoor use and with an IP66/67 degree of protection.

Due to its structure, it allows a power and signal bus line on the pair of aligned connectors and a derivation line on the third one, which can be disconnected — avoiding any bus line interruption and making it suitable for daisy-chain distribution systems.

The T-Box can be used with the whole range of compact 21.21 ILME inserts and hoods and can be supplied in a variant for aggressive environments and for electromagnetic compatibility (EMC) according to the installation requirements.

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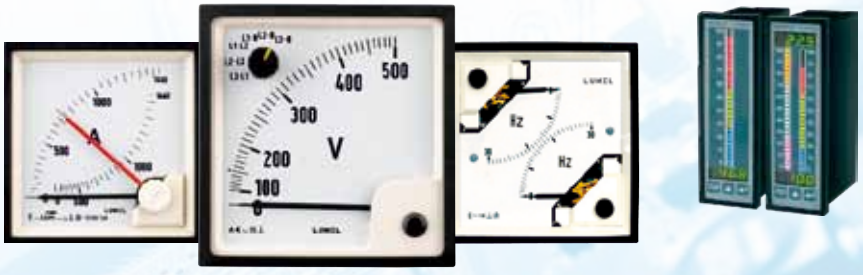

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ANSTO automates radioactive waste storage processes

ANSTO, which produces nuclear medicine vital to the Australian health industry and undertakes research critical to many other industries, is now using a new Swisslog automated storage and retrieval system (ASRS).

The federal government campus in Lucas Heights, NSW, about 40 km south of the Sydney CBD, will utilise Swisslog's technology to safely move 200-litre drums of low-level contact handled radioactive waste. The waste will be transported through a combination of conveyors, pallets (including 908 individual pallet locations), racking and Swisslog's S12 Vectura crane.

ANSTO conducts some of Australia's most important national scientific research and operates much of Australia's landmark and national infrastructure, including one of the world's most modern nuclear research reactors, OPAL.

"The technology solution for ANSTO has a number of additional safety benefits, specifically designed for this unique application," said Swisslog Head of Sales and Consulting, Sean Ryan. "We included a drum inspection station, from which ANSTO will continue to accurately monitor drum characteristics. The entire system provides end-to-end traceability to optimise safety, tracking and efficiency."

In addition to safety benefits, ANSTO's new ASRS optimises use of available space by stacking pallets in a compact grid-like racking area, to make the best use of the available footprint of the site.

Swisslog's ASRS is seamlessly integrated with ANSTO's warehouse control system (WCS) to provide receipt and inspection timestamp tracking (such as compliance to pallet, weight dimensions and auto-receipt), zoning, accurate reporting and an intuitive interface with the host system.

Paula Berghofer, General Manager, Waste Management Services, ANSTO, said that in order to optimise safety and ensure the responsible, traceable management of radioactive waste at the facility, "the drums will be inspected periodically, and radiation levels will continue to be monitored".

"These drums will be housed in the ASRS and then will be processed through a super-compactor into over-packs. It is intended that they would eventually be destined for Australia's National Radioactive Waste Management Facility once it is established."

ANSTO manages radioactive waste safely and in accordance with all standards set by several regulators including the independent nuclear regulator, ARPANSA.

Swisslog's Vectura crane technology used at ANSTO is an energy-efficient high-bay warehouse pallet stacker crane used in more than 2000 sites globally. The company said that Vectura cranes can perform equally well in temperatures as low as -30°C in a frozen food warehouse or in ambient environments as high as +50°C. Depending on the storage density and throughput requirements of a warehouse, it can handle one, two or more loads in single, double, triple and multi-deep layouts.

In high buildings and where land space is limited, Vectura cranes operate at heights up to 50 m. Vectura cranes are also a more sustainable technology, with up to 20% lower energy consumption compared to traditional cranes, due to their mast design and lighter crane weight.

"Swisslog recently celebrated over 50 years of Vectura cranes. The technology — which has continuously improved over the decades — is one of the world's most trusted ASRS solutions with nearly 4000 individual cranes in use around the globe," Ryan said.

Swisslog Australia

www.swisslog.com.au

RUGGED EMBEDDED COMPUTER

The MPL TRICOR15 is a rugged embedded computer that combines a built-in 15″ screen and a core functional module based on MPL's single board computer.

The system is constructed with a military-grade, high-strength and lightweight HE30-grade aluminium alloy housing. Its modular architecture allows the system to be configurable with a number of options. The fanless design helps with the noiseless operation, increasing reliability, and in giving the system a longer MTBF. The operating temperature range of the TRICOR15 is -20 to +60°C.

Operational accessories such as MIL connectors are available on the sides for easy access. The unit has console mounting provisions and has been designed for applications that need a rugged and reliable solution.

The TRICOR15 meets the MIL-STD-810F and MIL-STD-461E standards and is suitable for all applications. It also supports up to 64 GB memory and has space for 2.5″ SSD and three Gigabit Ethernet ports.

Backplane Systems Technology Pty Ltd
www.backplane.com.au

OK, BUT WHAT DOES DIGITAL TRANSFORMATION MEAN TO ME?

The term 'digital transformation', or DX, probably surpassed peak familiarity in the industrial automation sector a few years ago; however, common agreement on the definition, I think, still lags. To offer one perspective on this, DX can be thought of as a continuation of the digitalisation that has been ongoing in the industry for at least three decades, and involves adopting modern technology to help to *transform* human behaviours.

Any industrial producer will tell you that they will embrace digitalisation wherever it makes sense to their operation. But, as one example, they may not be aware of the opportunities that exist to reduce manual data gathering and processing, and instead rely on workflow automation and analytics to support decision-making. It's the change in the way people do their jobs and prioritise activities that is the real *transformation* part of DX.

The way that DX initiatives are currently being applied in our industry is as varied as the individuals, teams and businesses applying them; in other words, it's a wide and multi-coloured spectrum.

Anything from the simplest problem-solving purchases to a sweeping, organisation-wide rollout of new systems, software and training; and, of course, everything in between. However, the one theme that is common amongst the vast majority of cases, is that *MORE* must be done with *LESS* — less resource, less time and, above all, less forgiveness if things don't go according to plan.

And this can be tricky: expectations tend to organically set themselves within the minds of those who judge us. But having expectations based on a concept that is so varied in definition and relevance can lead to a misalignment of what is achievable with prescribed resources. So what's the answer to minimising your risk?

Many will say "start small" or "be focused" or "map out your KPIs in advance, so you know when you're successful or not"; and this is all excellent advice. But what I say is that you are delving into a concept that is relatively new in the context of industrial automation, and there is a chance you won't succeed.

The majority of engineering disciplines have progressed throughout history in a conservative, yet certain manner — and the one thing that has always occurred during that time is that lessons have been learned, and lessons have been shared (even if it sometimes takes a very long time). In DX, this should be the same: take your time, have a plan, listen to the experience of others and share yours.

I'm an avid reader of science fiction, and there is a plot device used in the *Dune* saga by Frank Herbert, whereby individuals can share their life experiences across many millennia using genetic engineering. This is referred to as 'other memory'.

Now, in the real world, we don't have the convenience of such technology; but the next best thing is a proactive and open attitude to sharing knowledge. It is my hope that one day we'll take for granted the myriad DX methodologies that improve safety, reliability and sustainability because they're simply part of our industrial collective memory.

**Martin Kolos is a Digital Transformation Lead with Emerson Automation Solutions and has a passion for future energies, emerging techniques for solving industry's toughest challenges and collaborating with people who aren't afraid to try something different.*

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