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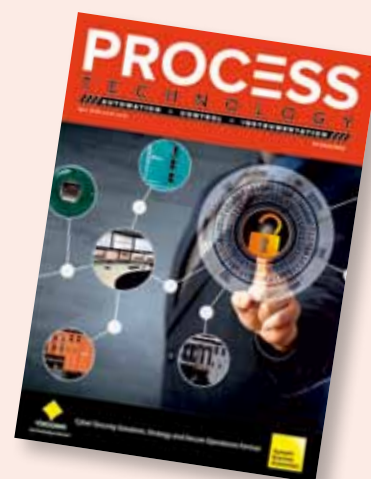
PROCESS TECHNOLOGY
APRIL 2018

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ON THE COVER



Rapid technology advancement and a growing cybersecurity threat have pushed traditionally conservative industries outside their comfort zone. Organisations wanting to immediately become better connected and embrace new ways of working face the risk of process interruption, specification deviations and opening themselves up to external security threats. This is a huge dilemma for under-pressure plant personnel with business objectives, proven operation practices and plant security all at loggerheads.

Better alignment of IT and OT functions is a step in the right direction, although both recognise the need for a cybersecurity management solution developed in a manner that limits negative impact on control system operation. The growing influence of the IIoT and big data also presents a new challenge, as highly distributed sensor arrays and cloud-based environments become more commonplace. Demographic change in the workforce is also an often-overlooked cyber threat as more experienced personnel retire. Greater functionality is built into control logic to compensate, making the system smarter and run more autonomously. But this can also open the process to greater cybersecurity risk. If the system is not designed to be inherently secure the potential for a major incident is significant. Cybersecurity has evolved, and a holistic approach to potential threats is required to assist an industry where personnel and skills shortage are commonplace. Vendors are increasingly challenged to provide better guidance and support to help fill this void. Yet this is a dangerously dynamic and high profile realm where vendors need to understand that the stakes are high and failure is not an option.

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INDUSTRIAL CYBERSECURITY

PEOPLE, PROCESSES AND TECHNOLOGIES

Glenn Johnson, Editor, Process Technology

Industrial cybersecurity is not a technological problem to be solved, but a process of continuous awareness and adaptation.

The increasing digitalisation of industrial control and automation systems is resulting in greater than ever integration (especially with IT systems) and volumes of data. The adoption of open standards has been necessary to provide the integration to make these changes possible.

Of course the dark side of this trend is increasing vulnerability to cyber attack. Greater integration and open standards make it much easier for attackers to access systems and cause havoc. Much has been published already about the increase in cyber attacks in recent years, so I will not labour that point here, but the reality today is that industrial systems face professionally implemented attacks. The changed threat situation this presents demands a fundamental rethink of information security, access protection and the whole process of establishing industrial security.

As those in the IT industry have well known for years, attackers are always upgrading their arsenal, and constant change in the threat landscape is the normal state of affairs — system security (whether it is IT or OT) is an ongoing process, and never an end goal.

It is however possible — with the right methodologies — to establish an effective defence. The first concept that must be understood is that “100% secure” is an unrealistic concept and is therefore out of the question: the art of effective cybersecurity is in understanding the possible threats and mitigating the risks they pose. Bringing risk under control in this way requires a comprehensive security plan that promotes strong cooperation between the various parties involved — whether they be internal IT and OT staff, or system integrators, machine builder or other equipment and automation vendors.

The solution to the issue of cybersecurity risk mitigation is first and foremost a ‘people and procedures problem’ before it

is a technical one. Any partner or vendor that offers to help your organisation with only a technical solution should be treated with suspicion: while their solution may be good for some (or even all) technical aspects of security protection at the time it is offered, any idea that this can be the total solution over time is false. No matter how good a technical solution may be, it will not remain so over time as the threat landscape evolves, and if the people and procedures aspect is not in place, it can actually become more of a burden and a threat in itself. Why? Because it can result in complacency.

This point cannot be stressed enough: cybersecurity is not a problem that needs a solution — it is a process.

Organisational and technical measures must be coordinated holistically in a way that relies on people, processes and technologies working together.

The defence-in-depth concept

Much has been said in the literature about the concept of ‘defence in depth’ in accordance with the recommendations set out in IEC 62443, the leading standard for security in industrial automation.

The plant security, network security and system integrity elements are all key factors that need to be considered, including physical access protection and organisational measures such as procedures and processes in addition to the technology-specific technical measures.

Plant security

It doesn’t matter how effective the computing, networking and device or plant level technical security is if it can be circumvented by physical intrusion. Plant physical security, while it has always been important for the safety and physical protection of the plant, should also be seen as an important aspect of cybersecurity.



THE SOLUTION TO THE ISSUE OF CYBERSECURITY RISK MITIGATION IS FIRST AND FOREMOST A 'PEOPLE AND PROCEDURES PROBLEM' BEFORE IT IS A TECHNICAL ONE.

Plant security measures include physical access protection, such as barriers, turnstiles, cameras and card readers. Organisational measures take the form of a physical security management process.

Physical access protection

Physical access protection involves:

- preventing unauthorised persons from entering the plant,
- the physical separation of different production areas with different access authorisations,
- physical access protection for critical automation components.

In some cases, physical access protection measures may reduce the level of complexity of technical security measures required, but only if the physically protected equipment is not also networked into the larger operational or IT system. In this case, the physical security is acting to prevent technical measures from being circumvented.

Security management

Organisational security measures must be tightly coordinated with technical measures, as the effectiveness of each depends on the effectiveness of the other.

Organisational measures include the establishment of a security management process. The first step in determining which measures are likely to be required in a given situation is to analyse the specific risks that exist and identify which cannot be tolerated — this is known as a threat-risk assessment (TRA). The significance of an identified risk in this connection depends on the damage associated with such an event occurring (depending on the specifics of the plant) as well as its probability of occurrence. Failure to conduct

a proper TRA and ascertain security objectives is tantamount to 'flying blind' — not correctly identifying the real risks and their probabilities specific to the plant and organisation can result in the spending of money and resources on ineffective measures, not identifying the appropriate cybersecurity measures, or wasting money and resources on risks that don't need mitigating.

The TRA helps the organisation decide where best to utilise its resources and with what priority. As the situation will inevitably change over time, the TRA must be repeated from time to time or after material changes just in case the threat situation or underlying factors have altered.

The TRA brings transparency to the security status of a plant and identifies weaknesses, thus providing a basis on which a comprehensive cybersecurity plan can be developed along with a roadmap to how the security status of a plant can be raised to a higher level.

Engaging external services

Steps such as undertaking a TRA (while similar in methodology to a plant safety assessment) are often tasks that the organisation may not have the resources to perform, at least initially. There is still a lack of skilled industrial cybersecurity staff in industry, and the organisation may not have the staff or resources to dedicate to the necessary training in the initial stages.

Many process and factory automation vendor organisations are now offering such services on a consulting basis, and there are also organisations specialising in this field. If your organisation has a good relationship with a trusted vendor, then taking advantage

of their services to assist in establishing a cybersecurity plan may be the most effective way to get started.

Implementation and training

The next step is to implement the measures proposed to close the gaps identified. Resources encompassing both hardware and software solutions are available for this purpose. And in the end it must not be forgotten that security solutions can only work properly if employees have been educated and trained accordingly. Employee awareness and understanding should be promoted continuously through effective and ongoing training, much in the way that safety training is achieved.

Network security

Network security is a core element of achieving industrial cybersecurity, and involves the protection of automation networks against unauthorised access and the control of all interfaces to other networks (such as the business network and, in particular, the internet). It also involves protecting communications against interception and manipulation.

Securing interfaces to other networks

Interfaces to other networks can be monitored and protected using firewalls and, where appropriate, by setting up a demilitarised zone (DMZ). A DMZ is a network in which technical security mechanisms protect access to all data, devices, servers and services. The systems installed within the DMZ are shielded from other networks by firewalls that control access. This separation makes it possible

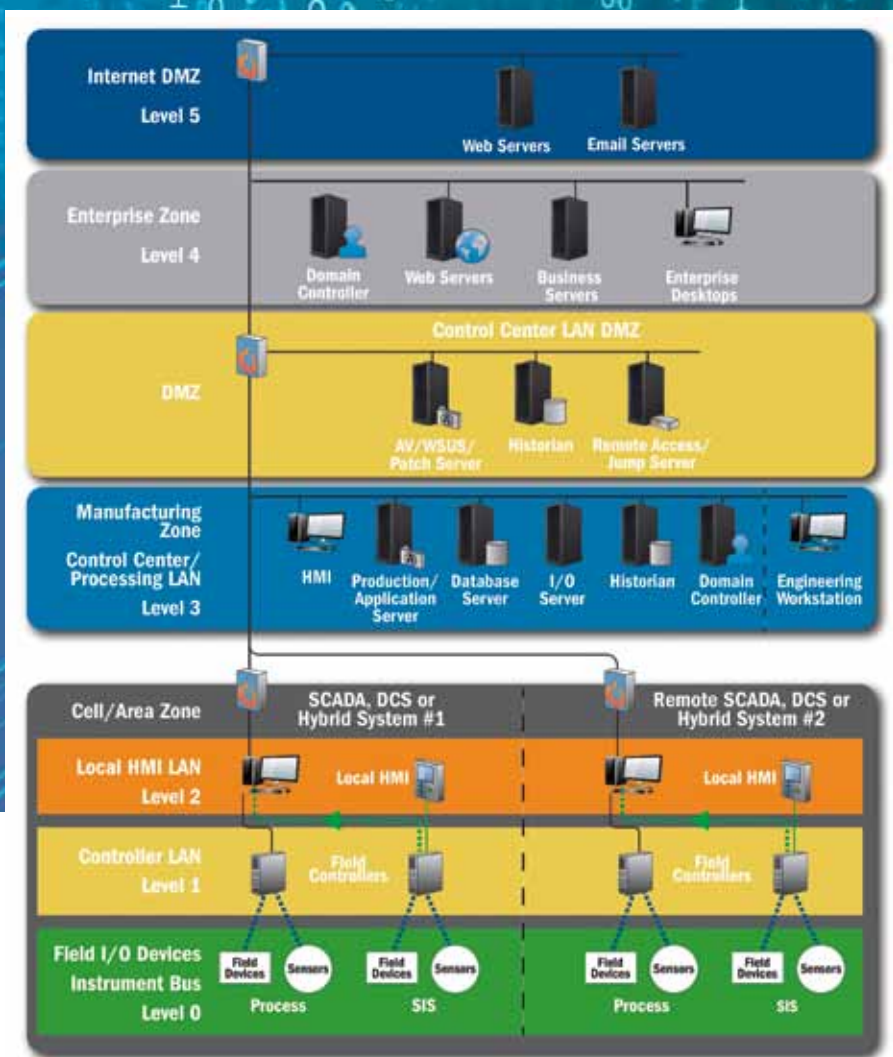


Figure 1: Defence in Depth architecture.

to provide data from internal networks (for example, the automation network) on external networks without having to admit direct access to the automation network. A DMZ is typically designed so that it also does not permit access or connections to the automation network, which means that the automation network remains protected even if a hacker gains control of a computer inside the DMZ.

Network segmentation and cell protection

The segmentation of the plant network to create discrete automation cells protected by technical security mechanisms helps to minimise risk further and increase security.

Network segmentation involves protecting elements of a network, such as an IP subnet, with a security device that separates them from the rest of the network. The devices within a segmented cell are protected against unauthorised access from outside without need of any compromise in terms of real-time capability, performance or other functions.

Of course data must also move in and out of the work cells. Data transmission to and from the cells can be controlled via the firewall device protecting the cell, permitting only allowed data communication to and from nodes external to the cell, and encryption can be employed to protect against unauthorised data monitoring/collecting and manipulation.

Secure remote access

It is becoming increasingly common to connect plants directly to the internet and to link up remote sites via mobile networks. This is normally done to enable remote

maintenance, to use remote applications and to facilitate monitoring of machines installed at sites external to the main plant, or at multiple plants.

The problem with such remote access via public networks is that hackers can find unsecured access points easily and inexpensively using search engines, port scanners or automated scripts. It is therefore very important to ensure that communication nodes are authenticated, data transmission is encrypted and data integrity is protected, especially in the case of critical infrastructure plants.

VPNs (virtual private networks) provide the security functions required, such as authentication, encryption and integrity protection and have proven to be particularly effective in securing communications provided they are correctly set up and monitored.

Remote access management platforms

Because industrial plants are often widely distributed, sometimes even spread across different countries, public infrastructure may be the only cost-effective way to ac-

cess plants and machines. Where a large number of VPN systems are required to be managed, one option is to use a secure remote management platform to manage these connections and secure, authenticate and authorise all communications.

Such platforms are commonly offered by automation vendors and also facilitate a way for the vendor to provide secure remote support and maintenance of the plant technology to better facilitate predictive maintenance services. It also enables OEMs, for example, to definitively identify a large number of similar machines in use with different customers and address them for remote maintenance.

Authorisation versus authentication

The concept of defence-in-depth also involves setting up multiple obstacles for would-be attackers to overcome. The principal concept here is the difference between authentication and authorisation: any actor that needs to act on an end object in a secure system must first be authenticated (identified) and then

authorised to act on an end object in a particular way. Specifically:

- **Authentication** is the process of determining that the actor (person, device or process) is known to the system and permitted to access it. The actor must be uniquely identified, and there may be multiple methods of doing so. We are all familiar with this from our banking transactions: passwords, PINs and tokens for example.
- **Authorisation** is the process whereby the authenticated user or process is associated with what objects (devices and functions) it can access and in what way. For example, being only able to access particular devices, particular tags, and only read or read and modify (write).

Managing many authorisations can be complex, and complex security management is prone to human error and security holes going undetected. It is therefore best practice is to establish a system of graded access rights or categories of rights and being able to define a role that encompasses a particular category of authorisations. Users or groups of users are then assigned these roles and thereby receive the corresponding access rights. This reduces complexity by not needing to assign rights to users specifically, and allows for easy and secure changes when staff change, for example.

The features and facilities for managing authentication, authorisation and roles should be an important consideration when evaluating control systems and security software or devices. Needless complexity (or lack of role-based management features) can in themselves raise security risk by increasing complexity.

System integrity

The third pillar of a balanced security concept is system integrity. The systems whose integrity is to be protected in this context comprise control components and automation, SCADA and HMI systems. These require protection against unauthorised access and malware or have to meet special requirements in areas such as the protection of expertise.

Protection of PC-based systems in the plant network

PC systems used in the office setting are typically protected against malicious software and have any weaknesses detected in their operating system or application software rectified by the installation of updates or patches.



THE FEATURES AND FACILITIES FOR MANAGING AUTHENTICATION, AUTHORISATION AND ROLES SHOULD BE AN IMPORTANT CONSIDERATION WHEN EVALUATING CONTROL SYSTEMS AND SECURITY SOFTWARE OR DEVICES.

Equivalent protective measures are also required for industrial PCs and PC-based control systems. Protective mechanisms familiar from the office environment, such as antivirus software, can also be used in industrial settings in principle, although it is essential to ensure that they have no adverse impact on the automation task. The problem with patching and updating these systems, however, is that such procedures are often intrusive and may require reboots. Each patch should also be tested to make sure it will not affect the automation processes that run the device.

The extra work and potential downtime that may result from patching PC-based automation equipment means that many organisations cannot keep them up to date in the same way that they can for the IT systems (which are inherently more tolerant of downtime).

One option to mitigating the risk from unpatched PC systems is whitelisting solutions. Whitelisting involves the creation of approved lists in which the user explicitly specifies those processes and programs that are permitted to run on the computer. Any attempt by a user or malware package to install a new program is then denied, preventing the associated damage.

There are also a number of integrated security mechanisms provided in the Windows operating system, such as a software firewall, which can also be configured as required.

Technology secure by design

The IEC 62443 standard states that security aspects should be considered as part

of product development and production. In other words, the automation devices used in a plant should be part of a holistic security-by-design concept from creation to production to use. Assets in this context can include source code, IT processes and production machines.

It is important to be sure that your automation vendor is implementing security in their product design and support, and this is particularly important for devices that have security functions.

Conclusion

The digital factory is only possible with new technologies and plant design, encompassing increasing interconnection, greater volumes of data and the use of open standards. Shying away from these developments on security grounds alone is no solution, as this course would result in your organisation falling behind competitively. Defending against threats and attacks is consequently a fundamental prerequisite for the digital transformation. Companies would be well advised to conduct a careful review of their data security situation, bearing in mind that engineering and technology alone can never suffice: organisational and technical measures must be coordinated holistically in a way that relies on people, processes and technologies working together.

References

1. US Department of Homeland Security 2016, Recommended Practice: Improving Industrial Control System Cyber Security with Defense-in-Depth Strategies.

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Using a built-in reference thermometer improves the accuracy of the calibration, reduces the amount of extra equipment that needs to be carried and, with the smart connector technology, it's easy to plug and measure with precision. Users can also use the reference sensor for more accuracy when calibrating shorter sensors that cannot reach the calibration zone of the insert.

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The iBASE Technology IDOOH-210-IR panel PC has been designed for deployment in an outdoor environment and has a 21.5" sunlight-readable display. It features 24 h operation in extended temperature environments and is rated for temperatures from -40 up to $+50^{\circ}\text{C}$. The IDOOH-210-IR is also IP65 rated, meaning it is both dust tight and water resistant.

The IDOOH-210-IR is powered by Intel's Atom E3845 1.91 GHz Quad-Core CPU and offers low power consumption.

The IDOOH-210-IR has many features that make it suitable for deployment in an outdoor environment, such as the infrared touch screen. The infrared technology enables it to be used in environments where a normal touch screen would not be suitable, eg, cold environments where gloves must be worn. An IR touch screen uses light to pick up movements, not the actual physical touch such as in a resistive or capacitive touch technology. The display is also IK06 vandal-proof glass, which is harder to damage than a traditional touch screen.



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PLC MOBILE APP

IDEC Corporation has released the WindEDIT Lite app for iOS and Android devices, providing two-way access to its range of MicroSmart FC6A PLCs. The app provides quicker, simpler and easier connection as compared to browser-based access, according to the company.

The app enables users to monitor any PLC parameter, as well as change set points and other values. Data register, input, output, timer and counter values can be monitored and controlled using the standard Dialog Interface. The app also has a custom Dialog Interface which the user can configure to allow only certain PLC parameters to be monitored and controlled. Trending is supported within the app, with users able to plot multiple register points for graphical views.

The app interfaces to the MicroSmart FC6A PLC via wireless Bluetooth or Wi-Fi for two-way local or remote access. It provides access to the SD memory card of the PLC, so logged data can be easily accessed, viewed and forwarded via text message or an email.

Logged data can also be pushed to a local or cloud-based database, or to a data storage platform such as Dropbox, Google Drive, Apple iCloud, etc. In addition to logged data, other data such as user programs, firmware, recipes, etc, can be sent and retrieved from databases and storage platforms.

Access to the PLC via the app needs to be configured in the PLC for each user, with each app user required to provide their correct username and password. Read/write protection is configurable for each designated user.

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Treotham is extending its Pflitsch blueglobe cable gland series with a flexible variant. Fitted with a multiple inlet, it allows the user to remove one or more of the three inlets as required simply using a screwdriver. The M25 cable gland can accommodate cables with diameters from 6 to 20 mm and provides an IP68 (15 bar) protection rating.

The advantage for the user is that with only one cable gland size, the product can be used to install all the cables most commonly found in automation, machine construction and electrical engineering applications. The required sealing range can be set in seconds without the use of special tools. The gland also achieves high strain relief up to class B as defined in EN 62444, making additional safety measures to prevent cables being pulled out superfluous in most applications.

The cable gland is available in the handy M25 size and in stainless steel grades AISI 303 and AISI 316Ti. It is approved for operating temperatures from -40 to +130°C. Slit versions of the sealing insert are available to allow quick and easy installation of preassembled cables.

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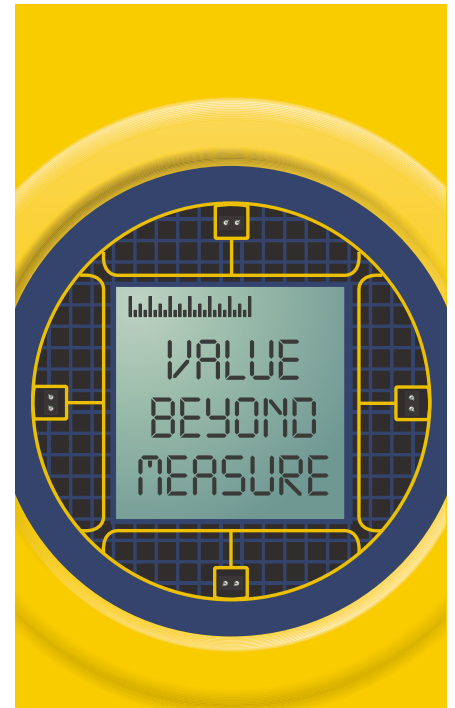
POWER QUALITY CLAMP METER

The Fluke 345 power quality clamp meter, available to rent from TechRentals, is suitable for commissioning and troubleshooting modern electrical loads such as variable frequency drives, electronic lighting and UPS systems. A low-pass filter and high EMC immunity design make the Fluke 345 suitable for noisy environments. The internal memory enables long-term logging for analysis of trends or intermittent problems.

The Fluke 345 allows users to measure and log harmonics and inrush current, as well as providing direct measurement of DC ripple (%) for battery and DC systems. This device has a clamp-on measurement of up to 1400 A RMS and DC current up to 2000 A without breaking the circuit. This power quality clamp meter has a high safety rating of 600 V CAT IV. Users can analyse data and generate reports easily due to the bright colour display and included Power Log software.

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Sunrise Dam gold mine implements a dewatering control system

AngloGold Ashanti's Sunrise Dam gold mine, located 55 km south of Laverton in Western Australia, began operations in 1995, commencing underground gold ore extraction by 2003. As the ore extraction started to go deeper underground, several electrical substation and pump stations were being installed across the mine to perform the hypersaline water-pumping duties from the pit bottom all the way to the surface.

An increasing number of manually operated pump stations — as well as limited data about running hours per drive, equipment faults, pressure readings and volume of water being displaced to the top — led to engineering studies that concluded on the necessity to implement a dewatering process control system (PCS).

KAPP Engineering, as a systems integrator that has an ongoing working relationship with AngloGold to maintain and support the operations for the respective processing plant, was engaged to design and develop the PCS that would ultimately monitor, interconnect and control the dewatering function of the underground operation.

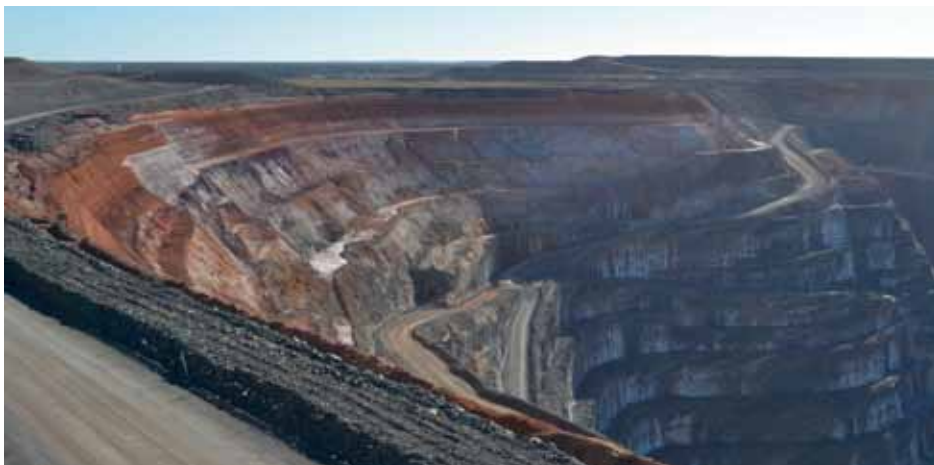
The solution was to integrate nine independent mono pump stations, four diesel pump stations, an intermediate flow monitoring station and two additional subsystems: an underground vent fan and stench gas release system respectively.

PLCs and SCADA servers were implemented in a redundant configuration, with two single-mode optic fibre rings to carry the field I/O data and SCADA data respectively. The rings, forming the backbone of the control architecture, provide self-healing and rapid recovery times in the event of a failure.

Rockwell Automation Allen Bradley 1756-L74 PLCs were selected for controlling the operations of the entire dewatering system, having two EtherNet/IP adapters, which allowed the ability to have two independent networks sharing the same control data. The first Ethernet adapter was assigned the field and I/O data traffic, communicating using EtherNet/IP through an optic fibre ring. The ring itself is composed of 18 Moxa industrial switches with a Turbo Chain redundancy protocol, interconnecting 15 POINT I/O EtherNet/IP adapters with respective I/O cards.

A second Ethernet adapter was assigned for the monitoring of SCADA data traffic using an independent optic fibre ring interconnecting three Moxa switches, two Dell PowerEdge R710 servers running CitectSCADA, and two SCADA clients for the underground infrastructure department and Barminto's mine operation shift supervisor.

The CitectSCADA servers are set up in a manner that allows automatic detection of a server failure and automatic failover, ensuring that the SCADA system will be available as long as one of the two servers remains operational.



Critical pump stations were allocated with a standalone Allen Bradley L74 PLC and PanelView Plus operator interface panel to give the operators the option of controlling it locally and independently in case of communications failure. This is the case for the level 2225 pump station, which is controlling eight mono pumps and three diesel rental pumps, and similarly for the level 2004 (Hammerhead) pump station controlling two trains of three pumps each.

In normal operation these standalone controllers communicate with the main redundant dewatering controller performing a produce/consume procedure, making the local tags available to be monitored and controlled by the SCADA system up in the surface.

Specific situations require customised implementation, as in the case of the diesel rental pump stations installed during the wet and rainy seasons to support the operation. These pumps are controlled locally by DCU Intelidrive unit with Modbus RTU capabilities and through several protocol conversions, making the data available for the main controller to read data and command the start and stop of the drives. These protocol conversions consisted of a first Modbus RTU (RS-232) to RS-485 to achieve longer transmission distances and then a second RS-485 Modbus RTU to EtherNet/IP.

"Without the ability to see the various pumping stations within the dewatering network underground, it was very difficult to identify any issues with the overall mine water balance and establish if there were any underperforming pumps or pump stations," said Richard Austin, underground infrastructure superintendent at Sunrise Dam. "Implementing a de-watering process control system gave us the option of controlling and monitoring the pump stations underground and in the pit, while having reporting capabilities on the volume of water being pumped out to the surface. Trend analysis proves to be a very useful tool to manage pumping networks."

A slightly longer version of this article can be read online at: <https://bit.ly/2IfIUZI>

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The DOSIC ultrasonic sensor from SICK operates according to the concept of time-of-flight difference and provides an alternative to Coriolis mass flowmeters. The sensor can detect a wide range of challenging liquids and matter for beverage and food production, irrespective of their properties.

The absence of moving parts in the sensor eliminates potential contamination risks in the demanding hygienic environments of the food industry. Also, the sensor has a straight, seal-free and self-emptying measuring tube made of high-quality stainless steel (316L with Ra ≤0.8). The stainless steel housing also provides the necessary ruggedness and resistance. The sensor therefore has EHEDG certification and demonstrates FDA compliance, since there is no contact between the sensor and the flowing matter, and the flow volume is determined in a non-contact manner.

Aggressive cleaning agents in CIP and SIP operations are not a problem either. The sensor can easily withstand temperatures up to 143°C in SIP processes for up to 1 h. The rugged design ensures a long service life and reduces the need for maintenance.

The DOSIC is available in two sizes (DN15 and DN25) and can be used in the most confined spaces. Two configurable digital inputs and outputs, and up to two analog outputs and an IO-Link interface, ensure that the system monitors and implements effectively.

It is not necessary to set specific parameters before the measuring process. If the medium is changed, the sensor automatically adjusts its parameters accordingly.

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SIL CERTIFIED VORTEX FLOW METERS

Facilities with safety instrumented systems can now take advantage of the SIL 2/3 functional safety certification of Emerson's Rosemount 8800 vortex flow meters, per IEC 61508, which can help mitigate risk, enhance plant safety and protect personnel.

The non-clog Rosemount 8800 vortex flowmeter range offers safety and reliability features such as online removable sensors to reduce process downtime and a critical process valve for aggressive applications, which increases personnel safety by preventing exposure to hazardous fluids. A variety of configurations are available to suit a variety of requirements, including flanged, wafer, reducer, dual and quad meter body styles, supporting installations in up to 300 mm line sizes.

Per an accredited third-party assessment, a single Rosemount 8800 vortex meter may be used up to SIL 2. The dual vortex meter is capable of up to SIL 3 and offers a simple drop-in solution to reduce installation costs. This configuration includes single or dual shedder bars, dual sensing elements, and dual transmitters for redundancy and 1oo2 voting to reduce unexpected shutdowns.

In addition, the Rosemount 8800 Quad Vortex uses a dual shedder bar, quadruple sensor and quadruple transmitter configuration to meet hardware fault tolerances and eliminate the need for multiple flow meters. This option offers the highest level of reliability to guard against spurious trips using 2oo3 voting and includes a fourth transmitter for process control.

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OPERATOR INTERFACES

The GE QuickPanel+ operator interfaces range integrates process control, view and an option to run an embedded data historian for real-time control in one complete unit.

Available in 6", 7", 10", 12" and 15" screen sizes, the product is a high-performance controller supporting the five IEC programming languages — relay ladder, sequential function chart, structured text, instruction list and function block diagram — along with support for a wide selection of controllers and I/O from multiple vendors.

With a wide-screen, high-resolution display to provide vivid, clear images and enhanced process visualisation, the product offers PC functionality such as remote desktop, web browser, built-in peer networking, and FTP and HTTP servers.

Control Logic Pty Ltd

www.control-logic.com.au

PROFINET BUS CABLE WITH HIGH TENSILE STRENGTH

Bus cables often reach their mechanical limits in hanging applications due to their small cross-section and more fragile design. The CFSPE-CIAL.182.060 bus cable for Profinet has special strain relief elements in the PUR outer jacket that decouple the sensitive bus elements from the high tensile forces. All vertical applications, such as storage and retrieval equipment, can now be safely supplied with bus signals.

Due to its special structure with integrated strain relief elements, the cable can allow hanging applications of 100 m and more, and can carry the weight of the cable up to 50 kg.

The CFSPECIAL.182.060 is shielded and features an abrasion-resistant PUR outer jacket with integrated strain relief fibres. The cable is resistant to oil and coolant, as well as to hydrolysis and microbes. The cable is also impact-resistant and free of PVC and halogen.

Treotham Automation Pty Ltd

www.treotham.com.au



SOFT STARTER WITH INTERNAL BYPASS

The Allen-Bradley SMC-50 smart motor controller with internal bypass is intended to bring greater operational control over motor starts and stops.

Soft starters traditionally use solid-state, silicon-controlled rectifiers (SCRs) to control voltage to the motor during start-up, runtime and shutdown. The reduced torque and current slowly introduces energy to the motor, mitigating electrical and mechanical stress to the application. If these SCRs remain in the circuit once the motor is up to speed, the heat generated by these devices leads to electrical inefficiency.

With the smart motor controller, users have the option of choosing the proper power structure for their application. For operations that run over an extended period, built-in internal bypass allows users to shift from solid-state switches to bypass contactors. By switching over to the bypass circuit, users can save on energy by minimising excess heat build-up.

The smart motor controller with internal bypass also provides access to several communication modules, including EtherNet/IP and DeviceNet networks.

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REMOTE I/O MODULE

Artila Electronics has announced the RIO-2017PG, a compact remote I/O module with up to eight isolated analog input channels. It provides programmable input ranges on all channels and is powered by an ARM processor and the FreeRTOS operating system.

For users who would like to develop their application software using the module, Artila provides tools including a C compiler and debugger.

Each analog input channel can be configured as current and voltage and it is auto-calibrated with 2500 V isolation. In addition to the analog input, the product also has a relay output. It is suitable for remote data acquisition and control, and for other industrial measurement and monitoring applications.

Micromax Pty Ltd

www.micromax.com.au



CYBERSECURITY-CERTIFIED CONTROL SYSTEM

Emerson has launched DeltaV version 14. The latest release is said to provide significant innovations to the entire DeltaV architecture, and includes several enhancements to eliminate costs and reduce complexity in capital projects, plus improve productivity during operations through enhanced access to production and equipment data, improved usability and greater security.

Continuing to advance DeltaV Electronic Marshalling with CHARMs on capital project engineering, CHARM I/O Block takes CHARMs closer to the field. Small enclosures with up to 12 CHARMs can now be installed closer to field devices, significantly reducing wiring and overall installation costs by as much as 60% and providing more engineering flexibility.

Smart Commissioning has been expanded to reduce device commissioning time to as little as 10 min, a nearly 93% reduction in costly commissioning.

DeltaV Live Operator Interface is a modern, built-for-purpose operations experience that is easy to understand and modify. The HMI comes pre-engineered with the industry's best practices for user experience including ISA 101.01, and the HTML5 interface enables scalable graphics and gives operators the flexibility to adjust their displays to focus on process data that is most important for each situation.

DeltaV is also said to be one of the only systems to have a top-to-bottom cybersecurity certification, and will be certified ISASecure SSA Level 1 by the International Society of Automation (ISA).

OPC UA access is also expanded in Emerson's DeltaV hardware and software offerings. DeltaV applications and servers can now securely share data to cloud analytics applications, remote monitoring solutions and third-party technologies.

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POWER SUPPLY

The Phoenix Contact Trio Power supply range now includes a 40 A device.

High system availability is a high priority for all machines and systems. This power supply provides dynamic boost, which also starts heavy loads, with 60 A and thus 150% of the nominal current for 5 s. The robust design, with its high electric strength, high MTBF values of over 1 million h, active function monitoring with DC OK LED and floating signal contact, ensures that all connected 24 VDC loads are reliably supplied.

Tool-free wiring with push-in connections saves time during installation. With an overall width of 110 mm, the three-phase 40 A device provides space in the control cabinet. The wide operating temperature range of -25 to 70°C ensures a high level of flexibility in terms of deployment. The wide input voltage range from 320 to 575 VAC and the comprehensive approval package enable use worldwide.

Phoenix Contact Pty Ltd

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SERVER FOR THE POWER INDUSTRY

The RS37AS17 from Crystal Group is a rugged server designed to meet a growing demand for a quick way to modernise and streamline power generation and distribution substations, boost efficiency and security, reduce costs, minimise downtime, and meet current and future requirements.

The RS37AS17 3U Rugged Server converges key data-handling capabilities — including high-performance processing, storage and networking — in a single, rugged, reliable server designed to bring military-grade durability and reliability to power substations. It can replace multiple ageing devices with a single, compact solution to reduce size, weight, power and cooling overhead, as well as streamline maintenance.

The RS37AS17 is completely configurable with four drive bays, three PCI Express (PCIe) slots, support for up to 1 TB of memory and flexible I/O. Compute, storage and networking capacity can be added quickly and easily to accommodate future upgrades and expansion.

It has been designed specifically for critical power infrastructure applications. High-quality components are stabilised in a rugged aluminium enclosure with advanced thermal management to boost system reliability, availability and survivability in the face of challenging conditions and extreme environments, including shock and vibration, extreme temperatures, humidity and more at even the most remote power substations — where consumer-grade systems may fail.

The RS37AS17 is designed and tested to meet or exceed the IEC 61850-3, IT-65, IEEE 1613 (surge only) and MIL-STD-810 standards, and complies with Export Control Classification Number (ECCN) 5A992.c. It leverages the latest commercial off-the-shelf (COTS) technologies such as Intel Xeon scalable processors and VMware virtualisation software.

Metromatics Pty Ltd

www.metromatics.com.au

SECURITY APPLIANCE

The Tofino Xenon Security Appliance Release 3.2 supports the Tofino Xenon Generic Object-Oriented System Events (GOOSE) Enforcer Loadable Security Module (LSM), to help protect critical energy infrastructure. The plug-in security module ensures data packets are delivered in a secure and scalable manner.

The product is said to enable users to better manage networks through several features. They can simplify compliance to safety and security standards with updated protection against attacks and misconfigurations, as well as reduce downtime, maintenance time and production losses by managing large deployments of data from a central location. In addition, improved integration capabilities with Tripwire solutions are said to improve system stability.

The Tofino Xenon GOOSE Enforcer LSM, the featured update to Release 3.2, is suited to sectors that require enhanced DPI to prevent attacks and support dispersed network communications, SCADA Master Station protection and NERC CIP compliance. The device is suitable for industrial markets that communicate over long distances, often from a centralised location, such as the energy, manufacturing, machine building, food and beverage, and water/wastewater sectors.

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WIRELESS LINKS AND NETWORKS

DETERMINING YOUR ANTENNA NEEDS

Glenn Johnson, Editor, Process Technology

In today's industrial environments, wireless networks are becoming increasingly commonplace. Most process and automation engineers are not necessarily trained in radio physics, so here is a basic antenna primer.

The use of wireless technology in industrial environments is on the increase, whether that be common standards-based technologies such as 802.11 Wi-Fi, or proprietary systems for long-distance communication. But whatever the technology used, the signal must successfully propagate between a transmitter and receiver node successfully, and that means successfully converting the RF electrical signal from the transmitter into an electromagnetic wave in free space, and then converting that wave back again at the receiver. The device that couples the electrical signal to the air is, of course, the antenna.

The true design of antennas and how they couple electromagnetic energy would appear to many to be a bit of a black art: a piece of metal sticking up in the air somehow sends and receives information out of the 'ether'. The true physics of antenna design involves the complex geometry calculus of electromagnetic field theory, and is a practical application of the famous Maxwell equations.

The antenna is possibly the most important and influential element of your wireless system design, because the right antenna can make your radio system sing, while the wrong one can be a disaster. Sometimes, in applications where radio reception is unduly influenced by interference, or where the signal strength is only just making it (and maybe fades in bad weather, for example) then choosing a higher gain antenna may solve the problem simply and easily.

In industrial environments there may be many elements that can interfere with the clear reception of a signal at the receiver, and a good application of the right type of antenna (or combination of antennas) can customise the transmission path to your needs.

This article is about the basic knowledge of the key performance characteristics of antennas commonly used. Of course, antennas come in many shapes and sizes, ranging from the small antenna hidden in your smartphone, to the multi-element arrays that your television uses, to the huge dish antennas you see at satellite base stations. This article will focus on the basic designs and how they are practically implemented.

General features of antennas

Every antenna has its own specific design characteristics that determine the range and radiation pattern of the radio signal. Also, if you analyse its radiation pattern for transmitting, its sensitivity pattern for receiving is the same. That is, the direction in which it transmits the strongest is also the direction in which it is most sensitive for receiving.

But what do we mean by radiation pattern?

If we transmit a constant power from an antenna, and then measure the strength of the radiation at a fixed distance in a sphere around the antenna, we get a variation in received signal strength depending on what angle we are to the antenna. This can be charted as a 3D geometrical shape showing where the signal



is stronger (more focused) and where it is weak, or even non-existent. No antenna transmits equally in all directions spherically.

Two antennas will 'couple' best when they are geometrically aligned on the best transmitting/receiving axis. In between them is the free space over which the energy will propagate, and there is a 'free space loss' associated with the propagation that means only a portion of the transmitted energy will arrive at the receiver.

Gain

The shaping of the radio signal is what is referred to as antenna gain. The higher the gain of an antenna, the more focused the signal.

Antenna gain is measured in decibels. A decibel is a logarithmic ratio between a specific value and a base value of the same unit

of measure. With respect to radio power, dBm is a ratio of power relative to 1 mW, where 1 mW equals 0 dBm.

Table 1 shows the logarithmic relationship between dBm and power ($10\log(P)$): a small change in dBm results in a large change in power.

For every reduction of 10 dBm the power is reduced by a factor of 10 and power levels below 1 mW are negative decibels. The system's power is reduced by half with a change of only -3 dBm.

Specifications for most antennas refer to the gain in either dBi or dBd. The first one, dBi, is decibels relative to an isotropic radiator — a theoretical model antenna with a perfectly spherical radiation pattern (a point). Such an antenna, if possible to create, would radiate all the energy in all directions equally, so would

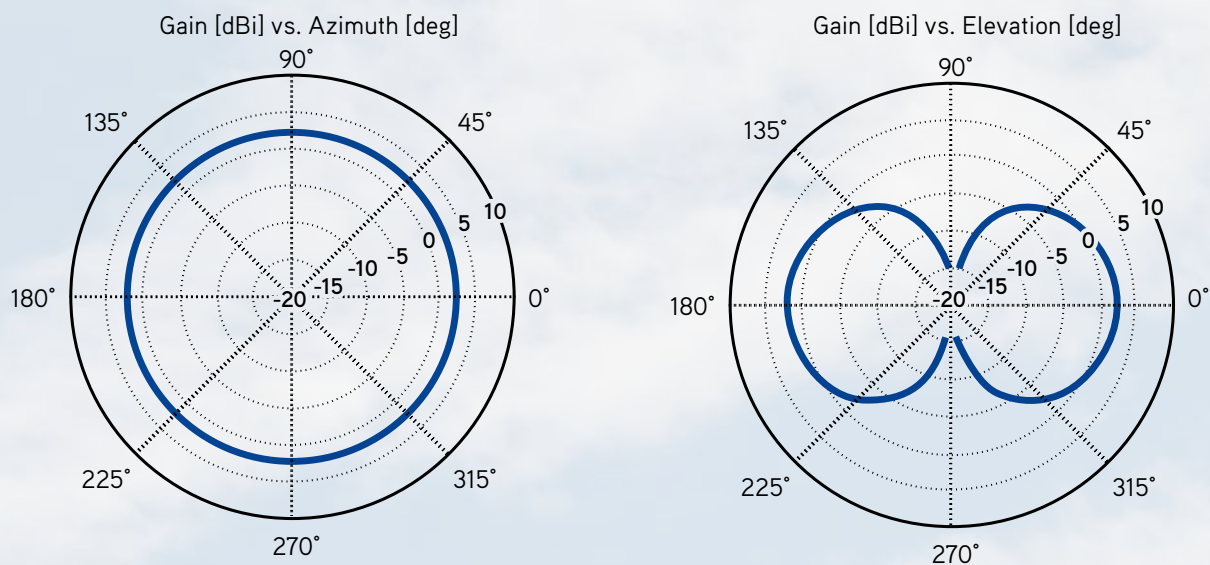


Figure 1: The radiation pattern of an omnidirectional antenna when viewed from the end (azimuth) and from the side (elevation).

not add to the transmitted power in any direction. This unit is commonly used, and so all antennas have a positive gain in dBi. Sometimes antenna gain is specified in dBd: decibels relative to a simple dipole antenna. At the operating frequency of the antenna (the frequency it is tuned to) 0 dBd is equal to 2.15 dBi. In other words, a simple dipole antenna has a gain of 2.15 dBi.

dBm	Power
+30	1 W
+20	100 mW
+10	10 mW
+3	2 mW
0	1 mW
-3	500 W
-10	100 W
-20	10 W
-30	1 W

Table 1: dBm versus power (W).

Omnidirectional antennas

The dipole antenna mentioned above is an example of an omnidirectional antenna. As the name implies, an omnidirectional antenna transmits and receives radio signals equally in all directions. But omnidirectional does not mean the same as isotropic: the omnidirectional antenna radiates equally in all directions on its axial plane, but the signal weakens at angles off-centre to that plane. In other words, the radiation pattern looks like a circle when viewed from the end of the antenna, but is a toroid, or doughnut-like shape, when viewed from other angles (see Figure 1). A good example of an omnidirectional antenna is a radio station transmission tower or the antennas used on mobile phones or walkie-talkies.

Notice from Figure 1 that the decreased energy sent vertically increases the energy transmitted horizontally. The radiation pattern stretches to extend the range, focusing the signal along a horizontal plane. When we say a dipole antenna has a gain of 2.15 dBi we are referring to the central horizontal axis of the radiation pattern (where it is strongest). Notice there is also only a weak signal very close to the antenna, so that the signal may be lost if the angle off centre is even very small.

In a wireless network, omnidirectional antennas are best suited to indoor environments and for devices at the centre of a star topology network. For long-range point-to-point communications, omnidirectional antennas would not be the best option, since they would waste energy radiating in unwanted directions.

Directional antennas

Only dipole antennas can really be considered omnidirectional. Other designs tend to focus the energy more in a given direction or axis. There are many designs of directional antenna.

There are two general techniques that are used to do this. One technique is to use large metal surfaces such as parabolic reflectors (think satellite dish) or horns, which change the direction of the radio waves by reflection or refraction, to focus the radio waves from a single low gain antenna into a beam. This type is called an aperture antenna.

A second technique is to use multiple dipoles in an array, fed from the same transmitter or receiver. If the currents are fed to the antennas with proper phase difference, due to the phenomenon of interference the waves from the individual antennas combine (superimpose) at various angles around the array. In directions in which the waves from the individual antennas arrive in phase, the waves add together (constructive interference) to enhance the power radiated. In directions in which the individual waves arrive out of phase, with the peak of one wave coinciding with the valley of another, the waves cancel (destructive interference) reducing the power radiated in that direction.

A Yagi-Uda antenna (usually known simply as a Yagi), named after its Japanese inventors Shintaro Uda and Hidetsugu Yuda, is a commonly used version of a multi-element array. It is made up



Figure 2: A commonly available Yagi antenna for 2.4 GHz Wi-Fi with a gain of 13 dBi. Note the one reflector behind the driven element and 13 directors.

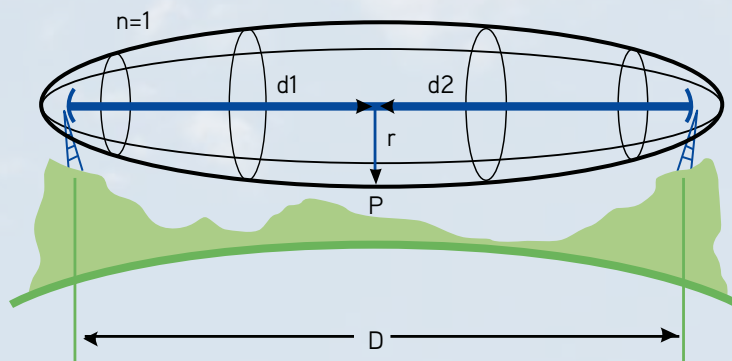


Figure 3: Even with clear line of sight, obstructions in the Fresnel zone may still cause reception problems.

of a series of different sized dipoles spaced at specific distances from each other, to enhance the signal strength in one direction and weaken it in another, as they interfere with or enhance one another. Only one element is driven while the other passive elements act as directors or reflectors, depending on their position and length. Depending on the design, a Yagi can typically have a gain of up to 20 dBi.

Yagi antennas are suitable for long-range communications. In process control and SCADA networks, Yagis are often used in outdoor applications like tank level monitoring. There must be a line of sight between the antennas.

The importance of line of sight

When using directional antennas, any obstructions, including buildings, trees or terrain, that interrupt the visual path between antennas will also interfere with the radio signal transmission, resulting in multipath fade or increased signal attenuation.

Multipath fade is the result of radio signals reaching the receiver via two or more paths. In industrial settings, a received signal may include the line-of-sight signal in addition to signals reflected off buildings, equipment or outdoor terrain.

There is a space around the radio 'beam' known as the Fresnel Zone, in which obstructions, even if not in the direct line of sight, can cause reflections and attenuation of the signal. The Fresnel Zone is an ellipsoid shape, and is thickest at the centre-point of the radio path. Antennas need to be raised high enough so that no obstructions come within the Fresnel Zone.

The size of the Fresnel Zone at any point on the path can be calculated, and is based on wavelength and the distance between the measurement point and the two antennas.

$$r = 17.31 \sqrt{\frac{d_1 d_2}{fD}}$$

where:

r is radius of the Fresnel zone in (m)

d_1 is the distance from the transmitter (m)

d_2 is the distance from the receiver (m)

D is the total link distance (m)

f is the link frequency (MHz)

This is not the height above the ground, but the radius of the zone around the line-of-sight path.

A site survey should always be conducted before committing to antenna placement.

Calculating link margin

Radio receivers have a minimum sensitivity (measured in dBm) below which they will not receive a usable signal. In order to select an antenna pair with the necessary gain to ensure a received signal, it is necessary to calculate the link budget. Essentially, the link budget is an indicator of link performance. Once we know the transmit power, the transmitting and receiving antenna gains and the free space loss over the link path, then we know how strong the signal is at the receiver.

Using decibels means that the formula for link budget is a simple addition of gains and losses. Gain (G) is positive in dB and losses (L) are negative. A full calculation also takes into account small losses for connectors and cables, as follows:

$$P_{rx} = P_{tx} + G_{tx} + L_{tx} + L_{fs} + G_{rx} + L_{rx}$$

where:

P_{rx} is the received power (dBm)

P_{tx} is the transmitter power output (dBm)

G_{tx} is the transmit antenna gain (dBi)

L_{tx} is the transmitter losses, coax, connectors etc (dB)

L_{fs} is the free space path loss (dB)

G_{rx} is the receiving antenna gain (dBi)

L_{rx} is the receiver losses, coax, connectors etc (dB)

An additional element for fading and other path losses (if estimated) can also be added.

Another term you may come across is EIRP, or effective isotropic radiated power. This is the first two elements of the equation above (transmitter power plus antenna gain) and represents the effective power transmitted in the centreline of the main radiation lobe.



THE ANTENNA IS POSSIBLY THE MOST IMPORTANT AND INFLUENTIAL ELEMENT OF YOUR WIRELESS SYSTEM DESIGN, BECAUSE THE RIGHT ANTENNA CAN MAKE YOUR RADIO SYSTEM SING, WHILE THE WRONG ONE CAN BE A DISASTER.

The difference between the received signal strength and the receiver sensitivity is known as the link margin. The link margin needs to be greater than 0 dB to be a working link (the received signal is greater than or equal to the receiver sensitivity).

Since it is an idealised calculation, not taking into account natural variables such as weather or other forms of interference, the link margin is effectively how much additional attenuation can be tolerated by the receiver: the higher the margin the better.

Free space loss

Free space loss is caused by the geometric spreading of the wavefront. The energy is spread over an area that increases with distance from the transmitting antenna, so the power density per unit area diminishes. Figure 4 shows free space loss versus distance for two common Wi-Fi frequencies.

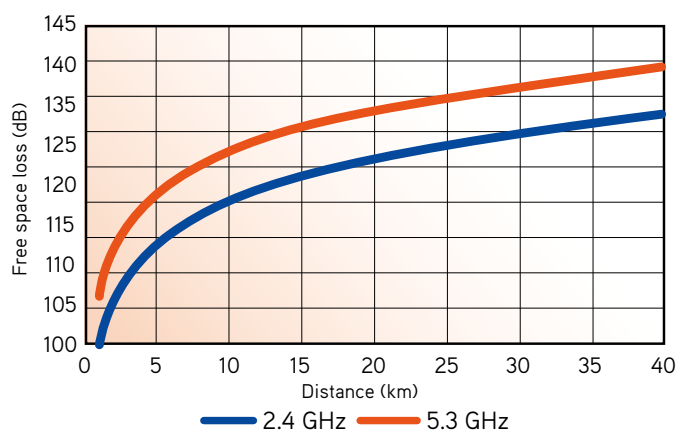


Figure 4: Free space path loss at 2.4 and 5.3 GHz.

The idealised free space loss is calculated using:

$$L_{fs} = 32.45 + 20 \log(d) + 20 \log(f)$$

where:

L_{fs} is the free space path loss (dB)

d is the distance in (km)

f is the carrier frequency (MHz)

For example, a 2.45 GHz signal transmitted over 5 km will exhibit an ideal free space loss of -114 dB.

Assume we have a receiver with a sensitivity of -82 dBm. If the signal is transmitted from a transmitter with a power of 20 dBm and an antenna with 10 dBi gain, the receiver antenna has 14 dBi gain and the cables cause a loss of 2 dB at each end, then we have a received power of:

$$P_{rx} = 20 + 10 - 2 - 114 + 14 - 2 = -74 \text{ dBm}$$

The link margin is therefore +8 dB, so the link should work.

Conclusion

As you can see, determining the appropriate components for your radio system is not as complex as it might appear, without detailed knowledge of radiophysics.

Data sheets for all radio transmitters, receivers, antennas, cabling and connectors should list the transmit power, receive sensitivity, antenna gain and cabling losses. Connector pairs may have a 0.5 dB loss while a lightning arrestor could include a loss of 0.5 to 1.5 dB. Cabling losses vary by manufacturer and are typically listed per unit length of cable.

The only parameter to be determined for the specific application is free space loss. Using the equation for free space loss, you should be able to determine if there is sufficient link margin for each link in a point-to-point radio system.

Disclaimer

I should add a small disclaimer. There are other parameters that affect antenna performance, which are beyond the scope of this article. For example, if an antenna is mounted on a metal structure or surface, the structure acting as a 'ground plane' can alter the radiation pattern of the antenna, and focus it more or less in different directions, depending on its shape, so placement can be important if your link margin is small.

Also, every antenna has a characteristic impedance, and for best results (minimum losses), the cabling and connector system should match the antenna's impedance as closely as possible. If you are buying your equipment from a good supplier, this should be easy to sort out.

There are also many types of antenna design: this article only gives general examples.

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Cyber-secure SCADA platform for Arkansas utility

Clarksville Light & Water (CLW) is a municipally owned utility that has been serving the Clarksville, Arkansas, community since 1913. With annual revenues of approximately US\$25 million, it provides retail electric, water and wastewater services to the community as well as water to eight other cities and water districts in the region on a wholesale basis. It plays a major role attracting new investment from the business community, driving job creation. Towards that end, CLW recently enhanced



its municipal infrastructure with 26.9 km of 288-strand fibre cable in redundant loops throughout the city. CLW General Manager John Lester recognised the opportunity to leverage that investment into long overdue monitoring and control of the city's four electrical substations and water treatment and distribution operations, and eventually its wastewater utility systems.

"A fibre network communication system was the most reliable, cost-effective and secure network we could put in place. It also offered the potential to layer in other revenue generation services, both internally and externally," he said. "The fibre-optic network gave us a way to tap that new functionality for our remote operations."

To that end, CLW has implemented a Bedrock Automation control system for cyber-secure SCADA RTU monitoring and control of its electric, water and wastewater utilities. The project is part of the city's plan to save up to US\$2 million over the next five years through improved control, monitoring and security of its electric grid and water treatment facilities.

"When we learned that choosing Bedrock as our RTU system would mean that military-grade cybersecurity was already built in, we saw a very cost-effective way to reduce cyber risk while also addressing looming NERC CIP compliance requirements," said Lester.

With the new system in place, CLW now controls functionality via remote access for RTU sites as well as 24/7 automated and on-demand remote monitoring of key assets. That kind of connectivity enables the utility to optimise asset maintenance actions through custom email and text alerts based on real-time data. The system is already generating results according to Lester.

"This project has reduced overtime: a direct savings. Problems can be identified, sometimes even solved without having to physically be at the plant or in the field. That translates into cost savings, improved reliability and higher customer satisfaction," he said.

Bedrock certified solution provider Brown Engineers, of Little Rock, Arkansas, completed the installation in the second quarter of

2016 and the system is now in full operation. Brown Engineers is a consulting engineering company that provides mechanical, electrical and automation systems. The company has extensive experience in SCADA, control systems and system integration for water, sewer and electric utilities.

Brown Engineers paired the Bedrock control platform with Inductive Automation's Ignition software platform to deliver an integrated, secure open systems solution that enables Clarksville Light & Water to proactively manage critical infrastructure assets both on-site and remotely.

"We wanted each substation RTU to have enough horsepower to aggregate all power meter data and protective relay data for sequence of event recording," said Dee Brown, PE and principal at Brown Engineering. "We also considered the future development needs for power management techniques that support demand management and load shedding controls."

"The Bedrock controllers provide all those features in an easy-to-manage integrated development environment (IDE) as well as built-in cybersecurity protections embedded at the hardware level."

Each Bedrock controller uses an electromagnetic backplane instead of a traditional pin-based backplane, which eliminates pin corrosion and breakage, while improving long-term reliability. The electromagnetic backplane also contributes to the system's high security by preventing the possibility of using counterfeit I/O modules. A galvanic isolation barrier between field wiring and the controller provides a high degree of electrical protection and reliability in electrically noisy environments — ensuring accurate measurement in the presence of high voltages like those found in power substations.

Brown explained it this way: "This platform scales easily from a single RTU or PLC to supporting a complex control network...and all applications can be engineered from the same dozen or so part numbers."

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HMI SOFTWARE UPDATE

Rockwell Automation has updated its HMI software to equip industrial workers with better information to run and maintain their systems. Updated features in the FactoryTalk View software version 10.0 include greater access to information, mobile device support and better cross-software integration to improve productivity.

Operators can now use the TrendPro tool in FactoryTalk View Site Edition (SE) software to overlay alarm information on trend data. This feature can help them connect alarm occurrences with data-point values to speed up troubleshooting. They can also use the tool to save and share ad hoc trends with other workers. It also adds support in the HMI for flexible alarming with the Allen-Bradley Logix line of controllers. With tag-based alarming, operators can create the alarm configuration in Logix and the HMI will process it automatically, which saves time by reducing the need for programming.

FactoryTalk View SE v10.0 also integrates the ThinManager software login into the FactoryTalk View platform. User can now use an automatic login pass-through for easy and fast operations.

For process industries, the FactoryTalk View SE software introduces an abnormal situation management (ASM) multimonitor framework. This feature allows operators to see different levels of data across multiple screens in accordance with standards-based ASM guidelines.

The updated FactoryTalk ViewPoint software, which extends the FactoryTalk View SE software to mobile devices, now supports recipe management, as well as alarm history. The FactoryTalk View Machine Edition (ME) software v10.0 adds design time and runtime enhancements to improve user efficiency and productivity.

Rockwell Automation Australia

www.rockwellautomation.com.au



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MINIATURE TRIAXIAL ACCELEROMETER

The Model 35C from Meggitt Sensing Systems is said to be the world's smallest IEPE triaxial accelerometer. The ultraminiature design and lightweight footprint of the device is suitable for applications in restricted spaces, such as in automotive, aerospace, precision machinery, human body and consumer electronics, where conventional accelerometers are not suitable.

The 35C accelerometer is manufactured with a titanium case and hermetically sealed for protection from humidity, corrosive materials and other contaminants that may damage or deteriorate the device performance. It also has three sensitivity options which maximise its potential for use in a wide variety of test applications. The high signal-to-noise ratio and low-noise design fosters accurate measurements.

The device also passes CE and RoHS certifications and is environmentally safe. It also comes with a calibration certificate, a removal tool, and optional cables and signal conditioners for complete integration into the system.

The 35C weighs 0.75 g and is a cube 5.9 mm in size, it has a sensitivity of 2.5, 5 or 10 mV/g, a frequency response of 2 to 8000 kHz ($\pm 5\%$) and a shock limit of 5000g. It comes with a 92 cm cable terminating in a 4-pin connector.

Bestech Australia Pty Ltd
www.bestech.com.au



ARM-BASED HMIs

Aplex Technology's ARMPAC Series of industrial ARM-based HMIs runs at low power levels with built-in memory and storage. Based on processor performance, the ARMPAC Series provide two levels of HMI from entry to high-performance grade.

The ARMPAC Series features an IP65 flat front bezel, not only preventing water and dust from penetrating and accumulating inside the computer in harsh environments, but also allowing the PC's front panel to be easily cleaned.

The ARMPAC 5 Series is available from 5.6" to 12.1" TFT-LCD and the ARMPAC 6 series comes in 7" to 21" TFT-LCD with the resolution up to 1920 x 1080 (full HD). Additionally, both the ARMPAC 5 and ARMPAC 6 support a 7H anti-scratch projected capacitive/resistive touch screen. The ARMPAC Series also supports a sunlight-readable solution with auto-dimming for providing the viewable surface while operating in high brightness environments.

The ARMPAC 5 and 6 have more room for expansion by the way of Aplex's TB-508 Series of expansion boards allowing the addition of extra COM ports or even CANbus features. The ARMPAC 5 and 6 Series supports comprehensive communication modules such as Wi-Fi, Bluetooth, GPS, 3G/4G LTE and PoE.

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UNIVERSAL TRANSMITTER

The ECD Model X80 Universal Transmitter is a single- or dual-channel transmitter designed for the continuous measurement of pH, ORP, pION, dissolved oxygen, turbidity, conductivity or resistivity in a general-purpose industrial environment. The transmitter digitally communicates with any ECD Model S88 or S80 Intelligent Sensor, automatically configuring the transmitter's menus and display screens to the measured parameter.

The same transmitter can be used for any of the measurements. For example, plug an S88 conductivity sensor into a Model X80 transmitter and it will automatically reconfigure into a conductivity transmitter.

The Model S88 intelligent sensors facilitate two-way communication with the Model X80 transmitters. The type of sensor, identity and serial number are stored in the sensor's memory along with calibration registers. The Model S88 sensors are calibrated at the factory, so they are ready to use when connected to a Model X80 transmitter. The Model S80/S88 sensors are waterproof and submersible, with all internal components epoxy encapsulated inside the ¾" housing. The Model S88 sensors use the same easily replaceable electrodes as the Model S10, S17 and S80 sensors.

The Model X80 transmitter features a large, easily viewed LCD display. Loop-powered instruments have black lettering on a grey background, while the 24 VDC powered instruments have blue lettering on a white background when the LED backlight is on. The Model X80 has three easily switchable main display screens: the data screen, the millivolt screen and the graphical display screen (six screens for two channel units).



AMS Instrumentation & Calibration Pty Ltd

www.ams-ic.com.au



MOBILE LABEL PRINTER FOR CABLING INSTALLATIONS

The THERMOMARK PRIME from Phoenix Contact is designed to offer reliable printing technology, integrated marking software and a durable, independent energy supply. It is a transportable, mobile marking centre, simplifying printer operation right on site.

Equipped with a rechargeable high-power battery, the THERMOMARK PRIME has various interfaces for connecting to other systems to make the processing of extensive printing projects convenient. It also has an interface for transferring printing projects. An automatic material detection function checks the components used, thereby preventing printing errors.

The marking software is installed directly on the printing system and is operated via touch display. This makes a connection to an external PC unnecessary. It also means users can create labels using the THERMOMARK PRIME in locations where a power supply is not automatically guaranteed. Its battery is designed to last an entire work shift and is capable of labelling up to 500 UCT cards. Its power supply unit is capable of fully recharging it in 3 h.

With its wide variety of functions, the THERMOMARK PRIME can mark terminals, cables and conductors as well as devices and systems. The handy, battery-operated printer is based on thermal transfer printing technology.

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RADAR LEVEL TRANSMITTER FOR BULK SOLIDS

Emerson has launched a dedicated version of its Rosemount 5408 non-contacting radar level transmitter to meet the specific demands of bulk solids level measurement.

The inclining or sloping nature of the material surface and the peaks and troughs of uneven surfaces deflect energy away from a radar signal and can generate false signal reflections, which affect measurement accuracy. By using a signal processing algorithm that merges surface peaks, the Rosemount 5408 is said to provide a high level of accuracy. The device's two-wire frequency modulated continuous wave (FMCW) technology also produces a continuous echo to maximise radar signal strength and produce a more robust measurement.

The considerable amount of dust created during the fill cycle in solids applications creates a further challenge for measurement technology, so the Rosemount 5408 includes an integrated air purging system for cleaning the antenna.

Advanced surface tracking and a condensation-resistant cone or parabolic antenna enable the product to provide measurements in demanding applications. In addition, radar-on-chip technology replaces a circuit board, removing sources of EMC noise which cause signal disturbance. An embedded power backup removes vulnerability to intermittent power losses.

Two-wire technology enables simple installation, while still providing the same high amount of data and diagnostics that would normally require four-wire connections. ATEX and IECEx approvals allow installation in hazardous locations and the device's SIL 3 capability enables integration into safety instrumented systems, supporting efforts to increase plant safety.

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MODULAR PANEL PC SOLUTIONS

Advantech's TPC series of modular panel PC solutions are based on three performance-segmented models: a control panel (TPC-5000), an industrial thin-client (TPC-2000) and an industrial monitor (FPM-7000). The modular design of the solutions allows the computing modules to be interchangeably combined with various display modules (available in five sizes) to provide up to 15 flexible platform solutions for specific field applications. These platforms can be customised and easily configured according to usage requirements. Users can choose from an industrial thin-client or standard box PC equipped with an Intel Atom or Core i processor, analog resistive single-touch or projected capacitive multi-touch displays, as well as over 30 I/O expansion modules

in order to assemble a solution based on specific requirements.

The flexibility, serviceability and modularity of Advantech's industrial panel PCs offer numerous performance and cost-saving advantages, including complete HMI control and monitoring, customisation, rapid integration and deployment, reduced system downtime and maintenance costs, and support for future expansion. With wide operating temperature support, an IP66-rated true-flat front panel with built-in Wi-Fi/NFC antenna, an anti-scratch surface and optional NFC reader, the panels are suitable for both industrial and commercial applications.

Advantech's thin-client box module features a low-power consumption Intel Atom processor that satisfies green requirements and can support a secondary display for increased monitoring flexibility. With its compact and slim dimensions and HTML5 compatibility, this thin-client box provides a space-saving, economical platform that facilitates the centralised management of multiple devices and enables rapid interface development.

Advantech Australia Pty Ltd

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FIBRE-OPTIC AMPLIFIER

When the installation space at the detection site of a machine is not large enough even for a miniature sensor, fibre-optic sensors are often the only option for detecting objects. The separation of optics and evaluation make it possible to come close to the detection object both with scanners and with through-beam systems. High temperatures, aggressive oils, chemicals or mist are conditions in which the appropriate versions of fibre-optic sensors are needed. In both hidden and invisible mounting, fibre-optic sensors often have the decisive advantage that their amplifiers can be installed at easily accessible places.

The WLL180 fibre-optic amplifier has a compact size, a fast response time of 16 μ s and high light intensity and resolution, which ensures an additional operating reserve in dusty operating environments.

Sensing distances of up to 20 m are possible and its high light intensity delivers a high-powered solution — even in difficult ambient conditions, like dust, spray, mist and water jets. Commissioning is simple — either via the external teach-in input or directly on the unit. Two four-digit displays provide visualisation of all programming steps and status displays, plus target and actual values through an intuitive menu structure.

The WLL180T sensors can be operated either stand-alone or in a bus configuration, depending on the requirements. In a bus configuration, several sensors are networked via an internal bus, enabling the settings on one WLL180T to be copied to all other devices on the bus.

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CONNECTIVITY: BACKBONE OF THE DIGITAL ENTERPRISE

PART 2

Bridging the divide between operational technology (OT) and enterprise information technology (IT) in the right way will support collaboration and enhance overall production efficiency, reliability, visibility, flexibility and security.

It has been well established that connecting the two worlds of IT and OT for a truly, end-to-end digital enterprise is essential for enabling companies to be competitive in the future. Bringing the IT and OT teams together and aligning their perspectives is essential in making IT/OT integration work. Unfortunately, for far too many organisations, sharing data between these two worlds can be a struggle because their network infrastructures could be more up to date and better connected.

Ensuring the highest availability

Without fast, reliable and secure communications across all components and systems, the digital enterprise would remain a vision instead of the practical operating model it has become today.

Bottoms-up

To start, it helps to understand how automation in the digital enterprise works. Complex automated industrial systems used in discrete manufacturing and production processing are organised as

a hierarchy, linking the various components — actuators, contactors, motors, sensors, switches and valves — that do the work at the field level (for example, shop or production floor) to PLCs. As mentioned previously, PLCs are microcomputers with software that monitors and controls the operations of these devices, such as turning motors on or off and opening or closing valves. PLCs can also control the motion of industrial robots, but require precise data timings to do so.

In turn, PLCs are connected to a HMI, typically a display of some kind that enables human operators to monitor overall system performance and component behaviours then, if necessary, adjust parameter set points. Many modern PLCs have built-in web servers. These enable the HMI to be securely displayed and accessible remotely in a web browser on a laptop, tablet or smartphone.

One or many control systems can be vertically integrated to even higher-level systems, such as a manufacturing execution system (MES) or a manufacturing operations management (MOM) system. These provide much wider, even enterprise-wide, views and controls.



Redundancy, key to availability

Asset utilisation is tied to availability — the higher the availability of machinery, for example, the greater the asset utilisation. The consequences of a system failure can be costly downtime, high restarting costs and the loss of valuable data or materials. That's why OT engineers have designed redundant control systems and redundantly configured networks.

In the event of a fault, a plant's high-availability industrial communication can take over automatically without any consequences for the facility. Such systems support reconfiguration times of a few milliseconds in the event of a fault. In general, there are two types of redundancy:

- **System redundancy:** A high-availability automation system is implemented by deploying backup systems and communication components that operate in parallel with failover to them if the primary system goes down.
- **Media redundancy:** Systems are only implemented individually,

but should the network be interrupted, the plant will continue to operate along substitute communication paths.

While IT professionals are likely familiar with how system redundancy works, they may be interested in understanding more about media redundancy in an industrial context. There is a range of approaches to implement media redundancy, including Profinet-compliant MRP (Media Redundancy Protocol), HSR (High availability Seamless Redundancy) and PRP (Parallel Redundancy Protocol).

Based on IEC 62439-2, MRP enables rings of Ethernet switches to overcome any single point of failure with near instant recovery times. Operating at the MAC layer of the Ethernet switches, MRP uses redundant rings and ensures reconfiguration times (relearning of the communication paths) of 200 ms in rings of up to 50 switches. For smaller rings, the worst-case recovery time scales down.

To eliminate reconfiguration time, there is an extension to the MRP protocol — Media Redundancy for Planned Duplication (MRPD) — for sending message frames in duplicate within a ring



IT'S POSSIBLE AND HIGHLY DESIRABLE TO INTERCONNECT THE ENVIRONMENTS OF IT AND OT IN PRACTICAL, SECURE AND ACCOUNTABLE WAYS THAT RESPECT THE STRENGTHS AND REQUIREMENTS OF EACH.

structure, leveraging Profinet IRT to do so. Standard recovery for MRPD is 0 ms.

The HSR (High availability Seamless Redundancy) protocol based on the IEC 62439-3 standard utilises double transmission of message frames over ring-topology networks in both directions. In the event of an error, the message frame will be transmitted without any delay. No reconfiguration time is necessary for the network, as is the case for most other redundancy protocols.

The PRP (Parallel Redundancy Protocol), again based on IEC 62439-3, also uses double transmission of message frames but it does so over two separate networks. Network access points connect up to two network segments or terminal devices without PRP functionality, without delay, over two parallel networks. This seamless data transmission offers extreme reliability and high availability in parallel networks and can be used for numerous applications, for example, in ships, energy switchgear or along pipelines.

Network segmentation

Virtual local area networks (VLANs) enable the partitioning of one physical LAN into a number of smaller, logical LANs. These help separate the networks connecting OT automation systems from IT systems, for better security and optimised real-time performance.

As enterprise LANs are usually maintained by a company's IT group, security concerns can override the OT group's concerns about maximising uptime. But while a compromised endpoint on an enterprise LAN can generally be quickly isolated by disconnecting it from the LAN, 'pulling the plug' on a compromised device that's tied into an OT automation LAN can be potentially disastrous to the system that component is part of.

With VLANs, the offending VLAN can be isolated from affecting its larger physical LAN domain, then OT can work with IT on the best way to remedy the security breach and minimise downtime and production impacts.

Another reason for using VLANs in OT environments is that the amount of real-time, broadcast and multicast data traffic OT systems typically generate using Ethernet can use most if not all available bandwidth. VLANs use OSI Layer-2 access switches to handle data traffic within a VLAN, while Layer-3 switches and routers direct data traffic across different VLANs, limiting broadcast and multicast transmission.

Bridging IT and OT worlds

It's possible and highly desirable to interconnect the environments of IT and OT in practical, secure and accountable ways that respect the strengths and requirements of each. Following best practices, a robust network backbone should be established to create a structured and reliable interface that interconnects dedicated production and office networks.

The former will include production cell-to-machine and shopfloor-to-cell subnetworks, all with specific IP addressing for fully managed components and systems, plus the use of real-time, deterministic communication protocols. While this backbone will be an integral part of the OT production scope, especially in delivering the high-



est availability of product assets to the business, it will be aligned with IT in regard to user governance and security.

This way, for example, should a third-shift failure occur in off-hours, qualified and authorised production personnel can address the issue directly. And they can potentially do so much sooner than having to wait hours until an IT person arrives, according to the terms of an IT/OT service-level agreement. By minimising the production disruption, such an approach can possibly avoid significant amounts of associated costs and risks to customer delivery commitments.

Facilitating data interchange

Highly automated production environments often have a wide variety of data communication interfaces, usually as a result of various field-level components being sourced from different manufacturers. These elements must communicate their data to — and, for many, get their instructions from — higher level control systems and HMIs. The former can include SCADA and manufacturing execution systems; the latter can include HMI panels, web interfaces, PCs, tablets and even smartphones.

So, how can data be exchanged effectively and efficiently across such heterogeneous communications landscapes? One approach is OPC Unified Architecture (UA), a manufacturer-independent standard that allows field devices to communicate with each other. OPC UA



can be used in all Ethernet networks thanks to its underlying TCP/IP communication protocol. In particular, OPC UA and Profinet are fully compatible, enabling parallel operation.

Wireless

Wireless industrial communications, especially for wireless local area networks (WLANs), are fast becoming as ubiquitous in factories, warehouses and other production and logistics facilities as they are in non-industrial environments. Reasons include greater flexibility and speed in configuring (and reconfiguring) floorplans and the elimination of long lengths of costly cabling.

Wireless industrial communications includes low-power, short-range Near Field Communication (NFC) technology used in RFID solutions for product authentication and asset tracking, among other NFC applications. Another NFC use is for machine diagnostics. Bluetooth can be used for relatively simple, close-range applications, usually in a symmetrical configuration by pairing two Bluetooth devices.

For longer-range wireless communications of up to 100 m between access points, IEEE 802.11 Wi-Fi is most widely deployed. Compared to Bluetooth, Wi-Fi has an asymmetrical client-server connection with data routed through a wireless access point. For specific directional applications, for applications that require a defined path, like monorails, cranes and automated guided vehicles,

RC coax radiating cable emits a radial field along the axis of the cable, which can be laid in a floor or along overhead rails.

Ruggedisation for reliable performance is the biggest difference in the components used for industrial WLANs compared to non-industrial systems. They need to withstand temperature extremes, adverse weather and corrosive conditions that are typical of industrial environments.

Meet the digital thread

Of course, what ties together all these devices and systems is industrial data communications, the digital thread referenced earlier. These have come a long way since early point-to-point, wired protocols such as analog 4–20 mA current loop or analog/digital HART communications — both still widely used despite their limited communications capacity, including relatively slow data speeds.

In time, however, multipoint, digital fieldbus protocols emerged, such as Profibus, one of eight fieldbus types described by the global IEC 61158 standard. These enabled local area network (LAN)-type connections to be used to link up to hundreds of devices. This tremendously simplified cabling and lowered its cost.

Today's industrial networks are quickly migrating to Industrial Ethernet, which provides greater performance, higher speeds and more flexibility than fieldbus communications. It's based on the same Ethernet used in non-industrial IT networks, both wired (IEEE 802.3) and wireless (IEEE 802.11) protocols, but has been enhanced for the deterministic routing and real-time control that automation requires.

Making the digital thread real

Today and in years to come, digital enterprises supported by advanced industrial communications and backed by fully aligned IT and OT teams will enjoy distinct competitive advantages over those without.

With a vibrant, coherent thread of data running end-to-end through their operations, companies can execute their business strategies faster, gain performance feedback and insights sooner, respond to market changes and opportunities more quickly, and improve their time to market with new products and services.

Another benefit of modernised industrial communications is simplification. This can help lower both capital costs and the management overhead and expenses required for operating highly integrated networks spanning both IT and OT environments. It can also vastly improve the reliability, visibility and security of dynamic OT landscapes to boost availability and, ultimately, asset utilisation.

A fully digital enterprise needs the expertise of both IT and OT teams to make it happen, enabled then with the connectivity that advanced industrial communication technologies can offer. The sooner companies with such aspirations move forward to modernise their industrial data networks, the sooner they will realise the benefits of being a true digital enterprise.

Siemens Ltd
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COMPACT ROTARY SCREW BLOWERS

Kaeser has extended its compact and turnkey range of rotary screw blowers. The CBS series delivers compressed air with differential pressures up to 1000 mbar, power from 7.5 to 22 kW and flow rates from 15.7 to 22.3 m³/min.

The screw blowers are said to offer significant energy advantages in the two-digit range, with one of the screw blowers said to efficiently cover the control range of two or three rotary blowers.

This efficiency is achieved in part by the inclusion of Kaeser's screw compressor block which features its Sigma Profile rotors. This screw compressor block includes a wide control range and ensures virtually constant specific power. Even at maximum speeds, the rotors ensure minimal transmission loss. In addition, the use of high-tech bearings and no need for ancillary equipment further minimises energy consumption.

With low maintenance, energy efficiency and the ability to set up units directly adjacent to one another, the screw blowers are advantageous for continuous operation. Delivered ready for immediate operation, the turnkey blowers are equipped with a star-delta starter or frequency converter.

For efficient blower control and system monitoring, the screw blowers come with an integrated Sigma Control 2 compressor controller. Various interfaces enable rapid communication with control centres.

Kaeser Compressors Australia

www.kaeser.com.au

X-RAY INSPECTION SYSTEM

Manufacturers of pumped food products can benefit from high detection sensitivity and improved overall equipment effectiveness (OEE) with the X38 X-ray inspection system from Mettler-Toledo Safeline X-ray.

The single vertical X-ray beam system for pumped food products has a complete set of software algorithms that have been specially developed for piped food products, including meat and poultry, fruit and vegetables, dairy, baby food, syrups, jams and preserves. It offers optimum detection capabilities, particularly for contaminants such as calcified bone, mineral stone, glass shards and metal filings, while allowing the timely and accurate opening of the reject valve, ensuring precise removal of the contaminated product with minimal product waste.

The air conditioner has an IP69 rating that makes it capable of withstanding the high-pressure and high-temperature cleaning applications commonly seen on pumped food lines. The casing also has sloping surfaces and curved edges, which allows water to run off quickly and easily, reducing the need to wipe the machine dry after cleaning and eliminating bacteria traps. These means the frequency of downtime for cleaning can be reduced and in addition the product's robustness means higher reliability of performance. Both of these facts significantly increase OEE and reduce the total cost of ownership (TCO).



The X-ray system can be easily integrated into production pipelines with flow rates of up to 14 t/h, depending on the diameter of the pipe and the application. It is available with 2.5", 3" or 4" diameter pipes as standard, but can be built with other sizes on request to suit customers' existing pipework.

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ZERO-BACKLASH SERVO GEARMOTOR

maxon motor has released a servo motor and gearhead combination that can produce 364 Nm with a peak torque rating at the output of 686 Nm. Fitted with both an encoder and a holding brake inside the IP-rated motor's rear enclosure, the combination can move heavy loads into position and make sure they stay there.

The high acceleration of the brushless DC motor with neodymium magnets enables a zero to 2600 rpm speed change in under 4 ms. Being both brushless DC and slotless gives the motor zero cogging or position detent for smooth position transitions and good low-speed performance.

The solid construction and sealed nature of the motor drive components makes it suitable for mining, food, process control and manufacturing environments.

Customisation of the motor and gearhead features is possible and both 24 and 48 VDC supplies can be used. The unit is compatible with standard servoamplifiers and position controllers from maxon motor.

maxon motor Australia Pty Ltd

www.maxonmotor.com.au

SMALL E-CHAINS

The low-profile E2.10 e-chain from igus has an inner height of 10 mm and a small bend radius, making it suitable for small installation spaces. The links in the series consist of only two parts: the bottom/side part and a crossbar. They feature quiet operation, a cable-friendly design and easy assembly, due to the chain opener.

In confined spaces on machines, a safe energy supply with highly dynamic travel of the cables is especially important. The E2.10 e-chain from the E2.1 series has an outer height of 15 mm, making it suitable for small spaces. It can be opened from the top and from the side easily with a screwdriver. With each first order, a simple e-chain opener tool for opening the chain quickly is also included. Thus, the chain can be opened within a few seconds and, after fitting the cables, easily closed again by hand.

The series has a robust stop-dog for up to 25% more unsupported length, 100% higher fill weights and at the same time 10% less weight than identical igus e-chain types. The 'brake' on the stop-dog of the links provides quiet chain running.

Lightweight yet sturdy and strong, the series is suitable for a wide range of applications. Due to the smooth contours, the series has a cable-friendly interior.

Treotham Automation Pty Ltd

www.treotham.com.au



PHOTOELECTRIC SENSOR WITH IO-LINK

Balluff has added IO-Link functionality to its standard 18 mm tubular photoelectric sensors. Configuration of the sensors can be accomplished either through the integral teach button or via IO-Link. The range includes diffuse, retroreflective and through-beam modes of operation.

IO-Link functionality includes multiple switching modes and multiple teaching options for easier integration and better stability. The added diagnostics provide faster troubleshooting, which translates into more uptime and productivity.

The tubular sensors have multiple output modes, including single-point, window-mode and two-point sensing modes with either standard or dynamic teach functionalities. With IO-Link, simple installation and easy controls integration translates to savings for machine builders on design, build and commissioning, while manufacturers see value in the ability to hot-swap smart sensors via the automatic parameterisation functionality.

The sensors incorporate a bright red light for easy alignment, and they can be taught with the integral push-button enabling quick and easy integration. Applications include part presence, general automation, error proofing and assembly. Industries include automotive, material handling, machine tool, packaging and assembly robotics.

Balluff Pty Ltd

www.balluff.com.au



IloT GATEWAY WITH MQTT

HMS Industrial Networks has announced that its IloT gateway range, eWON Flexy, now supports Message Queue Telemetry Transport (MQTT) protocol, a simple and lightweight messaging protocol aimed at minimising network traffic and device resource requirements.

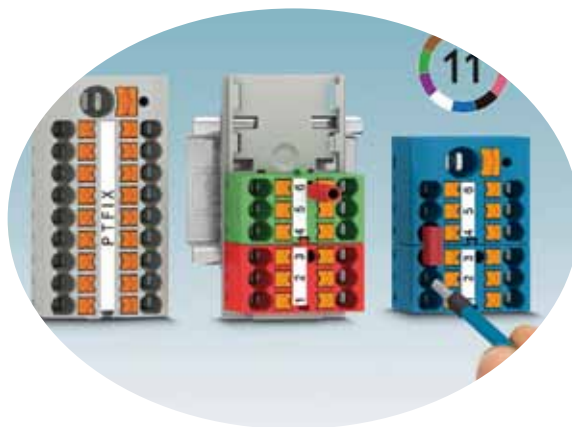
Initially created in 1999 to help oil and gas distribution firms control their pipelines effectively, MQTT has recently seen increased popularity because of the exponential growth of the IoT and the need to facilitate communication between low-powered smart devices.

MQTT is essentially a publish/subscribe protocol aimed specifically at low-powered embedded devices. One of the upsides of using the MQTT protocol with eWON Flexy includes the ability to resume operations from any breakpoint without data loss. In addition, during network interruptions, data can be buffered until network communication is resumed and a client device reads the data. This not only prevents data loss but also allows users to manage the information flow to network nodes.

Designed to facilitate the transmission of large volumes of data to numerous servers and client devices constrained by low bandwidth, high latency or unreliable networks, MQTT is suitable for dynamic communication environments. As the name indicates, the main purpose of the MQTT protocol is telemetry.

Global M2M

www.globalm2m.com.au



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Phoenix Contact has released its PTFIX ready-to-connect distribution blocks with push-in connection technology to provide technicians with greater convenience.

Users connect pre-treated or rigid conductors to the PTFIX distribution blocks by simply aligning and inserting the colour-coded wire to the block.

Conductors as small as 0.25 mm² can be connected without using tools. To disconnect or to connect stranded conductors without ferrules, technicians can use the push-button.

The ready-to-connect distribution blocks, which provide a flexible and cost-effective solution for loading and controlling current distribution, can be mounted rapidly and without manual bridging to further save on time.

Various installation options — DIN rail mounting and direct or adhesive mounting — provide users with maximum flexibility when installing their application. In addition, transverse mounting on the DIN rail enables high wiring density and space savings of up to 50%.

Available in different numbers of positions and 11 colours, the PTFIX distribution blocks can be expanded as required and arranged in series without losing pitch. They can be extended with two-position standard jumpers. The devices can also be checked and marked individually for clear and safe installation.

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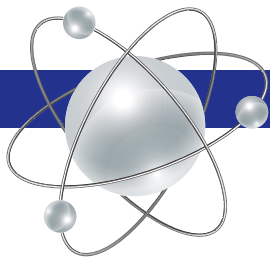
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Intelligent rotor blade optimises wind energy utilisation



Image © Fraunhofer IWES, Pascal Hancz

The share of the overall electricity market made up by wind energy continues to grow year after year, and the giant rotor blades utilised are one of the most important parts of a turbine.

More than 28,000 wind turbines with a total output of 50 GW are currently in operation in Germany. This equates to a 12.3% of the total electricity production in Germany in 2016. The current focus of research is now on developing this technology even further.

Within the framework of the joint SmartBlades2 project, the Fraunhofer Institute for Wind Energy Systems IWES and its partners have turned their attention to the bend-twist coupling (BTC) concept for rotor blades. The passive working coupling adapts continuously to the wind forces acting on the rotor blade. When the wind loads become too high, the bend-twists reduce the forces affecting the structure.

The rotor blades of conventional wind turbines react to changing wind strengths very slowly. A rotor blade measuring up to 85 m in length describes a circular area of 22,670 m²: the equivalent of four soccer pitches or St. Peter's Square in Rome. The wind strengths within this area can vary greatly. The pressure acting upon the blade pointing upward, for example, can be very different from the pressure on the lower blade. Conventional rotor blades cannot compensate for a single gust of wind as they are too rigid to twist. This means if there is a gust when the wind is already strong, the turbine operators turn the rotor blades completely away from the wind, resulting in long downtimes during which no electricity is produced.

"The demonstrator BTC blade developed as part of this project is swept back, while the blade tip is offset slightly to the rear in the direction of rotation," explained the IWES technology coordinator for BTC blades, Dr Elia Daniele. "The 20 m long rotor blade is therefore able to rotate slightly around its own axis should strong gusts occur, in order to mitigate the wind pressure to a certain degree."

This ability reduces the forces acting upon the blade and, ultimately, the entire turbine. By using BTC blades on a newly planned wind turbine,

the overall turbine weight can be reduced as the structure is subjected to lower loads. In the case of existing turbines, the retrofitting of BTC blades allows the rotor diameter to be increased without having to adapt the other turbine components. This results in an increase in revenue due to a greater wind yield.

To test this innovative design, static and dynamic tests are being conducted on the Fraunhofer rotor blade test bench in Bremerhaven over a period of several weeks. The test engineers have installed a BTC blade for the first time here. The blade was designed by Fraunhofer IWES and produced by the project partner German Aerospace Center (DLR). Its durability when subjected to extreme loads will be tested in static tests.

"Although the setup for the rotor blade torsion test is similar to the conventional scenario for static testing, it is in fact more complex, as the additional deformation has to be measured precisely," said IWES test engineer Tobias Rissmann.

Deformation along the three main axes is monitored using a visual measurement system. Angle sensors were also used to ensure that the force was introduced vertically to the blade axis. During the subsequent dynamic tests (fatigue tests), the stresses incurred over the entire service life of the rotor blade spanning 20 years are simulated within a drastically reduced time frame.

Upon completion of the test bench testing, three identical BTC rotor blades will be transported to the USA to be installed at the foot of the Rocky Mountains for a field test on a research turbine from project partner National Renewable Energy Laboratory (NREL). The aim of subsequent measurements, which will be led by Fraunhofer researchers, is to demonstrate whether passive twisting performs as expected in real, open-air operation.

The Aeroprobe System, which has been newly developed as part of this project, will also be used for testing. In this system, two pressure sensors on the surface of the blade measure the flow dynamics around the rotor blades. The flow on the rotor blade is also made visible by strands of wool. This allows the experts at Fraunhofer to determine the aerodynamic conditions precisely. Within the blade, further sensors work to measure the acceleration at the blade tips while camera-reflector systems detect any deformation.

Fraunhofer IWES is not planning to design rotor blades itself; instead, it is focused on developing its expertise in this field and making this available to its industrial partners. The BTC blade serves to demonstrate the technology and assess the usability of this technology on commercial blades.

Fraunhofer Institute for Wind Energy Systems IWES

www.iwes.fraunhofer.de/en.html

UNMANAGED SWITCHES

The Hirschmann SPIDER III Premium Line allows users to quickly and easily configure basic switching parameters through the device's USB interface and the Switch Programming Tool software — available for both Windows and Linux operating systems.

As an unmanaged switch, the product's plug-and-play nature makes installation easy. For networks with special needs, the switch can also be customised for any use case. Through the USB interface, users can turn off unused ports to better secure the network and enable or disable the transmission of large data packets (jumbo frames) to increase network efficiency.

The switches have the flexibility and ruggedness to support any industrial environment. With up to 26 available ports, users can select the port types that meet the needs of the application, including Fast Ethernet, Gigabit Ethernet and fibre-optic ports. The ruggedised IP40 metal enclosure also protects the switches against harsh environments, and they have an operating temperature range from -40 to +70°C.

The switches are designed to regulate energy depending on network traffic through the Energy Efficient Ethernet standard. This low-power feature uses less energy when there is no data moving through the network.

Belden Australia Pty Ltd

www.belden.com



CORRUGATED TUBE FOR CLEAN ROOMS

The production of microchips, flat screens, implants, pharmaceutical products or micro- and nano-products would be inconceivable without a clean, pure or high-purity manufacturing environment. Any contamination has a direct negative impact on products and processes and results in high costs for the manufacturer. Motion plastics company igus has developed a corrugated tube for energy supply in clean rooms that it calls the e-skin. It has been approved as a Fraunhofer Tested Device of the ISO class 1 and received second prize in the Fraunhofer clean technology award 'Clean! 2018'.

The e-skin is made of tribologically optimised, abrasion-resistant plastic. The separable upper and lower shells can be easily put together by a 'zipper' to create a fully enclosed tube that is highly dustproof and water resistant. This guarantees both cleanroom compatibility and a quick filling and maintenance of the cables. The assembly-friendly e-skin is also light and suitable for small installation spaces, eg, in pick-and-place applications. It can be used for short unsupported distances due to the stiffness of the material, the rib profile and a defined direction of motion.

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STANDALONE DUST COLLECTOR

A standalone dust collector from Flexicon removes airborne dust from upstream processes and discharges it into containers positioned below the collection hopper, protecting operators and improving plant hygiene, while eliminating material waste.

The housing is equipped with a 15 mm diameter side inlet port, dual filter cartridges, a 1.5 kW fan motor, a 70 L collection hopper with flanged slide gate valve and automated controls.

Any upstream process that generates dust can be vented to the system through hard piping or a flexible connection, drawing dust onto dual filter cartridges. At timed intervals, an automatic reverse-pulse filter cleaning system releases short blasts of compressed plant air inside the filters, causing dust build-up on the outer filter surfaces to fall into the hopper. Because the filters are blasted alternately at timed intervals with adjustable force, operation of the dust collection system is both continuous and efficient.

An indicator light on the control panel notifies the operator when the receiving hopper is full. The slide gate at the hopper outlet can be opened manually, allowing collected material to gravity discharge into a container.

The system's stainless steel housing and support structure, together with water-resistant controls and washdown-duty fan motor, allow rapid cleaning or sanitising of the entire unit between product runs.

Flexicon Corporation (Aust) Pty Ltd
www.flexicon.com.au

CMOS CAMERA

The Pixelink PL-D range of USB 3.0 cameras links together the benefits of high frame-rate CMOS technology with the high-speed data throughput of USB 3.0 technology. The colour camera provides low-noise images for a broad range of industrial applications, including parts inspection, metrology, biometrics, PCB and flat panel display inspection, and microscopy.

The PL-D7512 model is based on a Sony IMX253 CMOS global shutter sensor with a 1.1" optical format. The camera provides the user the choice of 8- or 12-bit digitisation and has a dynamic range of up to 70 dB. It also features a 12 MP (4096 x 3000) resolution imager capable of 35 fps at full resolution in 8-bit mode and 29 fps in 12-bit mode.

The external hardware trigger and two general-purpose outputs ensure users have the flexibility to synchronise the camera with their processes and illumination. The wide range of built-in image processing possibilities (image preprocessing) is said to result in improved image quality, less load on the system and higher performance.

SciTech Pty Ltd
www.scitech.com.au



DISTRIBUTED MODULAR I/O FOR FOOD AND BEVERAGE

Balluff has introduced a range of machine-mount, IP69K protection rated, ECOLAB certified distributed I/O modules supporting EtherNet/IP, Profinet and IO-Link.

The IP69K range includes network I/O, IO-Link masters and IO-Link I/O hubs. These distributed I/O modules can be mounted right on the machine, close to sensors and actuators, to reduce cable routing. Standard M12 connections to sensors eliminate the need for cable terminations in the cabinet. All the modules are equipped with onboard diagnostics for ease of integration and maintenance.

ECOLAB certified stainless steel V4A (1.4571) housing with elevated two-hole mounting makes the modules easy to clean with high-pressure fluids or steam wash or corrosive chemicals.

Balluff's IO-Link I/O hubs can scale-up to 240 I/O points on a single network node. IO-Link enables machine builders to bring the status and configuration of sensors on board the controller with the same M12 washdown-rated sensor cable that is used for standard 3-wire sensors.

Distributed modular architecture is commonly used in automotive and general automation applications. With IP69K modules, users in the food and beverage industry can simplify their controls architectures and reduce cabinet space by utilising machine-mount devices.

The range includes IO-Link masters with eight IO-Link ports. Each port can be configured as dual input or output, or can connect to a wide variety of IO-Link sensors or actuator modules as well as IO-Link sensor/actuator hubs. Network nodes equipped with an IO-Link master communicate directly with the controller or machine control device via EtherNet/IP or Profinet.

Balluff Pty Ltd
www.balluff.com.au



LIGHTWEIGHT TABLET

Panasonic's rugged handheld Toughpad FZ-F1 is a thin, lightweight tablet in the 4.7" category intended to support those who are exposed to tough and high-risk work environments.

Powered by Windows 10 IoT Mobile Enterprise, the device has 3-in-1 capabilities combining a mobile barcode reader, phone and tablet into one device with a long-lasting battery that provides up to 8 h of continuous use. The rear barcode reader allows users to scan items easily, while the multitouch display can be accessed even with gloves on, making the device suitable for transportation and logistics, manufacturing and retail industries. It is also suitable for a wide variety of applications, such as inventory management, shipping and receiving, delivery routing and parcel tracking, and retail store queue busting.

The FZ-F1 is expected to help slash field failure rates, raise productivity and reduce work-based injuries thanks to its innovative design. The tablet is certified on leading mobile carrier networks, providing 4G LTE/3G/GPRS/CDMA2000 mobile broadband for voice (or VoIP) and data, provides up to 630 h standby time and has military-certified toughness.

To ensure clear voice communications above industrial noise, the device is equipped with intelligent noise suppression capabilities and dual front speakers providing a maximum volume of 100 dB. Wi-Fi 802.11 a/b/g/n/ac, near field communications (NFC), standalone and assisted GPS (A-GPS) and Bluetooth, v4.1 (Class 1) are standard.

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HELICAL GEAR UNIT

The single-stage NORDBLOC.1 helical gear unit from NORD DRIVESYSTEMS has been specifically designed for applications with high speeds and torques. The gear unit is especially robust, efficient, quiet and compact.

The NORDBLOC.1 helical gear unit features high efficiency, high torsional rigidity, low running noise and a long service life. In addition, it meets stringent hygiene requirements due to its washdown design. It does not have any separating joints or closing caps, increasing the stability of the drive and at the same time providing a smoother surface on which neither liquids nor solid materials can accumulate.

Bores and mounting faces are machined in one step, enabling precise tolerances — thus ensuring accurate positioning of gear teeth, bearings and seals — and an overall longer life for all components. The housing is made from high-strength, corrosion-resistant aluminium and is therefore lightweight and robust.

A benefit of the large bearings is the larger diameter of the internal shafts, which increases the bearing strength. The gear wheels are made from case-hardened steel and permit high short-term overloads.

The NORDBLOC.1 is available in five sizes with motor powers from 0.12 to 7.5 kW for output torques of up to 280 Nm. All variants are available as flange mounted (B5 or B14) or foot/flange mounted versions. Options for IEC and NEMA motor mounting as well as a wide range of equipment variants for shafts, bearings and lubrication can be flexibly implemented.

NORD DRIVESYSTEMS (Aust) Pty Ltd

www.nord.com





INDUSTRIAL PC

The GE RXi2 IPC range of industrial PCs is designed to provide mid- to high-end performance computing capabilities to run HMI, historian and analytics applications right at the machine and provide real-time control of critical operations.

With up to 32 GB of DDR4-2133 RAM with ECC, and a strong graphical rendering capability, the product is designed for demanding industrial environments with robust visualisation needs. Based on the 6th Generation Intel Core and Intel Xeon processors in dual- and quad-core configurations, the device delivers high-performance computing for applications that need to load, manipulate and store large amounts of data, or to handle multiple communication ports in real time.

The PC is available in either a 0-, 1-, 2-, or 4-slot configuration for adding more functionality when needed and utilises fanless operation for a robust solution. Five high-speed Gigabit Ethernet ports are available along with USB 3.0 ports.

Control Logic Pty Ltd

www.control-logic.com.au

MINIATURE PLC

The Panasonic FP0H micro-sized PLC takes up only 42 mm of DIN rail space, and combines onboard data logging and flexible connectivity options.

The FP0H expands to up to 384 digital and analog I/O utilising FP0H and FP0R expansion hardware while providing dual Ethernet connectivity for industrial protocols such as EtherNet/IP and Modbus, plus many serial options.



It also features SD card data logging to CSV files, unlimited PID, timer and counting and access to thousands of useful function blocks through Panasonic's FPLWIN Pro7 software that employs all five IEC61131-3 languages and hardware-free simulation. Configuration and commissioning time is reduced utilising the 'positional control wizard' for hard-computational set-up for counting, and two-axis X-Y linear interpolation.

Control Logic Pty Ltd

www.control-logic.com.au



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Bottled water company quenches its thirst for high-pressure compressed air



E'stel Water is a premium alkaline water that is sourced and bottled in Nelson, New Zealand. The artesian water comes from the snow-capped mountains of New Zealand and travels underground, 895 metres below the surface of the Waimea Plains, where it filters through various minerals. E'stel then extracts this high-alkaline water, before transporting it to a modern purpose-built bottling plant, where it is bottled, capped, labelled and packed ready for global distribution.

The uniquely shaped plastic bottles that this high-alkaline water is packaged in are manufactured on-site using a PET blow moulding machine. As demand for E'stel Water has steadily grown since the company was established just three years ago, so have the requirements for the bottling plant. This led to the recent investment into a much larger capacity PET blow moulding machine.

Responsible for manufacturing the water bottles, the PET blow moulding machine relies on an efficient supply of compressed air. At certain points within the process, compressed air needs to be pressurised up to 40 bar. This inflates the soft PET (polyethylene terephthalate) plastic into a mould cavity which takes the desired shape

and size of the water bottles. With a standard industrial compressor reaching around a 10 bar pressure, a booster compressor is therefore additionally required at those points in the production process where this high-pressure compressed air is required, to boost the air pressure up to the desired level of 40 bar.

The new PET blow moulding machine at E'stel is able to blow a staggering 11,000 bottles per hour (BPH). As it is a much larger system than what the company had previously, a new compressed air system was therefore required to meet this increased demand for compressed air.

Wayne Herring, co-founder and director of E'stel Water, called on existing and local compressed air specialist PSL Total Air to present a suitable solution. In order to meet both the low- and high-pressure compressed air demand of the new PET blow moulding machine, PSL recommended and subsequently installed a complete compressed air system that included a Kaeser CSD 105 rotary screw compressor and a Kaeser DN 22 series booster.

The DN 22 booster comes as a compact, plug-and-play turnkey package. These completely unique integrated booster systems are delivered and configured to provide a system that is ready for immediate use.

All DN series Kaeser boosters are equipped with premium efficiency IE3 class drive motors which comply with and exceed prevailing Australian GEMS regulations for three-phase electric motors. Along with the generously dimensioned axial fan, which also assures reliable temperature control, this contributes to the booster's cost-effective energy usage.

For all-round reliability, the DN series of boosters from Kaeser also come with an integrated Sigma Control 2 controller as standard, which delivers efficient control and monitoring of the compressor operation. This greatly simplifies the diagnostics process for precision service and maintenance work. They can also be connected to a monitoring system, such as the Sigma Air Manager 4.0 master controller, allowing full integration into an Industry 4.0 environment.

The DN series of boosters from Kaeser are available with initial working pressures of 3 to 13 bar with final working pressure 10 to 45 bar, motor power 22 to 45 kW and free air deliveries 2.9 to 19.6 m³/min.

"We already had two standard-pressure Kaeser Aircenter compressed air systems being used for various other pneumatic applications within the facility, so we knew these compressors were reliable — something that is very important to our operation," said Herring. "When we started researching high-pressure compressed air solutions, a lot of products on the market seemed to be manufactured using quite dated technologies, and the replacement of parts would have worked out to be very expensive. With the Kaeser DN 22 booster we were presented with a cost-effective and state-of-the-art packaged solution.

"PSL was able to tailor a compressed air supply system to meet our exact needs, and it is already proving to deliver an energy-efficient and reliable supply of compressed air on demand. Their after-sales service has also been fantastic."

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AS I SEE IT



THE EVOLUTION OF INDUSTRIAL GEARS

Mechanical gearing technology has been a mainstay of industry for over a century and has matured to the point where no major breakthroughs are expected. However, changes are occurring in the way this technology is meeting new demands for automation, reliability and safety.

The most interesting and profound changes are taking place at the large industrial scale in mining and mineral processing plants. The humble gearbox, primarily designed to convert electric motor power into torque, is becoming part of a much more complex and demanding automated and autonomous system. The mining sites of today are largely automated, with the human interface occurring through digitised, remote controls, often located far away from the mining and material handling processes actually taking place. It is fascinating to observe the operation of control centres in metropolitan Perth, where the operators have at their fingertips all the iron ore mining processes from the point of extraction, through preparation, blending, transfer to the sea port and ship loading, all happening in the Pilbara some 1500 km away.

Such a high degree of process integration puts new demands on the mechanical gearing technology. Reliability, availability, predictability of wear behaviour and serviceability are becoming the major drivers in this equipment's development. In the recent past, power electronics have become dominant in the way electrical power is delivered and modulated as an input into the gearbox and even large power inputs over 1 MW are commonly controlled that way. Also it is now generally accepted for modern gearboxes to process electric motor power with minimum mechanical losses, by utilising gear optimisation micro-geometries, advanced gear machining techniques as well as sophisticated bearing arrangements and lubrication. We accept these technological advancements, and others, as commonplace, and essential in delivering modern power drive solutions.

At the same time the gearboxes interface with digitised controls through an ever more sophisticated array of sensors and self-diagnostic devices. What we are observing is in fact the quiet blending of the borders between mechanical, electrical and information technologies.

With the human interface moving away from processing plants and into remote control centres, there is an increasing emphasis on preventive maintenance, accurate forecasting of drive availability, reliability and serviceability. To this point we see gearing suppliers moving support facilities close to the major industrial hubs to ensure the necessary degree, sophistication and effectiveness of aftermarket support. The future will see further blending of gearing technology with process management technologies, and these changes will influence future gearing product developments as well as relationships between power drives system providers and the site operators.

Considering the developments of the past two decades, and the recalibration of industry expectations occurring in the present, it is somewhat inevitable to see future gear developments moving towards standardisation and energy efficiency. Both trends are already signalled by the industry's increasing focus on serviceability and cost-effectiveness of the production and delivery cycle.



Lech Banasik is Business Development Manager for SEW-EURODRIVE

and has been involved with power drives technologies for over 20 years. He has been involved in developing power drives solutions for use by leading resource companies in the Bowen Basin, Hunter Valley and Pilbara regions of Australia.



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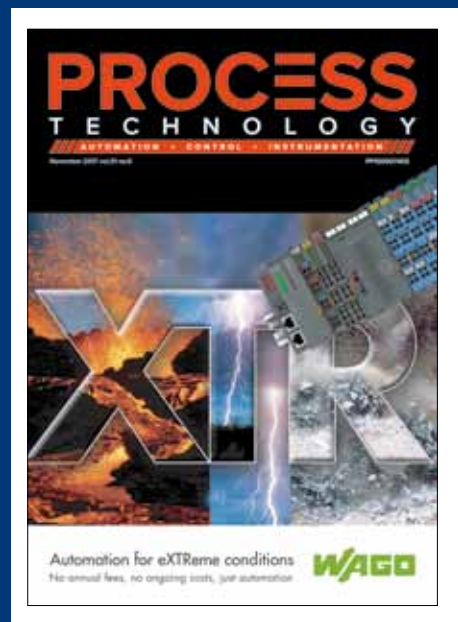
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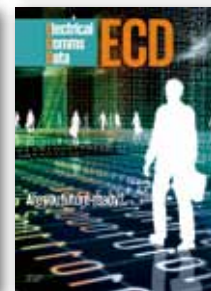
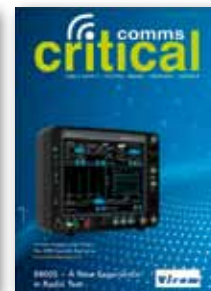
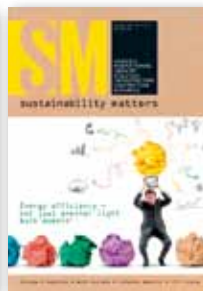
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