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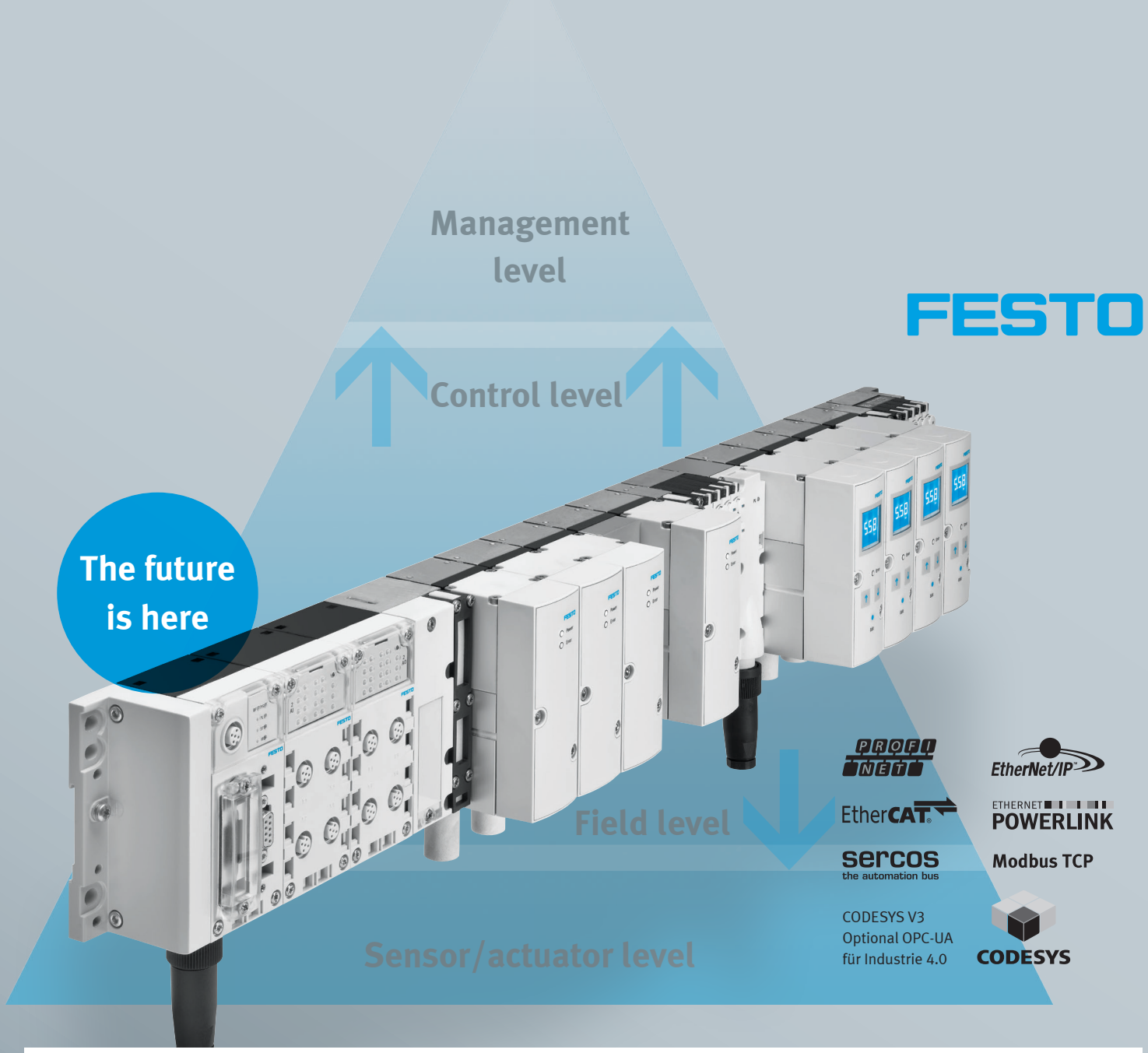
Digital transformation in oil and gas industry 8



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IoT in Oil and Gas Industry ...

The adoption of IoT technologies by the oil and gas industry could have a doubling positive effect on global GDP in the next ten years, raising it 0.8 percent or $816 billion in that period according to a study conducted by Cisco Systems. Along with greater operational and productivity efficiencies, the overall increase includes a "second round impact" from higher economic activity and raising overall employment.

The 14-country survey reveals that oil and gas professionals believe "operational efficiency of existing projects" and "maintenance of assets and infrastructure" are their top two areas of increased investment over the next 24 months.

Key findings from the study are that, while survey respondents understand that connecting "things" is a necessity, true value lies in the intelligence of extracted and analyzed data from devices. This intelligence allows oil and gas firms to drive business and operational transformation. More than 48% of respondents named "data" as the area where they need to improve most to make the most effective use of connected technologies (IoE).

One astounding fact is that offshore oil platforms generate between 1TB and 2TB of time-sensitive data per day. Slow satellite communication is the most common link to transmit this data, requiring over 12 days to move one day's worth of oil-platform data to a central repository such as the cloud. An effective data strategy involves being able to automatically detect whether the data needs to be sent to the cloud for analysis, or whether it should be analyzed at the "edge" of the network, where the data is collected Edge analytics allow oil and gas companies to gain greater real-time insight, providing specific business and operational advantages.

In this issue of IEB, you'll find two articles on this topic. On page 8, "A digital transformation in oil and gas networking" discusses how networking technology is creating new possibilities. Oil and gas companies need to address complex business problems, and technology is creating opportunities that can extend into all aspects of their operations.

On page 34, you'll find "Five ways the IoT is changing the oil and gas industry". This article discusses how the future IoT will integrate applications into larger systems-of-systems, and bring the power of cloud analytics and business intelligence to systems. This core vision requires standard protocols that provide new capabilities, and an ability to speed software integration that implements cloud-based analytics and optimization.

We hope you enjoy our coverage of this important industry transformation.

Al Presher

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Industrial Ethernet Book

The next issue of Industrial Ethernet Book will be published in **June/July 2015**
Deadline for editorial: June 5, 2015 **Deadline for artwork:** June 26, 2015

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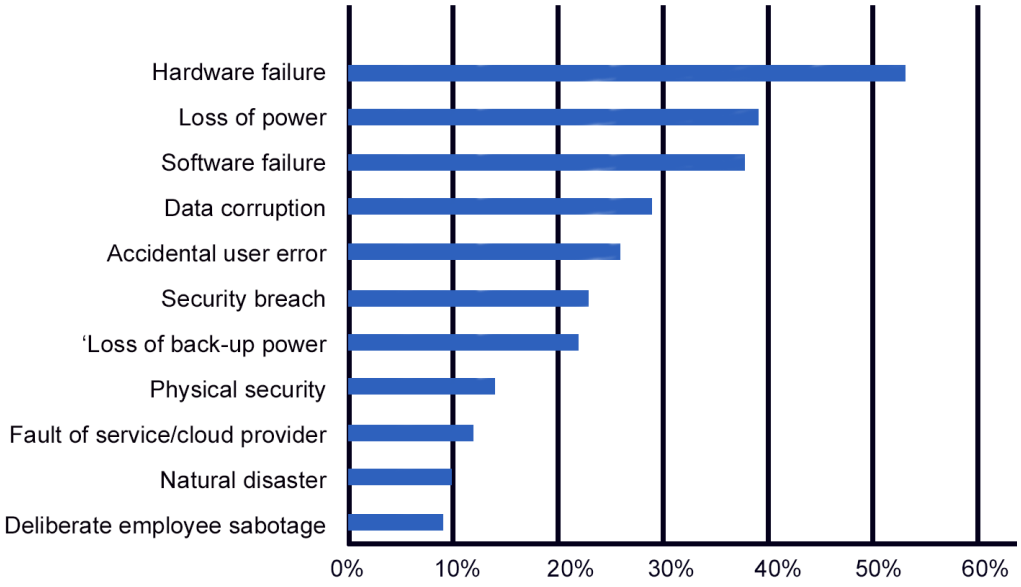
Backup as data security strategy

A major study in 2014 looked at data protection strategies against loss. Any company needs to look at the safety of its data, especially since every year thousands of users lose the content of their hard drives.

DURING A WORLDWIDE SURVEY in 2014, corporations were asked about data protection strategies against loss. According to their findings, 32% of enterprises had experienced data loss over the past 12 months, and the average loss for a company was 2.33 TB of data. This amount could be considered equivalent to 24 million e-mails, and the estimated cost of data loss is US$ 1.02 million. The total cost of losing all data amounted to US$ 754 billion.

We are able to limit each of these elements, but it is impossible to eliminate them. But to minimise the negative impact, a backup system that has been indicated by 41% of surveyed persons as a main component of the data backup strategy is applied. This system needs to meet the dynamically changing conditions in the IT/OT world and to be adjusted to a variety of circumstances.



SOURCE: COMARCH SA

Chart shows major factors indicated by respondents in the 2014 study that caused data unavailability.

On-going growth of data

The quantity of data in specific companies continues to grow, and the backup windows shrink at the same time. In theory, hardware might be continuously scaled, but this creates maintenance and upkeep costs. Apart from the data store technology evolution, the de-duplication functionality is developing dynamically and that makes it possible to reduce the volume of data stored. Backup data are easy to de-duplicate, and results in the ratio of data stored to data in systems exceeding 1:9.

Unfortunately, de-duplication has its disadvantages. First of all, it's more intensive use of computing resources may result in overloading of the backup managing server. The use of de-duplication may significantly increase the time for making copies, but it may mainly have a negative impact on the data recovery rate, which accounts for a critical parameter in an emergency situation.

Data dispersion

In companies, business systems often exist in a hybrid infrastructure. Services are started up in a conventional way on dedicated physical servers, and sometimes in a virtual infrastructure or private cloud. Others may be available at an external provider's in the form of the SaaS, IaaS or PaaS models. Subsequent systems may be located in regional offices, or smaller units dispersed all over the country, continent or all over the world. This is topped up by users, who often store important business data on their mobile devices, such as tablets, smartphones or laptops.

Ensuring reliable and fast protection of a new system, something that is particularly difficult in the cloud and on mobile devices, accounts for a major challenge for the IT/OT departments. In such environments, the backup system needs to provide functionality to automate the data protection process arising from the data protection procedure adopted in the organization.Providing application protection in environments beyond the direct control ensured by outsourced providers or, to a lesser extent, in regional locations or branches, is an enhance of this challenge.

There is no solution that can ensure the effective protection of each of these systems and backup is no exception. Enterprises need to make a choice: the application of two or more products which increases the TCO of an investment, or to come to terms with deficient support in one or more groups of systems.

Prioritization

When a backup system secures the data of several systems and a considerable number of users, there is a need to specify which of these data are most significant for the organization in order to cover them with priority protection. The growing volume of data and systems secured by a backup system makes it necessary to specify clearly which applications and data are most important and, therefore, have the highest priority in backup and restore. The production of such a model considerably reduces the costs of building and maintenance of infrastructure, but first of all it reduces the time of data restore and minimizes their losses. Such an approach requires having a transparent hierarchy of business services, an efficient IT management model in place, advanced expertise and experience in planning and maintenance.

As you can see, there are major challenges in designing and managing a reliable, effective and secure backup system. They require professional expertise, awareness of the solutions available on the market and relevant experience. Any decision on the selection of a proper solution, as well as the backup service model, needs to be thoroughly thought-out. Such a service might be, in particular, purchased from a third party company offering a complete solution in a professional and easily adaptable manner.

Backup also requires a failure-free hardware platform. Comarch Data Center ensures an efficient and readily accessible environment for the implementation of a backup strategy individually tailored to our clients' requirements.

*Research report by Miłosz Brzozowski, Business Solution Manager for **Comarch SA**.*

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New research lab focuses on cyber security developments

Honeywell Industrial Cyber Security Lab advances development and testing of technologies and software to defend industrial facilities and operations such as refineries and manufacturing plants from cyber attacks.

THE INDUSTRIAL CONTROL SYSTEMS CYBER Emergency Response Team (ICS-CERT), part of the U.S. Department of Homeland Security, reported cyber incidents on industrial targets in 2014 continue to increase and are up more than 25 percent since 2011.

ICS-CERT's latest report also said that in 40 percent of incidents that were reported, experts did not know how hackers intruded the system because of a lack of detection and monitoring capabilities. Similar concerns were reflected in a global survey on cyber security conducted by Ipsos Public Affairs in September 2014. In that survey, more than 75 percent of respondents from 10 countries said they were fearful that cyber criminals could disrupt major sectors of the economy, and identified the oil and gas, chemicals and power industries as particularly vulnerable.

Cyber protection a priority

For more than a decade, Honeywell has developed and provided proprietary cyber protection software and technology for its leading process automation solutions. During that time, the Honeywell Industrial Cyber Security group has delivered more than 1,000 industrial cyber security projects globally.

"We have a successful history of providing cyber defense solutions for our industrial customers and this new cyber lab expands our capabilities," said Jeff Zindel, global business leader for Cyber Security, HPS. "We will be able to validate new solutions faster in a variety of scenarios and increase our customers' defenses against the growing threat of cyber attacks."

A new Honeywell Industrial Cyber Security Lab, located in Duluth, Ga., includes a model of a complete process control network that Honeywell cyber security experts will leverage for proprietary research, hands-on training, and to develop, test and certify industrial cyber security solutions. This lab will help accelerate development time of new cyber protection technologies and speed availability to customers.

SOURCE: HONEYWELL

New Cyber Security Lab includes model of a process control network that cyber security experts will leverage for proprietary research, hands-on training and to develop, test and certify industrial cyber security solutions.

In addition to its new lab, Honeywell's Industrial Cyber Security group has also added a number of cyber security experts to increase the bench strength of its development and business teams.

"Many of our customers have come to us looking for cyber security solutions to defend their industrial facilities, operations and people from damage, disruption and misuse," said Zindel. "They understand the very real threat that is out there, and they want to be more proactive in guarding against it. Honeywell is building on its leading industrial cyber security expertise and experience with this new research and development lab as well as adding highly-regarded cyber security experts around the globe to support our customers' growing needs."

For more information, visit the website: BeCyberSecure.com.

EtherCAT & OPC groups join forces on interfaces for Industry 4.0

The EtherCAT Technology Group and OPC Foundation signed a Memorandum of Understanding at the Hannover Messe 2015 trade show to define common interfaces for Industry 4.0 and the Internet of Things (IoT).

"With this agreement, we create the prerequisites to integrate EtherCAT systems consistently into Industrie 4.0 and IoT architectures. Within the ETG Technical Committee, we decided in October 2014 that OPC UA is our choice for the connection with cloud systems and the IT world. Development thus far has proved this to be the correct choice, and we look forward to collaborating in the creation of mutually-beneficial definitions of the common interfaces," said Martin Rostan.

"EtherCAT is one of the leading technologies on the field level and provides an ideal complement to our functionality," said Thomas Burke. "OPC UA is not a competitor of fieldbuses; it seeks to enable the consistent, safe, and scalable communication of such systems into the IT world. Thanks to the common development of interfaces between both our associations, we expect quick and practice-oriented results which, of course, we will all welcome."

The groups will pursue Industry 4.0 requirements by defining a common interface between their technologies.

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A digital transformation in oil and gas networking

Complex market dynamics within the oil and gas industry are creating an urgent need for digital transformation. The key is improving operational efficiency by addressing both how to handle large volumes of data, and how to leverage connected technologies into real world business solutions.

OIL AND GAS LEADERS participating in a recent Cisco survey indicated that their company focus is to get more out of what they already have. Survey respondents named "operational efficiency of existing projects" and "maintenance of assets and infrastructure" as the top two areas of increased investment over the next 24 months.

To maximize operational efficiency, oil and gas companies must address the "data deluge" much of it increasingly generated by the Internet of Everything (IoE): the networked connection of people, process, data, and things. Many view this as a major challenge with a majority of respondents naming "data" as the area of IoE they need to improve most to take advantage of connected technologies.

Oil and gas leaders clearly understand data's potential. They named "data analytics for faster, better decision-making" as the No. 1 driver for IoE investments. IoE also generates business and operational advantages. Respondents identified "faster problem resolution" as the No. 1 business benefit of IoE, while "improved production efficiency" was the top-rated operational benefit.

These advantages are possible only if key business processes are automated. More than half of survey respondents believe IoE has the potential to automate anywhere from 25 percent to nearly 50 percent of manual processes. To realize these improvements, however, oil and gas companies must transform the way they do business particularly in the area of IT-OT convergence (people, process, and technology). Fifty-nine percent of survey respondents do not believe that their firms' IT and OT strategies are closely aligned.

IoE drives digital transformation

As an industry, oil and gas has been "digitized" for some time—perhaps longer than any other sector. What is different now is that, for the first time, oil and gas firms have the opportunity to make IT services a commodity in the business, creating potential for dramatic cost reduction and improved efficiencies.

This digital transformation, however, requires adoption of the Internet of Everything (IoE)—the networked connection of people, process, data, and things—throughout the O&G value chain, including both the IT and OT elements of the business.

SOURCE: CISCO

A key challenge will be how to address the "data deluge" generated by the Internet of Everything (IoE).

Using data to capture insights

Like their counterparts in other industries, oil and gas companies are deluged with all kinds of data, much of it generated by a multitude of sensors and machines spread throughout their far-flung value chain.

Despite significant investments in operational technology, however, many companies especially struggle to use real-time operating data to improve functional and business capabilities.

Survey findings bear this out: 48 percent of respondents named "data" as the area of IoE they need to improve most to make the most effective use of connected technologies (IoE). "Process" ranked in second position (28 percent), followed by "people" (17 percent) and "things" (7 percent).

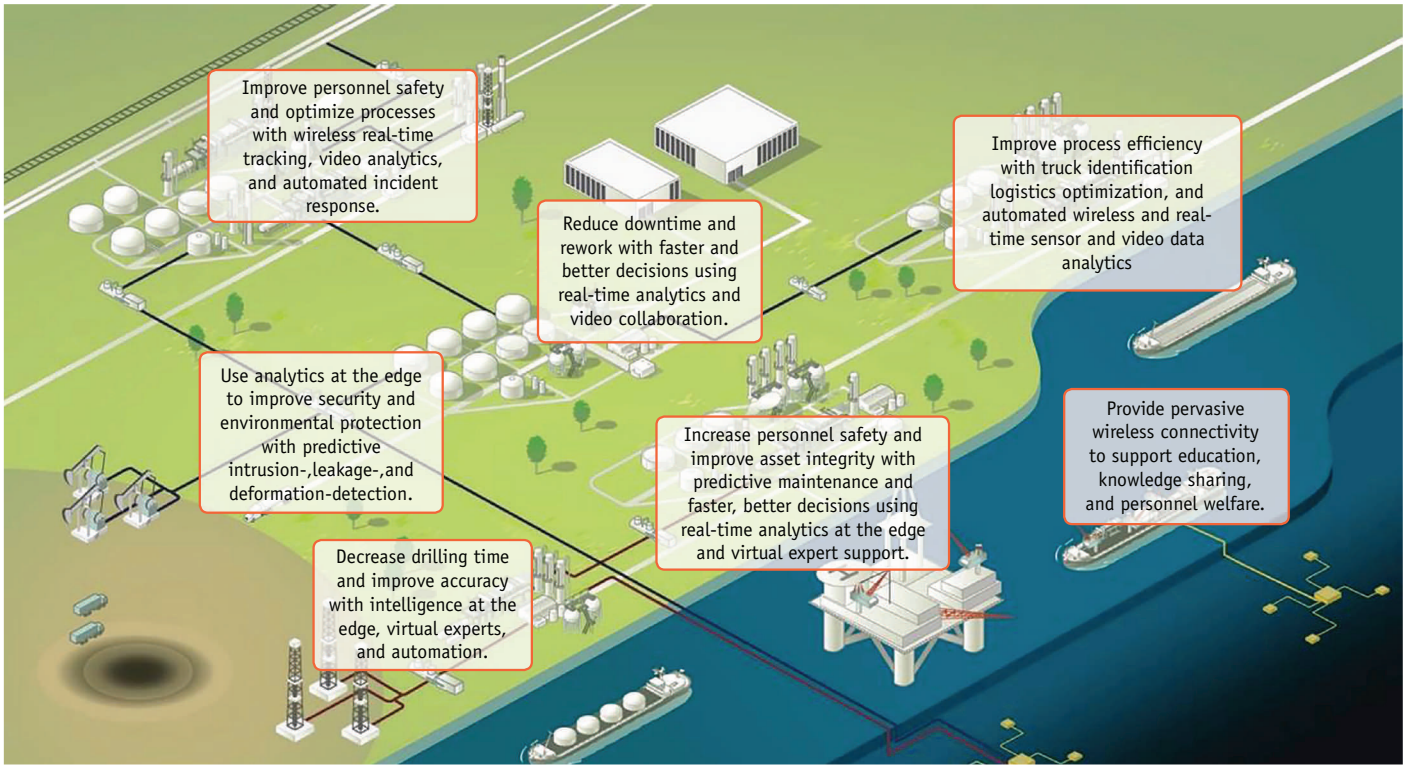
To capitalize on the wide range of data IoE generates, oil and gas industry firms must overcome three key challenges:

- Integrating data from multiple sources
- Automating the collection of data
- Analyzing data to effectively identify actionable insights

Integrating data

Clearly, integrating data from multiple IoE sources, particularly when those sources are varied in nature and highly distributed, poses significant challenges. Because copying all data to one centralized node for integration is no longer feasible for a variety of reasons (cost, technical difficulty, and possible regulatory issues) organizations are now starting to rely upon data virtualization to integrate widely dispersed data. Data virtualization makes a heterogeneous set of data sources look like one logical database to users and applications. These data sources do not have to be stored locally; they can be anywhere. This is valuable for an IoE application that relies on data from many distributed sources such as embedded sensors, video cameras, and third-party data.

Data virtualization provides another powerful advantage. Because it is designed and optimized to integrate data live, there is no need to physically store all the integrated data centrally. It is only when data from several different sources is requested by users that it is integrated. In other words, data



SOURCE: CISCO

Complex business problems are creating opportunities for a digital transformation that can extend into all aspects of oil and gas operations to increase efficiency and profitability.

virtualization supports integration on demand. Data virtualization provides instant access to all the data users want, the way they want it. Users can retrieve and manipulate data without needing to know how the data is formatted, or where it is physically located.

Traditionally, the process of gathering and integrating data across different parts of the oil and gas value chain has involved considerable manual effort. Data virtualization helps firms gain a single view of a well and all of its subcomponents, allowing for quicker identification of targets for improved efficiency that leads to increased profitability.

Process data at the edge

After IoE data is captured and integrated, organizations face the challenge of getting the data to the right place at the right time so it can be analyzed. This includes assessing the data to determine whether it needs to be moved to the cloud/data center, or analyzed where it is, at the "edge" of the network ("moving the analytics to the data"). Organizations, therefore, require a connected infrastructure that enables insight from the data center to the edge.

"Edge computing" is enabled by the extension of cloud computing and services to the edge of the network—a paradigm sometimes referred to as "fog computing." Fog creates a platform that provides compute, storage, and networking services between end devices and cloud computing data centers. It also supports emerging IoE applications that demand real-time/predictable latency (such as industrial automation, transportation, sensors networks and actuator). Thanks to wide geographical distribution, the fog paradigm is well positioned for real-time data analytics.

The oil and gas industry provides a prime example of the need for "edge computing." A typical offshore oil platform generates between 1TB and 2TB of data per day. Most of this data is time-sensitive, related to platform production and drilling-platform safety.

The most common communication link for offshore oil platforms is transmitting data via a satellite connection, with data speeds ranging from 64Kbps to 2Mbps. This means it would take more than 12 days to move one day's worth of oil-platform data to a central repository. There are similar examples across several other industries. In fact, 37 percent of respondents to a separate Cisco survey stated that within the next three years, most of their Internet of Things (IoT) data will be processed at the edge of the network on smart devices.

Analyzing data

Whether it is in the cloud or at the edge, IoE/IoT data must be analyzed to identify actionable insights that can be used to create better outcomes. Without this critical step, data remains just "data." Insights then need to be embedded into efforts such as process reengineering and broader business transformations. Oil and gas organizations sometimes lack analytical capabilities due to an absence of both the skill sets (such as those possessed by data scientists) and tools to deal with the exploding size, speed, variety, and distribution of data. These firms need to attract or develop employees whose knowledge intersects data science, design, and enterprise architecture. To deliver true value, data insights must link to specific business processes and outcomes.

Respondents to Cisco's oil and gas survey clearly understand the potential of data analytics to drive critical business outcomes: they named "data analytics for faster/better decision-making" as their No. 1 driver for investment in connected technologies such as IoE. "Improved operational efficiencies" and "increased productivity" ranked second and third.

An example comes from a Canadian oil sands company, which is combining sensors, GPS, and real-time analytics to track the movements of its trucks. Real-time data from the trucks can be viewed on virtually any device, including smartphones and tablets. The solution increases production efficiency, while reducing downtime.

Improved data management and analytics capabilities also have the potential to promote more effective allocation of manpower in oil and gas. When data is preprocessed through effective data management and analytics, for example, the workforce spends more time on capturing insights, rather than having to process the data manually.

IT-OT convergence & cybersecurity

According to Gartner, a growing number of regulatory directives aimed at critical infrastructure security—combined with

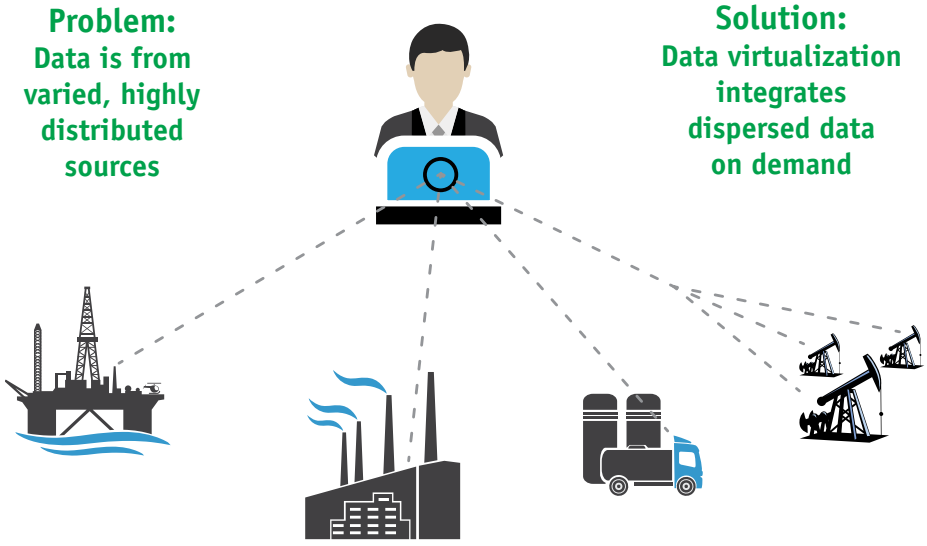
uncertainty about how they will affect the business of oil and gas—are creating an urgent need for stronger cybersecurity in OT environments. In addition, OT's increasing use of IT infrastructure to replace its own proprietary infrastructure is spurring greater collaboration between IT security staff and OT engineers. This is fueling faster convergence between IT and OT in the area of cybersecurity than in other aspects of the oil and gas business.

This is good news for the oil and gas industry, and comes just in time:

- According to the Department of Homeland Security, 53 percent of all cybersecurity incidents in the six months ending in May 2013 occurred in the energy sector, and the number of attacks is increasing.
- A study by Fox-IT reported that 60 percent of oil and gas companies do not have a cybersecurity incident response plan. In addition, only 11 percent are fully confident that they can address a cybersecurity breach appropriately. More than 23% percent admitted that they are not actively monitoring their network for potential intrusions.

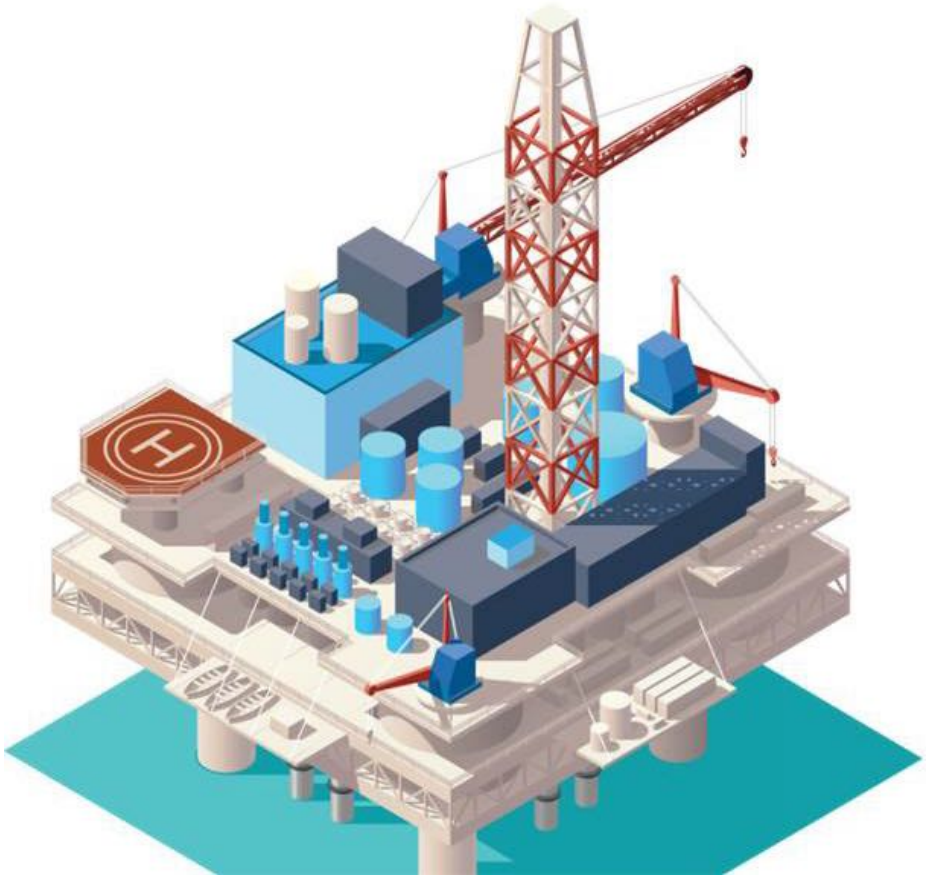
Oil and gas firms must have the proper cybersecurity measures in place to succeed with IoE—particularly as the mounting number of connected field-based sensors and greater use of closed loop systems (i.e., systems where machines, not humans, monitor, analyze, decide, and implement changes to the operating environment) introduce new areas of vulnerability.

This environment is creating more opportunities for professional cybercriminals and even hacktivists to exploit. Cybercriminals are well-resourced and take the time to find weak links in network defenses. They then exploit that weakness in a low-profile manner, often remaining undetected for weeks, months, or even years while targeting customer data, intellectual property, and other information.



SOURCE: CISCO

Data virtualization takes distributed sets of data and treats them as one logical database for dispersement on demand.



SOURCE: CISCO

A typical offshore oil platform generates between 1TB and 2TB of data per day, most of which is also time-sensitive.

Build a digital foundation

Here are five areas that firms should begin addressing now to ensure both short and long-term success:

Digital transformation: This demands that oil and gas companies leverage IoE to become more hyper-aware, predictive, and agile. These traits will enable oil and gas firms to innovate faster and achieve their desired business outcomes. Success requires application of this framework across technology (data), people, and processes.

Technology (Data): Fund data management and analytics as a business case at the enterprise level. Strive to ensure availability of high-quality, actionable, trusted, and complete data. This includes integrating structured transactional and sensor data with a variety of other data types including text from content repositories, web clickstreams, customer interaction text from non-social networks, mobile devices, geospatial sources, and rich media. Develop advanced analytics tools for predictive statistical analysis or data mining. People: Build skills in advanced, and complement those capabilities with a culture of collaboration. Apply analytics-driven insights to management decision-making. Work with data scientists and the business to ensure that data analytics align with business objectives.

Processes: Emphasize development of governance and performance measurement capabilities, internally or externally. Governance skills are critical to ensure proper deployment of data analytics. Also, create processes for information management and application development, along with information consumption.

Workforce of the future

To become agile enough to compete in the IoE era, the oil and gas workforce must possess an optimal mix of technical skills,

industry knowledge, and business acumen. With talent shortages due to massive numbers of trained executives and other professionals retiring over the next few years, O&G firms need to make bold moves to transform their workforce strategy. One approach is to take advantage of IoE-based technologies such as video conferencing to train current and new employees. Oil and gas firms also must work hard at developing or attracting employees who can see across IT and OT.

Automation offers an opportunity to reduce overhead of some repetitive tasks, while opening up opportunities to bring in critical thinkers with analytical skills such as data scientists. The primary role of the data scientist is to identify data that has real business value—and to develop the delivery path for information into the right parts of the business. Data scientists need to understand business and industry implications to derive the types of insights that could significantly impact the bottom line. The race for talent in this area bridges multiple industries; O&G firms should begin competing now to attract this talent or risk being left behind.

Align IT and OT

O&G firms will truly improve end-to-end business efficiency only when they enable integrated planning and operations across the silos that currently divide the IT and OT aspects of the business. Companies must build a culture of communication, collaboration and coordination between teams, supported by company leadership. One approach is to establish a center of excellence that spans IT and OT to govern digital architecture and standards. This provides an opportunity for members to communicate intentions, and expand participation from all relevant entities. The goal is to align skills, language, and strategy before architecture and technology.

Ensure end-to-end cybersecurity

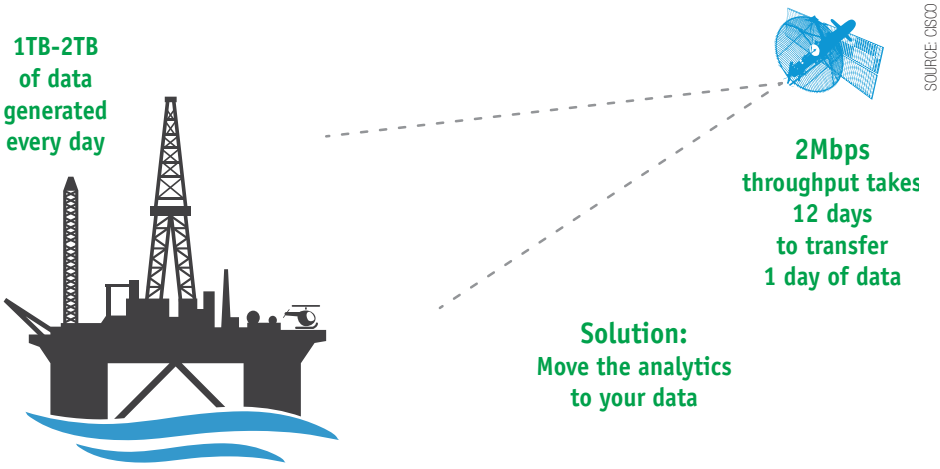
To help mitigate cybersecurity risks, as well as prepare for future industry developments, oil and gas firms should do the following:

Establish the Baseline: Take a comprehensive inventory of all assets and their current state. Design defenses based on the premise that a successful attack is inevitable. Defensive capabilities are required before, during, and after an attack.

Achieve Visibility: Ensure visibility of assets, protocols, users, applications and traffic patterns on the control network to develop a picture of what is "normal" for that environment. This can be done without disrupting real-time communications, and so that loads on sensitive OT devices are not increased.

Implement Controls and Automation: Prioritize assets and systems based upon their value to maintaining operations, and build out defenses for the critical assets and systems first. Implement a combination of IT security and IACS (industrial automation and control systems) security to limit the attack surface and attack window as much as possible.

Strive for Continuous Improvement: Regularly test, review, and update defenses and policies. Being "secure" is temporal, as threats and attack techniques constantly evolve. Therefore, defenses should be regularly tested and modified, as needed.



Edge computing is particularly useful in industries such as oil and gas that deploy many sensors in remote locations.

Innovate for growth

Once oil and gas firms have leveraged IoE to drive the efficiencies referenced earlier, they can begin looking at other opportunities to foster innovation and growth. Here are some potential IoE-enabled solutions that could create significant value in the future for the oil and gas industry:

Predictive and Prescriptive Analytics: Predictive analytics anticipate future behavior or estimate unknown outcomes. By understanding likely outcomes, organizations can choose alternative courses of action as well as modify investments to maximize return. Predictive maintenance is one area where predictive analytics can pay large dividends for the oil and gas industry.

Autonomous Field Vehicles: AFVs are unmanned marine, air, or ground platforms that can be configured to deliver a wide variety of sensor payloads to remote locations. AFVs will become increasingly important to oil and gas firms for monitoring extreme operating environments and efficiently conducting high-risk equipment inspections.

Smart Robots: Smart robots have the ability to work autonomously in the physical world and learn from their experiences. They sense conditions in their local environments, recognize and solve basic problems, and learn how to improve. They can also work alongside humans or replace human labor. Like AFVs, smart robots provide an attractive alternative to placing human O&G workers in dangerous locations or situations.

Wearable User Interfaces: Wearable user interfaces can sense the human body or the environment around the wearer, and then transmit relevant information to a smartphone or the cloud. Examples of wearable electronics include smart watches, smart glasses, smart clothing, fitness monitor wristbands, sensors on the skin, and audio headsets. Wearables have significant potential to improve the safety of oil and gas workers based in remote locations. They can also streamline workflow by enabling field workers to access technical information pertaining to a specific piece of OT equipment in real time. In addition, adoption of wearable technologies will help attract the younger, tech-savvy workforce of the future.

Cognitive Computing: Cognitive computing involves self-learning systems that use data mining, pattern recognition, and natural language processing to mimic the way the human brain works. The goal is to create automated IT systems that are capable of solving problems without human assistance. Cognitive computing will improve knowledge workers' decision-making ability by automating access to information and by highlighting risks and uncertainties. In the future, cognitive computing could impact not just the nature and structure of organizations, but how they achieve competitive advantage.

When the price of oil stood at more than $100 per barrel, the need for oil and gas companies to improve operational efficiencies was primarily driven by the competitive marketplace—and many firms took no action at all. With the oil-price collapse of 2014-2015, however, increased efficiency has become a business imperative that will determine both survival and competitive advantage. The time for oil and gas companies to act is now—through a strategic transformation underpinned by a new approach to people, process, and technology.

Technology report by Robert Moriarty, Kathy O'Connell, Nicolaas Smit, Andy Noronha and Joel Barbier of ***Cisco Systems****.*

Cloud-based modeling and simulation offers IoT solution

A prognostics-based computational solution accurately simulates the "real world" operating conditions for First Wind's gearboxes. Software tools help determine how specific components are functioning and predict when they will fail, saving significant time and expense needed to collect and evaluate field data.

SOURCE: SENTIENT SCIENCE

Prognostics and data modeling can help extend the Remaining Useful Life (RUL) of wind turbines through system monitoring and determining potential sources of premature failures.

WHEN FIRST WIND'S GEARBOXES began failing prematurely, the wind turbine operator with 980MW of capacity across 16 wind farms needed a way to predict and extend their fleet's life. Wind turbine operators have a pressing need to extend the life of their gearboxes and bearings due to premature failures. The importance of reliable operations forces operators to make difficult predictions and decisions regarding future failure risk for warranty renewal and maintenance and operations planning.

Predictive monitoring

To extend First Wind's turbine fleet life and improve profitability by controlling its failure risk and maintenance needs, First Wind chose DigitalClone Live technology to predict their fleet life "As Is" and understand how changes to operations and maintenance would affect life and financial performance.

"Predictive maintenance allows us to be able to manage maintenance downtime and costs better than reactive maintenance programs," said Frank Silvernail, Vice President of Engineering for First Wind.

Sentient Science integrated software and sensors with SCADA systems on 218 wind turbine gearboxes. Now First Wind can predict the failure risk of their fleet, analyze how different gearbox configurations extend life, and understand how operational or lubrication changes affect turbine life to schedule maintenance and improve turbine life.

Cloud-based modeling

The cloud based modeling and simulation software provides an ability to know future turbine component failure rates/modes and to take actions to minimize them by approaching the application with a five step process.

1. Connection to SCADA and CBM system for historical and current operations data.

2. Build a prognostics model for how the wind turbine or wind turbine farm operates.

3. Make predictions about the state of the wind turbine or wind turbine power plant which includes determining RUL and failure mode, establishing alarms and prepare reports that predict when problems will occur.

4. Establish goals for the ROI of the wind turbine or wind turbine farm.

5. Prepare control settings to optimize performance of wind turbine or turbine farm.

Prognostics enables the wind farm operator to devote little or no headcount to the vibration or other CBM systems. According to Stephen Steen, Manager New Business Development Energy and Heavy Machinery Markets for Sentient Science, "The service essentially runs itself because it is focused on predicting the failure and what it looks like in the data far ahead of time instead of looking for indications of failure within the data. As a result, the wind farm operator knows what the risks are and more importantly how to reduce them before they happen, preventing the condition from occurring."

The approach is to manage by exception, by only focusing on changes to predictions or sensor data rather than monitoring the data manually looking for indications of failure.

All assets in the wind turbine can be managed in this fashion for the entire system, major subsystems and all the way down to the individual components. The parameterized model means that a parameter under study can be changed to see how this affects life and reliability.

The result is the wind farm operator can make better informed recommendations on how to improve the operation of the turbines through better design analysis, understanding of suppliers and determine if components need to be remanufactured to achieve optimization.

*Case Study by **Sentient Science.***

Synchronizing Industrial Ethernet networks

Automation engineers can develop architectures that meet the demands of their applications by understanding the differences between distributed clocks and the IEEE 1588 precision time protocol. Two different approaches to industrial Ethernet network synchronization provide application advantages.

THE QUESTION TODAY IS NO LONGER whether to use Industrial Ethernet; the real question is how to take full advantage and how to ensure best practices are in place.

The general benefits of using one of the many industrial Ethernet protocols for machine networking are numerous such as for I/O, the motion bus, and safety in many cases. But some protocols have the potential not just to greatly increase the speed of cycle times, but also to generate significant improvements in manufacturing precision, accuracy of processes and system diagnostics.

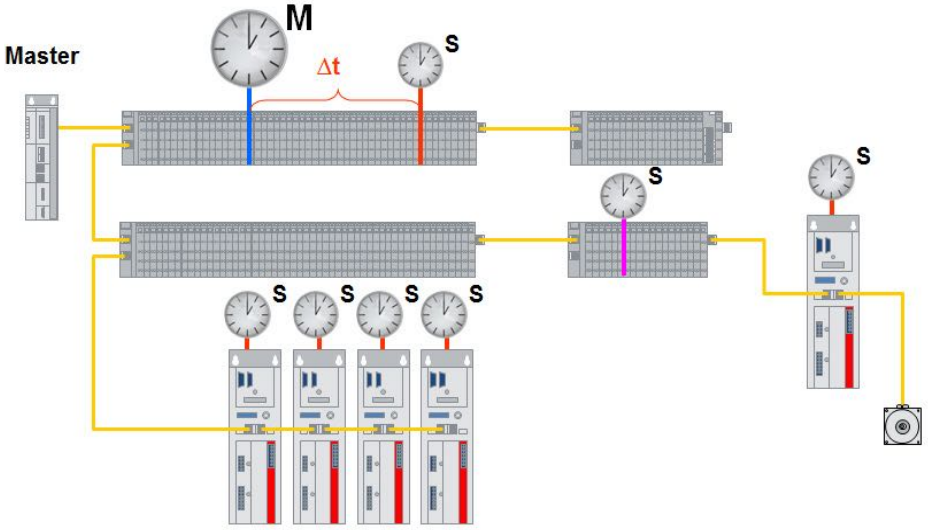
Advantages of consistent time base

Synchronization is an area where the more advanced industrial Ethernet protocols can make an immediate mark. By implementing synchronization, a consistent time base can be created across applications for any number of spatially separated industrial Ethernet-connected devices. This includes machine sections such as applications with multiple motion axes to achieve a path through space of a robotic arm, or those involving measurement technology for diagnostics of bearing wear.

Synchronization is a key element in modern automation systems to ensure that both simple and complex devices are always synchronized to each other, to external applications, and to events in a reliable, repeatable manner.

Device-level digital communication systems (fieldbuses) give the developers and end users of devices the opportunity to network these devices together, with industrial Ethernet being the most recent and most widely accepted entry into this market. However, what technologies are available today for synchronizing a network of Ethernet-connected devices, and how can this synchronization be used to the advantage of the automation engineer?

First, how should the term "synchronized system" be defined? Is it simply defined by how deterministically the frames are sent and received? Is it that the devices know what time the frame arrives and is sent? Also, how does one tackle commanding an I/O to turn on, or a motion move to begin at a future time? What about latching in the time of an external event? There are many factors relevant to the internal workings of the end devices that determine how well the device can interact with the environment, such as reacting to a time-valued command, or sensing when an external value has reached some limit. The answers will be different for each user. However, most will be more concerned with the need to ensure the input or output signal to the wire (or when motion begins, or when ΔT parameters are collected) is as controlled as possible, and with the least amount of jitter possible. Jitter is the variation from a perfect synchronization-or as good as it gets. Other concerns may include the complexity involved to implement and manage such a system.



SOURCE: ETHERCAT TECHNOLOGY GROUP

Using a method that distributes time from the reference clock can be extremely efficient and elegant.

IEEE 1588-PTP

IEEE 1588 precision time protocol (PTP) offers a solution for implementing network-wide synchronization down to sub-microsecond levels across a variety of transmission media, including over Ethernet. This standard has been adopted by several of the industrial Ethernet fieldbus protocol providers as the means of achieving temporal synchronization in their respective technologies.

The IEEE 1588-PTP standard does not specify some key parameters for devices, such as the type and frequency of device oscillators. Therefore, there can be various qualities of clocks in a given system, some better than others. A slower clock will have less time resolution and, therefore, will be less accurate with its time and timestamping. Because of this, the IEEE 1588 network has to determine the best master clock (BMC) to use in the network, a negotiation algorithm that involves communicating device parameters to each other and determining the best device to use as the reference clock. Obviously, if all the devices have lower-quality clocks, then the overall BMC may still not offer the performance the user desires. If the network becomes larger, spanning through several subnets may be required, and special switches with IEEE clocks built in will be required, each becoming the BMC of each subnet.

After determining the BMC, the time delay between the BMC and the other IEEE 1588 devices must be determined and periodic timing corrections to the BMC must be issued. Because in IEEE 1588 this has to occur in a switched network environment, the routing delays depend highly on the topology, and each additional switch not only adds delay, but additional devices on the network also increase network traffic, which means that traffic becomes more jittery and susceptible to being queued in a network switch, causing a considerable amount of jitter overall.

The actual timestamps that are accessed and read can vary somewhat in an IEEE 1588 system. The so-called asynchronous timestamp reads occur from one of two places: either a specialized Ethernet transceiver chip, or a specialized media access control-both

accessed from software on the host microcontroller via an interrupt from either of these devices. Synchronous timestamp reads occur when the timestamp is inserted into the message as it enters the device. This requires additional specialized hardware, as the timestamp addition changes the cyclic redundancy code of the Ethernet frame, which must be recalculated and changed. The advantage here is that the timestamp and data match. Both of these approaches require a microcontroller (as well as software, RAM, etc.) to be designed into every slave device, which may be overkill for simple devices.

Distributed clocks

As another way to implement synchronization, EtherCAT is an example of an industrial Ethernet system that uses distributed clocks (DCs). These DCs are built into the associated EtherCAT slave controllers (ESCs), so there is no external circuitry, or special infrastructure required for implementing DCs.

ESCs are the IC chips that implement the EtherCAT protocol in hardware. Devices with and without DC functionality can be mixed freely in the same network with no impact to the synchronization quality of the network. The EtherCAT specification dictates the frequency and quality of the DC device's oscillator.

Therefore, there is no need for a BMC determination to be made. Any DC device can be the reference master clock. By operating principle, the reference clock is always the first EtherCAT slave that has DC functionality enabled. The advantage of this is that there is no negotiation required, and all slave devices have the same oscillator quality. Furthermore, the method of distributing the time from the reference clock is extremely efficient and elegant.

Because of the processing-on-the-fly operating principle of EtherCAT, every frame is effectively routed in a cut-through fashion through every slave of an EtherCAT network (up to 65,535 slaves). Regardless of which slave is, or is not, being addressed, every frame goes through each slave device in the same path every time (there is no active routing of frames). This results in the same timing throughout the network.

Each slave can predictably calculate how long it takes for data to pass between the forward direction (Tx) and returning direction (Rx), and the master also knows the exact EtherCAT network topology. This is important because the master can easily calculate the propagation delay between any two points in the network with these sets of data, such as between its reference clock (always the first DC-enabled device in the network) and each additional DC-enabled slave. This calculation needs to be done only once for a given network, and is completely topology-independent.

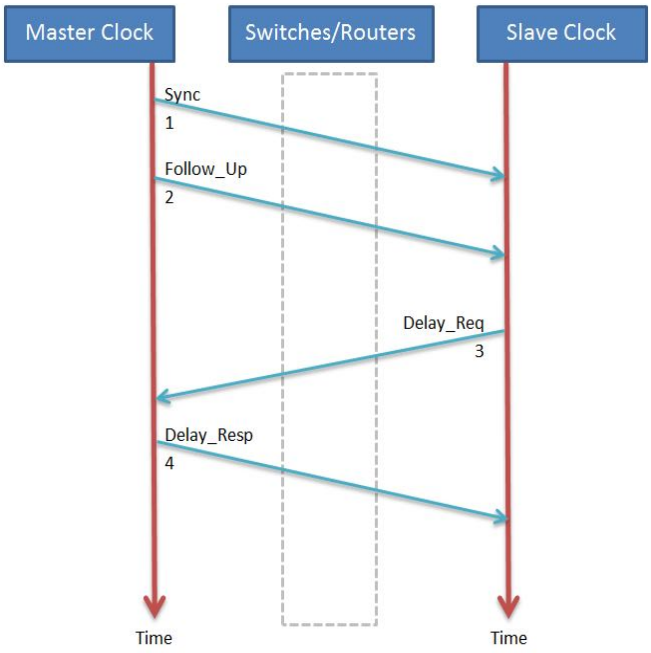
After calculating the propagation delay from the reference clock to an individual slave, this value is given to the slave, and each slave receives its unique propagation delay value. This is done so that each slave can set and maintain its local clock to that of the reference clock. For drift compensation, the master simply adds a very small instruction (16 bytes) to every cyclic frame, which grabs the time from the reference clock and distributes it to all other slaves.

Each slave will compare the sum of the received time value from the reference clock, plus the propagation delay to its own local clock value and determine if it is running fast or slow. Compensation is done simply by adjusting how much time is counted for each pulse of its local oscillator, thereby closing a phase loop to the reference clock.

The performance of DCs is independent of the network topology, number of slave devices, and jitter of the frames coming from the master. Real-world jitter values of less than ±100 nanoseconds are regularly achieved. The main factor in tightening the phase lock loop is simply the need to issue the time distribution command more often. Because neither the jitter of the network nor the timekeeping of the individual slave devices is impacted by any jitter of the Ethernet frames, the EtherCAT network doesn't require any special master card to facilitate jitter-free frames. As long as the data is received by the farthest slave prior to the network-wide time interrupts to use it, there are no problems with frame jitter. All EtherCAT masters calculate how far in advance they need to begin sending out the frame based on any NIC jitter, any delay and jitter in the network, as well as the length of the frame itself.

Additionally, the DC unit that facilitates this synchronization doesn't require the added complexity or cost of a microcontroller. So, even low-cost digital I/O can be constructed of only the EtherCAT slave controller chip, an EEPROM, and the driver circuitry for the input/output signals.

Yet this can deliver output signals that can be commanded down to the nanosecond, or latch in time values on rising or falling signal edges (configurable) with the same nanosecond resolution, all without the addition of a microcontroller.



This standard has been adopted by several of the industrial Ethernet fieldbus protocol providers as the means of achieving temporal synchronization in their respective technologies

Time & field devices

Getting the slave device to behave in relation to the time is the ultimate goal of a synchronized system. Here, the differences between IEEE 1588 and DCs are quite apparent.

IEEE 1588 devices are typically somewhat complex because a microcontroller is required regardless of whether the core function of the device is a simple one (such as a digital I/O) or not. However, the devices will typically be implemented within the slave with the microcontroller running some kind of software, which reads directly from time registers to facilitate any and all functions, from simple digital signals to complex motion profiles.

On the other hand, the internal DC unit inside the EtherCAT slave controller is tied directly to the internal frame transceivers, the logical processing unit, an interrupt request to an optional microprocessor, and to a set of input and output pins. These input (latch) and output (sync) pins can be used directly as I/O signals for simple digital devices, or can be used with a microcontroller to achieve interrupts that can enable more advanced functionality.

At the basic level of device implementation, the sync pins can be used as outputs for digital signals. Associated with each sync pin is a time value register. When a value is set to this register, the sync pin will fire automatically with nanosecond resolution after the local time reaches this preset. In this way, a very inexpensive digital output module can be constructed, because there is no accompanying cost of a microcontroller, RAM,

or software stack. These devices will have very low jitter, and can be synchronized to other network-wide DC devices in the network.

Again, the corollary to the sync pins are the input latch pins. These pins can be used as input pins in a simple I/O device, because a time value will latch into their associated registers when the configured rising or falling edge is detected. Both the sync and latch pins give functionality that is not tied to the scanning of a traditional PLC, but allows input capture or output command to occur at any point in time with nanosecond resolution.

When precise input time can be paired with precise output response, the user can measure the exact time that an event occurred and command an exact time to react to this event. This can include, for example, reacting to an alarm in a manufacturing line and calculating the future time required to avoid the rejection of product that is not at risk, but reliably eliminating the product that is at risk.

Oversampling can be accomplished through the use of subordinated interrupts, which will allow a device to take many samples of a signal at a rate that can be a multiple of the controller scan rate. This permits the capturing of an event (or even multiple events) that would otherwise be invisible to a traditional PLC, because their duration is short enough to fit between PLC scans. Similarly, oversampling digital output devices can generate pulse trains that would be impossible to detect with simple I/O, which at the maximum would only be able to create square waves of half the scan frequency.

Using oversampling with analog capture ability enables analog modules to capture or create waveforms, which can add great functionality to a high-speed process. Continuously running oversampling modules can be used for adding condition monitoring and preventive maintenance functionality to an automation process, where fast Fourier transform (FFT) algorithms can self-diagnose motors, bearings, or gears for wear and tear. All this is possible while providing the control of the process and equipment itself.

The preceding paragraphs are not meant to imply that DCs and IEEE 1588 are necessarily rival synchronization schemes, nor that they are incompatible. The key point is that the internal synchronization methodology inside EtherCAT is based on DCs because of the aforementioned benefits of simplicity, cost efficiency, and flexibility in design. Also, DCs are already built into the EtherCAT slave controllers, so there are no additional hardware requirements.

As a matter of fact, there are several sources of EtherCAT-to-IEEE 1588 boundary clocks that allow the bridging of time values from one to another. These are used for synchronizing an EtherCAT network to an exterior IEEE 1588 timing source, such as from a grandmaster clock, or another fieldbus system that uses IEEE 1588.

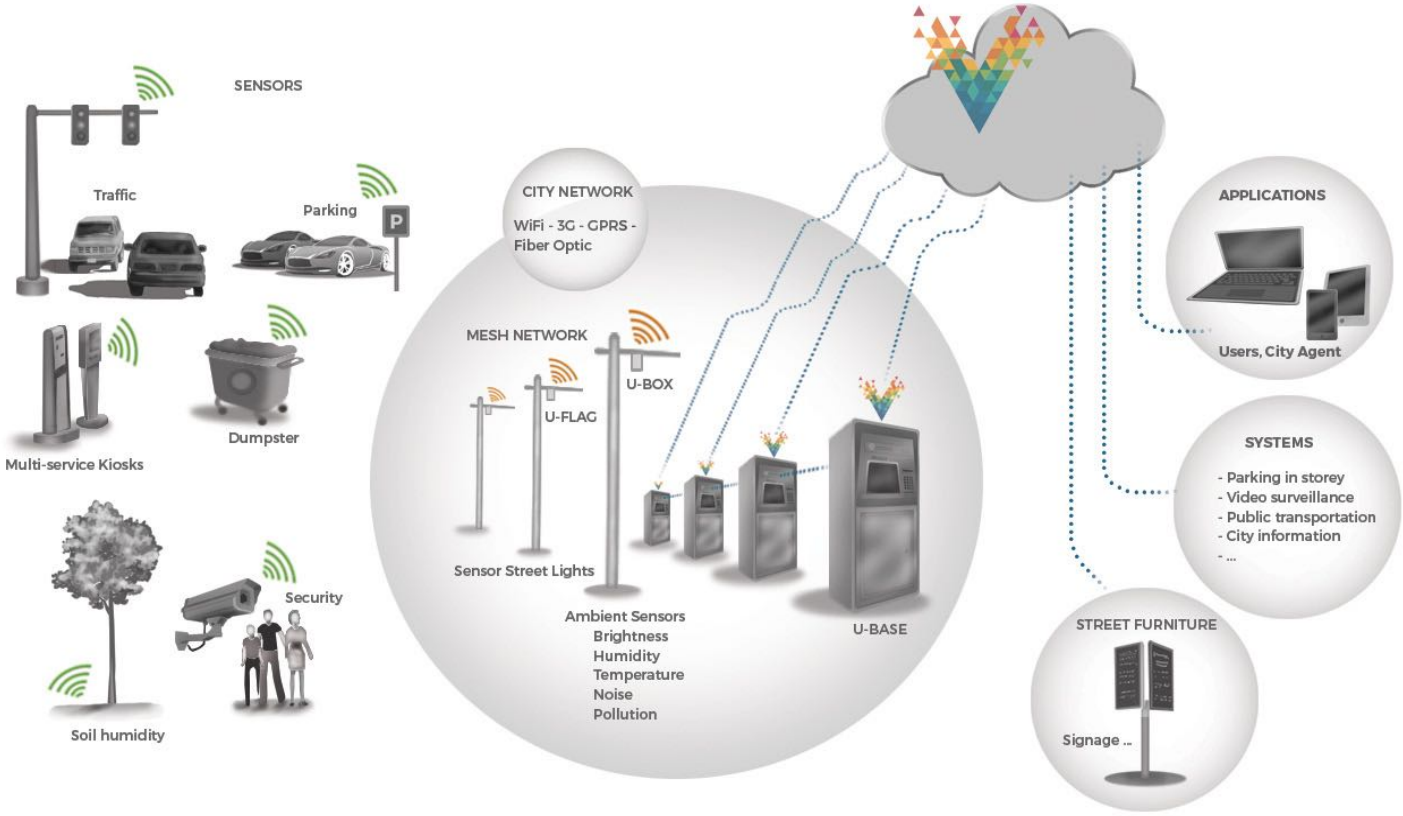
Conclusion

Both IEEE 1588 and DCs offer the automation engineer the ability to implement a network of highly synchronized devices spread across a large area and long network distances. Whereas IEEE 1588 offers a viable solution for Internet- and switch-based protocols, EtherCAT uses the more streamlined, bandwidth-efficient DC solution, which also ensures very low jitter. Whereas IEEE 1588 requires special and complex microcontroller-based hardware even for the most simple of digital I/O devices, EtherCAT DC devices can be implemented without microcontroller support, resulting in lower device and system costs. These two synchronization schemes can still be used together, bridged via boundary devices. This allows the network time to be shared between an EtherCAT network and an IEEE 1588-based system. Between these two synchronization schemes, automation engineers can develop bottom-up or top-down architectures to meet the demands of their application or their customers.

Joey Stubbs is a North American representative for the ***EtherCAT Technology Group.***

“Connected Boulevard” leverages IoT solution

The city of Nice has implemented a range of E-services including smart parking and alternate transportation information. Data sharing technology provides real-time information on traffic, transportation, wastage and air/water quality. Future services will focus on smart street lighting and smart waste management.



SOURCE: PRISMTECH

The Connected Boulevard project is an example of how Internet of Things networking will ultimately be applied to a wide range of applications, systems and city services.

INTELLIGENT DATA SHARING TECHNOLOGY is serving as the real-time connection and foundation for the City of Nice’s Connected Boulevard project. The Vortex Intelligent Data Sharing Platform is a fundamental part of the City Operating System that has already helped to enable the rollout of a range of E-services for the city including smart parking guidance, public/alternate transport information and details about city services.

In the future, additional E-services to improve city management and the everyday lives of the residents of the City of Nice will be deployed. These new services will include smart street lighting and smart waste management.

Challenge & solutions

In 2008, the City of Nice made a commitment to become a model Eco City and put in place a plan for renovation by launching the Connected Boulevard Project. One of the key areas of focus was to develop green transportation and reduce the negative consequences of urban activity on the citizens of the city.

As part of the City of Nice’s Intelligent Mobility strategy, Mentis Services was contracted to develop an implementation of The City Operating System, an ecosystem that aims to improve the efficiency of city services. These new Smart systems add value to citizens by providing real-time information on traffic, transportation, wastage, air/water quality etc. countering the problems faced by cities due to rising population and urbanization.

Connected Boulevard Project

Already the City of Nice and its residents are seeing real benefits from improved city mobility. By having real-time access to car park space availability data via mobile devices, drivers are taking much less time to park and parking income from reduced fraud is up by 35%. This in turn is helping improve traffic flow and has reduced congestion by 30%. Air pollution and noise levels have been reduced by 25%. In the future, better city management will see savings of between 20-80% in areas such as street lighting and waste management while improving overall environmental quality.

Vortex OpenSplice technology was selected to provide the information backbone for this Connected Boulevard project and to help realize the goals of Intelligent Mobility and Environmental Quality in the City of Nice. The initial phase of the project involved the development of a Smart Parking system to allow drivers to make informed decisions on their movement by combining traffic information and parking availability (on street and garage), as well as alternative transportation (public transportation, bicycle sharing and electric car services). Smart Parking increases parking efficiency, safety, and reduces pollution.

Vortex has been deployed throughout the city and has shown its ability to scale extremely well ensuring that critical information is shared reliably and in real-time between different services, information

SOURCE: PRISMTECH

The plan in Nice is to eventually deploy over 10,000 wireless sensors and 800 next generation, multi-service kiosks.

systems and applications. Vortex enables sharing of real-time information about parking availability and traffic density. It enables wireless sensors deployed throughout the city to inform commuters in real-time about the availability of a parking space and is also used to re-route traffic alleviating congestion, while facilitating the availability of this information to the public via mobile devices such as smart phones.

In 2012 the City of Nice started the deployment of the system. Initially a test zone was setup containing 1000 sensors and 80 next generation multi service kiosks. The plan is to eventually deploy over 10,000 wireless sensors and 800 kiosks. The kiosks are connected to the information system via the Vortex enabled "City Message Bus" which is running IP over the power network.

Connected Boulevard Project

PrismTech's Vortex Platform is being used successfully by Mentis Services as the real-time data sharing foundation for the City of Nice's new Connected Boulevard project. The City Of Nice is at the forefront of the next generation of Smart Cities leveraging the Internet of Things. Vortex is a fundamental part of the City Operating System developed by Mentis Services. Vortex supports a range of new Smart systems that add value to citizens by providing real-time information on traffic, transportation, wastage, air/water quality etc. countering the problems faced by cities due to rising population and urbanization.

The City of Nice and its citizens are already seeing real benefits from the new systems with parking income up by 35%, traffic congestion reduced by 30% with much better traffic flow and improved air quality in the city. It's expected that even greater savings will be realized in the future when new Smart Lighting and Smart Waste Management systems are deployed.

*Application case study by **PrismTech**.*

RJ45 technology offers unique wire management

Easy fabrication of Profinet systems can be achieved using a four-wire cabling system but now the same is true for contacting eight-wire cables using FastConnect RJ45 technology for systems that operate up to 10 Gigabit Ethernet.

SIMPLE ASSEMBLY OF ETHERNET-BASED automation systems is a key objective for users implementing industrial control networks. The costs for installation can quickly get out of control if assembly takes a long time to complete or handling quickly leads to errors that can only be discovered with elaborate measurement procedures at a later date. Every user wants a simple and robust system that prevents errors by its design alone.

FastConnect cabling technology offers a coordinated system of cables for Profinet users, a stripping tool for preparing the cable ends and an RJ45 plug without loose parts. But if Profinet systems need to be integrated into the network of a car manufacturing plant or another large durable goods manufacturing plant these days, for example, users often demand eight-wire cable designs for transmitting Gigabit Ethernet. Industrial-grade cables for Profinet have also been recently specified for these connections, whereby RJ45 is still used as an interface. This system provides a simple solution for avoiding fabrication mistakes.

The new system not only supports four wires, but also applications where eight wires that must be contacted on the plug instead. In an office setting, prefabricated systems are often used to minimize the amount of work involved. However, prefabricated cables often cannot be used in industrial plants because the cable routes cannot be exactly predicted, extremely long lengths need to be avoided and cables sometimes have to be drawn through narrow openings and channels. This type of handling can result in serious damage to the plug. This is why industrial cables are fabricated on-site and on-demand.

Snappy RJ45 plug

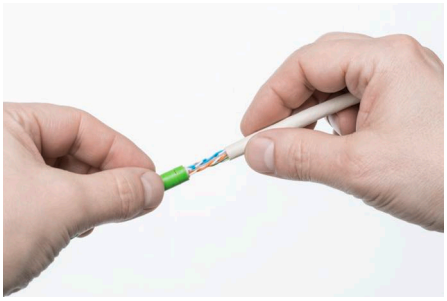
In order to improve the connection of eight-wire cables in the field, FastConnect RJ45 uses a novel wire management system. Similar to the four-wire version, this RJ45 plug features a rugged metal casing. With the same size as the version for four-wire cables, it can be also be used in all active network components of the Scalance and Ruggedcom product lines with an additional retaining collar.

The plug is connected to the housing of the network component through the retaining

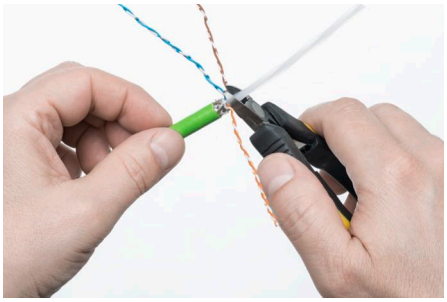
Measuring the cable end

Cutting the cable end with the FC stripping tool

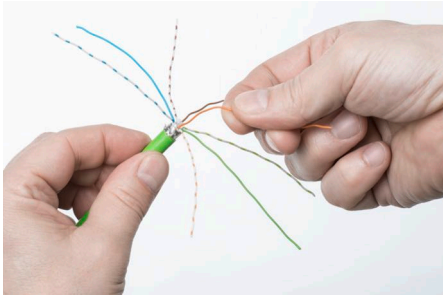
SOURCE: SIEMENS



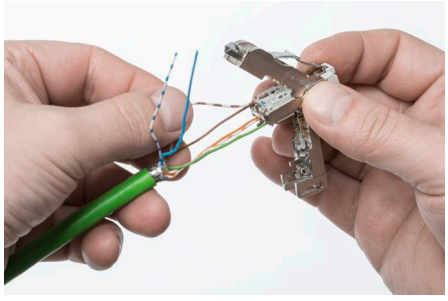
Removing the outer sheath and exposing the braided shield



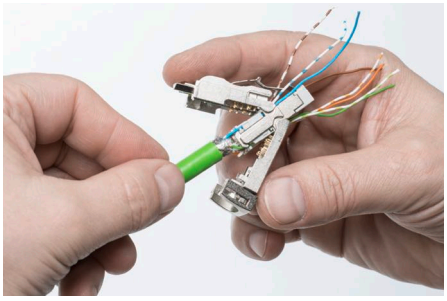
Removing the interior support cross



Unraveling and smoothing out the twisted wires

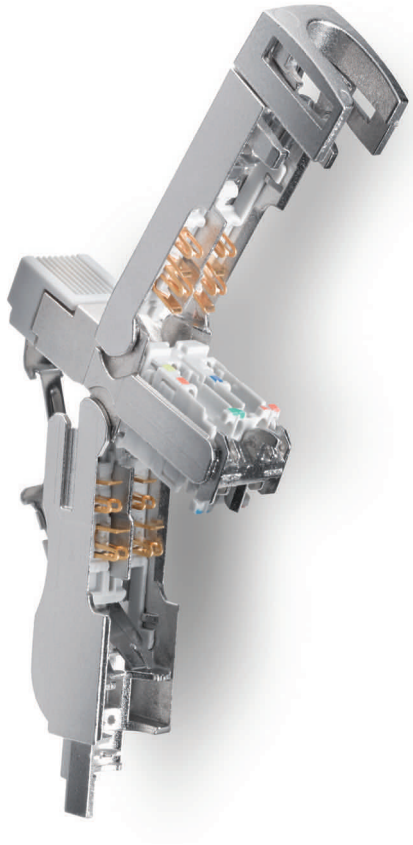


Inserting the wires into the plug according to color code and pull them out the opposite side



Pressing the plug casing to close it

Fastening the casing with a screwdriver



SOURCE: SIEMENS

Eight-wire cable in the new IE FC RJ45 plug 4 x 2 by introducing the wires through the plug casing.

collar. This means pull and rotational movements of the installation cables are caught by the housing of the network component and do not have a negative effect on the RJ45 socket on the device. Furthermore, the metal casing provides an optimal connection of the cable shielding to the housing of the active network component and thus good discharge of any EMC interference from the cable shielding. The plug casing needs to be opened to connect the eight-wire cables. This is done in two parts on both sides, making the eight-pin wire manager easily accessible to the user. Colored coding on the wire manager makes it easy to map the wires of the cable that have been exposed with the stripping tool.

Wires need not be cut to a certain length to make them easy to handle. In fact, the wires do not have to be exclusively inserted in the wire manager; they can also be pushed through the plug as well. Handling is easy due to the relatively long wires. Once all eight wires have been passed through the wire manager, the installation engineer firmly presses the RJ45 plug on the cable end. The two casing parts can be closed without tools.

The insulation displacement contacts on the inside connect to the wires one after the other and additional cutting brings the wires to the appropriate length in the casing. Protruding wire ends on the casing can then be removed by hand. The plug with its interior cutting and insulation displacement contacts enables easy assembly of eight-wire industrial cables with the correct length, even in difficult environmental conditions, such as a poorly lit control cabinet on a construction site.

Easy handling reduces overhead

The new Cat6A-capable FastConnect technology greatly simplifies making connections for eight-wire industrial cables. Unhindered access to the wire manager through a wide-open casing and color coding on the wire manager significantly reduces assembly time. The push-through system for the wires in the wire manager connects the cable to the plug much faster and the wires already inserted are prevented from slipping back from their intended position. Integrated cutting and insulation displacement contacts enable tool-free contacting between the cable ends in the RJ45 plug. This solution can significantly reduce installation and follow-up costs for locating potential errors. Cat6A connections for up to 10 Gigabit Ethernet can now be made in the field faster, more easily and without errors.

Michael Kasper *is a product manager for Siemens.*

Power-over-Ethernet switching leverages gigabit Ethernet

The rise in usage of IP cameras in manufacturing processes is driving the adoption of gigabit Ethernet. Power over Ethernet (PoE) has become a powerful technology solution by deploying cameras that require just one cable for data transmission and power supply.

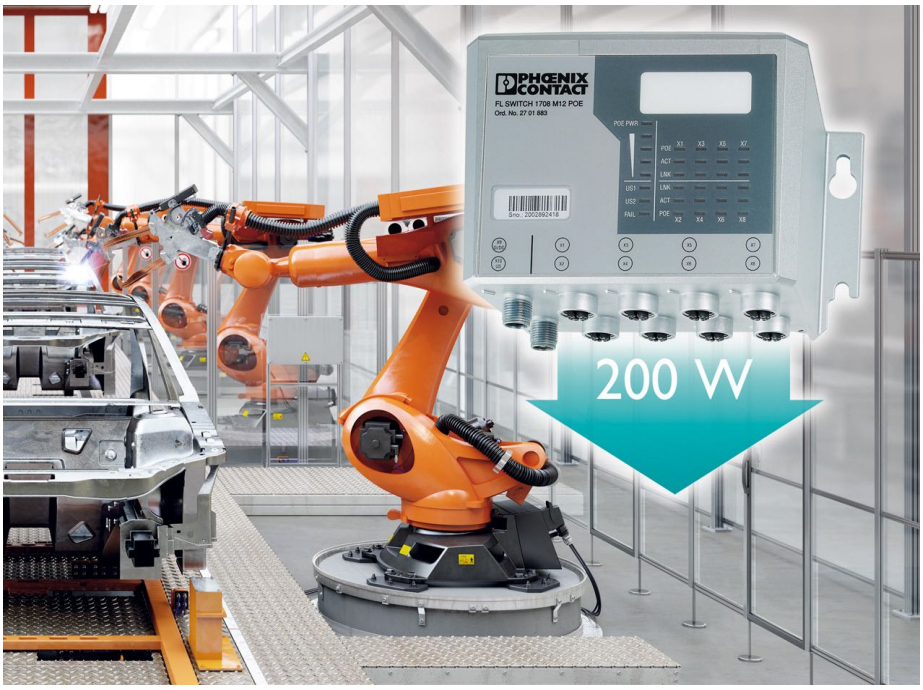
CAMERAS AND IMAGE PROCESSING SYSTEMS are widely deployed for the monitoring, streamlining, and optimizing of industrial manufacturing processes. Devices with Gigabit Ethernet interfaces supply high bandwidth raw data for further processing. Industrial image processing systems use such data for tasks such as identifying patterns and positions, or for determining complex 3D workpiece geometries.

In order for visual objects to be captured in the best possible way, camera components need to be positioned in suitable locations. Accordingly, one or more of the components are usually installed at a considerable distance away from the control cabinets. What makes things even more difficult is that these components are then often mounted on difficult-to-access parts of the plant.

Image systems

For camera connections, combining the Power-over-Ethernet standard with the Gigabit Ethernet data rate is an excellent solution. The Power-over-Ethernet design means that the deployed cameras require just one cable for data transmission and power supply. This significantly lowers the cabling requirements, which can result in significant cost savings. In addition, this approach makes it even easier to flexibly integrate the cameras into different types of systems. Due to the harsh environmental conditions inherent to industrial production, only dust and splash-proof M12 circular plug connectors are used for connecting the components. Gigabit Ethernet transmission makes use of an eight-pin cable design with an x-coded plug-in connector compliant with CAT 6A.

Thanks to Power-over-Ethernet, no separate power cable needs to be laid. At the same time, the Gigabit Ethernet standard ensures there is a universal interface that provides a sufficiently high data rate for transmitting raw camera data in real time. There already are other solutions where camera components are mounted remotely and connected via Power-over-Ethernet. For network connection, however, these require central Power-over-Ethernet switches that are installed on a DIN rail or in a 19 inch rack inside a control cabinet. This may necessitate the installation of a dedicated second control cabinet, which takes up more room – and which may be prohibitive to the network integration of newly fitted image processing systems in existing production systems.



SOURCE: PHOENIX CONTACT

Local Power-over-Ethernet switch technology provides Gigabit Ethernet in harsh industrial environments.

48 VDC voltage

The new Power-over-Ethernet switch with Gigabit speed and a protection class of IP67 makes it possible to integrate Power-over-Ethernet end devices into production systems flexibly and economically. To satisfy the special requirements of image transmission, the switch is optimized for networks based on the Gigabit standard. This means it supports very long Ethernet packets with a length up to 9720 bytes, also known as jumbo frames, to achieve a very high throughput of image data. The switch, which is housed in a rugged metal enclosure, can be mounted on any level surface with just four screws. The Ethernet ports are connected via well-proven M12 plug connectors; these feature downward-pointing cable outlets for easier installation.

To ensure easy integration with the existing system, the Power-over-Ethernet FL Switch technology is powered using 24 VDC, which is a standard in automation technology. The approach is to internally convert this to the 48 VDC required for Power-over-Ethernet operation and supplies the stepped-up voltage to the data cable. This eliminates the need for a separate 48 V system with its own power supply units. The 24 V connection of the Power-over-Ethernet switch is provided via a M12 Power plug-in connector which can handle currents up to 12 A. In total, this approach can be used to supply up to eight Power-over-Ethernet devices with a total output of 200 watts.

Easy plug & play start-up

Any Power-over-Ethernet devices conforming to IEEE 802.3at or IEEE 802.3af, as well as any standard Ethernet devices can be connected to the eight ports via x-coded eight-pin M12 plug connectors. When the cable is connected, the switch automatically detects whether power needs to be supplied, and what power class is required. The intelligent device management is very easy to use and is based on plug and play. There is no need to enter any configuration settings.

Being in full compliance with the Power Sourcing Equipment (PSE) standard, the first thing the FL Switch 1708 does is to determine whether the connected end device

SOURCE: PHOENIX CONTACT

Gigabit Ethernet is transmitted via x-coded eight-pin M12 plug-in connectors.

supports Power-over-Ethernet – this ensures both device safety and efficiency. Next, it determines how much current is required by the Powered Device (PD). For this, the device supplies the necessary information about its maximum power consumption. The voltage is only released to the cable once the correct signature, which specifies the power class, is negotiated. IEEE 802.3at includes the following power class definitions:

- Class 0: 15.4 watts (default)
- Class 1: 4.0 watts
- Class 2: 7.0 watts
- Class 3: 15.4 watts
- Class 4: more than 15.4 watts

In addition, the technology automatically detects the data rate for communication, which can be 10, 100, or 1000 Mbps. When Power-over-Ethernet operation with a data rate of just 10 or 100 Mbps is intended, a four-wire network cable is sufficient; the switch simply feeds the power through the two data wire pairs. This makes it possible to connect not only Gigabit cameras but also any Power-over-Ethernet devices such as WiFi access points, IT phones, and IT cameras to the network quickly and cost-efficiently.

Reliable operation

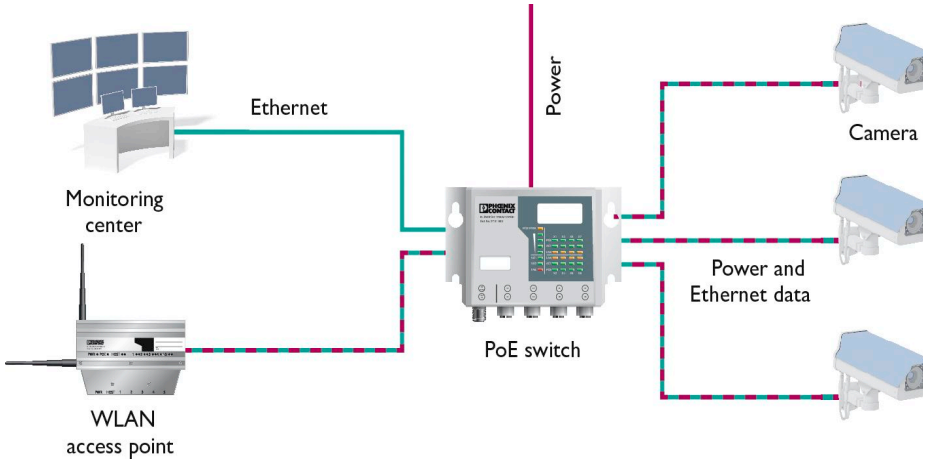
Integrated power management ensures reliable powering of the end devices according to the required power class without needing any further configuration. When they are plugged in, the Power-over-Ethernet devices register their consumption right up to the maximum available output. An LED display (Power Bar) indicates the ratio between the total power currently drawn and maximum output provided. During operation, the switch's power management ensures that all limit values are adhered to. Overloads are detected reliably, and any device damage is prevented.

Should an overload occur during operation as a result of the permitted Power-over-Ethernet total load of 200 watts being exceeded, or because one of the connected devices is overloaded, this is indicated by activating a fail LED and opening a signaling contact.

When a connected Powered Device is overloaded, for example, by a short circuit, the power management disconnects the corresponding Power-over-Ethernet port and indicates the fault by causing the corresponding port LED to flash. After the service technician has cleared the overload fault, the Powered Device is simply plugged back in to resume regular operation.

Using a consistent implementation of the plug & play philosophy, Gigabit Power-over-Ethernet technology makes it possible to integrate Power-over-Ethernet applications into plants and systems easily and economically. In addition, the easy-to-install concept ensures fast and efficient upgrading of existing systems. Preassembled network cables with M12 plug connectors are provided for installing any connected Power-over-Ethernet devices.

***Uwe Nolte** is a Product Manager for Phoenix Contact Electronics.*



SOURCE: PHOENIX CONTACT

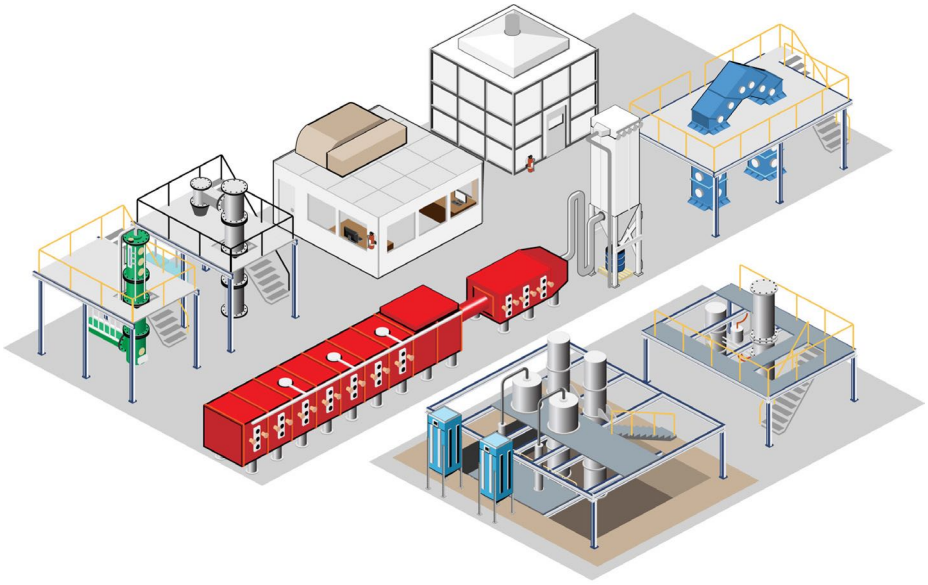
Topological representation of Power-over-Ethernet switch with Gigabit Ethernet deployed in the field.

Industrial combustion and gasification research center

The University of Utah is partnering with industry to conduct research on gasifiers, combustors, pilot-scale reactors, a fluidized bed reactor and process heaters. An updated control system monitors and coordinates all equipment and processes from a central location.

THE INDUSTRIAL COMBUSTION and Gasification Research Facility (ICGRF) at the University of Utah in Salt Lake City performs research on coal, shale oil, natural gas, municipal waste, biomass, and other energy resources found in the Rocky Mountain region of the U.S.

The original facility housed a 1.5 MW pulverized coal research reactor to investigate the formation and control of oxides of nitrogen in utility boilers. Since that time, the ICGRF has grown to eight pilot-scale reactors and numerous small research and support facilities. But now a current project with Opto 22 consists of removing all legacy control hardware and updating it with programmable automation controller (PAC) technology to form a modern, integrated automation system.



SOURCE: OPTO 22

The ICGRF at the University of Utah performs research on coal, shale oil, biofuel, municipal waste, and other fuels for the U.S. Department of Energy, major U.S. utilities, Praxair, and other companies. The entire facility is controlled by advanced automation systems.

ICGRF capabilities

The ICGRF houses numerous combustion and gasification test facilities with capacities ranging up to 1.5 MW (5.1 MM BTU/hr). Research performed at the ICGRF includes:

- Underground thermal treatment of coal and oil shale to produce gaseous and liquid fuels.
- Investigating CO2 capture combustion technologies including oxygen combustion, gasification, and chemical looping combustion.
- Fuel switching and combustion of multiple fuel blends including: coal, petroleum coke, fuel oils, natural gas, biomass, municipal waste, biohazardous waste, and many other fuels.

Process equipment to perform this research includes entrained and fluidized bed gasifiers, grate-fired and oxy-fuel combustors, a circulating fluidized bed reactor, chemical looping systems, diesel engines, fire test facilities, and process heaters. This equipment provides comprehensive capabilities for gas- and liquid-phase analysis and particle characterization.

The pressurized fluidized bed gasifier, for example, processes solid fuels such as biomass and unreactive fuels requiring a long solids residence time. The gasifier is capable of gasifying up to 32 kg/hr of fuel with steam or air, with or without adding oxygen.

The reactor is built in five sections and consists of a gas distributor, bed section, and freeboard. Fuel is fed directly into the bed where it is converted into a hydrogen-rich synthesis gas. Eighty heaters located within the bed allow it to be indirectly heated if desired. A pressurized lock hopper system at the bottom of the bed allows automatic removal of bed solids.

The ICGRF uses the gasifier to test conditions favorable for synthesis gas production and to measure pollutant emissions, deposition, and conversion efficiency for coal and various biomass fuels. The other combusters, gasifiers, and processing equipment at ICGRF perform similar analyses on various fuels.

New controls

As the ICGRF grew, improved control systems were needed. Legacy automation systems controlled individual systems, but a plant-wide automation system was needed, so operators and research engineers could control, monitor and coordinate all equipment and processes from a central location.

The upgrade path ICGRF took is similar to the one followed by many commercial facilities where islands of automation are joined together, making the upgrade project particularly relevant to students and research partners.

"One might assume that upgrading seven separate automation systems and 1,360 total I/O points would be a major undertaking," said ICGRF Director Dr. Andrew Fry.

Some equipment was controlled by legacy Opto 22 mistic G4 control systems, and many of the newer furnaces had more recent versions of Opto 22 hardware and software. However, Fry found that replacing the older hardware with modern SNAP I/O and SNAP PAC System controls was largely a straightforward and uncomplicated effort.

One reason why replacing the older hardware was relatively simple is that both modern and legacy equipment share the same programming and configuration procedures. This made it relatively easy to set up new control programming and I/O on older systems. This common foundation between new and old systems allowed students to install and configure the hardware without having to learn a plethora of different standards, networks, and procedures.

The controller hardware supports Ethernet communications, which made it easy to connect peripheral equipment such as analyzers, chromatographs, remote I/O, and similar devices. Ethernet also made it feasible to network all the remote systems into a central control room.

Steps to upgrade

The upgrade process was executed primarily by four students, none of which had previous experience with instrumentation and controls, and only two of them had previously taken a course in controls. The first step in the upgrade was to review the old control programs and account for all the I/O points involved. This included three control programs for the 1.5 MW multi-fuel furnace (L1500), circulating fluidized bed combustor, and grate-fired combustor (stoker) plus building services and analyzers for 422 individual I/O points.

A list of I/O points was created, so new hardware could be ordered. One goal of the upgrade project was to be as minimally invasive as possible to the existing wiring. Fortunately, the engineer who originally set up the automation systems had done a good job of wiring I/O points to terminal blocks instead of directly to the control modules, facilitating reuse of existing wiring.

However, there was no documentation describing the mapping of the wiring, so one of the students mapped and labeled all wiring. Once that was completed, both undergraduates removed all of the old control hardware.

The next step was to install and wire the new control hardware for the building services and the L1500 multi-fuel furnace, a task assigned to the post-doctoral researcher and the PhD student. Due to the earlier preparation, this went fairly quickly and smoothly.

The following step was to troubleshoot each of the control points. Some 4–20 mA analog points had to be rewired because they were not all uniform in their power and grounding requirements. This turned out to be a valuable troubleshooting exercise for the students.

Next, a student recreated the old control strategy in the new software. Some of this was performed by importing parts of the existing strategy into the new software, but much of the original strategy had to be recreated. Once this step was completed, the team duplicated the process for the stoker furnace. With minimal direction, the student installed and wired the new hardware, and created the control strategy.

Fry provided guidance during the upgrade, but says he has yet to touch a tool on the retrofit project since students were able to perform the required work themselves. He did install one of the groov Box hardware appliances.

He said that groov provides an important new capability for securely monitoring and controlling equipment from off-site using a PC, tablet, or smartphone. "This remote access is an important capability, as we have to leave furnaces running in our facility with no supervision during the heat-up and cool-down phases of a project," he added.

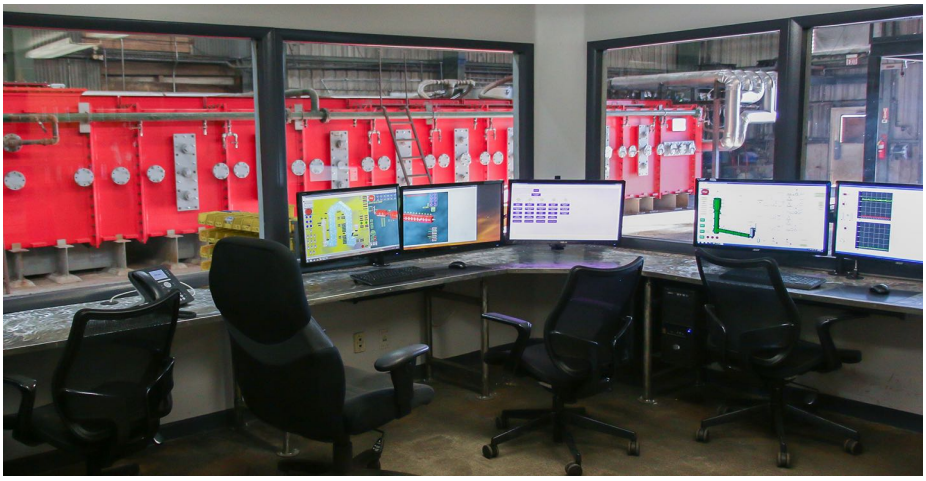
Central control room

The ICGRF control room has four HMI stations, each with its own PC and either two or three monitors. Any HMI can be used to control any reactor or furnace, which allows several pieces of equipment to be operated at once while the control strategy on another piece of equipment is being modified. Also located in the control room are analyzers that determine the composition of combustion gases.

In addition to a local operator interface at the central control room, remote monitoring and control is critical. This is provided by the monitoring appliance's mobile interface which allows secure browser- or app-based access from virtually any device connected to the Internet including remote PCs, tablets, and smartphones. Remote access and an operator interface are simultaneously provided to any number of devices on a royalty-free basis.

What could have been a complex project to upgrade seven automation systems with 1,360 I/O points and integrate them into a plant-wide system turned out to be an exercise accomplished by student engineers, leveraging the open architecture, common software and remote access capabilities of the automation components.

Case Study by ***Opto 22.***

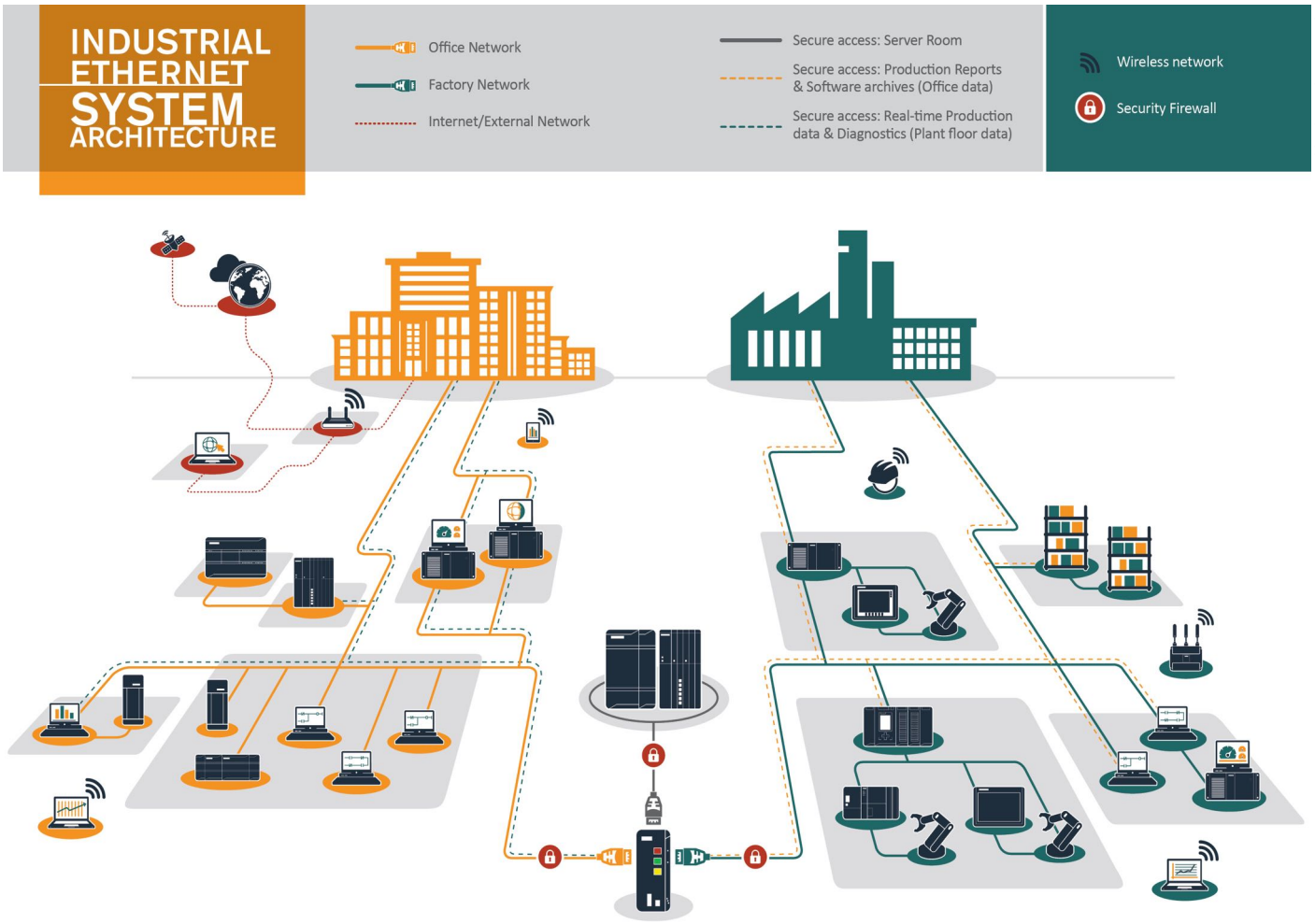


SOURCE : OPTO 22

All operations of process equipment at ICGRS can be monitored and controlled from this central control room.

IT/OT guide to deploying Ethernet on the plant floor

There are numerous advantages to using Ethernet on the plant floor, and also critical issues to consider for a successful implementation: migration strategies, communications differences, security needs and the need for industrially hardened devices. IT and OT personnel need to work together to deploy networks.



A unified system architecture for companies deploying Ethernet extends seamlessly between the office and factory environments, and needs to provide solutions for secure access.

ETHERNET ADOPTION ON THE PLANT FLOOR is in full swing. Collaboration between IT and automation engineers benefits both parties. Mutually arrived at, practical considerations for migration and security help ensure that the Ethernet trend on the plant floor will proceed smoothly. This article provides insights into issues that IT and automation professionals should consider as they connect Industrial Ethernet and solutions such as PROFINET to the plant floor.

Major manufacturers such as major automotive companies are moving exclusively to Ethernet for both enterprise and plant networking. Why? For one reason, it allows an entire assembly line to be on one physical network, and enables the ability to plug in anywhere and access any node on the network. This is a huge step forward from the past, when companies had a collection of isolated fieldbus networks, one at each machine. With Ethernet, companies get a unified network that is far easier to manage.

From an architectural perspective, the design is simpler and cleaner, making troubleshooting easier and giving users the ability to log on from anywhere. Once connected, tools can be used to see if a node is responsive, and to harvest detailed data for better decision making. Bottom line: bringing Ethernet onto the plant floor opens the door to engineering capabilities that current fieldbus networks can't handle, from the free flow of production data to simplified device monitoring and maintenance. There are a few issues, however, that both IT and OT staff should keep in mind as they make the move.

Five Critical Issues to Consider

It's an evolution, not a revolution. As demands on the plant floor exceed the capabilities of legacy fieldbus networks, Ethernet is positioned as the successor. High bandwidth, single cable networks, and vertical integration are all key drivers in the evolution of plant floor technology. Ethernet builds on but does not necessarily have to replace fieldbus technology. One advantage of using an Ethernet network: if there is a legacy fieldbus, you can make the migration to Ethernet in small blocks. It can be done at the fieldbus

IT and OT: Tips on moving to Unified Ethernet architecture	
Changes will be evolutionary	Ethernet builds on but does not necessarily have to replace fieldbus technology.
Adopt a migration strategy	Due to devices such as proxies and gateways, it's possible to design production lines and machines that integrate with existing equipment onto the network.
Need for communication and collaboration	Involving automation engineers and IT staff early in the planning process lets companies clearly define roles and responsibilities for everyone involved.
Create DMZ for security	Creating network segmentation, or a "demilitarized zone" (DMZ) in the Ethernet infrastructure between the business and plant floor networks, helps ensure traffic from one doesn't inadvertently flow to the other.
Use security devices designed for plant floor	When companies use tools designed with plant engineers in mind, the engineers can administer firewalls and secure VPN tunnels on their own.

level in stages, or it can be a higher-level integration to the corporate network or the server level of the network. Because this can be planned and done in small pieces, it makes it relatively easy to manage. You don't have to rip everything out and start from scratch. PROFINET, for example, can integrate legacy fieldbuses through a proxy, a device whose protocol mapping is defined in the PROFINET specification.

Put a migration strategy in place. Installing Ethernet on the plant floor doesn't require a complete overhaul. Due to devices such as proxies and gateways, it's possible to design production lines and machines that integrate with existing equipment onto the network. Specific details of the migration can be addressed during budget and schedule analysis. The key is to have a strategy, not go at the project in a haphazard way. What will the end product look like? Everything you do should be based on that vision.

Communicate and collaborate across functions. Involving automation engineers and IT staff early in the planning process lets companies clearly define roles and responsibilities for everyone involved. Web-based management tools and other technologies allow engineers to administer and maintain the plant floor network without IT tools or expertise.

Especially with PROFINET networking devices, all managed devices have web-based management tools. Typically those implementing on the plant floor network are engineering personnel—they're not IT. So it's important to have IT involved in the planning process. If IT knows what production is planning on implementing on the plant floor, they can make suggestions on how to optimize the network from an IT perspective, improving security and manageability. Because engineers are on the frontline of implementation, the web-based tools mean they don't have to be IT experts. This collective vision, collaboratively arrived at, is a key to success.

Create a "DMZ" for security. One of the big issues on the manufacturing floor is segmenting the manufacturing network from the corporate or IT network. Creating network segmentation, or a "demilitarized zone" (DMZ) in the Ethernet infrastructure between the business and plant floor networks, helps ensure traffic from one doesn't inadvertently flow to the other. This not only keeps unwanted traffic off the network, but also prevents unauthorized personnel from accessing areas that are off limits. The DMZ is created using security appliances that feature separate firewall rules for traffic moving between the plant floor, the DMZ, and the office network. Essentially it's a separation point between IT and the engineering management areas.

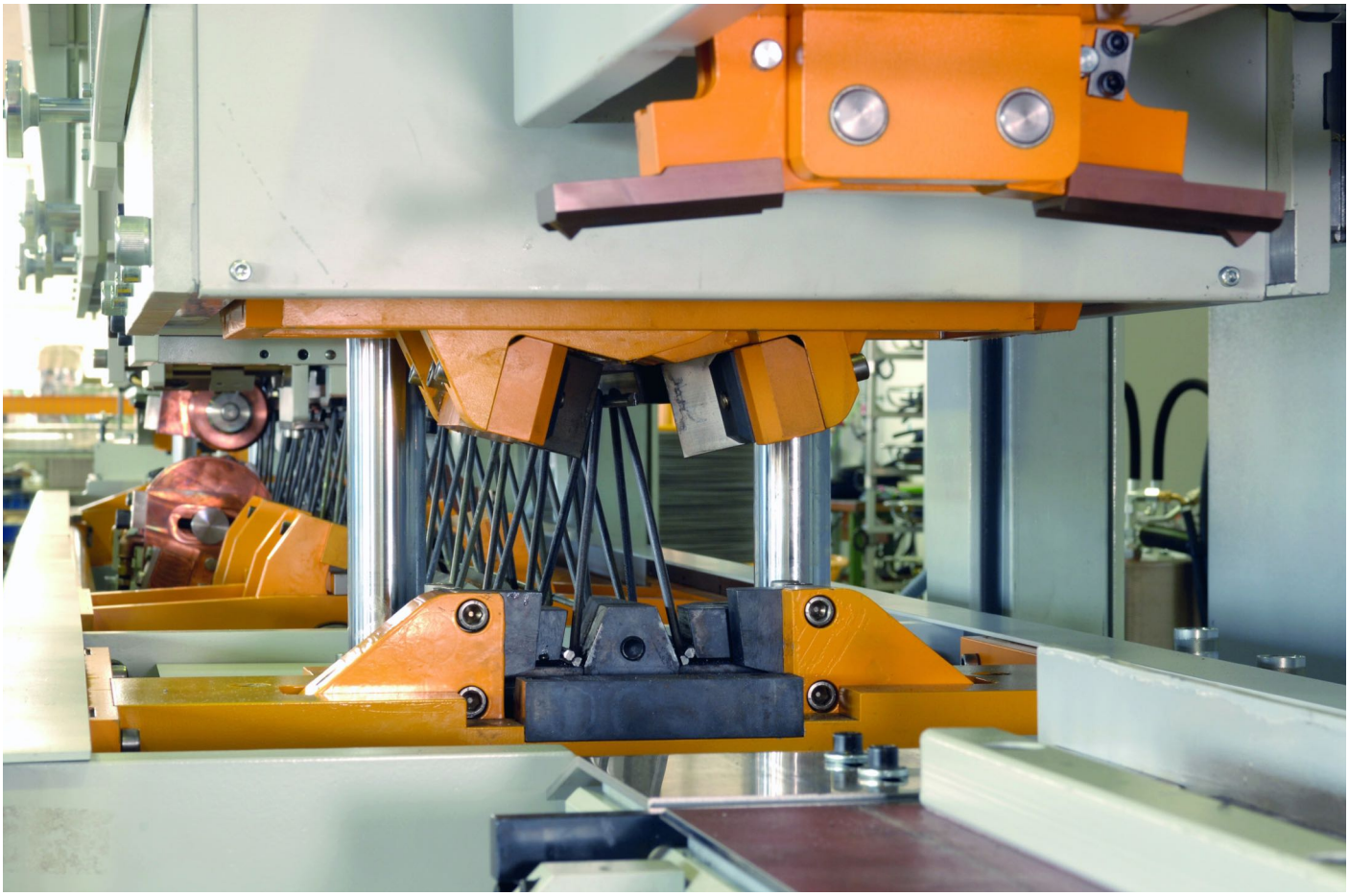
Use security devices designed for automation. When companies use tools designed with plant engineers in mind, the engineers can administer firewalls and secure VPN tunnels on their own. For example, you can deploy a dual firewall DMZ using a firewall on the office network and a firewall on the plant floor. Both IT and plant floor engineers would own the firewall on their side of the network. This allows domain experts to maintain their own firewalls and reduces the possibility of a common security gap in the DMZ.

A managed switch provides information that can prevent downtime and speed troubleshooting when the line goes down. The more expensive downtime is in your facility, the more important it is to invest in a managed switch. Managed switches cost more but the incremental cost is trivial compared to the cost of downtime. Up to now, you probably think this topic covers standalone Ethernet switches. But managed switches are also contained within PROFINET devices. So the same kind of diagnostic information you can extract from a standalone switch can be extracted from a switch in a PROFINET device.

Carl Henning is deputy director for ***PI North America****.*

Open safety offers solution for flexible mesh welding

New automation controls help Schlatter combine hydraulic and electronic components into a modular system solution through the use of an intelligent control system and safe motion technology. Safety barriers in the system are divided into sectors to maintain production while unrelated issues are addressed.



SOURCE: B&R INDUSTRIAL AUTOMATION

At speeds of up to 18 m/min, the CTM310 girder production line provides maximum efficiency even with very small batch sizes.

A SPECIALIST IN FLEXIBLE PRODUCTION LINES for all types of wire mesh and lattice girders is using advanced automation technology for its new lattice girder production unit. In addition to effective changeovers, Switzerland-based Schlatter was able to transition smoothly from one-off development of highly specialized machines to series production of highly customizable standard machines. Using openSAFETY, every machine variant shares the same level of advanced safety technology.

At speeds of up to 18 m/min, the CTM310 girder production line provides maximum efficiency even with very small batch sizes. Wire mesh is found in a wide variety of products from grills, ovens and refrigerators, to shopping carts and store shelves. As a concrete reinforcement or a truss in a prefabricated ceiling, it makes buildings stronger and more resilient.

Schlatter is a specialist in developing the welding and weaving machinery used to produce wire mesh, screens and girders. The company has achieved a high level of expertise in two key areas. With its mastery of mid-frequency electrical resistance welding, Schlatter creates seamless connections between railroad tracks and freight truck axles, while expertise in the field of motion control allows it to provide sophisticated coordination of the wire feed and electrode movement required for precision welding.

From specialized to standardized

When it came time to develop its new production unit which creates the lattice girders that stabilize concrete elements used in prefabricated construction, Schlatter adopted an entirely new strategy.

"In the past, each Schlatter machine was developed individually for a specific customer," said Beat Huber, technical manager for Schlatter. "Our goal now is to move toward more standardized production. To do this without compromising the flexibility that is so important to our users, we gave the CTM310 a highly modular design."

The new solution unwinds wire with a diameter of 5-16 mm from multiple winding tables holding three-ton or five-ton coils and feeds a belt of four wires into the welding unit, where they are bent and welded. At the final station, the finished girders are cut to length, stacked and bundled for shipping.

Motion control

One of the system's most impressive features is its ability to rapidly accommodate variable wire gauge and girder height. This flexibility allows it to produce girders with specific dimensions in small batches, down to batch size one, while maintaining a high overall output rate. With production speeds up to 18 meters per minute, the quality of the final product relies on synchronizing the movements of the various wires, the hydraulic perforating press and electrode holder. The significance of motion control is reflected in the solution's total of 30 servo motor axes, 16 of them in the welding unit alone.

When developing the CTM310, Schlatter's engineers combined the hydraulic and electronic components into a modular system solution through the use of an intelligent control system and safe motion control.

"One of our primary development goals was to harmonize the integration of hydraulics and electronics with an intelligent control system," said Schlatter electrical engineering manager René Frey.

One of the reasons for this was that Schlatter was looking to let go of old traditions in the selection of an automation system for this new generation. "What impressed us about B&R was the level of integration between control, HMI and motion, as well as the quality of synchronization we could achieve between the many axes using POWERLINK. Another decisive factor was the possibility of implementing a modular safety solution with very little cabling," Frey added.

All-in-one safety

Higher-level control tasks are handled by an Automation Panel 920 with a 15" XGA color TFT touch screen mounted in the control cabinet of the central welding unit. The inputs and outputs are controlled by distributed X20 stations on each machine. The servo motors are controlled in pairs by ACOPOSmulti drives featuring SafeMOTION. These provide safe reactions in the event a safety door is opened or a light curtain is tripped on the stacking unit.

"The safety barriers around the system are divided into sectors. That way, the stacking unit can continue to operate if there is a violation in the wire feed sector," said Frey. The safety application runs on a central SafeLOGIC controller, where the signals from over 30 safe I/O modules come together via the openSAFETY protocol.

Schlatter was able to use the same safety sensors and door locking mechanisms that had proven themselves in earlier generations. "Since integrating preconfigured machine modules in the central safety controller is simply a matter of hooking up an Ethernet cable, we now spend less time running cables and a whole lot less time on tedious troubleshooting," he added. In the event that a new option needs to be added to an existing machine, it is no longer necessary to shut down the whole line to perform the wiring.

Accelerated restart

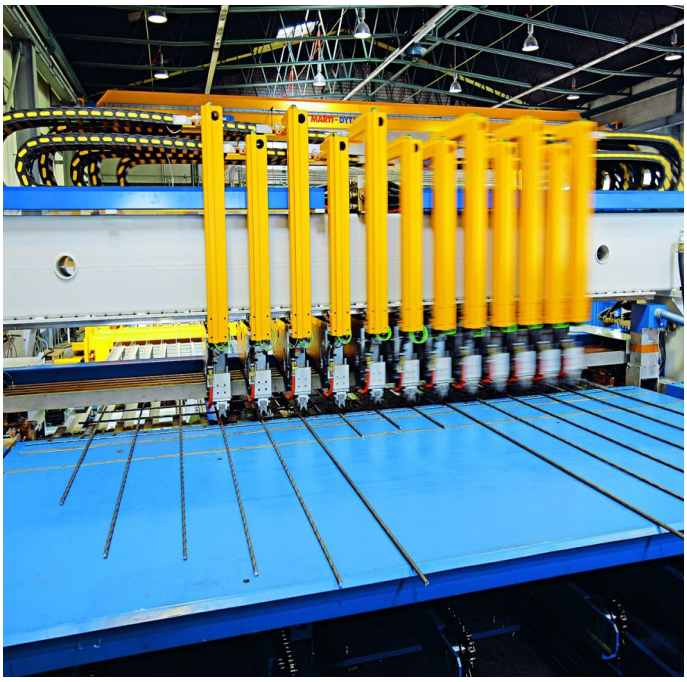
The most-used reaction to safety events is Safe Torque Off (STO) which is included in the portfolio of Smart Safe Reaction options offered on the ACOPOSmulti drives.

"On a fully-equipped line, we're operating close to the maximum number of nodes permitted for one SafeLOGIC controller," said Fabio Giacomini, the software engineer responsible for both the automation software and the safety application.

He is particularly happy to be able to develop the safety application in the SafeDESIGNER editor, within the familiar environment of Schlatter's MG630 Tailor is a flexible line that produces complex reinforcement mesh in virtually any geometric pattern.

Automation Studio, and also appreciates the ability to communicate between the standard controller and the SafeLOGIC safety controller.

This allows the automation software to react to safety events, for example by stopping the wire feed when there is an alarm in a downstream unit. And the potential for system-wide control goes much further than that. "We use a special trick to get started back up even faster after stopping for a safety event," said Giacomini. "Before the safety reaction – which we have intentionally delayed – takes effect, the standard controller shuts down the system. That allows the machine to be started up much more quickly since all we have to do is acknowledge the safety-related intervention."



SOURCE: B&R INDUSTRIAL AUTOMATION

Schlatter's "MG630 Tailor" is a flexible line that produces complex reinforcement mesh in virtually any geometric pattern.

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

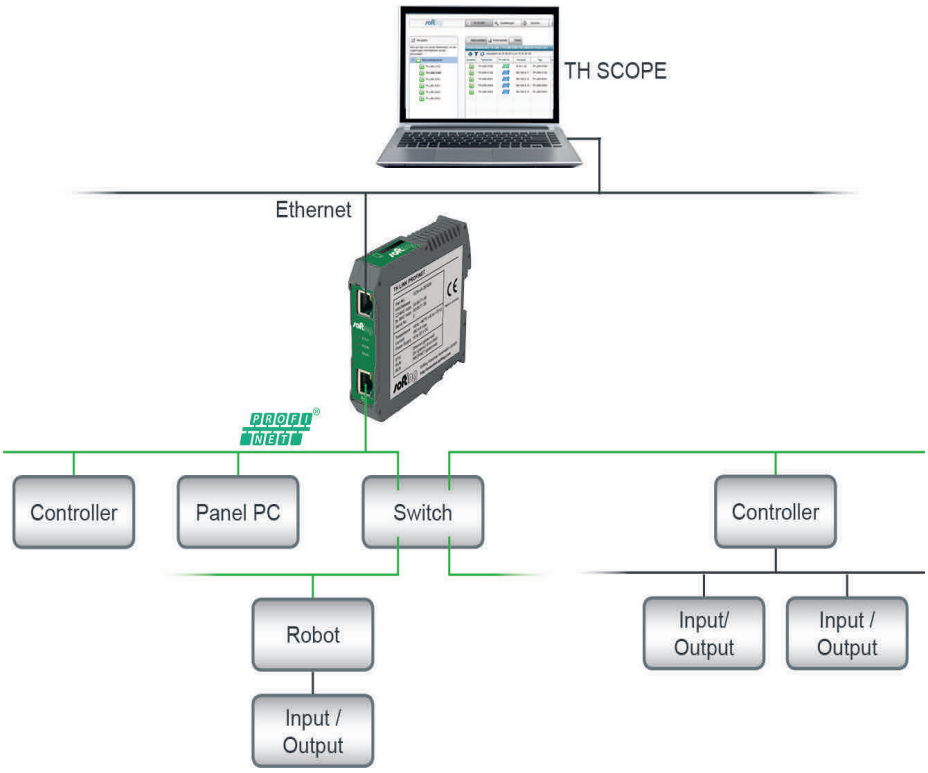
Efficient diagnostics for PROFINET networks

Developing best practices is vital to monitoring PROFINET networks, developing a plan to keep them up and running, and resolving problems quickly. The plant's life cycle and users involved are key factors to determine the required set of diagnostic tools and functionality needed.

PROFINET IS AN ESTABLISHED COMMUNICATION standard in industrial automation and, in the majority of cases, the development and installation of PROFINET networks presents no problems. If a diagnosis of the PROFINET network is needed, however, many users venture into new territory. For example, the plant commissioning procedure often does not include acceptance testing of the PROFINET networks, and plant operators and maintenance staff are looking for clear best practice guidance on how to monitor PROFINET networks during operation, how to reliably keep them up and running, and how to react quickly and efficiently if problems occur.

The reason for this situation lies in the profound changes brought about by the shift from traditional fieldbus systems to PROFINET or, more generally, to TCP/IP-based industrial communication. The first part of this article addressed organizational aspects of these changes. The second part will now discuss technical issues and describe the appropriate PROFINET diagnostic tasks and tools for the different life cycle phases of the network.

The tasks and the requirements on the diagnostic tools employed differ depending on the phase of the plant life cycle and the users involved. These factors determine the required set of diagnostic tools and the necessary functionality. The individual phases of a plant's life cycle require different diagnostic functionalities for PROFINET networks.



SOURCE: SOFTING

The graphical topology view with the different filters provides a quick overview of the examined PROFINET network.

Cable validation

A key task in the installation phase is to ensure correct cabling. Testing every single cable that is used would involve too much effort, however. Therefore the focus is on checking all important network cables, which is primarily cables that are used as the backbone and that are permanently integrated and difficult to replace, as well as custom cables. Standard cables can generally be used without special verification. A useful tool for the validation and certification of Ethernet cabling, e.g. during acceptance testing, is the WireXpert 500 IE product from Softing Industrial Automation.

Commissioning

Once installation is complete, the next phase in the plant's life cycle is the commissioning phase. Here the diagnostic tasks are aimed at detecting general configuration and communication faults in the installed PROFINET network, and documenting the network and the acceptance test in order to minimize the residual risk of network failure during operation of the plant. The configuration faults to be detected include, for example, device names that are used in the controller, but not assigned to any device in the network.

During acceptance testing, documents are issued that detail the current characteristics of the PROFINET installation and serve as evidence and as a basis for future comparisons. One of these documents is the network topology representing the nodes connected to the network. Selectable filter settings allow adjustment of the size, layout and level of detail.

Another document in this phase is the inventory list which contains a complete, detailed list of all devices. An acceptance test report automatically summarizes all the individual results of the acceptance test. The last step in this phase is the reference measurement with a record of the network status that was rated as "good" in the acceptance test. This record provides a basis for future comparison with the current network status during operation of the plant, and is a useful aid in troubleshooting if network problems occur.

Depending on the situation, it may also be advisable to run a network load test as part of commissioning. This test examines the behavior of the installed network (utilization, number of frame errors, etc.) under load and differs from load or stress tests for single devices, in which the robustness and the conformity with device standards are typically assessed in a laboratory environment.

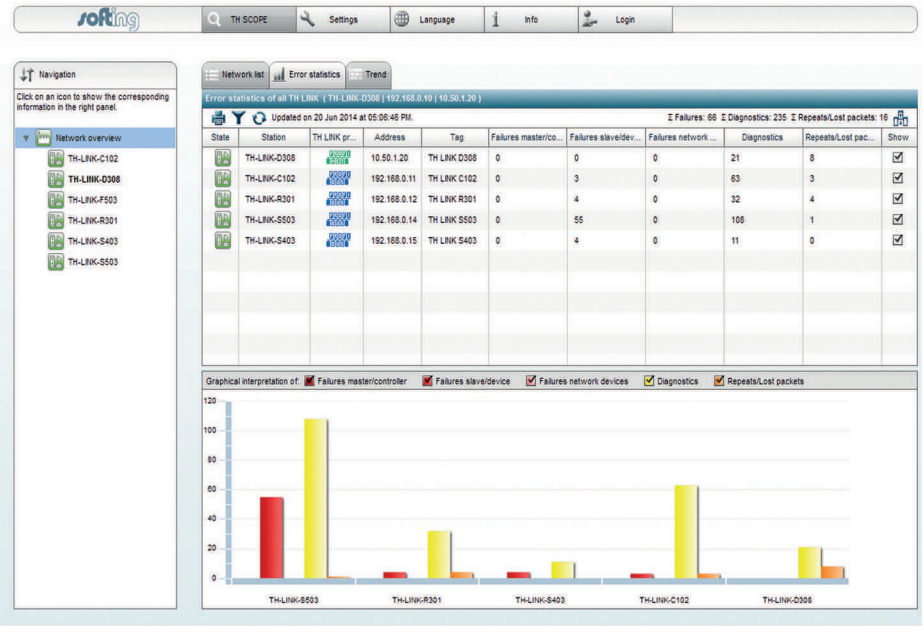
Operation

While the plant is running, plant operators need an overview of the plant-wide status.

Diagnostics in this phase are aimed in particular at ensuring high plant productivity and avoiding costly downtime. The focus is on the continuous monitoring of the PROFINET communication and on the efficient support of users in the case of emerging problems or network failure. During continuous monitoring, key characteristics such as the current network load and the number of error packets are monitored. In this way, negative influences on the PROFINET data exchange can be eliminated, for example, when replacing an Ethernet device or expanding a decentralized I/O system. If a specified limit value is exceeded on the monitored network, the user is automatically notified.

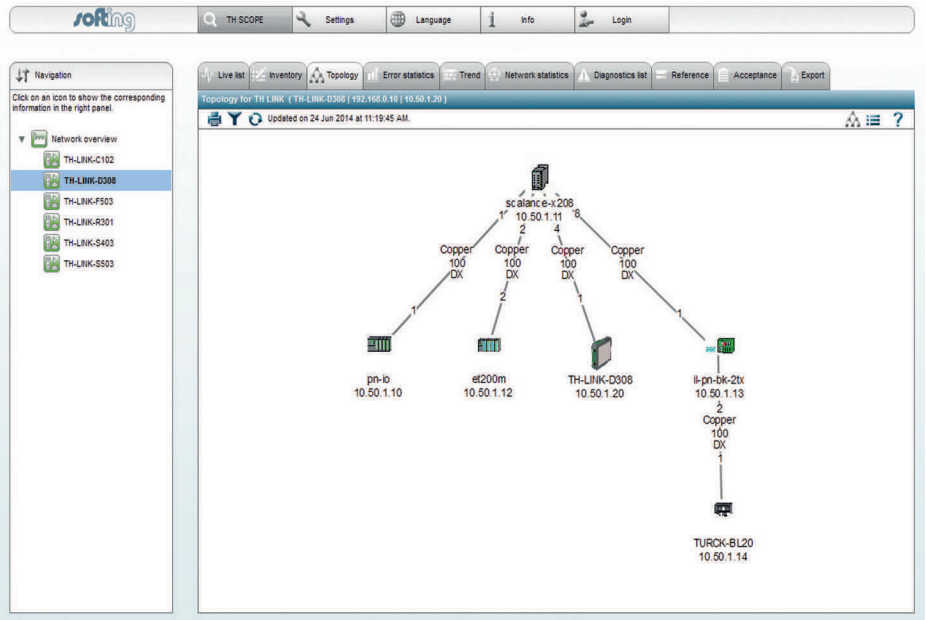
For many maintenance tasks and for finding typical faults that are common during operation, users do not need special IT knowledge. The employed tools provide the necessary functionality, such as an aggregated view of the overall network, network communication statistics, and maintenance and troubleshooting advice in plain text. The tools also detect cable problems, device drop-outs and broken connections.

During plant operation, users are also faced with "network management" tasks. A typical task, for example, is to update the firmware in all devices of a particular device type. Using suitable tools, the users can quickly see at a glance if all devices are discovered after the update and if they have been updated to the correct firmware version.



SOURCE: SOFTING

The results of continuous network monitoring can be accessed locally or remotely through a graphical user interface.



SOURCE: SOFTING

The solution architecture for plant-wide PROFINET analysis is based on use of sophisticated software tools.

Software tools

The key components for acceptance testing and network diagnostics in this phase are TH LINK PROFINET and TH SCOPE software tools. Designed specifically for maintenance staff and plant operators, these tools can be used without in-depth IT or Ethernet knowledge. The TH LINK PROFINET gateway provides access to the PROFINET network independently from the controller or control room. The gateway can be integrated at any time, without interfering with the operation of existing installations. It requires neither configuration nor development work.

The TH SCOPE software application is used for the monitoring and maintenance of the PROFINET networks used. It processes the data acquired by the TH LINK PROFINET and displays it in the form of graphs. This solution enables local and remote access, and also provides a browser interface. Third-party tools can be integrated into the diagnostic solution through the SNMP or OPC standards. The BC-200-ETH Industrial Ethernet Tester can be used additionally in order to perform network load tests.

Troubleshooting

During commissioning or operation of the plant complex faults, such as a large number of error frames on a particular port, may occur without apparent cause. Troubleshooting these problems usually requires in-depth knowledge and expertise in communication and information technology, as well as special tools for locating, identifying and correcting the fault. In many cases, for example, users may need to perform a frame analysis of the communication. This can be done with additional tools, such as temporary taps in combination with the Wireshark software.

The use of TCP/IP-based communication changes the character of industrial networks. The comprehensive plant-wide planning of the diagnostic tasks to be performed provides key benefits to PROFINET users looking to minimize the failure risk of their production plant and increase the efficiency of their maintenance work. A thorough acceptance test for the PROFINET network provides a sound basis for the future smooth operation of the plant. Softing offers a complete portfolio of products for PROFINET network diagnostics, ranging from installation and network acceptance testing to continuous network monitoring during plant operation.

Dr. Christopher Anhalt is Senior Product Manager Diagnostics for ***Softing Industrial Automation.***

Monitoring and controlling multiple EtherNet/IP groups

Advanced switch technology simplifies the process of managing multiple groups of I/O, drives and HMIs that communicate over Ethernet using the Common Industrial Protocol (CIP). These EtherNet/IP networks use different switch-based topologies to manage field devices for optimum performance and flexibility.

ETHERNET/IP NETWORKS FOR I/O, drive and other control components are used in an increasing number of process control installations worldwide. This technology enables devices made by different vendors to communicate via standard Ethernet infrastructures that use the ODVA Common Industrial Protocol (CIP). These networks can be monitored and controlled using a variety of switch-based topologies. Network configuration dictates performance, flexibility and connectivity to field devices when the PLC or Process Controller is not running. This article will discusses how to monitor and control multiple EtherNet/IP groups.

EtherNet/IP networks

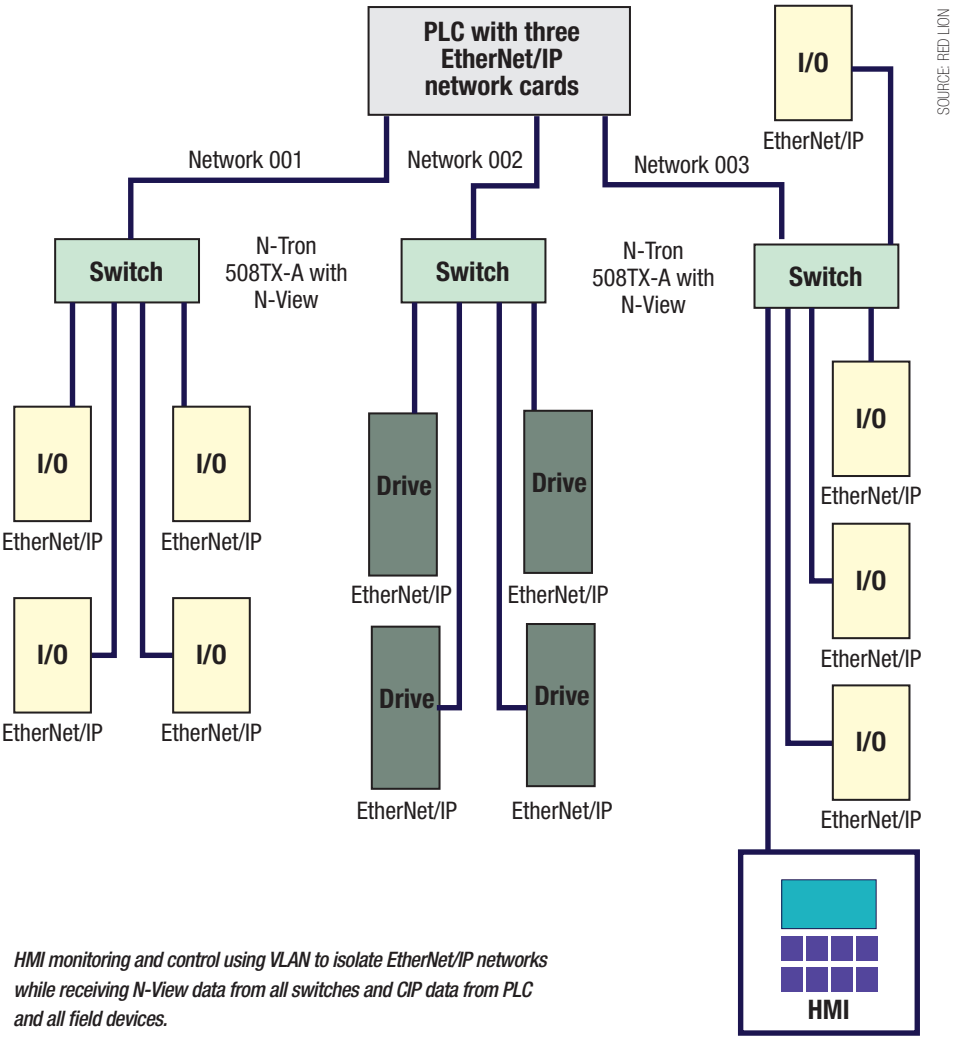
A typical EtherNet/IP environment represents a topology with field devices split between three EtherNet/IP controllers in a single PLC. The topology breaks the control scheme into three separate networks that communicate with each other through the backplane of the PLC. Control engineers will frequently build multiple EtherNet/IP networks for several reasons:

1. System performance enhancements through increased bandwidth
2. EtherNet/IP group multicast isolation
3. Separate control levels such as I/O control, HMI supervision and enterprise communications
4. Process control of individual network locations

A PLC that has been stopped intentionally or halted by a failure will force maintenance personnel to connect to each individual network to view connected field devices. This limits the ability of a system to use all of the troubleshooting options in the switches and I/O. If commercial grade switches are used, MTBF is reduced from over one million to 25,000 to 50,000 hours with extreme conditions causing failure much sooner. This can complicate startup and data acquisition.

Combining networks

EtherNet/IP networks can be combined into a single topology that provides the ability to communicate directly to all devices during a PLC outage. The concerns listed above can be addressed by using network switches to combine EtherNet/IP control groups using switches for these types of applications.



HMI monitoring and control using VLAN to isolate EtherNet/IP networks while receiving N-View data from all switches and CIP data from PLC and all field devices.

N-Tron switch technology can be used to combine EtherNet/IP control groups over several switches located in different control areas. These process control switches can configure themselves automatically in a multi-controller, EtherNet/IP environment. By detecting other managed switches on the same network, each switch is able to configure itself to handle the EtherNet/IP traffic in the most efficient manner.

The three Ethernet switches do not require user setup. The 500-A series requires no IP address and will automatically perform the following EtherNet/IP setup:

1. Internet Group Management Protocol (IGMP snooping) is enabled to allow each switch to route EtherNet/IP multicast packets efficiently through the switch.

2. In networks using more than one switch, the switches vote and elect one switch to create IGMP queries periodically. These queries will cause each IGMP Group Multicast consumer (each EtherNet/IP controller on the PLC) to send an IGMP group join signal to each connected switch. Each switch will log the EtherNet/IP group number transmitted by each controller. This group number is then stored along with the port number of the receiving port. Anytime an IGMP group multicast with this group number is detected entering the switch from field devices it will be routed to the proper consumer port.

3. Each switch will detect the presence of

another switch connected to any of its ports and automatically establish bi-directional router port communication on these ports. The bi- directional router ports will forward all IGMP commands (IGMP group join and group leave commands) and IGMP multicasts to the other switches in the network so that these switches will know how to route IGMP multicasts across the network if necessary. IGMP commands are not forwarded to other switches unless the switch that receives these commands has established bi-directional router ports.

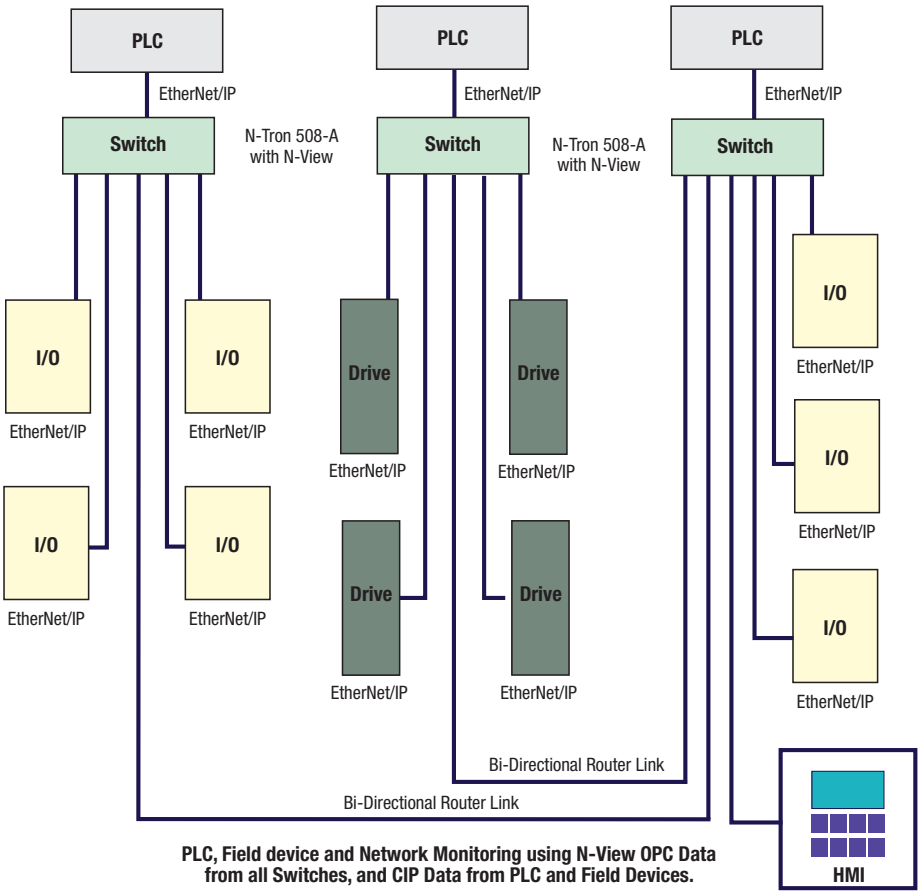
If these ports are not setup properly the group multicasts from the field devices will be broadcast out all ports of the switches that have not received the group join routing information. This will cause devices that are sensitive to high traffic volumes (half duplex equipment, wireless products and RS232/485 to Ethernet converters) to stop communicating properly and will cause general network congestion.

4. A switch or router connected to an EtherNet/IP network may have no use for the EtherNet/IP multicasts being sent to it over the established bi-directional router ports. It may have no IGMP consumer for the group in question. If these IGMP multicasts are sent to a network device over a bi-directional router port and this device has no consumers for the group address, it will broadcast these packets out through all ports.

N-Tron switches with registered IGMP groups will prevent these group multicasts from being forwarded to ports with no IGMP consumer for that group by using an automatic port filtering feature (R-Filter), which prevents these multicasts from being transmitted out of a bi-directional router port that has not received an incoming IGMP group join for this group. R-Filter will prevent packets from flooding routers with unwanted traffic.

Once the switches auto configure the network, the EtherNet/IP controllers will communicate with assigned field devices. No unwanted traffic will be introduced into the control groups because each switch will route EtherNet/IP multicasts only to the individual controller that requires the data. Communication between control groups is now possible without using the PLC backplane. This means that programming, setup and troubleshooting on the entire control network can be accomplished by connecting to any switch in the network. The HMI can directly monitor and control all CIP devices on the network and will be able to monitor the OPC operational data from each switch in the control network. This flexibility is not possible when separate networks are used.

The N-View Ethernet heartbeats generated by each switch are multicasts and will not be transferred over the PLC backplane. Creating a single control network will allow data from all



SOURCE: RED LION

Adding CIP Switch Monitoring, Control & DHCP to Deliver Fixed IP Addresses.

switches to be monitored from anywhere in the control network. EtherNet/IP control schemes using multiple PLCs can be configured to use one network to improve access to all PLCs, CIP field devices and switches from any switch port on the network. The switch technology can automatically isolate the EtherNet/IP multicasts from each control group and provide OPC diagnostics from all switches.

Using port VLAN routing

Switches can be used to form separate VLAN networks, isolating each EtherNet/IP control group. With typical industrial Ethernet switches, it is necessary to control EtherNet/IP multicast traffic.

This is not the case with a network consisting of N-Tron technology switches, but it may be desirable for security reasons to isolate the plant floor from the HMI network or the enterprise network. The overlapping port VLAN feature allows VLAN routing on a selected port enabling this port to communicate across a multiple port VLANs configuration with no external router necessary.

Switches can be configured with multiple overlapping VLAN ports if more than one uplink port is required. Connected end devices do not need to be VLAN capable. OPC and CIP data from all control devices and switches will be transported across the Overlapping VLAN ports for monitoring, control and troubleshooting.

Switches can also be used in EtherNet/IP control networks to provide the same capabilities in addition to many new system options. The PLCs and HMI can monitor and control all compatible switches using ODVA CIP. All Dynamic Host Protocol (DHCP) clients can be served IP addresses from a DHCP server either dynamically from an IP pool or with fixed IP addresses using DHCP option 61, option 82 or direct port base IP addressing.

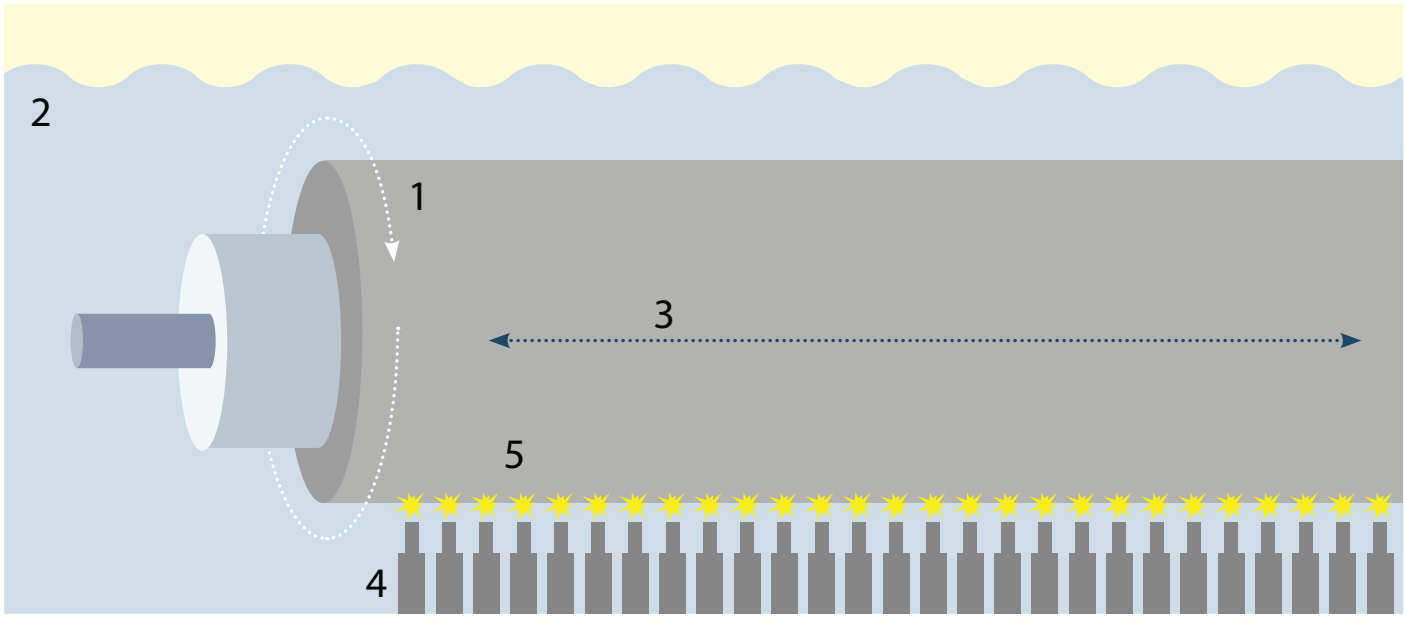
Fixed IP addressing is required for all EtherNet/IP control PLCs and field devices because these devices are preprogrammed to use fixed IP addresses to communicate with each other. The IP addresses of the system's PLCs and field devices can be programmed into the DHCP server. Switches in each control network will serve these addresses port by port to the PLCs and field devices connected to the ports of each switch configured as an option 82 relay.

PLCs or field devices that fail can be replaced and will receive the same IP address as the original device. This will allow maintenance personnel to replace malfunctioning equipment without the necessity of loading the IP address in the replacement equipment, eliminating the possibility of errors.

*Technology article by **Red Lion**.*

Sub-micron motion for painting texturization

Machine tool specialists at Kleinknecht use arcs, precise linear motors and Sercos networking to texture rollers later used to scarify the surface of sheet metal. The result is that painting the metal later is more economical and environment-friendly



SOURCE: BOSCH REXROTH

Spark Erosion

The roller that is to be texturized (1) rotates in a dielectric fluid (2) and, in addition, oscillates in the axial direction (3). Up to 60 electrodes (4) are moved towards the surface of the roller until they are mere microns away from it. During the erosion process, large numbers of microscopic electrical discharges (5) are emitted at precise intervals and currents. They texturize the roller's surface to give it the required structure. Accurately maintaining the distances between the electrodes and the roller's surface is determinant for quality. Additionally, electrode burn and the associated loss of metal must be constantly compensated for.

A FRESHLY WASHED CAR shines brightly in the sunshine, and a domestic appliance just cleaned sparkles as it waits for the next job. To make the paint work look so perfect and smooth, the sheet metal underneath must have a surface that has been scarified to depths of just microns. This is done with a roller which, applying great pressure, embosses its structure on the surface of the metal – just like minting a coin. Not only do paints and powder coatings adhere better to such surfaces, but application is also significantly more economical.

This texturization saves car manufacturers some four kilograms of paint for every vehicle, for example. But how is the roller itself engraved? The most popular method is spark erosion or electrical discharge texturing (EDT). H. Kleinknecht & Co. GmbH, are following a new path with linear and rotational direct drives and advanced control technology.

Working in the sub-micron range

As the first manufacturer of high-end EDT machines, the company utilizes electric linear motors to correctly set the electrodes used for spark erosion. "The challenge when developing our EDT machines was to move all 60 electrodes in a coordinated fashion and to position them in the sub-micron range. Having achieved this, we are able to transfer the required surface structure to the roller at perfect quality," is how Christoph Hauck, business manager at Kleinknecht explains the process. The drive system adjusting the distance between the electrodes now positions the electrodes with a precision of under a micron – ten times more accurate than before. The system makes use of nonferrous IndraDyn L linear motors from the MCL series as well as compact IndraDrive Cs actuators.

Kleinknecht's automation experts programmed the basic function for the EDT process directly in the drive controls for the integrated IndraMotion MLD. Higher-level controls, working through the Sercos automation bus, command the machine from the insertion to the removal of the roller. Additionally, this links the machine to the operator's production system by using, as desired, Profinet, Profibus, Ethernet/IP, CANopen or Sercos network. Since the erosion process is locally controlled on MLD, the system can be operated more accurately and relieves some of the burden on the central controls.

Purposeful interaction

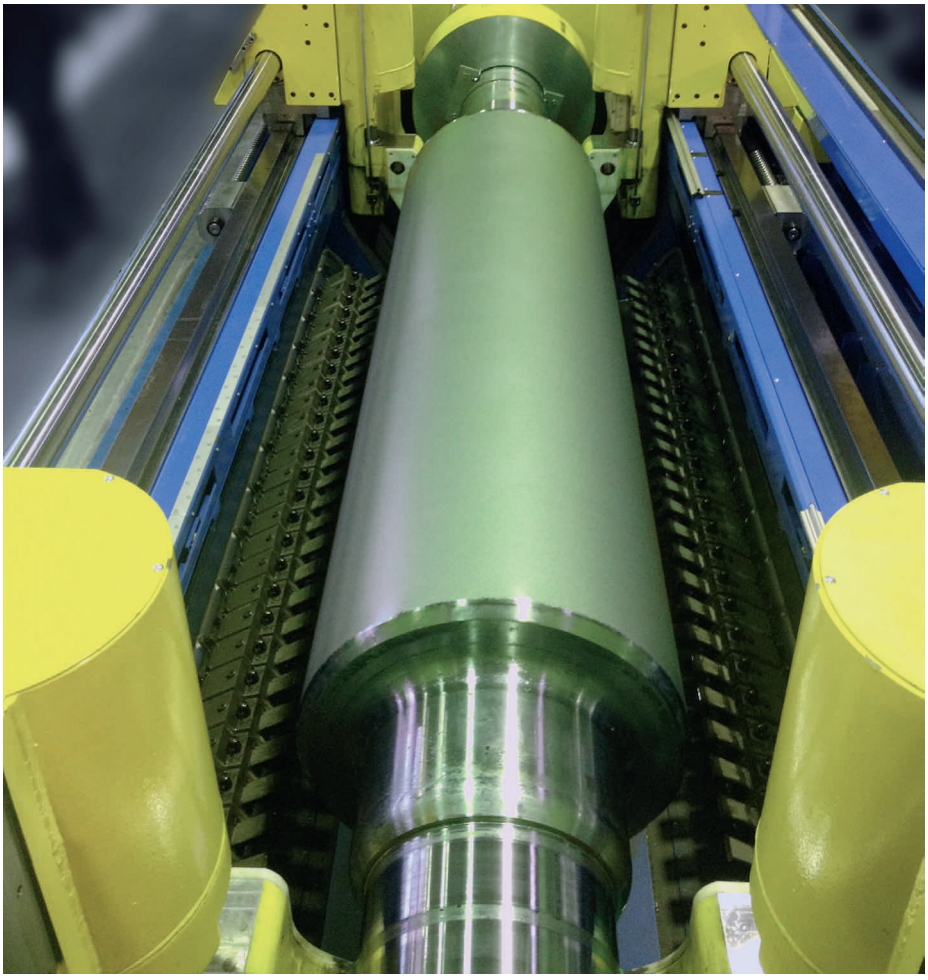
At the system's heart are Rexroth's nonferrous MCL linear motors. Within them, the lightweight primary components are moved by coreless magnetic coils between two rows of permanent magnets into the secondary components in fixed positions. The electrodes in Kleinknecht's machines are attached – directly, mechanically and rigidly – to the motor's primary component. The high degree of gain achieved in this way guarantees dynamic movement and accurate positioning, in the shortest possible time. Furthermore, the control behavior of Rexroth's linear drives is also constant across the entire travel distance. These characteristics ensure that the required

SOURCE: BOSCH REXROTH

Nonferrous linear motors move 60 electrodes with great precision, leveraging the speed of the high speed Sercos motion network.

electrode clearances are maintained precisely during the erosion process. Over and above this, there are no detent forces in the MCL linear motors; this means that there are fewer disturbance variables in the positioning controls.

The low deadweight and inductivity of these nonferrous drives make for high acceleration forces. These can, for instance, compensate for problems caused by vibrations close to the machine. "The very first test runs made it clear that Kleinknecht's innovation had great potential," says Jan Schönerstedt, product manager for gearless drives at Bosch Rexroth.



SOURCE: BOSCH REXROTH

Kleinknecht's EDT machines texturize rollers used in sheet metal processing.

"This allows textured surfaces to be processed under much closer control than is the case with conventional EDT machines. Furthermore, the process is considerably more reliable." This new approach has proved its worth on many occasions under practical conditions.

Using Rexroth drive and control components throughout simplifies planning, commissioning and maintaining Kleinknecht's EDT machines. In addition, it opens up new ways to structure roller surfaces. Since all the drive parameters and process characteristics can be accessed at any time, Kleinknecht has been able to develop new technological approaches to spark erosion.

An open software structure

On the software side, the programming, configuring and commissioning operations in the IndraWorks software run with a single, uniform user interface. Project administration with central data management for the machine's configuration, visualization, and PLC programming ensures the consistency of all the data and offers a clear, easy-to-understand depiction.

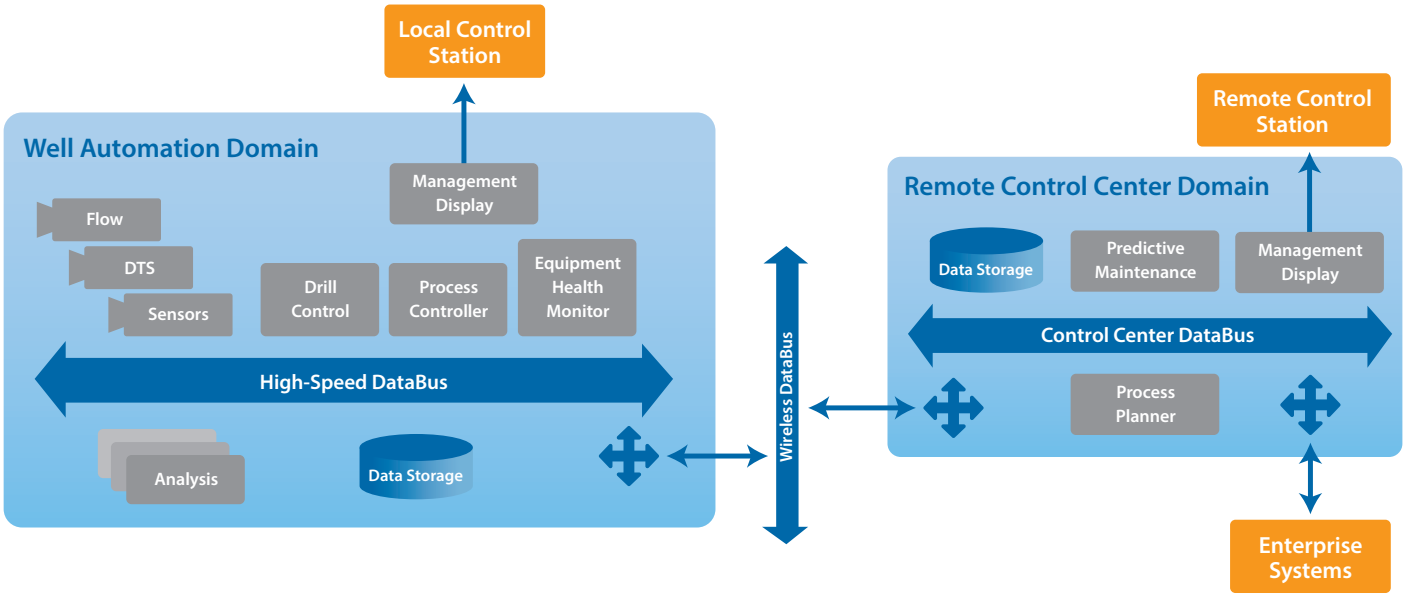
Thanks to the PLCopen automation architecture, machine operators now find it easy to integrate the software for EDT machines into their production systems. Intuitive helps support users every step of the way – from configuring the machine to assigning parameters to technical functions.

"A significant benefit of the open structure is that it requires no proprietary field buses or program platforms. This means that EDT machine software can be individually adapted to the customer's environment whenever needed – adding confidence when making long-term investments," Hauck said.

Application story by ***Bosch Rexroth.***

Five ways the IoT is changing the oil and gas industry

The future IIoT will integrate applications into larger systems-of-systems, and bring the power of cloud analytics and business intelligence to systems in the oil and gas industry. This core vision requires standard protocols that fulfill the vision by providing new capabilities required by intelligent machines, and an ability to speed software integration that implements cloud-based analytics and optimization.



SOURCE: REAL-TIME INNOVATIONS

At the well site, a high-speed DDS DataBus connects all the sensors (e.g., temperature sensors, flow monitoring) and actuators (e.g., top drive, key drive, flow controllers) along with a process controller to automate the process of drilling and completion. The high-speed connections can also be used to monitor the health of the equipment, analyze activity, log status readings, and more.

UNCONVENTIONAL RESOURCES CHALLENGE the oil and gas industry. Exploration and development of oil and gas reservoirs require new sensors, analytics, and processes. Systems require better connectivity, monitoring and control and process automation. Previously deployed technology limits the ability to quickly and reliably integrate and robustly operate field-to-cloud systems, especially across large field installations.

The Industrial Internet of Things represents the biggest opportunity in recent decades for the advancement of oil and gas technology. Major global companies are transforming their infrastructures to take advantage of the Industrial Internet's open, high-bandwidth protocols and low-cost, intelligent networks.

Just this year, GE, Cisco, Intel, AT&T, IBM and 80 other companies acknowledged the importance of this transformation for all sectors of industry. They formed the Industrial Internet Consortium (IIC) to speed the adoption of the latest Internet technologies in industrial applications.

Innovative networking standards and protocols are enabling revolutionary system-building approaches that greatly ease field operations. Companies like GE, Siemens, Joy Mining, and Schneider Automation are using Industrial Internet technologies to re-vamp their product lines and field operations, and oil and gas applications are being fielded based on open standards and low-cost smart nodes.

Challenges & opportunities

The current challenges relating to systems at the forefront of the Oil and Gas industry are extreme. Massive data flow from new sensor technology, new analysis techniques, complex drilling processes, changing requirements and regulations for well monitoring and reservoir management, and other industry trends call for innovative solutions.

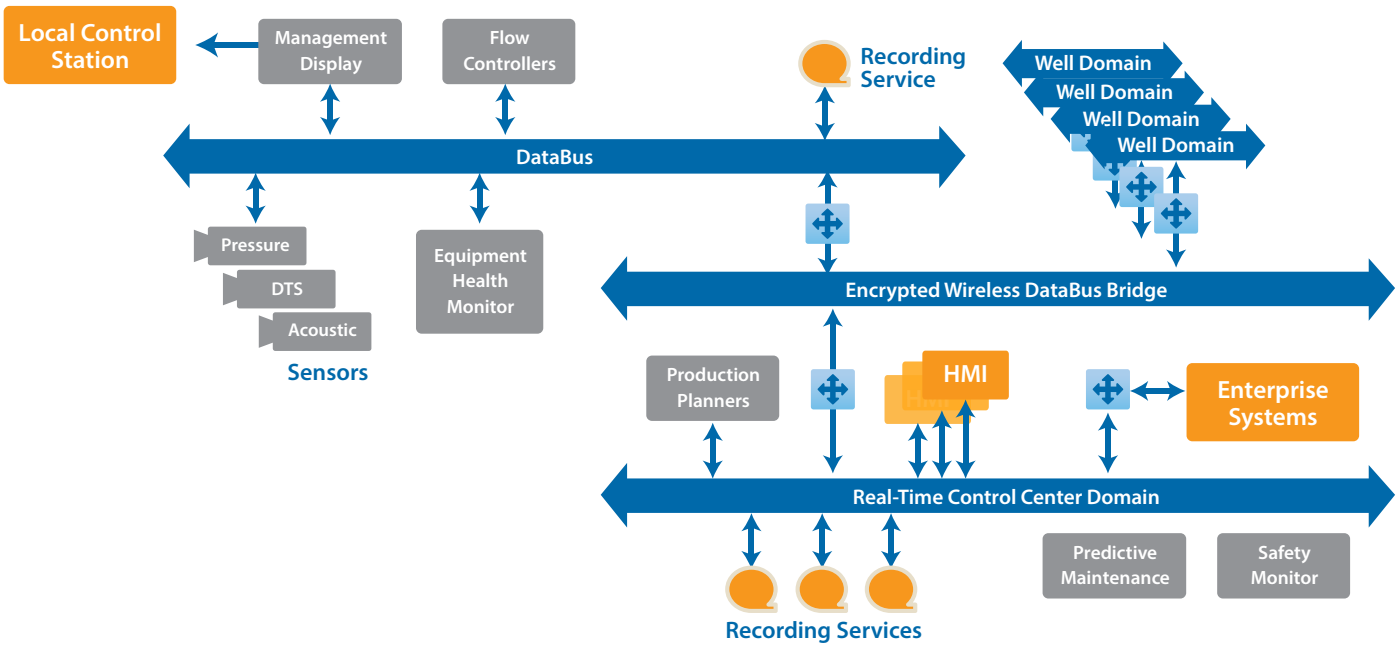
Simultaneously, the numbers of field experts are plummeting, with as many as 60% of the current field experts expected to retire over the next six years.

To address all of these industry changes, companies need to embrace more intelligent systems and processes. The Industrial Internet, which facilitates building smart, distributed systems, offers a foundation for taking real- time data and using it to drive more intelligent, safer operations with more automated oversight.

Connectivity has always been at the heart of modern industry. The first factories emerged as innovators found ways to connect machines and develop efficient production flows. The next wave of the industrial revolution – the Internet revolution – heightened the role of connectivity, with distributed information networks accelerating the globalization of industry.

Today, the Industrial Internet has the potential to exceed the transformative results of the earlier phases of the industrial revolution. Evidence of the radical nature of the changes can be found in everyday life. The Internet and the worldwide web make it easy to find the price of the house across the street, chat live with a college roommate who now lives on another continent, and watch TV reruns on a tablet or smart phone.

For industry, the changes are similarly profound. With the ability to connect intelligent objects, the Industrial Internet of Things lets businesses converge devices and machines into intelligent systems and applications:



SOURCE: REAL-TIME INNOVATIONS

An entire field can be integrated by combining local DataBus instances. The system can aggregate hundreds of thousands of sensors, providing data to a control center for easy analysis, health monitoring, and data storage.

- Embedded sensors and software can be tapped in real-time to self-diagnose and self-correct.
- Reliability skyrockets as systems can proactively react to changes in the environment.
- More sophisticated machines, services, and systems can be rapidly provisioned and delivered.

To drive the advancement of Industrial Internet connectivity, RTI and other leading technology providers joined the Industrial Internet Consortium. The IIC establishes proof-of-concept test beds and recommends reference architectures with the goal of bringing standards clarity to the Industrial Internet.

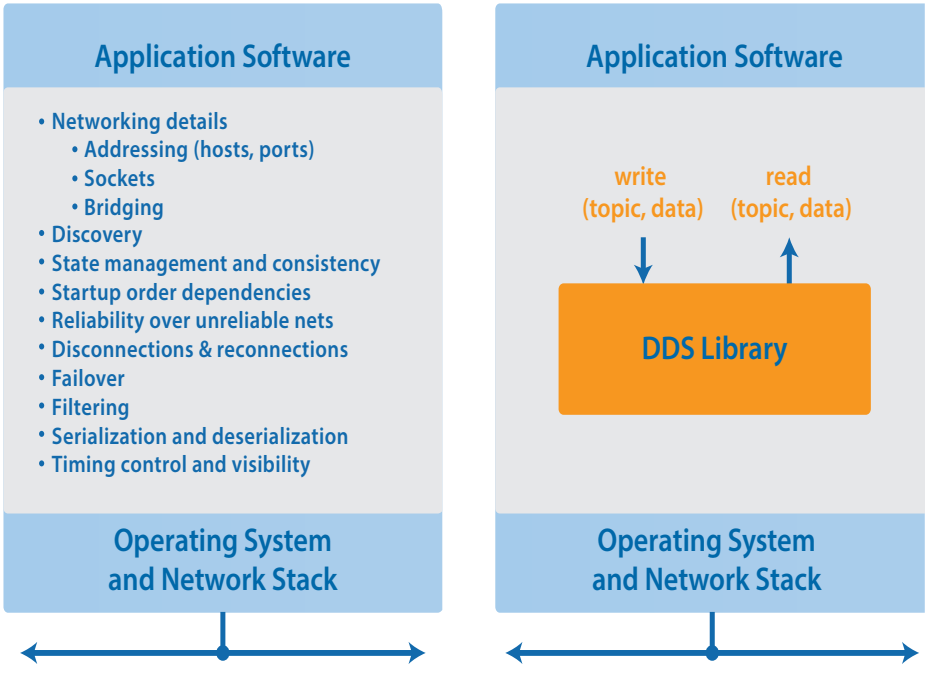
Data distribution system

At the core of the Industrial Internet, there are several protocol standards including the Data Distribution System (DDS) published by Object Management Group (OMG). Connext DDS technology directly addresses the development of intelligent distributed machines. These connectivity solutions deliver data at physics speeds to thousands of recipients with strict control of timing, reliability, failover, and language and OS translation.

Targeting device data use, this technology provides fast, deterministic device-to-device communications:

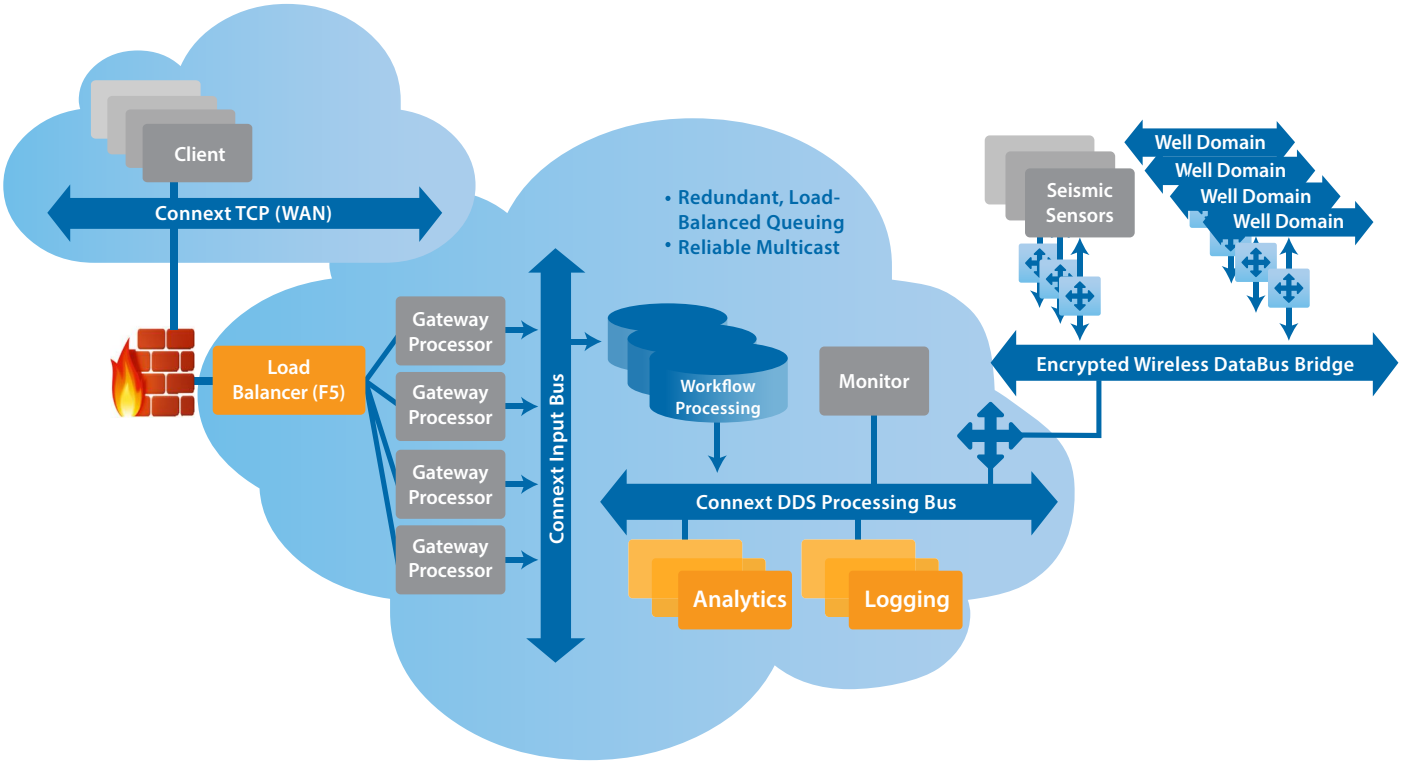
- A logical DataBus connects thousands of destinations simultaneously, with the ability to scale to hundreds of applications and hundreds of thousands of data-generating and data-consuming devices. The DataBus scales much better than hub-and-spoke designs.
- Detailed Quality of Service (QoS) control, multicast, configurable reliability, and pervasive redundancy address industrial environments where even a few minutes of downtime can be disastrous.
- Powerful filtering enables precise control of what data goes where.
- The data-centric architecture provides future-proof scalability and extensibility while greatly simplifying distributed system development.

DDS solutions have already been widely adopted in IoTapplications, with customers that include the world's largest companies in the oil & gas, automotive, underground mining, medical systems, military systems, air traffic control, and other industrial sectors.



SOURCE: REAL-TIME INNOVATIONS

DDS hides low-level connectivity details and automatically handles discovery, routing, fault tolerance and serialization. Start-up order becomes irrelevant, and DDS maintains shared, distributed state information. Application software is greatly simplified.



SOURCE: REAL-TIME INNOVATIONS

This example of a deployment model for a cloud-based analytics application connects well domains to a private datacenter cloud. The DDS processing bus facilitates the real-time collection and logging of well data, creating a repository for analytics applications. For high performance, a load balancer takes information and queues it up for processing. A single intelligent system can get data, process it, and drive appropriate actions and feedback back out to the active wells for optimized operations.

These solutions are helping the IoT to make major changes in the oil and gas industry.

Automating Remote Operations

At a time when well drilling and completion complexities are increasing and field experts are becoming scarcer, automation offers many benefits. Besides capturing domain knowledge, automation increases safety and decreases personnel time on-site and therefore lowers cost. Automation has also been proven to improve well quality, and decrease downtime and equipment failures.

On use case is automated well drilling and completion. High-speed connectivity also enables integration of the well domain and a remote control center. A wireless link or fiber network enables well information to be automatically sampled, with readings downloaded and stored in the control center. The data can then drive predictive maintenance and provide process planners with the ability to intelligently analyze well operations and send corrective feedback to the well systems. Experts in the control center can help debug and restart remote processes that have encountered errors the local automation cannot handle.

Enabling Massive Data Collection

The data generated from a single well can be sizeable; a large field of wells can produce massive amounts of valuable information. Industrial Internet technology can tackle the large-scale collection across an entire site. The proven results include better asset utilization across all wells, reduced effluents, and accelerated production. Broad oversight also accommodates hydrocarbon recovery, and offers insights that can lead to better decision making about well locations.

Intelligent Well Monitoring introduces an efficient communication and application architecture across an entire field, and builds on the well management model previously described in the automated well-drilling use case. To tie together an entire site calls for a wireless DataBus bridge between the well domains and the control center domain.

In this scenario, Industrial Internet connectivity gives the control center staff high-level site-wide visibility and analytic capabilities and also provides the links for viewing individual well sites and monitoring subsystems during operation. DDS DataBus technology supports this real-time operations visibility and simultaneous coordinated collection of massive data. Deployments have been proven to scale to encompass hundreds of thousands of devices.

Integrating Analytics

To fully exploit analytics, all of the components of the system under study must be integrated such that information can be reliably gathered. This is especially critical for real-time analytics that directly drive process improvements and production optimizations.

The data collection topology behind large-scale analytics can be complex, however. Every smart machine within every system must be connected and data driven up to site busses and eventually into the cloud or control centers for consolidation at the application level.

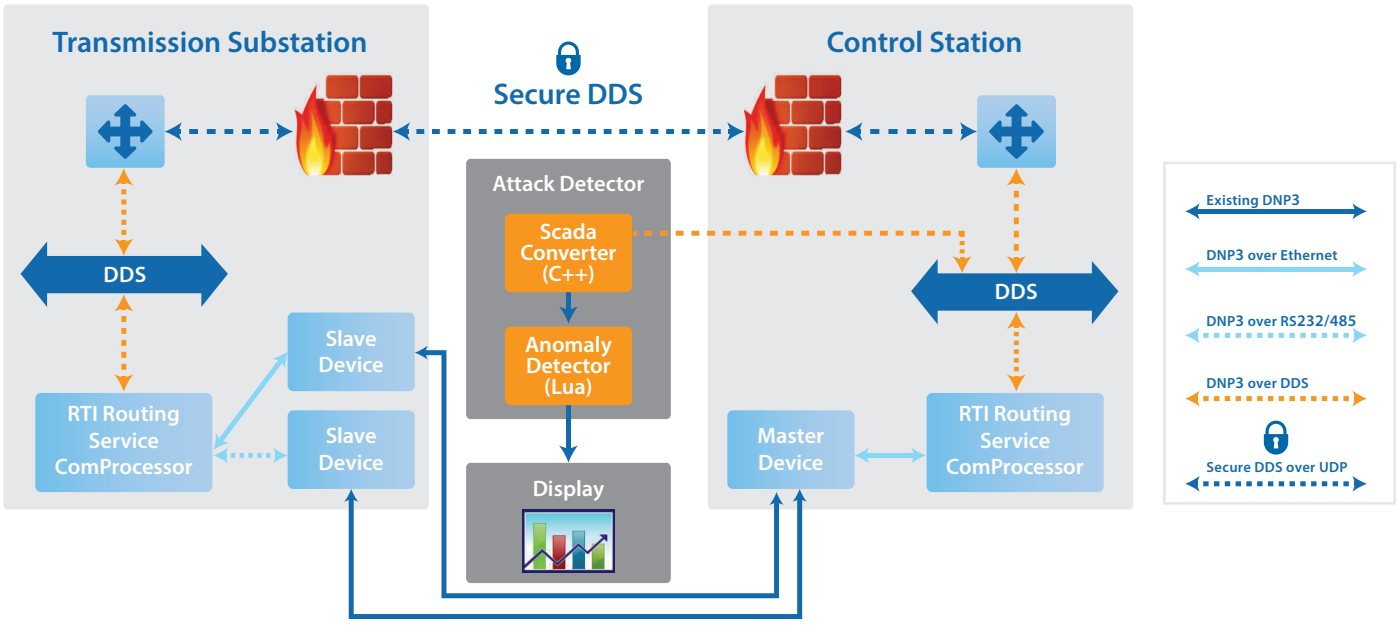
Using DDS across the system allows designers to build a single logical DataBus that connects the various subsystems. A single logical sensor-to-cloud DDS DataBus can hide the underlying complexities of the physical connections between machines, systems, and sites. One application example is Intelligent Real-Time Reservoir Management.

Securing Operations

The recently adopted DDS security standard offers complete security protection for data flows. Data flows can be secure, independent of protocols, roles, and nodes. The DDS security model allows protection of every dataflow. This "per-topic" security is logically simple: the DataBus connects information sources to information sinks. The security model simply enforces the connections by authenticating endpoints and allowing only the configured communications. The protocol supports discovery authentication, data-centric access control, plug-in cryptography, tagging/logging, and secure multicast in a 100% standards-compliant manner.

Because it leverages the existing data-centric design, adding security to an existing DDS system does not require any additional coding; security is implemented only by configuration.

SOURCE: REAL-TIME INNOVATIONS



This system demonstrated both protection of a previously-insecure link and detection of many attack vectors through simple scripted analytics.

Truly robust security requires both protection (stopping unwanted activities) and detection (finding and reporting when the protection has been compromised). This is why, for instance, a typical laptop has both a firewall (protection) and a virus scanner (detection).

The DDS DataBus also makes it easy to combine both protection and detection. Because it is a multi-channel bus, DDS supports facile data tapping. Because that bus has extensive information about the connection information and access to the data formats, it enables tapping programs to detect anomalies.

Security Breach Detection, an example from the power industry, is instructive. At Pacific Northwest National Laboratory (PNNL), an RTI DDS solution was introduced to both protect data flows and detect anomalies between a transmission substation and a control station. For protection, a legacy, insecure protocol connection was replaced with a Secure DDS connection. Messages in the legacy protocol were wrapped as Secure DDS messages and sent from substation to control station, to implement a secure, protected link.

However, even a secure link may be subject to virus insertion, man-in-the-middle attacks, and more. For detection, a data tap was installed in the secure control center. By monitoring both the "meta data" (who is connected, speed of connection) and the actual data flow, simple security scripts were able to detect various types of attacks.

Replacing Software

Developing distributed systems applications traditionally required a significant amount of networking and error handling logic. DDS middleware makes it possible to replace previously low-level communications programming with high-level data-centric publish/subscribe interfaces. Topics guide communications, rather than strict physical addressing schemes (sockets, host names, IP addresses, and ports).

The data-centricity introduced by DDS simplifies applications by eliminating code relating to:

- Message parsing and filtering
- Message caching and state management
- Discovery, presence, marshalling, and 32/64-bit issues

In a representative Asset Tracking System application, a DDS DataBus approach shortened application development times and eliminated many lines of code. In the example, an asset tracking system, a network operations center replaced an in-house system with an application built on a DDS-based Industrial Internet platform. A comparison of the before and after highlights the incentives that are driving adoption.

The exciting potential of the IIoT is to create bold new intelligent machines and vast distributed systems. The IIoT will change the world across many industries. The applications define the future: renewable energy, cars that drive themselves, planes that fly themselves, smart medical devices and smart hospitals.

DDS is a communications technology designed to handle data at physics speeds. It offers controlled access to exactly the right data, and the extreme reliability, security and scalability that real-world infrastructure needs.

The future of the IIoT must integrate these proven applications into larger systems-of-systems that bring the power of cloud analytics and business intelligence to industrial systems. This is the core vision of the Industrial Internet and requires standard protocols to fulfill that vision by providing both the extreme capabilities required by intelligent machines and the needed integration to extend to cloud-based analytics and optimization.

*Technology article by **Real-Time Innovations.***

In-House Platform	Industrial Internet Platform	Improvement
500K lines of code	50K lines of code	10X less code
8 years to develop	1 year to develop	8X faster
21 servers	1 laptop	20X less
20K tracked updates per second (with reliability and uptime problems; restricted to datacenter)	250K+ tracked updates per second; no single point of failure	Greatly improved reliability and uptime; mobility (laptop can be deployed anywhere)

Chart illustrates how in case of Asset Tracking System that the DDS DataBus approach shorted application development times and streamlined code needed.

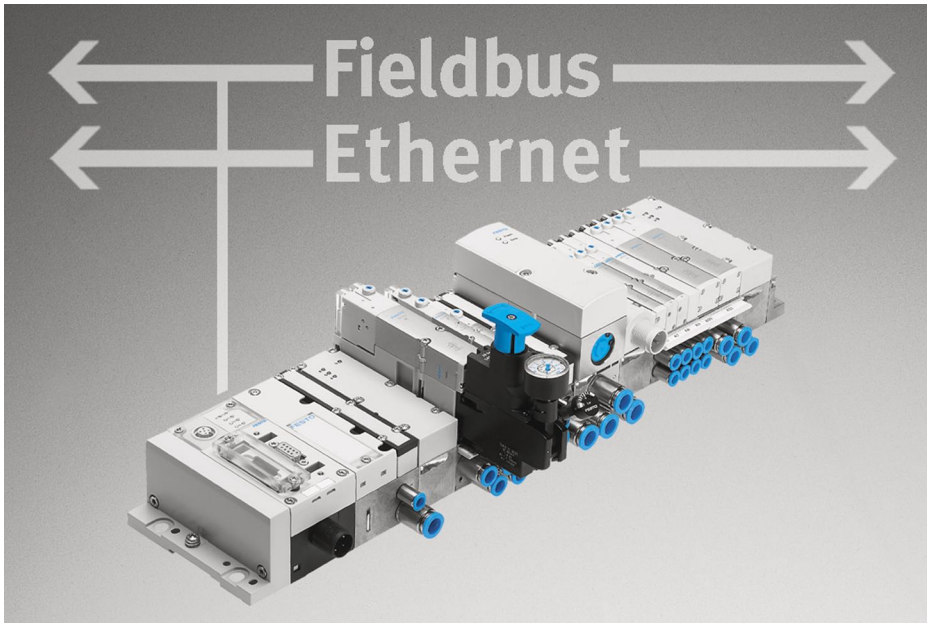
The future role of Ethernet and decentralised control solutions

The driving force behind industrial automation in the last ten years has undoubtedly been the networking of automation products via bus systems. Now, we are looking at how Ethernet solutions will develop in the future, and the move from pre-processing parameterisation to distributed control intelligence.

THE IMPORTANCE OF COMMUNICATION within machines and installations is increasing exponentially as networking is decentralised from its starting point, communication at control system level, through to the connection and perhaps intelligence of front-end devices, sensors and actuators.

While in the previous decade attitudes to the use of bus systems were still very critical, today fieldbus systems are regarded as a vital part of many applications. They are used in more and more areas. Installation-saving solutions with automation devices equipped with a bus connection are state of the art, while in front-end automation a new class of high-performance products is emerging as a next step to greater efficiency and higher availability.

This applies in particular to automation with pneumatics and valve terminals. Development is reflected in new trends and increasing acceptance of automation in more critical applications, and is leading to pronounced changes in the design of automation components and systems. Key questions are: What trends have emerged? What demands from practical users are generating new trends?



SOURCE: FESTO

In the field bus wars between manufacturer-specific bus systems and open systems, it is clear that the user decides.

Field bus wars

In the field bus wars in the past decade between the many manufacturer-specific bus systems and the open systems, one thing soon became clear that it is the user who decides. And the basis for this decision is performance, in particular, user benefit. The primary factor was not technology but the wide choice of field bus devices which were available with all kinds of technological functions, making it possible to achieve a seamless implementation in applications.

The clear winners were open field bus systems. The installed base of field bus devices is enormous, with over 50 million nodes, and represents a commitment for users to protect investments made in engineering and know-how. A decade or more ago, industrial Ethernet was associated with the idea of further consolidating the bus landscape, while at the same time lowering interface costs and boosting performance – and making IT services available in the field. A tempting thought – achieving performance standardisation in industrial communication with one Ethernet system.

The original objectives of standardising the communication landscape through the use of industrial Ethernet have not yet been achieved. The large installed base of field bus systems and the high cost of switching to industrial Ethernet is at present a barrier to

Industrial Ethernet versus field bus – competitors or partners?

Target	Current Situation
One industrial Ethernet protocol	≥ 5 relevant Industrial Ethernet protocols
Use of hardware from consumer and PC areas leads to uniform standardised products	Has not occurred: Individual hardware and designs required for each system, little usable electronics from PC area
Lower interface costs per device through economies of scale and inexpensive hardware. Vision: Industrial Ethernet in individual sensors/actuators	Target missed: Higher prices per interface due to smaller quantities, high-performance electronics and individual design
Use of IT services in front-end automation devices creates a transparent link to higher-level systems and allows higher volumes of data communication	Not yet used: IT services are generally used at the control system level and higher, few projects with IT at field level
High-performance communication in terms of data volume, speed and synchronicity allows the integration of motion control applications into a network with other field devices	Target achieved: Variants with high-speed clock-synchronised data communication in co-existence with standard communication on one bus

Target	Current Situation
Distributed networked control logic with central and intelligent programming tools – a neural network	Some integrated controllers in operator panels, motion controllers, remote I/Os and valve terminals
Replacement of central controller	Networking with central controller; conventional field bus communication, in certain cases download of user programs via field bus
High availability thanks to programmed fail-safe functions in the decentralised control logic	De-central periphery has parameterisable fail-safe functions and pre-processing function modules
Pre-commissioning of sub-functions and object-oriented user programming	Is used for discrete sub-functions and linked manual workstations, based on front-end controllers
Benefits to compensate for overhead costs of highly distributed control (see above)	Price/performance ratio for de-central control logic accepted only for certain applications.

the replacement of field buses by new system approaches.

However, new possibilities are emerging, and with these a very clear profile and target area for industrial Ethernet. As the result of the trend to ever-faster processes and machine cycle times, motion control applications and the necessary peripheral processes are moving ever closer together. This means potential for industrial Ethernet. Applications of this kind can be based on ProfiNet IRT, EtherNet/IP, Powerlink, Synch, EtherCat or even Sercos III.

Forecast for the future

Most simple applications (and most applications are simple) will continue in the future to be equipped with field bus systems. More complex applications – particularly those with high motion control content – will migrate to industrial Ethernet.

The principle once again applies that users will calculate the costs of migration and investment very carefully and then decide the proportion of industrial Ethernet and field bus on the basis of the benefit (price/performance ratio) for their application. Coexistence of the two systems to cover different applications and customer requirements would therefore seem to be the probable scenario.

Recent discussions about industry 4.0 and the need for even stronger horizontal and, even more importantly, vertical integration of devices, machines and control systems are interesting. OPC-UA is being discussed as the most appropriate data format to be implemented on existing Ethernet base networks. However the same arguments still apply; users will still have to take into account the benefits of this new technology with the cost of migration and investment.

Distributed control intelligence

The basic idea and the first move towards decentralisation by means of bus systems was the relocation of the I/O of the central controller in a control cabinet to de-central terminal boxes. Very soon, the principle was established of direct machine mounting of remote I/O units. A pioneering role was played by Festo valve terminals with their high degree of protection IP65/67. In a second step, more and more peripheral PLC functions were moved to the field level.

The logical consequence forecast as the third step was the distribution of control system/PLC functions to the field – "The network is the controller" was one of the slogans at the start of this decade. This much-discussed trend has established itself in only a few applications. The barrier for most users was the increased hardware costs for de-central control logic and the increased engineering costs for the generation and maintenance and management of user programs.

One aspect of "decentralized intelligence" has become established, however, by the increased flexibility of decentralized automation devices and integrated pre-processing functions. Examples include the ability to parameterise fail-safe functions for outputs, valves and actuators in the case of an interruption of communication in the bus system, or also software-configurable limit-value monitoring for analogue sensors and actuators. Function integration has established itself as a facet of this decentralized intelligence.

In future it is expected to see an increasing demand for subsystems to be run autonomously as so called cyber-physical-systems (CPS) in industry 4.0 environments. This could lead to simple stopper modules that have a smart controller and IP address on board or larger devices/subsystems such as gantry or handling systems featuring this CPS functionality.

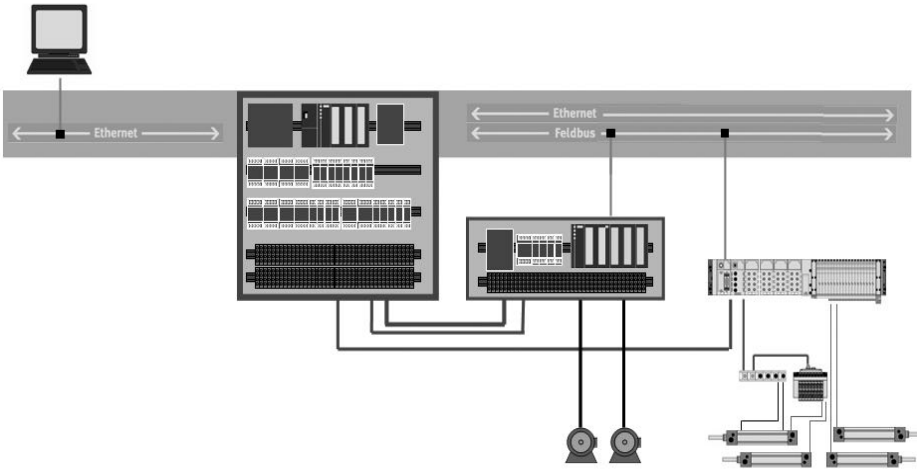
Changing customer requirements

As the result of the decentralisation of control system components and their relocation directly next to sensors and actuators, direct machine mounting is becoming ever more important. This development is due to a desire by users to cut wiring installation costs, use preassembled cables to further reduce wiring costs, and eliminate the need for a terminal box.

Particularly with regard to triggering a pneumatic control chain, direct machine mounting has clear benefits for users. The closer the triggering unit (the remote I/O or valve terminal) to the actuator, the more the environmental requirements of these front-end components also apply to the control components. Moreover, valve terminals in particular can be used for applications for which users would not previously have considered them.

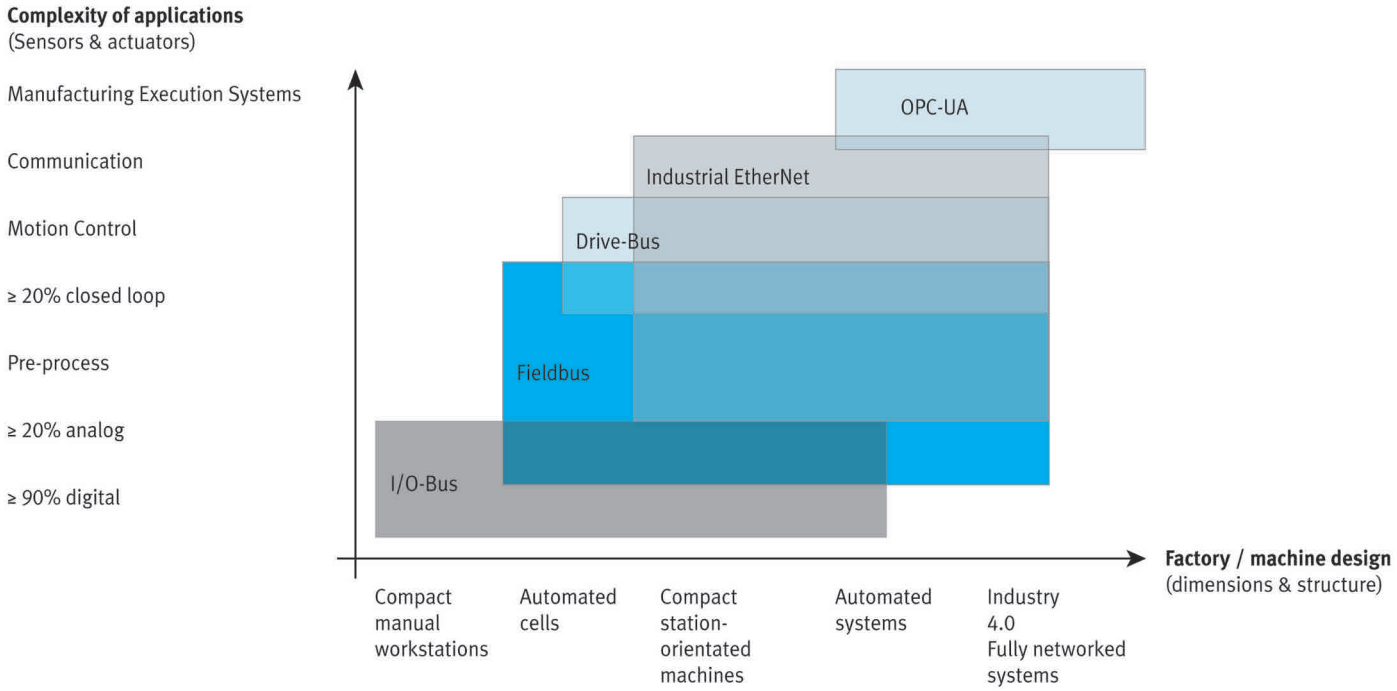
Examples include the following:

- Increased use in automobile body-in-white production directly in very harsh conditions (welding area, vibration and shock load)



SOURCE: FESTO

The main factors with regard to bus systems: less space in control cabinets and lower wiring costs.



SOURCE: FESTO

Positioning and potential of the various communication systems

- Use in process automation (EX zones, zones subject to standards such as FDA)
- Use in the food industry in splash zones (contamination by food ingredients and subject to spraying with cleaning agents)

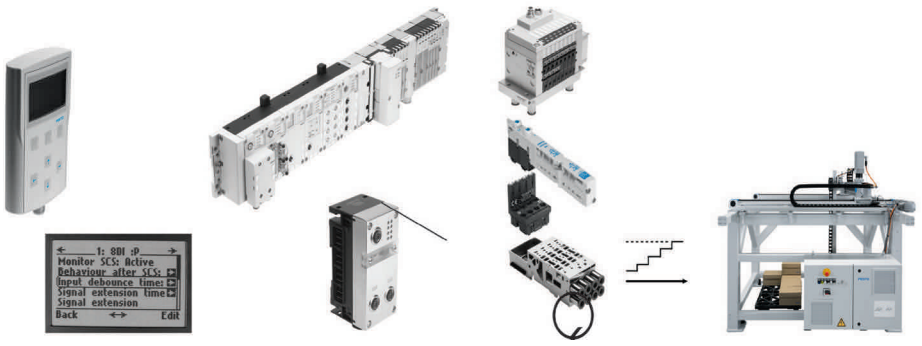
These requirements have led to noticeable changes in customers' demands, particularly in the last number of years. Of special interest, however, is the development of mono-technological units to form multifunctional units. Most interesting of all to users are units which provide complete subfunctions within a machine, and also the technological functions. This is now being discussed as the basis of optimised engineering and installation flexibility in industry 4.0 environments.

A good example of this is the development of the valve terminal to become a hybrid technological terminal. Previously the emphasis was on the triggering of valves via a bus, but now a high level of signal mixture is required for everything from the simple sensing of end positions through to the acquisition of temperature data and the integration of pressure sensors, proportional valves and safety-critical electrical power supply concepts, including simple diagnostic functions for the connected periphery, special valve diagnostics and a preventive maintenance function. Valve terminals are not just a platform which provides pneumatic and electrical connections but are also able through hybrid modular system concepts and de-central installation systems to adapt to a machine design. The quotation from the architect Lois Sullivan applies precisely: *form follows function*.

The design of new machine generations and system concepts also makes it very important to select the right system supplier. Products that fit well into applications will be cost effective and result in overall solutions with higher performance.

Possible potentials

- Higher cycle rates through the use of decentralised and faster components
- Higher system availability through more detailed diagnostic functions or a more robust design
- More compact processes through optimised design for a given application
- Higher flexibility in industry 4.0 environments due to functional units and pre-defined interfaces like OPC-UA



SOURCE: FESTO

The concept of pre-processing via parameters extends to all types of automation components and equipment.

Conclusions

The subject of "Open Communication in Automation" – in other words, control devices with a bus interface – is a popular one in a time of very dynamic changes. A distinction must be made between its influence on the control system level and that on the field level. On the field level in particular, the potential for lower installation costs has virtually been fully exploited.

There is greater potential in the pneumatics environment through an evolutionary integration of functions and technologies. This, however, demands an adequate link to the control system level – and thus the use of industrial Ethernet protocols as a data backbone for machines and systems.

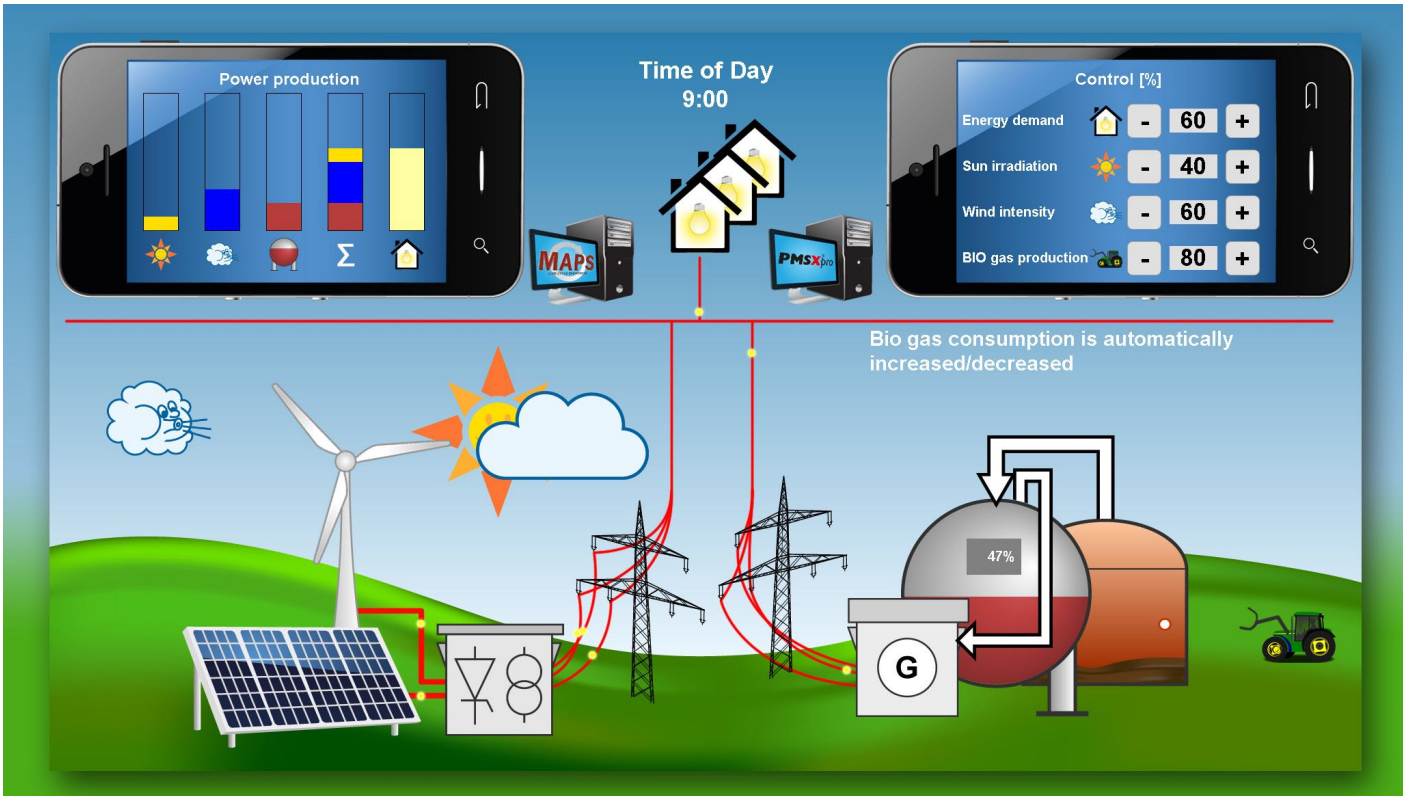
The established field bus protocols will continue in the next decade to play an important role in mass applications. Valve terminals are becoming multifunctional terminals able to provide complete sub functions of a machine or sub-processes within a system in a flexible form. And solutions, especially subsystems with valve terminals, will feature OPC-UA connectivity to fit Industry 4.0 host environments.

Front-end motion control, pneumatics, signal processing, safety technology and networking are the key technologies. This trend has been identified in joint projects with customers, and already today the first results are available in the form of products.

Uwe Gräff *is Head of Business Unit Netware Interface Control at Festo.*

Intelligently coordinating virtual power plants

To link single energy carriers into virtual power plants, a new process control system and lifecycle software tool intelligently coordinates various energy carriers. Plants can react quickly and flexibly to demands from the network, and control the connected virtual parts of the power plant according to loads and capacities.



SOURCE: MITSUBISHI ELECTRIC

Virtual power plants which combine different sources of renewable energy guarantee a stable energy network, by combining relevant sources automatically based on availability.

THE USE OF RENEWABLE ENERGIES such as hydroelectric, wind, solar and biomass energy has increased significantly and is still on the increase. The policy which promoted this energy revolution in Germany is formulated in the Renewable Energies Act (EEG). As a result of this, the number of units feeding the energy network has risen.

However, the amount of electricity produced by renewable energy sources can sometimes fluctuate significantly, making the network unstable. As a result, support from conventional power plants is required in order to balance out the situation. However, insufficient planning certainty can cause problems for the operators of conventional power plants since installations of this type are not necessarily suitable for flexible control.

Emergence of virtual power plants

Virtual power plants which combine different sources of renewable energy provide a solution to the problem. In order to guarantee a stable energy network, the relevant sources will be combined automatically based on availability. In order to facilitate the linking of individual energy sources to create virtual power plants, Mitsubishi Electric offers useful technology for coordinating different energy sources intelligently, namely the process control system PMSXpro and the life-cycle software tool MAPS (Mitsubishi Adroit Process Suite).

This technology can ensure that an installation responds quickly and flexibly to demands from the grid and control the sources connected to the virtual power plant according to their utilisation and capacities. As a result, this opens up new economic possibilities for the owner to participate in the overall energy market.

PMSXpro is certified to power plant standards and facilitates the reliable monitoring, operation and control of highly distributed systems in a way that is easy to understand. PMSXpro is a finely-tuned process control system based on standardised automation components and characterised by highly uniform hardware and software. It also fulfills all the necessary requirements regarding availability, economic efficiency, expandability and flexibility.

MAPS can ensure an increase in value along the entire value chain. An integrated project assistant can generate PLC and SCADA projects automatically, resulting in significant time savings during the planning and configuration phases. This can also ensure a structured system design, significantly facilitating the ongoing maintenance of the installation throughout its whole life-cycle.

The virtual power plant can be tested by visiting: https://eu3a.mitsubishielectric.com/fa/en/solutions/industries/power/renewables

*Technology report by **Mitsubishi Electric.***

Remote machine access and diagnostic software support

Proseal OEM tray sealing machines use remote access support and an effective diagnostics solution to minimise delays and downtime. The system provides a technology solution for resolving service issues anywhere in the world.

BY INSTALLING VPN ROUTERS and using an Internet-based remote access system, food packaging company Proseal UK is now able to securely access, diagnose and quickly resolve issues on its tray sealing machines located anywhere in the world via secure broadband connections.

Packaging OEM Solution

Offering customers a complete packaging solution, Proseal manufactures an extensive range of manual, semi-automatic and fully automatic tray sealing machines with throughputs from 6 to 180 packs per minute. These machines are designed to package many different types of food, from joints of beef and ready meals, to strawberries and sandwiches.

"Our customers are packaging foods in high speed production environments and so require high machine reliability and availability. Downtime has to be minimised to avoid expensive disruption to production packing," said Paul Watkin, Systems Development Manager at Proseal UK. "They will lose money if a packaging line goes down, so any issues need to be resolved quickly. Furthermore, our machines can be installed anywhere across the world – from Europe, USA and South America, to South Africa or the Far East."

"Our core values as a business are therefore quality, service, precision and rapid response. We provide our customers with 24/7, 365 days per year breakdown assistance on our tray sealing machines, wherever that machine is located in the world," he added.

Remote access connectivity

Prior to installing eWON routers on its machines, if a machine problem couldn't be solved over the telephone or email, Proseal would have to fly one of its service engineers out to the customer's factory to solve the problem, which was costly and time consuming, particularly if the machine was installed in Chile or Australia.

"These problems were often minor issues such as a machine operator setting up a machine parameter incorrectly, or a machine component failure, which needed replacing quickly. However, even such minor problems could still delay a production process and cost the customer valuable time and money. We therefore decided to search for a remote access and diagnostics solution for our tray sealing machines," explained Watkin.

SOURCE: EWON

The combination of a VPN router and remote access software simplified remote maintenance of tray sealing machines.

In order to fully understand the how the VPN router and remote access software solution would work, Proseal tested the system on a customer's tray sealing machine located in Inverness, Scotland. Everything worked well and they could immediately see the benefits of reducing service engineer call-outs. With the remote connection, it's as if engineering support is physically accessing the HMI display or PLC with a laptop.

Talk2M (Talk to Machines) is an Internet-based remote access support and diagnostics service. that offers a professional platform with all the security, reliability and traceability required by industrial applications. It enables OEMs, machine builders and systems integrators to provide remote maintenance, support and diagnostics for machines in remote locations, and can be accessed anywhere in the world using secure Broadband and other secure wireless connections.

Since 2010, Proseal UK has installed industrial-grade routers on 80-90% of its tray sealing machines. Watkin said Proseal now has an ability to fix any machine problem quickly over a secure Internet connection, wherever that machine is located. Our engineers can log in remotely from its site in Adlington, Cheshire and diagnose a machine fault within minutes. If a machine component fails, engineers can remotely diagnose the problem and advise the machine operator accordingly.

"We are also starting to look at using the routers as data collection devices, which will enable us to provide our customers with valuable operational data, to help the customer make better, more informed decisions about their machines and packaging processes. Offering this type of service has already helped us to sell more machines," Watkin added.

*Case Study by **eWON.***

Packaging automation using IO-LINK communications

IO-Link is a powerful standard increasingly deployed point-to-point, serial communication protocol used to communicate with sensors and/or actuators. In packaging applications, it offers an effective solution for data communications and events handling.

BY EXTENDING THE IEC 61131 globally-recognized PLC standard, IO-LINK allows three types of data to be exchanged – process data, service data, and events – that can be effectively used in packaging applications. Major sensor manufacturers and industrial manufacturing companies have adopted the IO-Link communication protocol due to its many advantages over standard I/O.

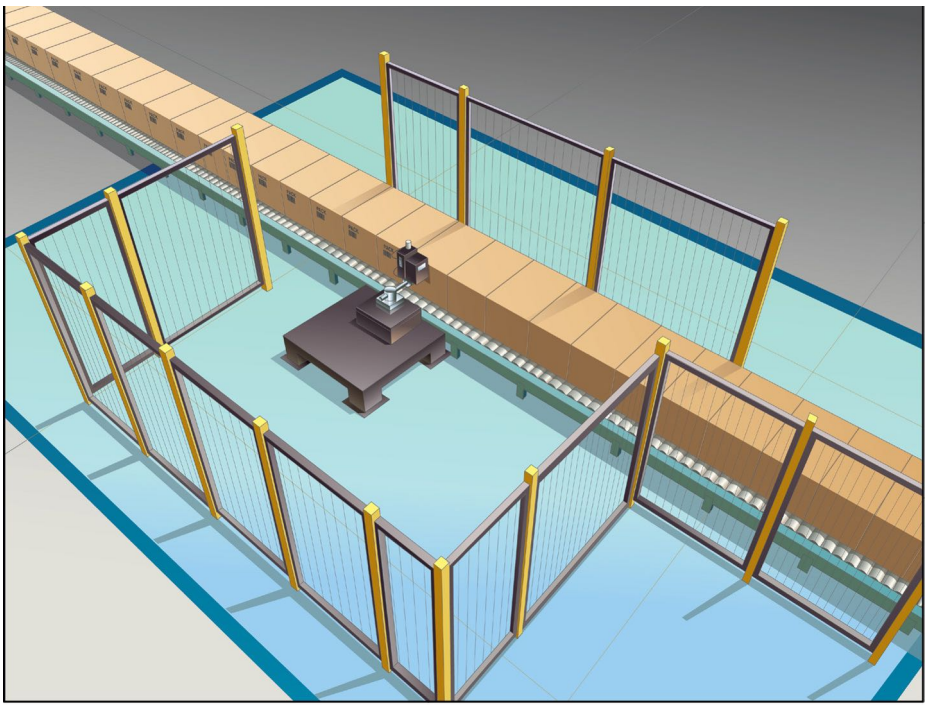
Benefits for packaging

A consumer packaged goods manufacturer produces several varieties of one product, requiring different printed labels during packaging. The packaging is mostly automated due to the heavy machinery that is used and the volume of the product being packaged.

The label printing occurs in the middle of the packaging cycle. Due to safety regulations, the area is blocked off during production. If configuration of a specific luminosity sensor for different printing requirements is needed during the packaging process, a technician is required to turn off all the equipment between production runs to access the luminosity sensor for reconfiguration. This requires the technician to go through all the safety access points on the assembly line before reaching the sensor, and the downtime costs the company time and a lot of money. In addition, a long screwdriver has to be used to bypass the required safety barrier. This action is not just inconvenient and clumsy, but dangerous for the technician.

As well as changing the configuration method of the luminosity sensor, the company wanted to gain easy access to process data from a photoelectric sensor from a different manufacturer. This sensor detects the number of products coming off the line. It was a challenge for the company to make manufacturing adjustments in a timely fashion, as the data was hard to access and required additional PLC programs to be written.

In addition to remote configuration and accessing process data, the company also needed a solution to easily integrate sensors from multiple manufacturers. In production, a variety of sensors were used to meet the specific needs of each system. Having a multitude of manufacturers' sensors made installation, maintenance, and monitoring cumbersome. The company was seeking to increase efficiency by using a central management system for all sensors.



For label printing, IO-LINK offers solutions for remote configuration and accessing process data, and the ability to easily integrate sensors from multiple manufacturers.

The company knew that the IO-Link standard was the answer because it provided the advanced capabilities required and would be simple to install in the existing architecture. The company had purchased IO-Link enabled sensors, but also needed a master to network them together. Other IO-Link masters provided some functionality, but posed concerns with product form factor and ease of integration with the PLC. An IO-Link Master was selected because it solved all these difficulties:

Small form factor: A slim-line design made it easy to mount to any machine, wall or panel. In addition, M12 connectors are IP67 rated, making it reliable in even the harshest environments.

Straightforward integration with the PLC: Free sample programs simplify the integration into PLCs, including Control Logix, Compact Logix, SLC 500, Micrologix, and PLC5. Using ISDU (Indexed Service Data Unit) handling, Comtrol has developed a flexible and simplified interface, eliminating the need for lengthy PLC programming by the user. With EtherNet/IP and Modbus support, the IOLM 4-EIP provides multiple protocol configuration options.

Remotely configure the luminosity sensor: Users can remotely view and update configurations based on current production requirements, making it easy to manage sensors in isolated or hazardous areas. Remote parameterization can be done through a PLC, HMI, PC, smartphone, or tablet. In addition, Comtrol has added IODD file storage to the IOLM 4-EIP web server, allowing for automatic discovery and default configuration of known sensors and devices. This works with all IO-Link devices, guaranteeing a variety of sensor and devices are automatically recognized.

Access to photoelectric sensor process data: The IOLM 4-EIP provides advanced diagnostic data via PLC, HMI, PC, smartphone, or tablet, supplying the user with timely production control. This process data can help detect potential repairs or adjustments needed on the line in advance to avoid costly downtimes.

Easily integrate multiple manufacturers' sensors: Each sensor requiring access for this company was designed by a different manufacturer. The IOLM 4-EIP is IO-Link V1.1

compatible and was designed to be sensor-neutral; most production environments have a mixed array of sensors. Regardless of the manufacturer, IO-Link sensors and devices are easily integrated with the IOLM 4-EIP.

IO-Link will work in any control system. Here are some of the technology advantages that may prove useful in your applications.

Sensor failure downtime scenario

Many sensors come out of the box with default settings that are intended to cover some portion of the market but more often than not, since some of these are quite versatile, there are a number of settings that need to be changed before the device can be used. Typically, when the sensor fails it may take a while to get noticed and when it does get noticed it's often a quality problem by then.

If your sensor fails, IO-Link can give you all the information you need to find and fix it, and customize the replacement automatically.

Diagnostics

Sometimes an end device is very close by, but difficult to get to. There may be dangerous conditions in the immediate vicinity, or it may be located up high or in a tight space.

Often you may find after waiting for the shutdown that the part in question is not the source of trouble which compounds the frustration even more. In other cases, access to the device may be great, but the site of interest is 1000 miles away from the person who built it. With IO-Link, you can view detailed diagnostics throughout your process control system, giving you the capability to put the most important information about the system in front of the people who know the most about it.Once a problem is diagnosed, you can remotely reprogram your end device as easily as if you were holding it. OEMs are increasingly providing a wider variety of customizable parameters which can be read and if allowed, written via IO-Link.

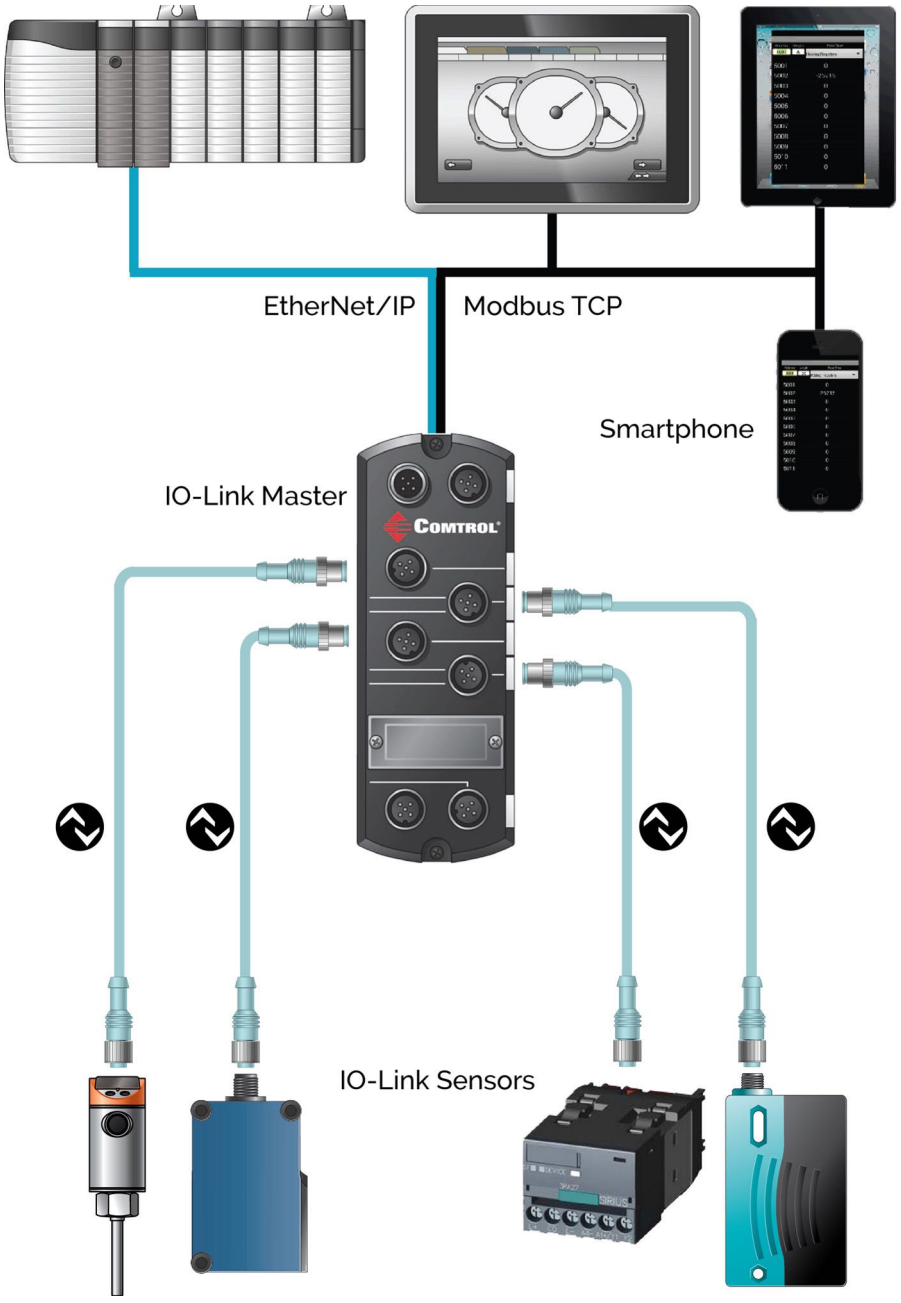
IO-Link Masters provide diagnostics about both sides of a given connection. You will get information about the connection that is running from the IO-link master to the end device and you detailed information about the Industrial data protocol connecting the IOLM to the PLC or SCADA - whether it's using EtherNet/IP, Modbus TCP or PROFINET IO.

Remote Parameterization

Boosting control system awareness and customizability, IO-Link's SPDU (or ISDU) allows the sensor or actuator OEM to move beyond the traditional model of one way connections that only transmit the core data; An OEM can make any aspect or property of their device accessible over IO-Link.

Without IO-Link, OEMs typically had to design an on-board screen interface with some sort of push buttons, or they had to use dip switches or other on board hardware, or the device could be configured only by taking it offline to connect it perhaps to PC based custom software which would configure their device before being returned to service where it would transmit (only its core data) by the traditional methods. IO-Link parameters can be written to remotely while the device is installed and in use.

The ability to do remote parameterization can be combined with the support for remote diagnostics. Troubleshooting and fixing problems with a system can all be done remotely. Additionally, for those processes or systems where a "recipe" architecture is appropriate, IO-Link sensors and actuators can be remotely parameterized by the PLC in bulk via a simple selector switch or other minimal operator action.



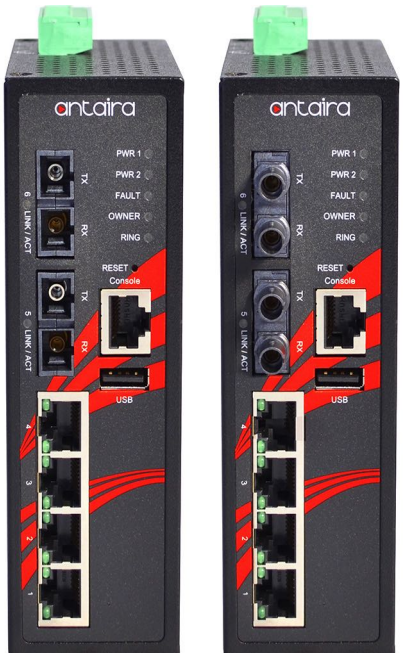
Sample IO-LINK system architecture.

Efficient wiring and connections

Multiplexing can save money, and for anyone with a control system that covers more area than a lab bench there is potential to choose a wiring scheme that minimizes total material and labor costs. If you have 20 motor starters at the bottom of a hydroelectric power production dam, and you have a control room at the top you could run individual "spool" wire connections from your PLC cabinet down to each MS individually, or you could just run an Ethernet cable to an IO-Link master and then connect all 20 motor starters to one IO-Link master. This saves a tremendous amount of wire and installation time. IO-Link gateways allow users to connect multiple smart devices (sensors or actuators) via ONE IP address.

*Application story by **Comtrol.***

Network management capabilities



Antaira Technologies: The new LMP-0602 and LMP-0602-24 series are six-port industrial PoE+ managed Ethernet switches that support a 48~55 VDC high voltage power input and a 12~36 VDC low voltage power input with a built-in voltage booster.

Each unit is designed with four 10/100Tx Fast Ethernet ports that are IEEE 802.3 at/af compliant (PoE+/PoE) with a PoE+ power output up to 30W per port. Additional dual 100Fx fiber ports support both an SC or ST type connection, and either a multi-mode or single-mode option. The dual power input designed product series provides a reverse polarity, EFT, surge and ESD protection. There is also a built-in relay warning function to alert maintainers when power failures occur. This makes it ideal for applications requiring a high reliability, distance extension capability, and/or any harsh environment flexibility.

Dual-purpose router

Belden: The Magnum 5RX fixed configuration security router offers superior network performance, while addressing the escalating security concerns associated with industrial applications in highly distributed environments.

Designed for mid-level industrial applications where hardened and industrial grade solutions are required, the Magnum 5RX Security Router offers a comprehensive set of features essential for success in the field. These features provide maximum protection for power transmission and distribution settings and make the router especially well-suited for deployments at the edge of the network where modular solutions are either too expensive or not required.

The new two-in-one router is equipped with legacy network protocol and interface supports, as well as EtherNet/IP presence, offering a valuable migration path to the new generation of network backbones. The router's advanced software features offer best-in-class firewall protection and virtual private network (VPN) security along with advanced Layer 3 routing capabilities.

Ethernet and fieldbus gateways

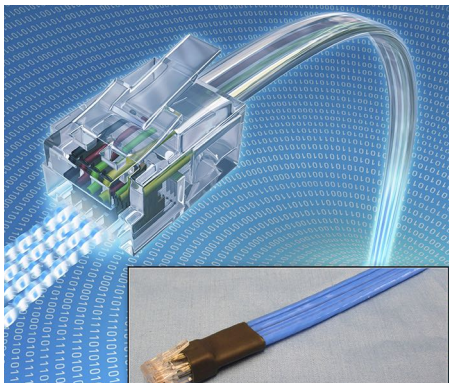
Deutschmann Automation: UNIGATE EL gateways connect all common industrial protocols with the Ethernet world and facilitate the communication between the control/office level and the shop floor.

Following customer requests, Deutschmann has now introduced a second Ethernet interface for these gateways in order to make starting up even easier. Service and maintenance staff can use the extra interface to directly access the configuration of connected communications gateways.

As an added beneit, the interface provides the devices with an additional regular bus port. Models are available for a wide range of fieldbuses and Industrial Ethernet systems including Modbus TCP, Profibus DP, MPI, DeviceNet, CANopen, EtherCAT, EtherNet/IP, and PROFINET according to the V2.2 specification (GSDML V2.3 specification).

Deutschmann optionally offers the devices with eight integrated I/O that can be freely configured as inputs or outputs by means of the company's script which can be programmed with the free-of-charge Protocol Developer tool without special programming or in-depth fieldbus knowledge.

Flat flexible Cat 6A cable

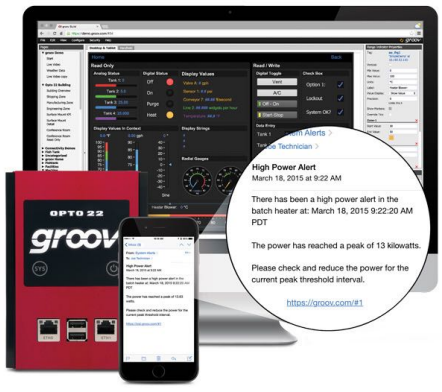


Cicoil: A new lightweight and ultra-flexible Cat 6A cable is unlike industry-standard Ethernet cables that don't provide consistent data transmission accuracy in continuous motion applications. The new cable's flat, compact design provides exceptional reliability when flexed, twisted or routed through tight spaces.

Cicoil's patented extrusion process allows four individually shielded 28 AWG 100 Ohm pairs to be placed in a small, flat profile, precisely controlling the spacing of each component, insulation thickness and the overall cable shape. As compared to other Cat 6A cables, the flat design concept allows for easy stripping and a significant decrease in cable prep time. The design is also compatible with standard handheld manual and automated stripping and crimping equipment.

While meeting or exceeding the requirements of the Cat 6A standard, the proprietary Flexx-Sil rubber encased cable is designed to provide high speed data transmission rates of 10 Gbit/sec, frequencies of 500 MHz and above average suppression of electromagnetic interference, especially in continuous flexing applications. In addition, the unique outer jacket is self-healing from small punctures and will not wear, crack or deform due to long term exposure to extreme environmental conditions.

Event notifications for groov



Opto 22: A major new feature of groov 3.0 is event-based email notifications that can alert selected personnel based on multiple parameters. Email messages can be customized

and sent to groups or individuals, and messages can include equipment data, time/date stamps, other key information, and even links back to the groov operator interface for one-click access to real-time, visual data for further investigation.

For example, if a machine overheats, stops working, or otherwise meets or exceeds one or more predefined criteria that trigger a notification, a maintenance technician can be notified via email or text message, and can click right to the groov screen with more data. With email available at almost any time or location thanks to mobile devices like smartphones, email notifications get critical data into the right hands right away.

Additional new features in groov 3.0 include an improved groov Build interface development environment where it's easier to position, align, and group on-screen objects.

Wireless totalizing transmitter

Emerson: The new Rosemount 705 wireless totalizing transmitter installs quickly to provide average flow and volume data from any turbine meter or pulse device.

The new unit is designed for installation on new or existing turbine meters or pulse devices to deliver average flow and totalised flow volume over time. The totalising transmitter delivers predictive diagnostics data to indicate instrument health and support timely maintenance to intervene on issues before they impact operations. A free app has the ability to be configured in nine languages, can be paired with multiple transmitters simultaneously, monitors and logs sensor data on your smart phone or tablet, and displays sensor data in digital, graph, or gauge format.

The transmitter provides average flow rate and totalisation in an operator-configurable k-factor. One second updates ensure timely information, and remote mounting of the device allows for flexible installation. It can be installed in a location convenient for the wireless signal up to one kilometre away.

DIN rail format PC

Lanner: To meet the demand for increased efficiency, low maintenance cost and simplified integration in industrial communication fields, Lanner has launched a high serial port density box PC in DIN Rail form factor as part of its product lineup.

This industrial system (LEC-3013-I10) is designed with 10 serial ports, low-power Intel Atom CPU, and other useful I/O connectors for easier integration and power-efficiency, making it an optimal solution for industrial automation and monitoring, energy transmission and distribution, and other substation and grid environments.

Different from traditional serial COM port in DB-9 configurations, the LEC-3013-I10 utilizes Phoenix Contact terminal blocks to deliver up to 10 serial COM ports to communicate using RS-232 or RS-485.

Quad IO-Link reference design

Maxim Integrated: Designers now have a single platform to develop an IO-Link master and multiple industrial sensors. The MAXREFDES79# allows manufacturers to bring IO-Link factory automation designs to market faster.

As Maxim's first-ever IO-Link master reference design, the offering reduces the cost and time required to develop and evaluate both IO-Link master and IO-Link sensor systems. While previous IO-Link master development units featured only one port, the new IO-Link master allows up to four sensors to be tested at one time. As an IO-Link compliant system, the MAXREFDES79# works with any IO-Link sensor on the market and complements four Maxim sensor reference designs to make the process quick and easy for customers to simulate factory operation.

Ethernet Extenders over copper

EtherWAN: New ED3501 and ED3541 Ethernet Extenders provide excellent Ethernet Extension performance via a single RJ11 cable or a pair of copper wires. The data transfer rate is able to reach 100Mbps at 300-meter point-to-point distance, and the maximum distance is up to 2600 meters with 1Mbps data rate.

THe Ethernet Extenders are used in a pair, offering point-to-point data transmissions with longer distance, wider bandwidth and better performance. They provide flexible settings to adapt the user's line quality. For instance, the auto detection of Local/Remote operation and symmetric/asymmetric data communication mode by DIP switch. The ED3541 Hardened Ethernet extender is designed to work from -40°C to 75°C, features a DIN-rail form factor and Link Down Relay (LDR) function to perform stable reconnection when a port link-down occurs.

Protocol converter for remote control

Phoenix Contact: New Resygate protocol converters can be used to create distributed stations for more cost-effective and easily monitored remote control applications.

Resygate devices compile many popular

communication protocols, for example, from the water management industry or energy supply, in modern, standardized remote control protocols. In doing so, savings for interfaces can be made in control systems. IP address areas are used more effectively by establishing subnetworks.

The following protocols are compiled in the TCP/IP-based communication according to IEC 60870-5-101 bal or IEC 60870-5-104: IEC 60870-5-101 bal; IEC 60870-5-101 unbal; IEC 60870-5-104; Modbus/RTU; and Modbus/TCP.

Users can select a precise solution for their data volumes from two device classes. The Resygate 1000 converters are available for up to 500 process variables, and Resygate 3000 for up to 4000 process variables.

Unmanaged Gigabit Ethernet switch

Red Lion: The N-Tron series 1008TX unmanaged Gigabit Ethernet switch offers eight 10/100/1000Base-T(X) ports with support for jumbo frames, features an extended operating temperature and wider power input range than most competitive offerings.

The new switch is a plug-and-play, unmanaged Gigabit Ethernet switch housed in a hardened, metal DIN-rail mountable enclosure designed to provide cost-effective, reliable performance in the harshest industrial environments. Ideal for use in mission-critical data acquisition, security and surveillance, control and Ethernet I/O applications, the 1008TX delivers low latency and high bandwidth to industrial networks.

Key switch features include: Compact design (4.6”x 1.5” x 4.0”) for space-constrained applications; hardened metal DIN-rail enclosurewith unmatched tolerance to 50 g shock and 200 g vibration; extended environmental specifications for reliability in extreme locations; and redundant power inputs.

New mobile wireless router

Siemens: The Scalance M wireless router series has expanded by adding two new devices. The Scalance M876-3 is ideally suited for transmitting data via third generation wireless internet access (3G).

In Europe, these are the well-known UMTS networks, with EVDO (Evolution Data Optimized) networks being prevalent particularly in North America. Using the second new addition to the series, the Scalance M876-4, users can connect to subnets and automation devices via LTE (Long Term Evolution) wireless standard, widely used throughout Europe. Thanks to their high bandwidths, performance capabilities and transmission speeds, the routers are able to be deployed in a diverse range of applications: from industrial remote access solutions, such as teleservice to the integration of distant substations in energy distribution or water treatment systems, as well as high-bandwidth applications, such as video surveillance.

In addition to the integrated 4-port switch, which can be used to connect up to four end devices, the new mobile wireless routers each come with two antenna connections, making it possible for operators to use multiple antennas (antenna diversity) and increase both signal quality and bandwidth.

Versatile entry-level switches

Kyland Technology: New Opal Series entry-level switches provide an extensive product range for safe and efficient networking of automation applications, even under harsh conditions.

The first units are two unmanaged devices with five and eight twisted pair ports, of which one or two optionally are available as fiber uplinks supporting selectable broadcast storm control.

Newer versions will add additional ports, gigabit data rate,PoE support and will follow later this year. The switches meet the requirements of protection class IP30, have a sturdy metal housing and are available both for a temperature range of -10 to + 60°C and -40 to + 70°C. Other features include high EMC resistance, broad protection to shock and vibration, a redundant universal power supply (9-60 VDC/9-30 VAC) as well as various certifications, e.g. for use in industrial control systems or in hazardous areas.

The twisted pair ports, that have RJ45 sockets, support auto-sensing, auto-negotiation and auto-crossing. The fiber uplinks are available for SC or ST connectors. Distances of up to 5 or 40 km can be bridged via multi-mode and single-mode respectively.

The switches can be mounted on DIN rails and operated quickly by the plug-and-play principle. Due to their compact design (30 x115 x 68 mm or 46 x 115 x 68 mm), they take up little space. Information about device and network status is displayed via LEDs on the front panel. Certifications include ATEX 2 and UL 508.

Robot protection with laser scanners

SICK AG: Safety laser scanners reliably monitor the hazardous area of stationary or mobile machines and systems such as welding robots or automated guided systems. The protection of personnel is the top priority: If a person enters the area, the dangerous movement must be stopped safely. In the established systems, this means that the person is protected but production stops.

In the future, SICK will be able to use intelligent sensor technology within the context of Industry 4.0 to not only ensure the safety of personnel, but to meet ever-increasing production requirements as well. SICK already offers up to four simultaneous protective fields, resulting in a significant improvement in the ergonomics and efficiency of complex machines.

Digital protective fields used today are being replaced by flexible ones. Flexible protective fields are calculated automatically for highly dynamic movements and adjusted according to hazardous areas. Intelligent sensors make commissioning much easier and quicker. An optimal interaction between intelligent sensor technology and modern machine concepts boosts the productivity of the machine and ensures the safety of employees at all times.

EtherNet/IP-to-PROFINET gateway

Softing: PROFINET machines with integrated PROFINET controller can be connected directly to EtherNet/IP controllers with the help of the FG-260 gateway and the I-Device functionality.

The FG-260 is of particular interest to export-oriented machine manufacturers and system integrators. It has been designed with a focus on the requirements of manufacturers who export PROFINET machines with integrated PROFINET controller to EtherNet/IP markets such as the U.S.

Using the FG-260, machine builders can offer customers an easy solution for direct data exchange in EtherNet/IP systems. For system integrators looking to implement their devices with PROFINET communication functions in EtherNet/IP systems, the FG-260 provides direct connectivity without the need for an additional PROFINET controller.

Open Source Soft-Master Core

Sercos International : In cooperation with Bosch Rexroth, a Sercos III Soft-Master core will be provided as open source software.

By using a Sercos III Soft-Master, a Sercos III master device can be implemented without specific FPGAs or ASIC Sercos III hardware controller. Instead, a standard Ethernet controller is used and the Sercos III hardware functions are emulated in a host-based driver software. With this implementation approach, a sufficient real-time performance can be ensured for a large number of applications. If an Ethernet controller is used that operates with multiple queues and a telegram scheduler (for example, the INTEL i210), a synchronicity similar to that of a hardware-based master can be achieved.

Various companies have already started to implement projects using the Sercos III Soft-Master in cooperation with Bosch Rexroth AG. After a controlled testing period, the Soft-Master will be made available under an open source license for general use in the software pool of Sercos International e.V. The license model will follow the one used for the Sercos III master library CoSeMa (Common Sercos Master, which has been available as open source since April 2009 and can be used for hardware-based as well as software-based master implementations.

Device management tool

Yokogawa: FieldMate R3.01.10 is the latest version of the company's multi-lingual stand-alone device management tool for configuring, maintaining and managing field devices in industrial plants.

With a user interface designed for use on tablet PCs, FieldMate supports EDDL and FDT device integration concepts and incorporates integrated communication paths for process automation protocols including HART, FOUNDATION fieldbus, PROFIBUS, Modbus and ISA100.11a wireless, as well as for Yokogawa's proprietary protocol BRAIN.

FieldMate automatically scans the bus and reports on the devices found including their status and basic device parameters. From there the user can, in an intuitive way, navigate to the device details such as diagnostics, configuration parameters and maintenance information.

Standard features include audit trail and device database search functions. Other protocols are handled by setting up FDT projects using the appropriate communication DTMs.

Controller, I/O & software products

Yaskawa: New Controller, I/O and software products combine to improve automation performance.

The MP3300iec machine controller makes automated equipment more responsive by boosting both processing speed and memory

capacity. In addition, MP3300iec has the ability to utilize MECHATROLINK-III motion network and take advantage of the new version's improvements in cycle time and network connectivity.

MotionWorks IEC version 3 software makes automation programming faster, easier and more effective with features including support for PLCopen Part 4, a built-in cam editor, an HMI tagging tool, an enhanced logic analyzer and long list of other improvements.

The VIPA SLIO system is a remote I/O solution that makes the addition of power and signal capability quicker and easier.

IP 67 I/O modules

Beckhoff: The IO-Link box module devices offer protection class IP 67 and enable the local connection of sensors in the field via simple and cost-effective sensor cables. This provides straightforward data transfer to an IO-Link communication system. The company offers a total of 28 module variants in plastic or die-cast zinc housings that cover a wide range of application requirements.

IO-Link box modules offer an extensive IP 67 product range for making cost-effective point-to-point connections directly in the field. The basis for data transmission is the IO-Link protocol, which is a communication technology for sensors and actuators that is 'below the fieldbus level' and is standardised according to IEC 61131-9.

These modules supporting IO-Link communication provide benefits particularly when complex sensors must be connected.

Previously, Beckhoff already made it possible to integrate up to four IO-Link devices via an IO-Link master, such as with the EP6224 EtherCAT Box, the EL6624 EtherCAT Terminal, or the KL6624 Bus Terminal (both IP 20).

Zero recovery networks

Moxa: The PT-G503-PHR-PTP series of redundancy boxes (RedBoxes) are compliant with the latest IEC 62439-3 standard, making them well-suited for electrical substation automation and process automation systems that require zero recovery time to ensure the highest system availability and data integrity.

The RedBox is a PRP/HSR all-in-one device that supports Gigabit, coupling, and QuadBox for versatile and scalable zero switch-over time networks that are easy to manage and deploy. These benefits enable efficient network management and fast error detection.

I/O-Box: radio-compatible

Steute: Up to four switching devices can be connected to the new I/O-Box. Power is supplied by battery or 24V DC connector. The wireless system in particular facilitates signal transmission to and from moving parts such as grabbers, tools, etc., without the need for sensitive signal lines. This increases the availability of the overall machine or plant, and also simplifies construction.

The I/O-Box collects the signals from up to four mechanical switching devices, which can be from any manufacturer. The only prerequisite is that these devices do not need their own power supply. With the battery version, an alternative option is to connect steute inductive sensors– e.g. from our RF IS M8 – M 30 series. They have been developed especially for operation in battery-based wireless networks and require a voltage of 3.6 V. The 24V DC version of the

I/O-Box can also process signals from all commercially available 24V PNP sensors.

With this new development, the aim is to assist applications which, to date, have been using cabled switching devices on moving machine components, requiring a costly power supply which is then susceptible to wear and tear. Another potential field is for very compact machines (or machine parts) where cable ducts are inconvenient.

All-Gigabit Stratix 5400

Rockwell Automation: The new Allen-Bradley Stratix family of industrial switches offer an all-gigabit option that helps manufacturers achieve higher network speeds for their increasingly high bandwidth applications. The switch also supports both Layer 2 switching and Layer 3 routing for a range of network configurations.

When used as a Layer 2 switch, the Stratix 5400 switch is designed for industrial environments experiencing an influx of high-performance, gigabit-speed end devices such as IP video cameras and telephony. It's also fit for heavy-industry applications that require resilient network topologies. When used as a Layer 3 switch, routing is enabled between segmented networks to help achieve better performance.

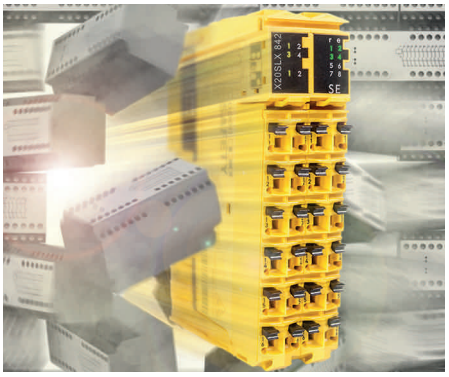
The switch uses an all-gigabit design for high-performance network and end device support. The GE Power over Ethernet (PoE) and additional GE fiber port options enhance scalability and help meet a wide range of application requirements.

Industrial 4G router for M2M

Westermo: This 4G industrial mobile broadband router provides reliable machine to machine communication in critical infrastructure systems

The MRD-455 is well suited to industrial applications where reliable machine to machine communication is vital. It has a compact design with all interfaces and LEDs at the front, DIN-rail mounting, isolated power supply and an operating voltage range spanning from 10 VDC to 60 VDC. The router offers a broad range of connectivity options, supporting many mobile standards including 4G/LTE, 3G, and GPRS. A GPS antenna port enables customers to track remote assets by location which can be helpful in order to reduce the time it takes to locate equipment in an area.

Programmable safety technology



B&R: New mixed modules provide more scalability on the low end of B&R's safety portfolio. Safety solutions on the smallest scale can now be implemented with a single X20 SafeIO module.

This programmable safety technology is based on semiconductor components that are not subject to wear like conventional electromechanical relays, which have to be replaced periodically to maintain the functionality of the safety application. Semiconductor-based safety technology is also considerably faster than relay-based solutions.

The company claims that, even in the smallest applications, integrated safety is no more expensive than a conventional relay solution.

Is sitting at an office desk bad for your brain?

In a typical working week, people spend on average 5 hours and 41 minutes per day sitting at their desk, says a study from the Work & Health Research Centre, Loughborough University, UK. The researchers found that prolonged sitting at your desk is not only bad for your health, but also for your mental well-being.

THIS DOESN'T SURPRISE ME AT ALL. Staring at grey office walls and a dull desk all day long cannot be good for your mental health.

Here are some ideas to make these 5 hours and 41 minutes at your office desk a more beautiful experience.

Flowers

Let's start with a little gardening in your cubicle. That is what Perch is designed for, the first ever magnetic wall-mounted vertical garden system. It allows the user to organize, decorate, plant and space-save.

PHOTO: MYURBIO

The Perch system features strong magnetic containers, in a variety of sizes, that attach to easy-to-install modular metal wall mounts utilizing 3M adhesive strips.

That way it allows you to grid out your urban garden customised to the available space. Perch's verticality takes advantage of the surface area of your walls while adding a design kick to your office.

Each Perch container is made from durable ABS with strong vinyl magnets that attach to any ferrous metal surface. The containers are sold individually and can also be purchased as three and five piece starter kits.

www.myurbio.com

Big screen entertainment

Beam can turn any flat surface into a big screen. What sets it apart from hundreds of other beamers on the market is that the powerful projector equipped with a smart computer sits inside a beautifully designed casing. You can screw it into any light socket (the slogan is: "Screw it in and have fun"). Alternatively you can use the included power cable to place it on any flat surface.

PHOTO: BEAM LABS INC.

Of course you can use Beam for boring Powerpoint presentations, but you can also play games, watch movies or share content from your smartphone or tablet. Beam is easy to set up and control with the accompaning Apple or Android app.

www.beamlabsinc.com

Great sound

The movies you watch on your projector are even more fun with proper sound. The Invoxia AudiOffice employs an innovative design with four wide-bandwidth speakers, and pairs with your iOS or Android device via Bluetooth.

PHOTO: INVOXIA

Thanks to the company's In Vivo Acoustic technology with sophisticated 'sound spacialization' algorithms, the sound is emitted from all directions.

This creates the sensation that the sound fills the room, not loudspeakers.

Of course, you cannot get your boss to buy you a home cinema sound bar. However, you can sell him the AudiOffice as a hands free telephone for conference calls.

Point out that the AudiOffice enables professionals to participate in conference calls with an unparalled quality of sound. It features two digital microphones and automatically eliminates echoes and background noise.

www.invoxia.com

Beautiful hardware

The Protonet Carla server brings some color to your desk and is a great conversation piece. No, you did not buy it for its great looks, but because you wanted to cut free from the hassle of cloud services and take complete control of your business data.

PHOTO: PROTONET

Carla is the personal cloud server for small to medium-sized businesses. It provides location-independent data access, anytime on any device. With up to 16GB of RAM and 12 TB of storage capacity, an Intel Xeon Quad-Core processor, and gigabit network ports, it can manage large amounts of data with maximum performance.

Carla runs on a bespoke Linux OS which already includes private clients for popular services like Dropbox. The basic setup does not require IT expertise. Carla can also virtualize your CRM, ERP, and other software, including Microsoft Small Business Server and Windows-based apps.

protonet.info

Leopold Ploner

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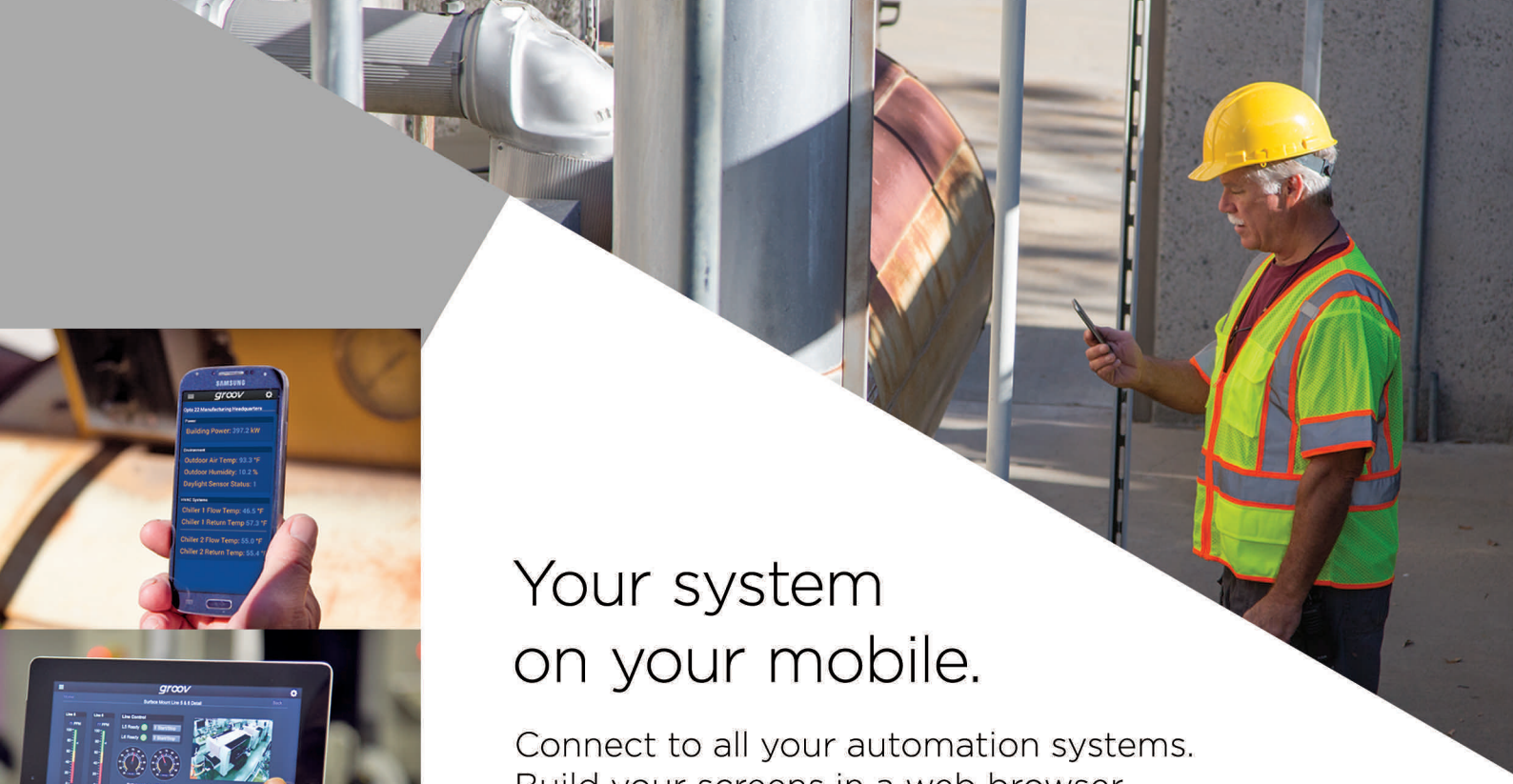

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