

# INDUSTRIAL INTERNET OF THINGS



## Protocols to Watch



ETHERNET



SENSORS



CONTROL



INTEROPERABILITY



INTELLIGENCE

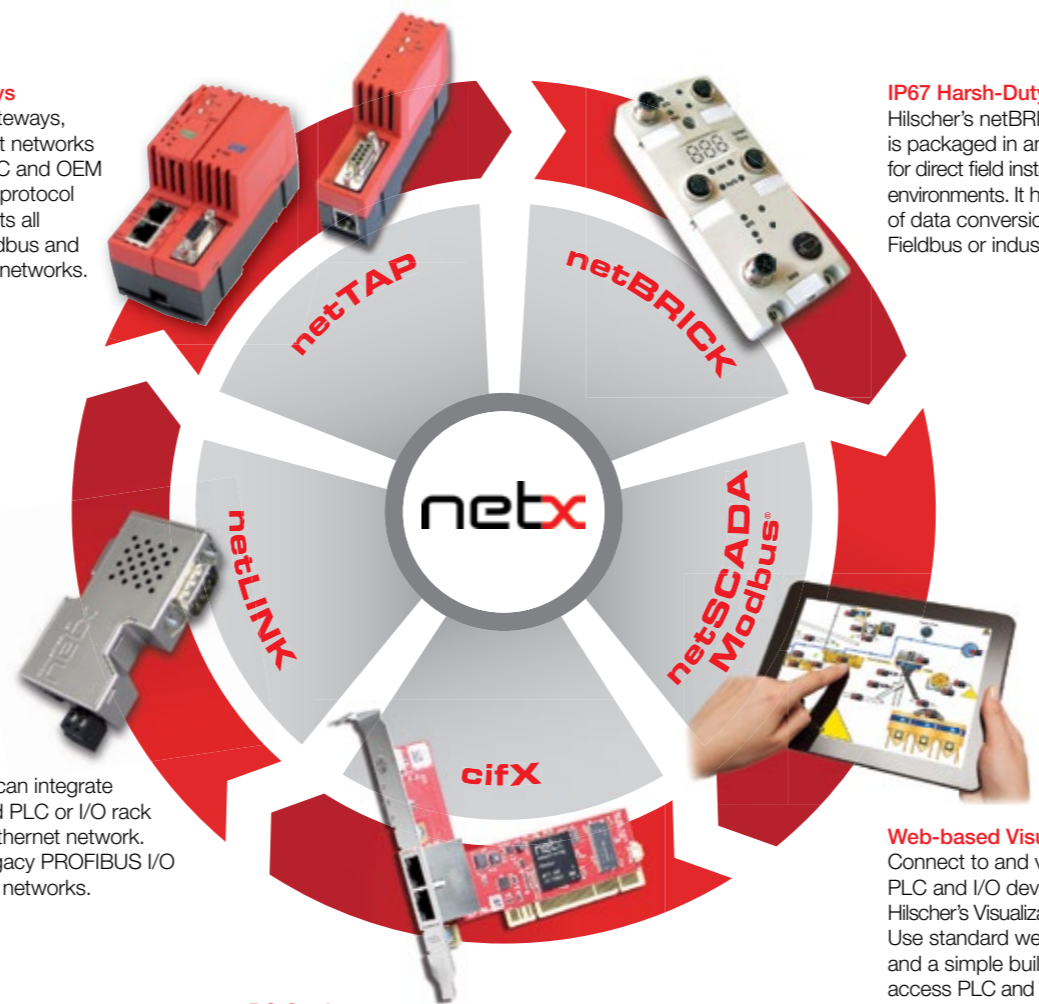


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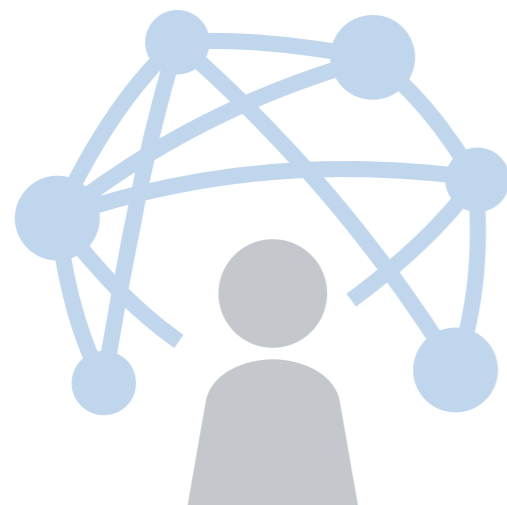
**OPTO 22**  
Automation made simple.

# Protocols to Watch

BY ARON SEMLE  
R&D lead, Kepware Technologies



A look at two open standards for connecting industry to IT and the use cases for each.



The Industrial Internet of Things (IIoT) is a true alphabet soup of technologies. OPC UA, HTTP, REST, JSON, MQTT, CoAP, DDS, AMQP, and the list goes on. Conceptually, we've discussed IIoT for a long time and understand the basic idea and technical feasibility. Now we're moving forward, identifying use cases and building prototypes. So it's time to work on that alphabet.

A big challenge in IIoT is interoperability. In a recent Nexus survey, 77 percent of respondents stated that interoperability was their biggest challenge when it comes to IIoT. Connecting industrial devices to IT and IoT platforms is big business, and it's where a lot of the abbreviations come from. There are many protocols to accomplish



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## Protocols to Watch

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There are many protocols available to connect industrial devices to IT and IoT platforms—some that are proprietary and other that are based on open standards. All are jockeying to be the one and only IoT protocol, but it's clear this will never be the case.

this—some that are proprietary and others that are based on open standards. All are jockeying to be the one and only IoT protocol, but it's clear this will never be the case. These protocols will co-exist—each with their own strengths and weaknesses—and it's our job to understand where and when to use them.

The two protocols I'll discuss in this article—HTTP and MQTT—have the potential to connect industrial devices with IoT platforms.

### HTTP (REST/JSON)

Hypertext Transfer Protocol (HTTP) is a connectionless client/server protocol ubiquitous in IT and the web. Because there are countless open source tools that use HTTP, and every coding language has HTTP libraries, it is very accessible.

The focus on HTTP in IoT is around Representational State Transfer (REST), which is a stateless model where clients can access resources on the server via requests. In most cases, a resource is a device and the data that a device contains.

HTTP provides a transport, but doesn't define the presentation of the data. As such, HTTP requests can contain HTML, JavaScript, JavaScript Object Notation (JSON), XML, and so forth. In most







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### Protocols to Watch

cases, IoT is standardizing around JSON over HTTP. JSON is similar to XML—without all the overhead and schema validation—making it more lightweight and flexible. JSON is also supported by most tools and programming languages.

Industry has some experience using HTTP for device and product configuration, but not for data access. As such, many IoT and IT platforms support consuming and providing data in HTTP form, but few industrial platforms do. This is changing as more gateways and programmable logic controllers (PLCs) begin to add native HTTP support.

Use HTTP for sending chunks of data, like one-minute temperature readings every hour. Don't use HTTP for streaming high-velocity data. HTTP can do sub-second data, but 100 ms updates over HTTP are difficult. It has a lot of overhead per message, so streaming small messages is inefficient. And always secure communications with HTTPS. The overhead is minimal.

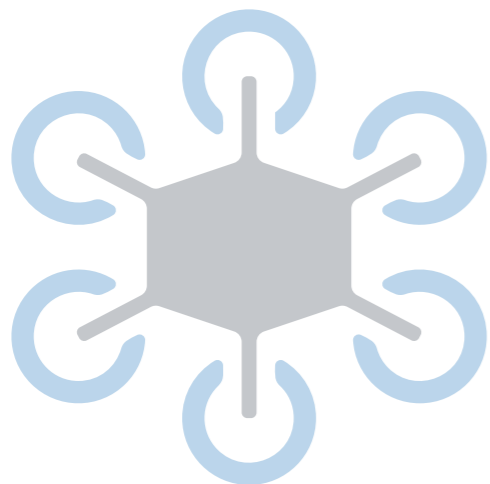
Be aware of interoperability issues with HTTP products. Just because two products support HTTP/REST/JSON doesn't mean they'll work out of the box. Often the JSON formats are different and require minimal integration to get things working.





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## Protocols to Watch



### MQTT

Message Queuing Telemetry Transport (MQTT) is a publish/subscribe protocol designed for SCADA and remote networks. It focuses on minimal overhead (2 byte header) and reliable communications. It's also very simple. Like HTTP, MQTT's payload is application-specific, and most implementations use a custom JSON or binary format.

MQTT isn't as widely used as HTTP, but it still has a large market share in IT. There are many open source clients/producers, brokers, projects and examples in every language. Many IoT platforms support HTTP and MQTT as their first two inbound protocols for data.

Use MQTT when bandwidth is at a premium and you don't know your infrastructure. Make sure you or your vendor has an MQTT broker you can publish data to—and always secure communication via Transport Layer Security (TLS).

Does the end application not support MQTT? If so, there are a lot of open source tools for getting MQTT data into databases and other formats like HTTP.

Beware of interoperability issues similar to HTTP. Just because two applications support MQTT doesn't mean they are interoperable.



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### Protocols to Watch

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It's important to pick the protocol that best fits your needs, and then select technology partners that can adapt to these protocols. This will ensure the success of your IoT applications and protect you from the protocol wars.

The topic and JSON formats may need to be adjusted to make the two products interoperable.

### Next steps

It's important to pick the protocol that best fits your needs, and then select technology partners that can adapt to these protocols. This will ensure the success of your IoT applications and protect you from the protocol wars.

If you would like to read more on this topic, please download the complete whitepaper “IIoT Protocols to Watch” at [www.kepware.com/iiot-protocols-to-watch](http://www.kepware.com/iiot-protocols-to-watch).



# ERP Data Decisioning Framework

BY STEVEN COOLIDGE  
Senior ERP product manager, Epicor Software



As more digitally controlled technologies are introduced, the number of connections drastically increases. And with the growth of data, manufacturers need new and faster ways to drive insight and actions, and easier ways to support decisions.

Holding tremendous potential to transform the industry, the Internet of Things (IoT) is definitely a trend to watch in manufacturing. However, while many manufacturers—especially those in the mid-market—recognize the IoT will impact their manufacturing operations sometime in the future, at present they aren't sure exactly to what extent or when this will occur.

This begs the question: If we define IoT as the digital connection of manufacturing resources, applications and analytics, what should manufacturers be doing right now to prepare for its eventual impact? First of all, preparation is key; one research firm estimates that IoT







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## ERP Data Decisioning Framework

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IoT-related applications will reach every corner of the business and beyond. The tremendous volume of data that will be generated, as well as insights from this data, will be more dynamic and more instant.

in manufacturing is estimated to grow from \$4.11 billion in 2015 to \$13.49 billion by 2020. This includes enabling systems for real-time insights to allow for greater quality and productivity and less waste, greater responsiveness and agility, improved customer service support, and adaptability to changing needs.

The manufacturing industry is already well prepared for this. For instance, machines on the shop floor already include sensors that provide real-time data to floor managers and the operations team on performance levels. IoT can also be seen in the supply chain through inventory systems that instantly notify suppliers when products need to be stocked.

IoT-related applications will reach every corner of the business and beyond. The tremendous volume of data that will be generated, as well as insights from this data, will be more dynamic and more instant. Everyone's expectations of technology and responsiveness will rise accordingly, setting new standards for communication and collaboration.

As part of this transformation, manufacturers are confronted with an overwhelming volume of data that operators need to convert into actionable intelligence. For this to happen, IoT data will be gathered



## CONTINUED

### ERP Data Decisioning Framework



and disseminated by a stream processing application. As such, a manufacturer's enterprise resource planning (ERP) system must have the ability to integrate with the stream processing application to allow for specific, filtered data to be passed to the system, thereby allowing the ERP platform to make better decisions. Manufacturers should move now to ensure their ERP platform is future-ready to address these coming IoT demands.

Today's next-generation ERP solutions leverage new technologies to bring information to those who need it, at the moment they need it, in a form that they can use, and in a way that they can act upon immediately, anywhere. With these capabilities, the value to business comes from increasing the reach of ERP, to every part of an organization—making it as usable on the shop floor as it is in the boardroom.

ERP, as manufacturers know, will form the core of the IoT generation of technology application. What will differ from ERP use in the past will be in how the ERP platform interacts with the new world around it. It will sit more quietly in the background and be focused on managing and monitoring the detailed transaction flows that are the lifeblood of every organization.





## CONTINUED

### ERP Data Decisioning Framework

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Today's next-generation ERP solutions leverage new technologies to bring information to those who need it, at the moment they need it, in a form that they can use, and in a way that they can act upon immediately, anywhere.

The challenge every manufacturer faces is preparing for the IoT future and putting in place the right ERP framework that can address the collaboration and responsiveness needed as new and emerging technologies shape the shop floor. This is the first and critical step to IoT readiness.

The future may not be here, but it is coming. There's no greater time than the present for savvy manufacturers to use this time to their advantage to put the right data decisioning framework in place to prepare for the IoT future.



# Challenges of Networking the Smart Oil Field

BY THOMAS NUTH  
Global vertical manager, Moxa



Adapting wellhead automation with cost-cutting technologies related to the Industrial Internet of Things can help stabilize upstream oil and gas operations in the face of drastically falling prices.



Falling global oil prices continue to have a backbreaking effect on cost-intensive upstream oil operations and the economies that are heavily dependent on oil production. As prices fall to less than half what they were in 2014, oil companies are feeling the pressure to finally implement modern cost-cutting networking technologies throughout their operations. Though the concept of the connected oil field presents new challenges with regard to security and new technology resistance, the benefits of edge computing, Ethernet and wireless gateway systems cannot be ignored.



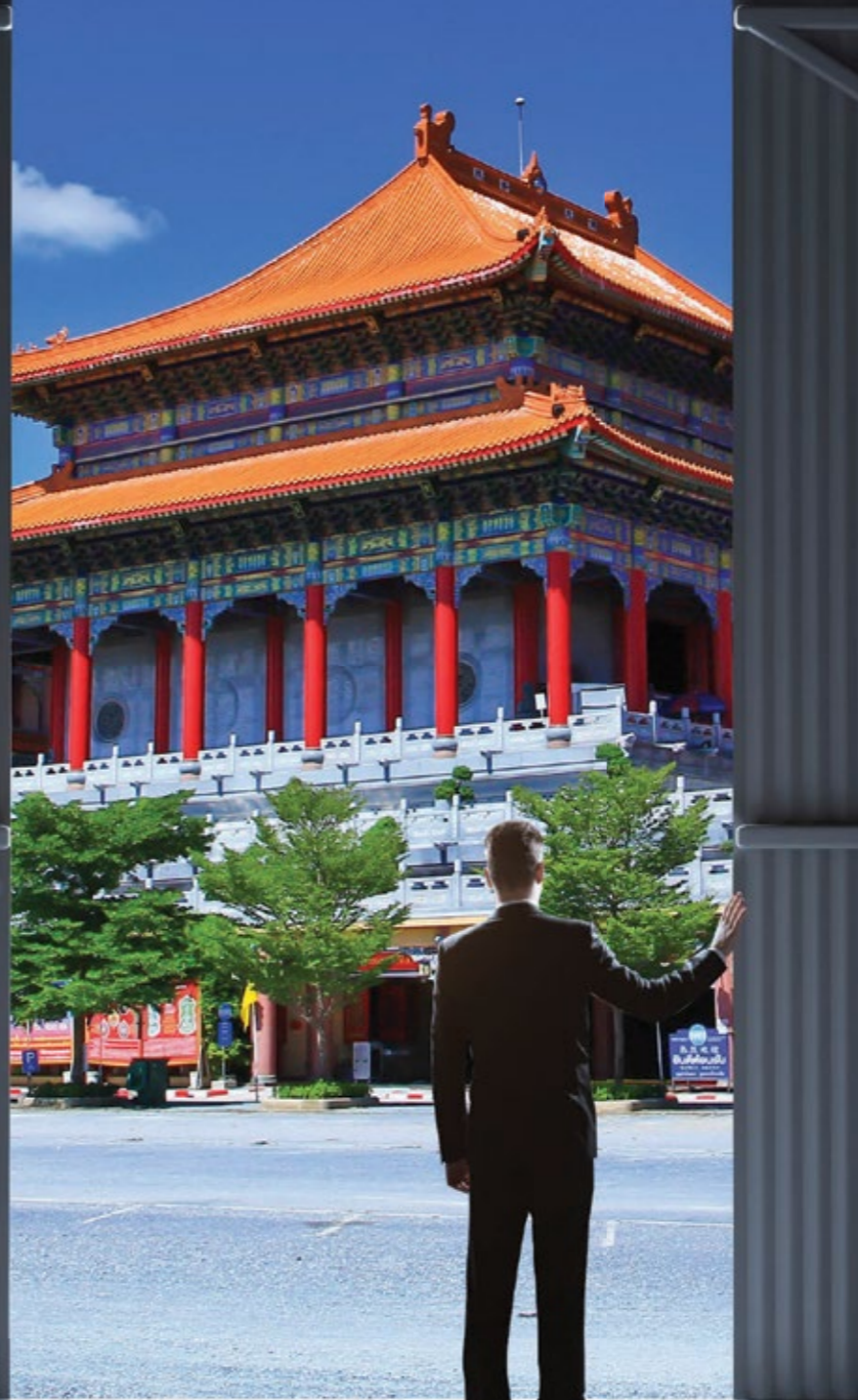
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### Challenges of Networking the Smart Oil Field

To address these issues and help move the industry forward, it's important to recognize the three main categorical drivers within smart oil field enablement: safety, legacy system modernization, and real-time analytic capability.

#### Safety

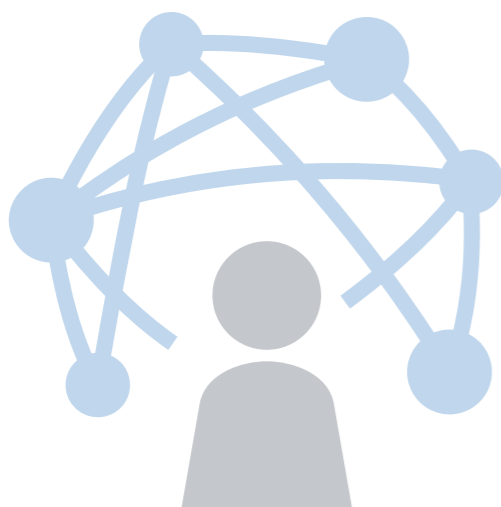
Pervasive Ethernet and wireless technology in oil field extraction raise concerns regarding reliability and cyber intrusion. Field operators understand that improving connectivity and networking capabilities between their field operation and control centers could provide large operating cost savings and leaps forward in efficiencies, but the question still remains: Is it safe and secure?

The truth of the matter is no network is 100 percent safe and secure, but with industrial routing, wireless and edge computing, a lot of oversight and redundancies can be deployed to manage assets in a manner that provides a higher degree of reliance and security than currently exists in most oil field operations today. And with plummeting oil prices forcing upstream oil to drive out as many inefficiencies in their operations as possible, the pressure is on to shift from simple serial networks to scalable, smart networking technologies.



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## Challenges of Networking the Smart Oil Field



In this shift, many oil companies are realizing the fact that industrial networking technologies, such as industrial routers and wireless gateways, don't simply offer more operational tools to drive production efficiencies; they offer increased security and safety as well. In addition, true industrial networking providers can now provide out-of-the-box functionality for easy integration into existing DCS and SCADA systems. In addition, industrial wireless and gateway technologies allow for remote access and increased control of assets in the field. This translates into recognizing more robust alarm and anomalous production data at each well in real time, thus significantly mitigating shutdown risks.

As for security concerns, industrial routing technology tethers the site-to-center operation together by providing secure firewall protection combined with scalable bandwidth for potential satellite expansion. The combination of ease-of-use and the ability to support VPN/firewall/NAT will assure that your smart oil field network is also a secure oil field network.

### Legacy system modernization

According to a 2015 industry report, 80 percent of oil and gas firms invested heavily in the operational efficiency of existing projects or reserves, highlighting the need to focus on smart networking



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### Challenges of Networking the Smart Oil Field

technology as a central means of achieving immediate return on investment in wellhead automation.

For example, the connectivity between field control and the sensor level is often ignored, severing the reliable data connection between the control room and each meter on each well, pump and attached pipeline. Because important metering information at each wellhead is often only actionable while on



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### Challenges of Networking the Smart Oil Field



site, this limits the potential for real-time analysis and control of wellhead operations via remote access. This common scenario is due to the fact that most leading automation vendors have invested heavily in advancing SCADA and sensor technologies while largely ignoring the connectivity in between.

With the new connection options available via modernized DCS infrastructures, paying a bit more attention to industrial networking investments can enable operators to connect all of their legacy devices to the control center for central management. Then, if a satellite expansion of a wellhead network is desired, wireless technology allows engineers to quickly install networked devices, thus saving time, commissioning expenditures and operations costs.

### Real-time data processing

The amount of data being generated each minute within the upstream oil industry is significant. In the traditional oil field, data is generated at the sensor level with limited modes of transport from the site of central control. The modes of data transport range from limited bandwidth pathways to onsite pen and paper reporting. Likewise, offshore networks rely heavily on satellite communication to pull operational data for analysis, which can take days to extract, aggregate and process. In short, the smart oilfield concept of





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### Challenges of Networking the Smart Oil Field

connecting these disparate sources of data to a central control area is not overly ambitious and uses modes of connectivity that are already developed, tried and tested.

The resistance to adopting Ethernet and wireless gateway technology is crumbling to logic and the realization that much of the oil and gas industry can no longer afford not to accept and invest in the benefits that smart networking technology provides to oilfield optimization and security.

Keep in mind, however, that real-time data processing can only be supported by a capable industrial network. Moxa, and other companies within our space, are enabling the smart oil field revelation by connecting the application layer with the pervasive sensing nodes dispersed throughout the modern oil field.

### Smart oil field investment

Industry leaders within upstream oil, both big and small in scope, are realizing the benefits of a smart oil field and investments in Industrial Internet of Things (IIoT) technologies in the field. For example, Shell Oil reports that as much as \$5 billion in value has been achieved by implementing smart oil field technologies in 50 assets between 2002 and 2009. As of 2010, Chevron estimates that the benefits



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## Challenges of Networking the Smart Oil Field



brought about by its own smart oil field initiative, iField technologies, resulted in an operational cost savings of 2-8 percent. According to Oxford Economics, the adoption of IIoT technology by the oil and gas industry has the potential to increase global GDP by up to 0.8 percent—\$816 billion—by 2025.

Today, amid another low in oil prices and further advancements in Ethernet and wireless gateway technology, companies like Moxa are further enabling the capabilities of upstream oil to convert existing serial networks, such as Modbus TCP, to Profinet, 3G, 4G, Wi-Fi and Ethernet. Expanding an oil well network to capitalize on peripheral resources is now less expensive and quicker to implement than ever before due to tested and resilient industrial wireless technologies. As such, the smart oil field is becoming the definition of operational success and, in many cases, leading oil and gas companies and holding firms alike cannot afford not to invest in the transition toward a connected, smart oil field.



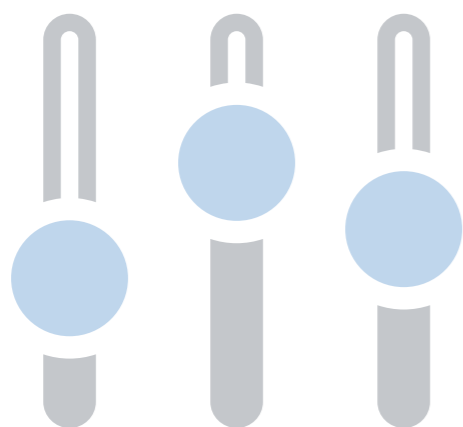
# Smart Operators on the Go

BY ALICIA BOWERS

Product marketing manager,  
intelligent monitoring and control, GE Digital



How mobility, analytics and geo-awareness are being used to optimize industrial operations.



Traditionally, companies have made disparate data actionable by reacting to it on screens. An operator sees a list of alarms on the control room screens, identifies a critical alarm and reacts to it. In most cases, the control room is reactionary rather than predictive, which results in higher downtime and inefficiencies.

With mobile technologies and innovative software apps leveraging the Industrial Internet of Things (IIoT), companies can drive real-time operational intelligence—taking the data from underlying plant systems and pushing it to operators, engineers and managers in an intelligent way. Operators no longer have to be watching screens



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### Smart Operators on the Go

while sitting in a control room. The right operator can receive the right information at the right time and place.

It sounds idealistic, yet it is happening now with today's mobile devices and industrial software. The same way mobile devices and real-time information have changed our personal lives, mobile devices and operational intelligence are changing our industrial world.

#### The right information

Mobility, however, doesn't mean replicating your control room on a mobile device. Technology allows us to be much smarter about how we filter and serve information.

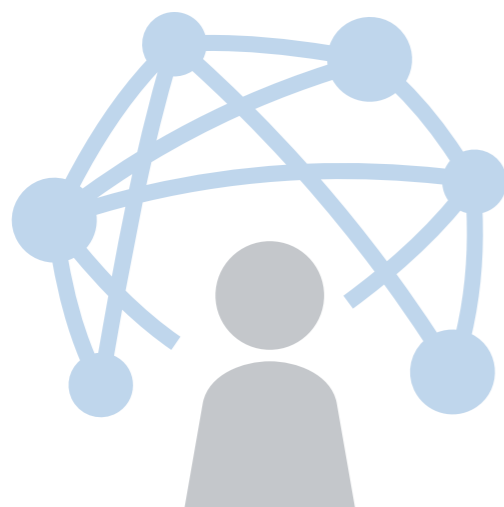
Now, you can drive the data to the device that makes the most sense and identify the particular data that would mean the most to the mobile user. In some cases, that could be all of the display tags in the SCADA system. In most cases, the ideal would be to deliver the key performance indicators (KPIs) that make sense for an asset, such as voltage or temperature.

By selecting the right data, users can access information in a mobile fashion to make better sense of it instead of sifting through hundreds of different pieces of raw data about a particular pump or machine.



## CONTINUED

## Smart Operators on the Go



Companies can also use technology to funnel the data into KPIs and trends. The information is easier to access and understand. This is the key difference between simply mobilizing automation systems vs. driving toward operational intelligence. The value is not just mobility—it is taking the mass of raw data, turning it into better information and making it available as a KPI on a mobile device.



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## Smart Operators on the Go

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With mobile technologies and innovative software apps leveraging the Industrial Internet of Things, companies can drive real-time operational intelligence.

## Geo-intelligence

Businesses can also now leverage the availability of geographical information to improve operations. Mobile devices have inherently built-in geo-awareness, which adds tremendous value not just in dispersed applications such as water/wastewater or power, but also for a small manufacturing facility. Whether the signal is coming from GPS or Wi-Fi, or being triangulated through cellphone networks, you can deliver the appropriate information to the user's location.

Today's geo-intelligence technology can take all of the underlying systems' data and assign it to particular assets, put it in context, and then apply a geo-location to that asset. This means that now, when operators approach a piece of equipment, they don't have to navigate through all of the plant's assets to identify that particular equipment.

Because it is geo-aware, the mobile device knows that the equipment it is next to is, for example, Pump 2 in the South River Pump Station. With this knowledge, the device can automatically display the appropriate screen, highlighting data such as KPIs. In addition, the device knows which other assets are close to the operator, according to an adjustable radius or field of view, and can, for example, display all of the pumps located within, say, 3 miles.



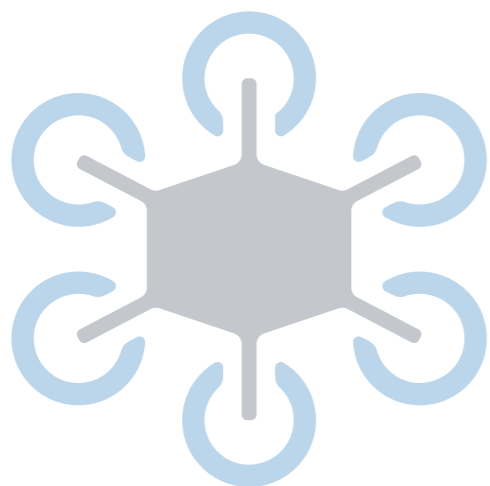
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### Smart Operators on the Go

In a manufacturing environment, geo signals are even more accurate using Wi-Fi than they are using GPS and cell technology. Operators can be in a noisy factory and use the geo-intelligence and navigation to have the right information at their fingertips based on their specific location.

Beyond automatic screen displays and easing asset navigation, the benefits of geo-intelligence multiply when applied to alarms and analytics.

Simply put, the technology available to industry today makes it possible to evolve industry from one of centralized control and masses of raw data held in disparate systems to one characterized by smart operators on the go, optimizing operations and improving efficiency as they go about their day-to-day duties.





# Reflecting on the Past to Advance the Industrial Internet of Things

BY COLIN GEIS

Product marketing manager, Red Lion Controls



Whenever we can take a moment to reflect, it is possible to find patterns that can help clarify future projections. One such pattern can be seen in the preservation of infrastructure value associated with the four previous industrial revolutions.

Historically, the idea of extending the lifespan of equipment in industrial applications is not a new or marvel concept. As in the past, leveraging existing equipment not only saves money, but can also strengthen a company's foundation.

Industry, as it is currently understood, began with the first industrial revolution (~1780-1840), which involved the migration from piecemeal production by hand to machine-assisted production. This change was pushed by readily available energy from water and steam to power factory machines and tools.



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## Reflecting on the Past to Advance the Industrial Internet of Things

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Extending the lifespan of industrial equipment is not a new or marvel concept. Leveraging existing equipment not only saves money, but can also strengthen a company's foundation.

These initial advancements were followed by the second industrial revolution (~1870-1914), which introduced newer technology and electric power sources to factories. By providing round-the-clock light, electricity enabled more continuous manufacturing, allowing workers to produce goods during the day and night. Much of the equipment from the first industrial revolution, however, was still functional and in operation. Rather than replace working machinery, it was simply retrofitted with electric engines in place of steam-driven versions. This required only nominal investments to extend equipment lifespan while still benefiting from the increased capabilities of consistently available grid power.

The third industrial revolution (~1947-2010), more popularly referred to as the Digital Revolution, traces its roots to the invention of the transistor. The transistor enabled the development of computers that spread to factory floors in the form of automation equipment to support manufacturing goals of waste reduction and production enhancement. While the automation of factory equipment increased production efficiency, it also required the purchase and implementation of vast amounts of new tools and machinery. These additions enabled factories to once again take production to the next level by further increasing output and reducing loss. Production began occurring in manufacturing cells with local control and monitoring.





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## Reflecting on the Past to Advance the Industrial Internet of Things

Maximizing efficiency of a single step within production required workers to supervise certain aspects of machine operation, such as watching over machine resources and monitoring equipment status. The current or fourth industrial revolution—the Industrial Internet of Things (IIoT)—is once again focused on refining processes to reduce waste and downtime by connecting all aspects of the supply chain to enable data communication between deployed equipment and processes. Where the Digital Revolution enabled the automation of production, the fourth revolution focuses on coalescing and connecting the vast amounts of data currently spread throughout organizations. Extracting data from existing equipment provides operational intelligence and visibility to increase production efficiency and reduce the time-to-market for produced goods.

The integration of production information can present complicated scenarios for existing facilities designed to optimize individualized processes. Some obstacles can be easily overcome through the use of media converters that provide the ability to change between cable media types (e.g., Ethernet to fiber optic or RS-232 serial to Ethernet) to physically connect equipment. A more difficult situation arises when it is not just a physical connection barring communication, but a logical one. For instance, factory equipment designed to perform a particular task uses protocols defined around unique parameters and





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## Reflecting on the Past to Advance the Industrial Internet of Things

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Where the Digital Revolution enabled the automation of production, the fourth revolution—the Industrial Internet of Things (IIoT)—focuses on coalescing and connecting the vast amounts of data currently spread throughout organizations.

are therefore not shared by other machines or machine components. Communication between disparate protocols (e.g., Siemens S7 TCP/IP to Allen-Bradley DF1 serial) requires the use of IIoT-ready protocol convertors like Red Lion's Data Station Plus, which is designed to allow the interchange of data despite differences in source programming.

When equipment from disparate manufacturers is connected, organizations can more easily access operational data to improve process visibility and therefore, drive productivity and operational efficiencies through real-time communication and data processing.

In this fourth revolution, forward-thinking manufacturers can once again take advantage of existing equipment investments by retrofitting current machinery with industrial automation and networking devices that support new capabilities to drive IIoT advancements. As a result, the benefits that began with continuous power and production—and then switched to increased efficiency—will next drive truly smarter production enabled by data interchange and analysis.

As we've seen with past trends, advances that extend the lifespan of existing equipment stand to realize greater returns and success.



# 2016: The Year of the IIoT Solution?

BY PHIL MARSHALL  
CEO, Hilscher North America

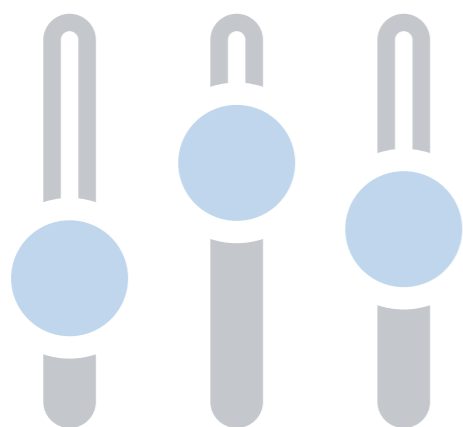


After two years of hype and the promise of gazillions of dollars in realized benefits, is this the year in which we're going to see real automation applications? Will terms such as "Big Data" and "cloud analytics" finally make it into our mainstream vocabularies?

Is 2016 finally going to be the year of the Industrial Internet of Things (IIoT)? I certainly hope so!

Unfortunately, the IIoT landscape remains foggy despite the many hardware products—particularly gateways—announced in 2015. There is still no discernible market pull for IIoT as yet, but that may be an issue that we automation vendors must help end users face.

As I see it, the reason for the lack of market pull around IIoT is twofold: First, the value proposition is unproven and without a clear return on investment (ROI); few, if any, CFOs are going to sign off on the



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## 2016: The Year of the IIoT Solution?

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As I see it, the reason for the lack of market pull around the Industrial Internet of Things is twofold: First, the value proposition is unproven and without a clear ROI; few, if any, CFOs are going to sign off on the investment. Second, a killer app for IIoT has not yet emerged.

investment. Second, a killer app for IIoT has not yet emerged. Yes, we've seen predictive maintenance and similar functions touted as having the most potential. But automation users have been deploying these for a decade or more and rightly ask, "What is the difference?"

The answer to this key question is Big Data—its potential to handle the volume, velocity and variety of data collected from plant floors is needed to access the fresh insights promised by IIoT. And though Big Data is a very new and, as yet, widely untested technology in industry, we must not be afraid to look for new ways of working.

At the same time, we must be careful to not repeat the same things we are already doing. Algorithmic solutions to automation issues, like preventive maintenance, currently rely on human interpretation. As a result, we all tend to look for what we know. With IIoT, we should be trying to benefit from what we do not presently know. A recent Forbes article identified this "relevance paradox" as a key issue for IIoT users.

One of the conclusions of the Forbes article is that artificial intelligence (AI) will play a crucial role in IIoT. If AI scares you, don't be worried because, in the background, huge steps have been made with this technology in recent years—many of which you are already familiar





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## CONTINUED

## 2016: The Year of the IIoT Solution?

with. Google is perhaps the prime example; music apps are another. IBM's Watson is making great strides in areas such as health. All this technology and more will find its way into automation, one way or another. Given this reality, I suspect that AI may well enter into our IIoT vocabulary during 2016 too.

Looking out further, I believe that these technologies are just the tip of the iceberg. In my last article for this supplement ("A Disruptive Inflection Point," November 2015, <http://awgo.to/616>), I hinted at how the automation hierarchy will change from a vertical architecture into a much more horizontal one, where mesh networks are prevalent. I think that kind of strategic jump may well be the ultimate way for IIoT to impact automation.

In other words, we may already be at an inflection point where distributed intelligence becomes a reality and novel interactions between machines and systems in cyberspace will bring completely new ways of working on the plant floor.

Many IT-centric suppliers are already pushing forward to help. Control system vendors are also seeking ways to handle the mass of data. Have they got perfect answers yet? No one is quite sure, but at least there is a growing range of options for testing the opportunities.



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## 2016: The Year of the IIoT Solution?

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We may already be at an inflection point where distributed intelligence becomes a reality and novel interactions between machines and systems in cyberspace will bring completely new ways of working on the plant floor.

My company recently responded by launching a family of IIoT solutions called netIOT. As an infrastructure company, and one that made its name as a connectivity solutions provider, Hilscher had a duty to do this. Embedded modules and edge gateways are included as hardware in netIOT, but we are not an IT cloud service provider. So, to help users test those opportunities, we have added a suite of services for common functions such as mobile diagnostics and data analytics.

More importantly, we have also chosen to form relationships with cloud service providers. Our edge gateways already integrate with IBM's Blue Mix offering, and we are pursuing similar arrangements with other IT-centric suppliers to ensure choice for end users.

Our aim is to make it easy for end users to work with the best IIoT technology that's out there. We know that whoever gets into this market early has an opportunity to become a disrupter. It's a massive opportunity, and one you shouldn't miss.



# Getting Started with the Internet of Things

BY MATT NEWTON

Director of technical marketing, Opto 22



If you're excited about the possibilities of the Internet of Things—or if you just want to be prepared for the future—here are some ideas to get you started.

Let's start with the basics: The Industrial Internet of Things (IIoT) intends to connect industrial and manufacturing devices and systems together so we can share valuable data in real time, improve processes, tune systems autonomously, predict system failures before they occur, decrease downtime, reduce costs and, ultimately, increase profit.

With new technologies rising and the cost of technology dropping as quickly as it has over the past several decades, you now have the ability to connect almost anything to a network. You can install low-level sensors and actuators, collect data from those devices, convert



## CONTINUED

## Getting Started with the Internet of Things

it into a routable protocol, send it across the Internet, and push it into a Big Data analytics system—all in near real time.

By doing this, you can gain visibility into your process control systems from across the globe. And that visibility is with you all the time, on your mobile device, no matter where you are.

Considering the extent of IIoT and its related technologies, a good place to start down the IIoT path is to learn about the technologies involved with the IIoT. If you're coming from the industrial automation side of the OT/IT convergence, it's a good idea to bone up on your basic networking skills. For example:

- Learn how Ethernet switches and routers move data across the Internet.
- Know what an IP address is and understand the potential need for IPv6.
- Get an overview of various web technologies and programming languages.

You certainly don't have to be a networking expert, but a general familiarity with these technologies will only make your life easier as the OT/IT convergence picks up momentum. Knowledge of networking will





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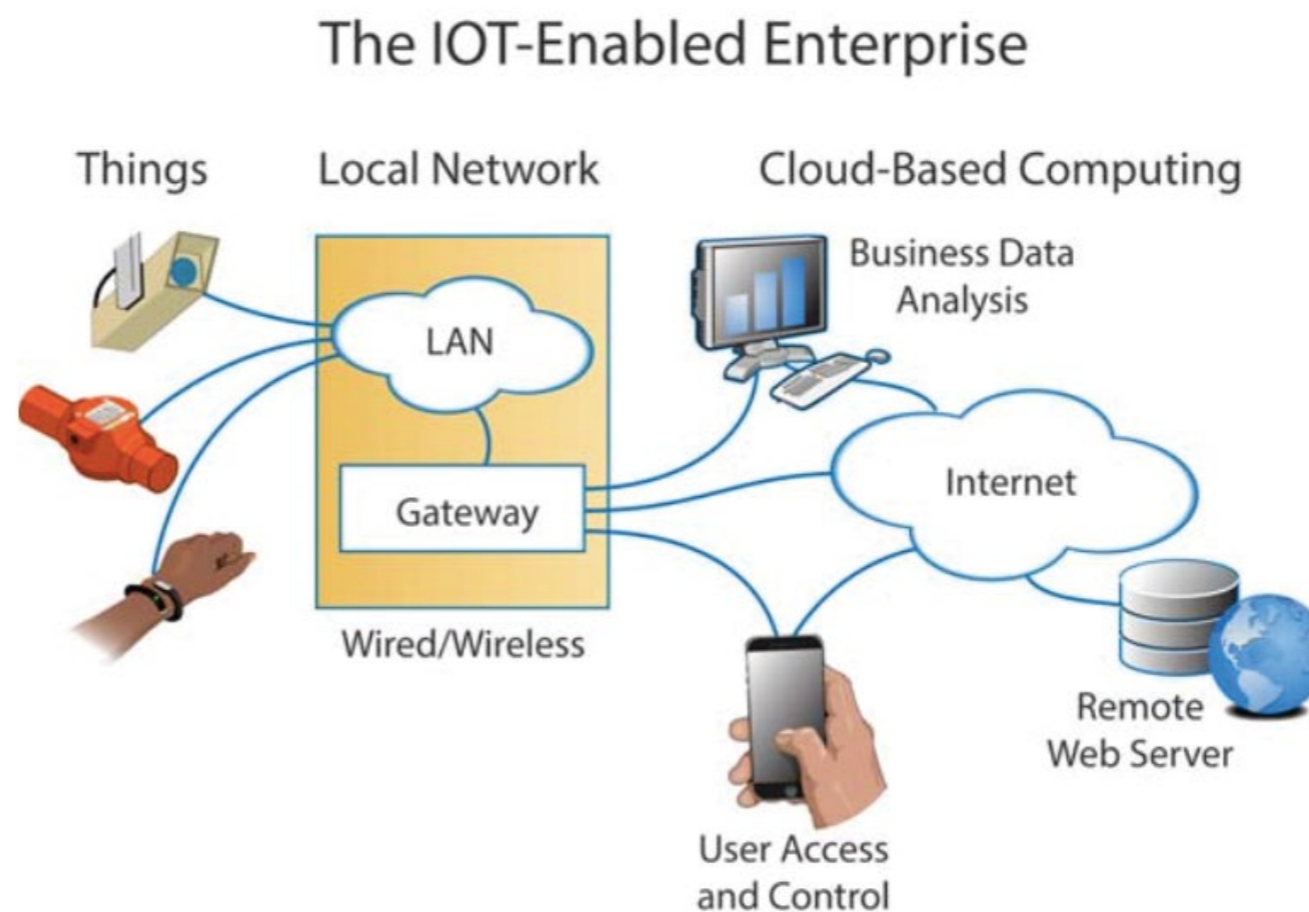


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## Getting Started with the Internet of Things

be on the important new skills that will be required in your organization as IIoT gathers steam. Other key skills include understanding programming languages, architectures and network security.

Because each IIoT application is different—depending on a number of factors—this means that there is no one-size-fits-all solution for developing your IIoT project. However, one of the principal objectives



## CONTINUED

## Getting Started with the Internet of Things

of the IIoT is to increase efficiencies, and that's a good place to start. With that in mind, following is a general three-step strategy you can apply for developing your first IIoT project.

- 1. Identify potential.** Walk around your facility, talk to your operators, and identify laborious manual processes such as pen-and-paper data collection and Excel spreadsheet data entry tasks. Also identify potentially useful data that is currently siloed and unavailable to other systems and business decision-makers. Good examples might be environmental data, production data, or data related to your batch process.
- 2. Collect data.** Look for opportunities to collect data at an asset or "thing" level. For example, is there a sensor you could install to more closely monitor and log your process? The cost of sensors has come down substantially, allowing increased visibility into all aspects of automation. Instrumenting equipment is the first step to getting enhanced levels of information from the plant, remotely monitoring assets, and analyzing production and reliability.
- 3. Centralize and analyze.** Identify a way to aggregate the data into a central repository. This might require some type of IoT gateway or protocol converter as well as a database to house the information.





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## CONTINUED

### Getting Started with the Internet of Things

Once you've centralized the data, you can analyze opportunities to optimize processes. For example, develop a report to cross-analyze your newly found sensor data with production output. Do certain variables in the process relate to a higher or lower yield?

It's easy to be overwhelmed by the potential costs and complexity associated with IIoT applications. To avoid this, remain focused on whether a project will benefit the enterprise by reducing cost or improving quality in order to clearly demonstrate a measurable return on investment.

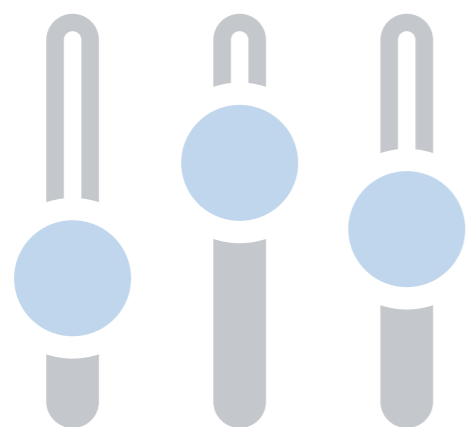
For example, you could connect a power-monitoring device to your plant's main power feed and start monitoring power usage. Once you've started collecting power monitoring data, over time you'll be able to determine exactly what it costs in real time to turn on a motor, run a process, or have the building air conditioning set to 78 degrees.

Or perhaps you want a daily report emailed to you showing production count, raw material inventory, and average production time. All of this data can be captured through IIoT technology and brought right to your mobile device.



## CONTINUED

### Getting Started with the Internet of Things



Another easy project to implement could help you save water. If you're in charge of the irrigation system at your facility, you could set up a simple intelligent system that checks the weather forecast on a website before turning on the sprinklers. The cost savings in reduced water usage (not to mention the impact on the environment in a dry area) are a great way to justify the cost of your first IIoT project.

Just remember—the IIoT doesn't have to be complicated. And technologies to accomplish all of these applications are available today, off the shelf.

For more than 40 years, we've brought commercial, off-the-shelf technologies to industrial systems all over the world. We pioneered the use of PCs in controls back in the 1980s, Ethernet networking at the I/O level in the 1990s, and machine-to-machine connectivity in the 2000s. Today, we bring systems information to your mobile device with groov, an easy-to-use IIoT tool for developing and viewing mobile operator interfaces to securely monitor and control virtually any automation system, equipment or device.



# The Continuing, Critical Role of Industrial Ethernet

BY MICHAEL BOWNE

Director of technology marketing, PI North America



Because the Industrial Internet of Things (IIoT) leverages so many existing technologies, it seems that everybody and their mother can claim to have the necessary expertise. But let's not forget that IIoT roots are firmly planted within industrial Ethernet.



The industrial move from analog signals to digital fieldbuses was nothing short of a paradigm shift. Instead of running 25 individual wires, with digital fieldbuses, users could run a single cable and truly create a network. Instead of a single scalar value in the range of 4–20 mA, users could now have an actual value—plus units and status information.

If the move from analog to digital fieldbus was a paradigm shift, the move from fieldbus to industrial Ethernet presented an opportunity shift by enabling functions that were not previously possible.



# Easier Wireless Data Acquisition

In a smarter and more connected world, the data from your sensors and equipment is collected and analyzed in real-time to automate your operations and make them smarter. However, it can be difficult and expensive, especially when dealing with remote locations or harsh environmental and operating conditions. Fortunately, new communications solutions like Moxa's ioLogik 2500 Series are addressing these challenges by bringing open wireless communication standards to data acquisition technology in a single, rugged unit. With options for wired Ethernet, Wi-Fi, 2G GPRS, and 3G HSPA connectivity, it's easier than ever to get more connected. Find out more at [www.moxa.com](http://www.moxa.com).

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## The Continuing, Critical Role of Industrial Ethernet

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If the move from analog to digital fieldbus was a paradigm shift, the move from fieldbus to industrial Ethernet presented an opportunity shift by enabling new functions.

Like digital fieldbus, industrial Ethernet is about creating an automation network; the difference is that industrial Ethernet expands the network beyond the realm of control engineers. To better understand this difference, consider safety applications. In the past, a separate, dedicated safety system of contactors and relays was required in addition to the existing automation network. Today, all those contactors can be connected to industrial Ethernet, thereby eliminating the extra wiring. Users can also replace many relays with a safety logic controller. And the differences don't stop there.

Because Ethernet is a commercial technology, industrial Ethernet is an infrastructure that can be used by other devices, thereby making the transmission of large data volumes feasible. Of the industrial Ethernet options on the market, Profinet is currently the only standard that supports the complete real-time spectrum—from hard real-time requirements in high-performance machines (with the necessary openness for IP communication) to the transmission of large data quantities in real time within automation systems and higher-level IT systems.

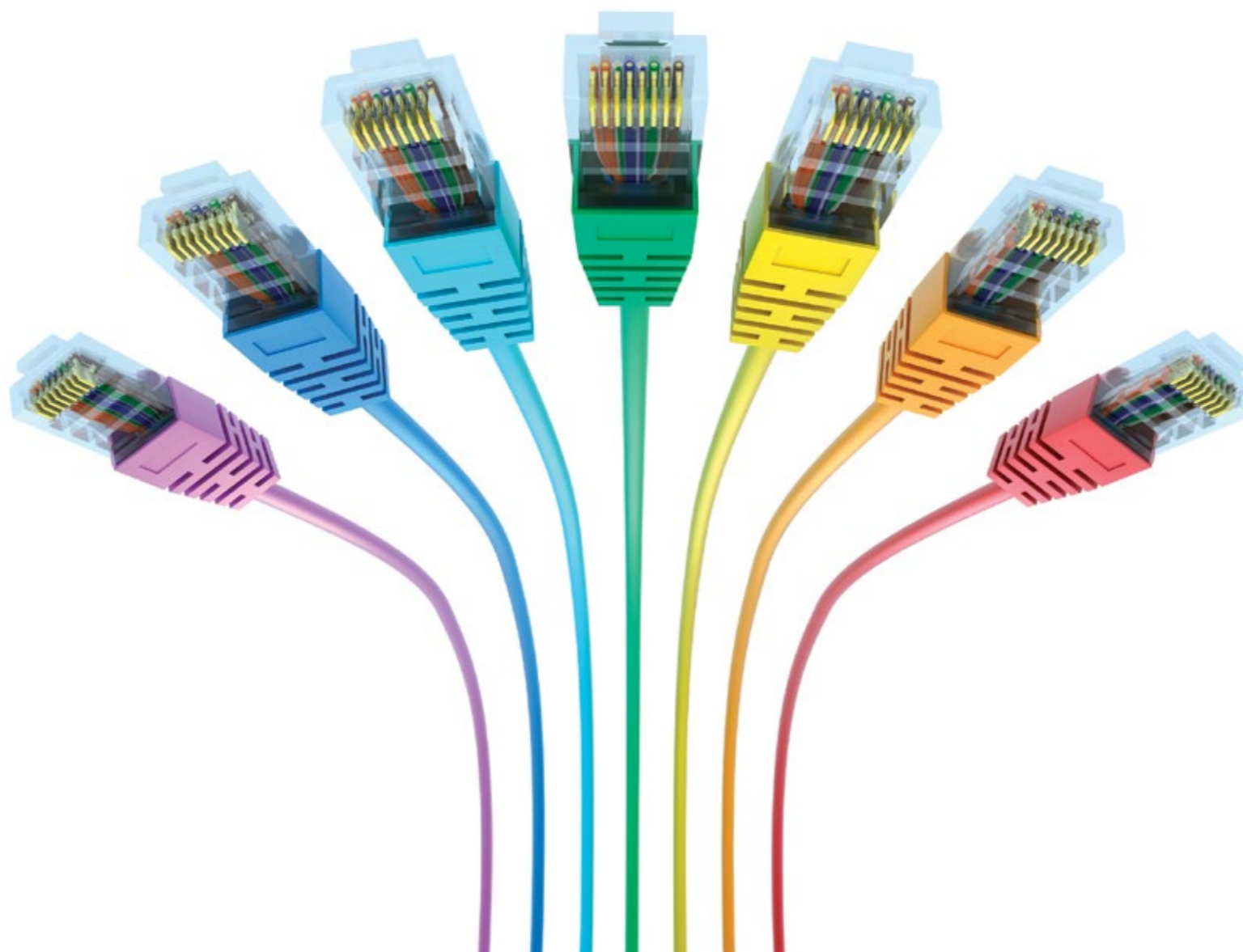
Proof of industrial Ethernet's capabilities in industry can be seen in hybrid industry applications. Here, adoption of industrial Ethernet is being driven by the introduction of ever more powerful programmable



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## The Continuing, Critical Role of Industrial Ethernet

logic controllers (PLCs), which can replace distributed control systems (DCSs) in some instances. Coupled with the fact that not all of these installations require intrinsic safety (which can be provided by Profibus PA), Ethernet is rapidly growing in popularity as a network backbone.



## CONTINUED

### The Continuing, Critical Role of Industrial Ethernet

These hybrid industry installations often lend themselves to the development of “islands of automation,” with each machine performing a specific task. Profinet performs well here, particularly because of the high demand for determinism. In addition, Profinet can be used to link these islands of automation for horizontal integration and provide the data for vertical integration into the enterprise.

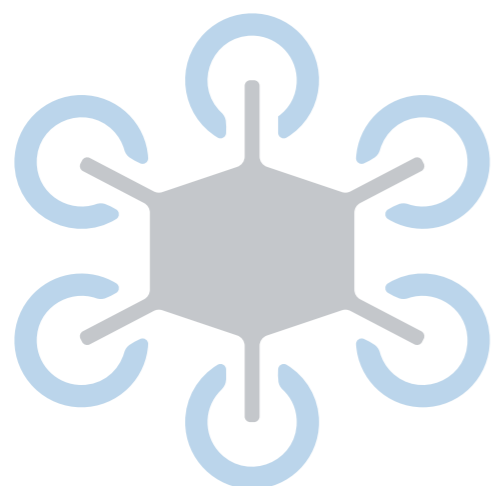
Even in strict continuous process applications where intrinsic safety is required, Ethernet is making inroads. These systems are typically complex in structure, consisting of different subsystems with numerous devices and differing topologies, manufacturers and technologies. Plant owners and operators urgently want this complexity to be harmonized and the data and information systems to be fully integrated and easier to handle. Using an Ethernet-based protocol solves many of these problems by allowing rich metadata to be transferred seamlessly.

In the case of hazardous areas in the continuous processing industries, an example of the industrial Ethernet inroads being made here can be seen in the handling of this data via standardized proxies from Profibus PA to Profinet. Many expect that, in the near future,



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### The Continuing, Critical Role of Industrial Ethernet



an intrinsically safe two-wire Ethernet physical layer will become available, thereby removing the need for such proxies. At that point, data transparency will be maximized.

As we've stated before: "If Industrial Internet is the 'what,' then industrial Ethernet is the 'how.'" That statement still rings true today. By betting on Ethernet-based protocols, we can ensure connectivity—even if we don't know exactly what the future may hold.





# Intelligent Machine Monitoring Connections

BY JOHN WOZNIAK

Senior network specialist, CC-Link Partner Association



A look at how CC-Link IE's Seamless Message Protocol simplifies integration of Schaeffler's FAG SmartCheck for potential use within Industrial Internet of Things applications.



Schaeffler Technologies AG & Co. has extended its intelligent machine monitoring capabilities with its FAG SmartCheck monitoring system, offered by Schaeffler Technologies' FAG Industrial Services group. The monitoring system detects early signs of potential damage to rotating machines and instantly alerts the operators and/or control system so that appropriate action can be taken.

The system can also measure a number of parameters, such as temperature and vibration. If these go out of predefined tolerance limits, a signal is sent to the control system. The signal is transmitted via the CC-Link Partner Association's (CLPA) Seamless Message Protocol (SLMP), a feature of the CC-Link IE open Ethernet-based



## CONTINUED

### Intelligent Machine Monitoring Connections

network that allows users to integrate field devices with gigabit CC-Link IE network systems.

SLMP can be used with any Ethernet-compatible device including barcode readers, RFID scanners, sensors, weigh scales, etc., and communicates over a standard TCP/IP Ethernet physical layer network.

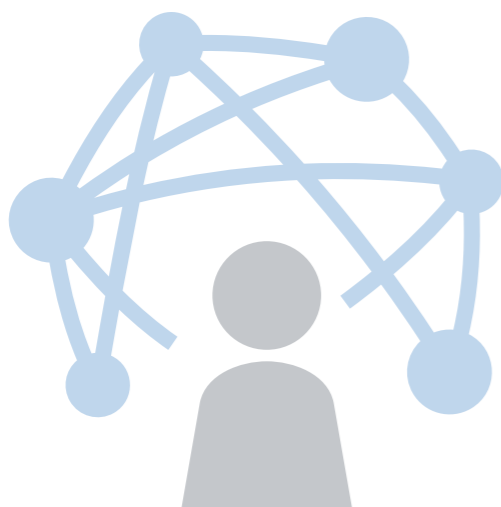
The key benefit of SLMP is that it provides a way for virtually any TCP/IP Ethernet-based device to connect to a CC-Link IE network without the need for hardware development. When we say virtually any TCP/IP Ethernet device can be connected to a CC-Link IE network, this includes everything from HMIs, PLCs and drives to printers, timers and sensors. Plus, since CC-Link IE and SLMP are open technologies, the technical specifications of both are freely available to companies who join the CLPA. Basic membership is free of charge.

SLMP is a simple client/server protocol and can therefore be implemented into firmware for 100 Mb devices. The devices can then connect to the CC-Link IE network via an Ethernet adapter. This opens up CC-Link IE to the full range of device manufacturers, regardless of whether or not their devices support its gigabit performance.



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## Intelligent Machine Monitoring Connections



CC-Link IE Field (CC-Link's industrial Ethernet) can be used as part of an Industrial Internet of Things (IIoT) infrastructure with the FAG SmartCheck monitoring system because of CC-Link IE Field's large data bandwidth and seamless messaging capabilities from the sensor/bit device level to information management data collection systems.

Schaeffler Technologies has stated that integrating CC-Link technology into its products has been key in developing its condition monitoring solutions for use in a fully integrated process and automation world. As a long-standing member of CLPA, Schaeffler quickly realized the potential of SLMP. Its FAG SmartCheck is one of the first products in the world to be developed using it, which can now be used within industry for applications ranging from process optimization and lifecycle cost reduction to improving total cost of ownership benefits.

"The potential [for CC-Link IE SLMP] is enormous," says Robert Miller, director of the CLPA in the Americas. "Now any product with Ethernet TCP/IP connectivity can be integrated into the 1 Gbps token CC-Link IE Field network. Device manufacturers can make their whole product range compatible with CC-Link IE at a stroke, while systems integrators and end users can add any device they like to their networks."



# Top 10 Benefits of Internet of Things-Enabled Mechatronics

BY MARK HUEBNER

Market development manager, PBC Linear



**With the rise of mechatronics, a new model has emerged that simplifies the machine design and build process while easily enabling Internet integration with the use of smart robot modules.**



From the smartphones we all carry to keep us connected to the smart house that can be programmed for tighter security and maximized electrical efficiency, Internet-connected technology has become intertwined with almost every aspect of our daily lives. These same kinds of advances in connectivity, control and automation are also found throughout industrial applications, and now are making their way into motion applications. The results of this type of Internet-enabled machine provide a new level of flexibility, performance and cost advantages.

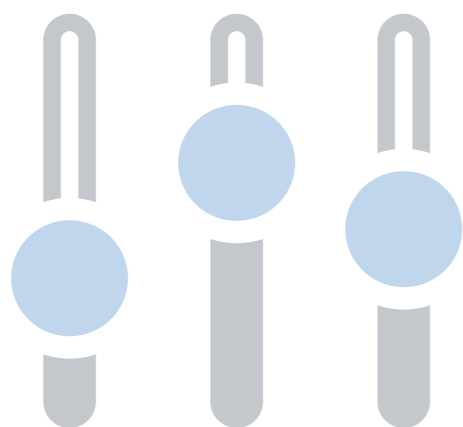
The old way of addressing machine integration and motion control focused on basic engineering disciplines—mechanical and electrical—





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## Top 10 Benefits of Internet of Things-Enabled Mechatronics



with each dedicated engineering group working independently. Mechanical engineering would work on the physical motion created, such as the bearings, rails, drive mechanisms and how to connect to a motor. Electrical engineering would select the sensors and connect the I/O, driver, PLC, controller, amplifier and power supply. Selection of the motor would, most often, be left to the electricians because it had to be connected to power and controlled.

With the rise of mechatronics, a new model has emerged that simplifies the machine design and build process while easily enabling Internet integration with the use of smart robot modules. This marriage of mechanical and electrical disciplines, leveraging optimized motion elements and smart stepper or step-servo closed-loop motor technology with integrated controls, can be applied to single-axis, multi-axis or XYZ Cartesian configurations.

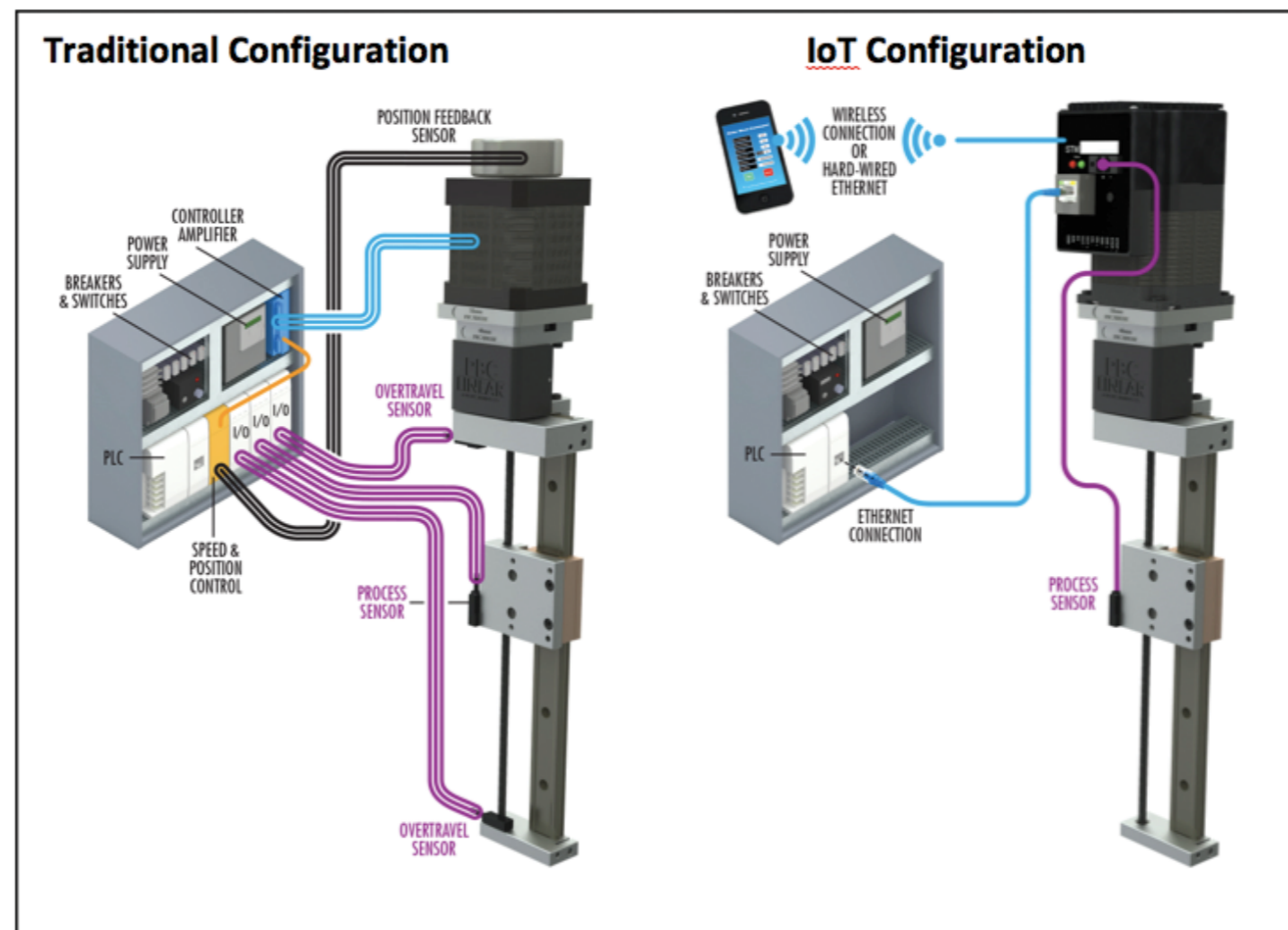
To illustrate the advantages of this combination of enhanced mechanical components with smart motor technology and control strategies, following are what I consider to be the top 10 advantages for both machine builders and users:



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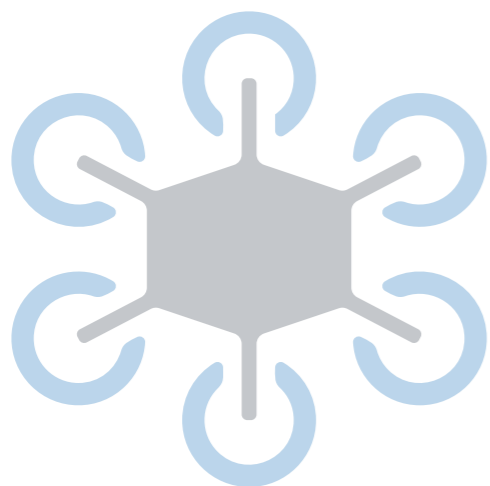
## Top 10 Benefits of Internet of Things-Enabled Mechatronics

- **Lower cost and enhanced functionality.** Less wiring and connectors, fewer components and sensors, less labor invested, reduced time spent in setup and maintenance, and maximized operational uptime all add up to substantial cost savings in overall cost of ownership and operation.



## CONTINUED

## Top 10 Benefits of Internet of Things-Enabled Mechatronics



- **Less space.** With the driver, controller and amplifier all built into the smart motor, the panel space required for these devices can be eliminated, resulting in savings of material, time, labor and overall cost.
- **Simplified wiring.** By eliminating the need for a driver, controller and amplifier to be housed in a separate cabinet, fewer sensors are required, especially when an encoder is used. All this results in fewer I/O connections and less complicated wiring schemes.
- **Reduced troubleshooting.** With fewer components and wire connections, the job of tracing down any problems that might arise is greatly reduced.
- **Streamlined commissioning.** Not only is machine installation and startup made easier with pre-programmed homing routines, so too is the ability to make changes at an individual axis without working through the PLC. This distributed control model frees up the installation team to work on multiple axes simultaneously and report progress via Internet connectivity. It also allows an operator to make in-process adjustments at an individual axis without affecting the PLC or production line.



## CONTINUED

## Top 10 Benefits of Internet of Things-Enabled Mechatronics

- **Modular integration.** Standardized smart robot modules make integration into multiple axes—or multiple machines—a natural and easy process.
- **Automated adjustment.** Rather than a time-consuming manual changeover, switching a packaging or assembly line to a different size or part can become automated and recipe-driven, thereby increasing manufacturing flexibility and speed. In addition, adaptive control is possible with conditions monitored and adjustments made locally—in real time—at the actuator level without having to route instructions through the PLC.
- **Maximized uptime.** Real-time monitoring of temperatures, friction, motor torque and other performance-related data can be routed to a mobile device, allowing the decision maker to proactively handle issues related to maximizing machine uptime.
- **Preventive maintenance.** Established timeframes for periodic maintenance based on cycles, number of pieces run or other dynamic conditions can easily be monitored and reported to any Internet-connected device, such as a workstation, tablet or mobile phone, allowing teams to proactively keep equipment running at peak efficiency.





## CONTINUED

### Top 10 Benefits of Internet of Things-Enabled Mechatronics



- **Increased output.** The above-listed features all work together in an Internet of Things-connected motion system to drive greater flexibility, less downtime, increased performance, and greater bottom-line output for manufacturing, assembly and packaging operations.

With the integration of processes and equipment enabled by the Internet of Things (IoT), traditional disciplines are merging, and the benefits can be seen throughout the lifecycle of a machine. The design phase is shortened with cross-discipline communication, design development and project management tools. Procurement and build cycles are shortened due to the need for fewer components along with the use of online configuration and purchasing tools. And with IoT-connected programming and real time analytics, ease of use, maintenance and overall life are increased for the user. All of which combine to increase your bottom line, creating more opportunity and increasing financial returns.

