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Knowing what data to process at the edge is a key Internet of Things infrastructure determination.

In a traditional supervisory control and data acquisition (SCADA) architecture, all data sources in the field are polled from a centralized host. This requires all raw data to be requested and provided across the network so that it can be stored, monitored and analyzed in the enterprise using various applications (such as SCADA, historians and analytics). There are many potential problems with this traditional SCADA structure—including bandwidth limitations and costly network burdens.

Many companies are struggling to support the number of connected SCADA devices across their networks. But industry leaders see
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pushing data collection—and some analytics—to the edge as a potential solution to alleviate network bandwidth limitations and security concerns.

**What is an edge solution?**

The edge is defined as the network entry points or data sources in the field on the opposite end of the network from the centralized host. In networking terms, an edge device provides an entry point into enterprise or service provider core networks. Examples include routers, routing switches, integrated access devices, multiplexers and a variety of local area network (LAN) and wide area network (WAN) access devices. Devices and sensors built for the Industrial Internet of Things (IIoT) with access to the network are also considered edge devices. There are many components of an edge architecture, and it is likely that the solution will include hardware and software from multiple vendors.

**Customizing an edge solution**

Data transmission is not free, and reducing the amount of data transmitted across the network is a potential cost savings benefit. Even a low-scale initiative that includes some analytics performed at the edge can help reduce data throughput and increase data consolidation. For example, a simple data reduction initiative could
involve publishing only data changes across the network—i.e., if the value of an endpoint has not changed, there is no need to publish that same value across the network.

More advanced analytics can also be pushed to the edge. By storing the data locally, models can be developed and patterns recognized by analytic applications running on the local gateway or industrial PC. For example, predictive analytics performed at the edge can apply machine learning techniques and applications to predict certain outcomes before they happen. This could be done locally at the edge with periodic updates on predicted outcomes and alerts if undesirable trends are predicted. Instead of performing centralized data analytics to determine what caused downtime after it happens, an edge solution could help companies prevent an undesired state entirely with real-time predictive analysis.

Prescriptive analytics, which use optimization and simulation algorithms to recommend changes to achieve a desired result or state, may also make sense to be performed at the edge. The ability to make decisions locally and quickly based on collected and analyzed data can significantly improve an organization’s efficiency and safety.
A large factor in determining how much analysis to push to the edge is how much bandwidth is available in each setting. It might make sense to just perform data reduction and consolidation at the edge and let the cloud or host do the majority of the enhanced analytics. In more challenging communication scenarios, more analytics are likely to get pushed to the edge. In cases where instant analysis and decisions need to be made, the more analytics performed—and decisions made—at the edge, the better.

For more information, visit PTC at www.ptc.com.
A new study on global growth has identified the top characteristics of manufacturing organizations poised for sustainable growth. These manufacturing “Grow Getters,” as the study referred to them, understand what it takes to get set for growth in today’s dynamic business environment.

One key characteristic of these Grow Getters is that they don’t just pay lip service to ideas such as new technology and innovation; they back them up with investment. According to the research, 88 percent of high-growth companies are planning significant investments in technology and innovation, compared with only 49 percent of slow-growth companies. Surprisingly, almost half of manufacturers are...
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behaving like slow-growth companies in that they are not planning technology or innovation investments in 2017.

If you are a midsize manufacturer, chances are you’re in this boat. There is a perception that Industry 4.0/Industrial Internet of Things (IIoT) initiatives are too high-concept and too expensive for small to midsize manufacturers that are just trying to survive. But perception isn’t necessarily reality.

As anyone in manufacturing knows, the past few years have been no picnic. After struggling to stay alive amid some of the toughest conditions the manufacturing industry has seen in our lifetime, I believe many manufacturers are experiencing what’s akin to “battle fatigue”—a military term for a soldier’s reaction to the stress of battle commonly involving slowed reaction time and indecision.

Battle-weary manufacturers have been so conditioned to being in heads down survival mode that they haven’t yet adjusted their view to look ahead and prepare for what’s next. And the future looks bright. Case in point: A new report from Ernst & Young (EY) shows middle-market companies are flourishing despite global uncertainty stemming from Brexit, increasing populism, the rise of automation and artificial intelligence, and skilled talent shortages. The report states
that 89 percent of executives see the current business landscape as being ripe with growth opportunities.

The report also says that 34 percent of middle-market companies plan to grow 6-10 percent this year, far outpacing the latest World Bank global GDP growth forecasts of 2.7 percent—while 14 percent of companies surveyed have current-year growth ambitions of more than 16 percent.

“Despite geopolitical risks and uncertainties, businesses being disrupted through new technologies and globalization rewriting the rules of supply and demand, middle market leaders are not only attuned to uncertainty but are seizing it to grow, disrupt other markets and drive their growth agendas,” says Annette Kimmitt, EY’s global growth markets leader.

A bold and motivating statement if ever there was one. So the question is: Are you seizing the day by putting in place a foundation for growth or are you seizing up? Not taking full advantage of the headwinds of change is like heading into the downhill portion of the race and locking up the brakes.
Manufacturers must do things differently to win market share in today’s environment because it is not enough to maintain the status quo. To survive and thrive, manufacturers must focus on growth.

For midsize manufacturers, leveraging Industry 4.0 approaches and new technologies can help even the playing field when competing against larger organizations. This doesn’t necessarily mean investing in expensive, time-intensive projects. Midsize manufacturers can test the waters with limited-scope, low-risk and inexpensive use cases (such as using sensors to monitor machine performance); other IIoT/Industry 4.0 initiatives can grow from there.

Midsize manufacturers are positioned exceptionally well for growth, but it’s up to you to take the necessary steps to ensure your technology is up to the task. Fortune favors the bold; now is the time to embrace the future.

*For more information, visit Epicor at www.epicor.com.*
A New Generation Takes Aim at IoT

BY PHIL MARSHALL
CEO, Hilscher North America

With the Raspberry Pi generating new levels of experimentation in plants and enterprises worldwide, we could be on the verge of a new innovative cycle in industry.

The Internet of Things (IoT) is sparking huge interest and, naturally, all vendors want to get in on the act. One interesting result of this interest in IoT, and a welcome result from my point of view, is all the effort taking place at different levels—from home automation up to the major IT companies that, quite clearly, are leading the way.

In some of the less advanced IoT areas, however, confusion reigns. For example, home automation solutions are riddled with interoperability and security issues. Not many devices can talk to each other. And many devices, such as coffee pots, refrigerators and even cars, are susceptible to being hacked. Now, if someone were remotely counting the number of cups of coffee I drink, then I would be mildly amused;
I might even offer them a job! However, my car is a different issue and I’d be appalled if they gained control while I was at the wheel.

Nevertheless, home automation is doing us a big favor because it’s sparking a lot of hobbyist activity. Many of these home developers (aka “makers”) are professional engineers who like to play in their spare time doing what their jobs won’t allow them to do during the day.

Made for innovators

The question is: How integral are these part-time technology tinkerers to the advancement of IoT? I’m mainly referring, of course, to products like the Raspberry Pi, which launched in the UK in 2012 to a youth market as a fun way of...
A New Generation Takes Aim at IoT

learning to code. It was originally delivered with a few simple sensors and actuators, so it was always, at heart, an embryonic control system.

Today, the Raspberry Pi is rapidly being absorbed into the technology mainstream. It has vastly outstripped its original target market and sold millions of units across the globe. Engineers are using Raspberry Pi to develop or refine work projects, and major technology companies are advertising for recruits with Pi experience. They know that any Pi maker keen enough to push boundaries in their spare time will be a valued employee. With the Raspberry Pi, engineers self-teach; companies recruit talent; new solutions emerge. Everyone wins!

Among my work colleagues are some whose homes—including their windows, HVAC systems and even their kids’ music downloading activities—are all run by Raspberry Pi. And I have no doubt that the same thing is happening elsewhere.

With this kind of experimentation happening in plants and enterprises worldwide, it’s entirely possible that we’re on the cusp of a new innovative cycle—maybe even new startups.

Hilscher recognized this market some time back and has been quietly developing related products. We offer a HAT (Hardware Added on
A New Generation Takes Aim at IoT

Top plug-in extension board, called netHAT, that is designed to add connectivity to Raspberry Pi board for the real-time Ethernet networks that run our plants. I bet the originators of Raspberry Pi never imagined that it would be used in the development of microcontrollers for automation or that Industrial IoT might be a target.

We’re also responding by launching an industrialized Raspberry Pi, called the netPi. It doesn’t look much like the original—more like a modern PLC— but it works exactly the same way as a Raspberry Pi. The difference is that, being industrialized, it can withstand the rigors of the manufacturing plant.

**Industrial solutions vs. toys**

Which brings me to my final point. As remarkable as the Raspberry Pi is, it is not an industrial product. I listened to a webcast recently, during which one questioner asked: If products like the Raspberry Pi are powerful enough to control a plant, why should he bother with an expensive industrial controller. We haven’t heard a question like that since commercial off-the-shelf (COTS) was a buzzword, and I can tell you it hurt.

In response, we developed a “Top 6 Reasons to Use Industrialized Microcontroller Kits” document and surprised ourselves with the
A New Generation Takes Aim at IoT

powerful arguments created in the process. Of course, the benefits of an industrialized microcontroller vs. a Raspberry Pi include access to all popular fieldbus networks with certified software, extensive built-in security, ruggedized hardware and software, and hardened electronics—in addition to being able to run commercial solutions aimed at industry.

The message is clear: Use low-cost consumer devices like the Raspberry Pi as much as you like for creative tinkering. Indeed, if you are a professional engineer, I encourage you to do so. But don’t rely on them for your industrial applications. It’s unprofessional to think cheap in real-world circumstances where rugged hardware, software and security are a must.

For more information, visit Hilscher North America at www.na.hilscher.com.
It’s Time to Elevate the Conversation About Your Data

For relatively modest investments, manufacturers can chart a reasonable upgrade path using proven data collection and analysis tools that can collect and correlate all the data from existing plant floor devices to improve quality, efficiency and profitability.

The Industrial Internet of Things (IIoT) asserts that “smart” machines can be faster, more accurate and more reliable than humans when it comes to capturing and communicating data. In the manufacturing environment, this means identifying sooner the inefficiencies and problems that can waste time and resources, and lead to costly recalls and warranty claims.

But how do you efficiently and cost-effectively manage all the data generated by the processes and test stations on a modern manufacturing line?
It’s Time to Elevate the Conversation About Your Data

In discrete manufacturing industries like automotive, off-highway or even medical, a line can include dozens, even hundreds, of stations. Each one generates reams of data per shift, be it scalars, digital process signatures or machine vision images with their related datasets.

Manufacturers can no longer afford to leave this data trapped in silos. It must be collected into a central database where it can be correlated, studied and visualized, by the serial number of the individual part or assembly.

The falling cost of sensors and data acquisition systems, network topology and throughput, and multi-terabyte class storage make collecting all these datasets from a line very feasible. Powerful and advanced off-the-shelf analytical tools make it easy to integrate, correlate and analyze all this data together, for rapid trending and root cause analysis. Quality engineers can then find trends and patterns that reveal the how and why of decreases in yield. This applies to any controlled process—from press fitting and leak test to rundown, crimping, welding and dispensing.

A part failure can easily be distinguished from a test malfunction. The quality team can spot anomalies that require further investigation, pinpoint where problems occur during a process, and optimize test stations by
understanding how to shorten the test. A few dozen defective units can be tracked down without having to scrap, rework or recall thousands.

This is the essence of IIoT.

**OEM struggles with production downtime**

Take the example of a manufacturer of agricultural machinery that struggled to make effective use of its production data. Its team understood the value of leveraging its data, but lacked a consistent and centralized means of collection, storage and retrieval.

Scalar pass/fail data from end-of-line engine hot test cells would end up in one silo, entered manually and indexed by time and date stamp. Further up the line, some process stations, such as torquing for bolts, collected full process signatures, indexed by serial number, but this data ended up trapped in a different silo.

These silos included a self-built SQL database as well as vendor-specific databases that lacked the functionality or connectivity to quickly pull full birth history for a part or assembly by serial number. The data wasn’t lost, but any exercise at retrieval and analysis to address an issue was a search for the proverbial needle in a haystack that required custom query tools.
The entire global operation suffered from a mashup of databases and data retrieval systems. Each plant operated with its own standards, processes and metrics for quality management. A quality engineer at a plant in Mexico could do nothing to help their counterpart in France who had an issue with a comparable machine or line because there was no standardization across the enterprise.

**Weeks lost due to safety fears**

When a product came back from the field due to a customer complaint or warranty issue, it routinely took as long as a week to retrieve all the related data scattered across the plant.

The result? A lengthy feedback loop to trace the root cause and scope of a quality issue. This created uncertainty and lengthy production delays because the manufacturer didn’t want to take the risk of continuing to ship what could be defective products. In one example, a faulty gear system caused high-risk issues for customers in the field. Full production was halted until the cause of this defect could be found and addressed. That took several weeks.

Though such disruptions have an obvious impact on revenue and profitability, the greater concern for this manufacturer was the public relations impact on its image. This is a premium brand with a quality
It’s Time to Elevate the Conversation About Your Data

reputation that justifies a higher retail price than its competitors. Better data analysis tools were needed to shorten the time to insight between the presence of a quality issue, awareness and resolution.

The solution

The manufacturer turned to a vendor that specialized in data management and manufacturing analytics.

The vendor took all the manufacturer’s disparate forms of process and test data from the line and converted it into formats that could be uploaded into its own centralized database. Data was no longer trapped in silos. The manufacturer’s quality teams were provided with the tools and know-how to develop a suite of algorithms to quickly search, retrieve and correlate data from this single centralized repository for rapid root cause analysis.

Production and quality issues that once took days or weeks to identify and address can now be resolved in minutes.

The vendor’s analytics tools have allowed the manufacturer to quickly drill into its data and analyze the impact of design changes, improve quality checks and report on metrics.
All this has been achieved from the data the manufacturer already collected—it just needed the right tools to unlock its potential. These tools were readily available from a third-party vendor and at a desirable price point.

**Improving quality, systemwide**

The manufacturer is now adopting the vendor’s data management system as a standardized quality platform across its engine and powertrain units at four plants in North America and Europe.

Additional work is being done to intensify the value of this investment by increasing the number and types of data collected from the line—automatic valve lash stations, torque tools and leak testing for engine block fuel, oil and coolant cavities.

It’s important to note that, in this use case, the vendor’s tools are flexible and agnostic—they can interface with and ingest data from other third-party process and test station equipment and operating systems. The manufacturer could elevate the return on its existing technology investments from other vendors—a costly rip and replace was not necessary.
Summary
The concept of IIoT, along with Industry 4.0 and Manufacturing 4.0, are no longer futuristic “hope to achieve some day” concepts. They are redefining the competitive landscape of global manufacturing today.

Manufacturers can chart a reasonable upgrade path using proven data collection and analysis tools that can collect and correlate all the data from the plant floor. For relatively modest investments, they can realize substantial gains in quality, efficiency and profitability.

If you want to benefit from rather than be sidelined by IIoT, it’s time to elevate the conversation about how to make the most of your data.

This article is provided by Sciemetric, a supplier of products that provide visibility into assembly line processes to optimize yield, boost quality and drive down costs. For more information, visit Sciemetric at www.sciemetric.com.
3 Questions to Ask Before Selecting an LTE WAN

BY ANDREW LUND
Product sales manager, B+B SmartWorx

You’ve figured out to use a connected device to improve a process. Now understand how to connect to the software app.

“We have our device, now we need to connect it to the Internet.”

You can imagine the scenario: A group of talented engineers has created a new way of using a connected device to improve a process. But to realize the benefits, the device must be connected to a remotely hosted software application.

When the team was developing its solution, they had Wi-Fi in the office. In field trials, however, they are learning the following:
• The solution is installed in areas where a wired WAN connection is prohibitively expensive.
• The solution is installed on third-party customer sites, and customers’ IT groups will not allow them to piggyback on the local Wi-Fi network.
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3 Questions to Ask Before Selecting an LTE WAN

• There is an OK network connection in 80 percent of locations, but customers also want to use it in places where there isn’t easy Internet access.

To solve these issues, sooner or later someone on the team will recommend using LTE. When that recommendation arises, here are a few questions the team will inevitably face.

“Can I build it myself?”

You have to consider the cost of certification and support. If you’ve already built an Internet of Things (IoT) device, it might seem like a no-brainer to just add an LTE module, especially if you see a module claiming to be pre-certified and ready to use. It’s important to realize that, just because a module claims to be certified by a carrier, it doesn’t mean the work is all done. For a company committing to embed a cellular module, it is just beginning. Network changes, radio firmware changes, security patches—these are all now their responsibility.

Then you have to consider if you need specific software. Sometimes the desire to integrate custom software leads companies down the complicated do-it-yourself path. However, some Linux solutions, such as SmartStart, include ample memory space for custom code as well as pre-published user modules that already support various integrated software.
“What is the best way to get an Internet connection?”

If you ask a carrier this question, it’s likely you’ll end up with a subsidized USB dongle. That could be a fine way to do a proof of concept, but USB dongles are consumer devices designed to connect a laptop to the Internet. They are not designed to connect an autonomous machine to the Internet, and certainly not designed to be centrally managed once hundreds—or thousands—are in the field.

Regarding Wi-Fi, some customers will allow guest devices on their network, but this is rare and becoming even rarer due to security concerns. Even if a device is allowed on, few service providers want to be in the position of relying on someone else (even their own customers) for a network connection. This means that support for Wi-Fi client mode, where the device is a client of the local Wi-Fi but can failover to LTE, is crucial.

This is why you should consider a standalone LTE router—it can provide an extremely secure and reliable network connection with a much lower opex proposition than an internally developed and supported embedded LTE solution. Because of this, LTE is increasingly the choice for value-add solutions in process automation, distributed media and remote monitoring applications.
3 Questions to Ask Before Selecting an LTE WAN

“How will I manage the network(s)?”

Once an LTE solution is selected, the process of receiving, configuring and installing begins. SNMP-based tools like OpenView or SolarWinds are great for basic monitoring functions like network uptime and packet loss, but the best way to improve both the initial mass configuration (getting the same profile on all devices) and ongoing monitoring (signal strength, change logging) is to use a device management solution, such as SmartWorx Hub or another vendor-developed tool.

When asking these questions, one thing is clear: Choosing and implementing an LTE router is more complex than simply finding a part number and pulling the trigger. There has to be a better way, and there is; it comes in the form of skilled assistance. For a successful LTE solution, it’s imperative to work with people who have the right engineering and support experience—individuals who understand your specific application needs for today and the future. With expert help and innovative devices, these questions simply become one step in the journey toward successful implementation.

For more information, visit B+B SmartWorx at www.advantech-bb.com.
Edge Computing: A Competing View

BY MICHAEL BOWNE
Executive director, PI North America

There still remains a lot of discussion about what ‘edge computing’ really means. At its core, it’s more about how control technologies are used than what they do.

A prominent topic lately associated with Industry 4.0 and the Industrial Internet of Things (IIoT) has been that of edge computing. As Wikipedia explains it, edge computing is “optimizing cloud computing systems by performing data processing at the edge of the network, near the source of the data.” Another term used for this is fog computing. But is this really a new concept in the field of industrial automation? And if so, what is really changing?

Historically, control at the edge has been done with a programmable logic controller (PLC) or distributed control system (DCS). Considering this, until the emergence of these new terms around
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IloT a few years ago, what exactly was a PLC at the edge of? A cliff? A knife? Ok, maybe field networks, yes.

So, until recently, “edge” terminology didn’t even make any sense. But now, information technology (IT) networks are being connected to operation technology (OT) networks, thereby putting OT controllers at the edge—from the perspective of IT. So, if you hear someone talking about edge computing in the OT world, they might be referring to a PLC, though they might not even be aware of what it does.

Another possibility is that, when someone is referring to edge computing with respect to OT, they might mean a PC employed in the OT world, such as an industrial PC (IPC). And just as with all the shifting that has taken place with “edge” terminology recently, the same has occurred with IPCs. We all remember the time when futurists prognosticated the end of the PLC when IPCs came out. Did this revolution come to pass? No. But if you look deep into a PLC or DCS today, what you’ll find is that it is just a computer. It might not run Windows, but this is likely the reason why IPCs didn’t wipe out PLCs—the blue screen of death is just too risky in a production environment.

With all this said, there is one area in particular where the concept of edge computing makes sense beyond our existing control methods—
and that is cloud connectivity. In other words, the Internet can be viewed as just another source of I/O. For example, a manufacturer with a cloud-connected PLC can take inputs from the Internet and make automated data-driven production decisions to gain a competitive advantage. What might those inputs be? It could be the weather forecast, for example, or the real-time price of oil.

So the next time you hear someone talking about edge computing with respect to OT networks, remember that it doesn’t necessarily mean that anything new is being installed. It’s really more about how we rethink the way our existing PLCs and DCSs are used in relation to IIoT.

*For more information, visit PI North America at us.profinet.com.*
So you’re tired of all the hype and buzzwords around this Industrial Internet of Things (IIoT) stuff? You want to actually start using predictive analytics, machine learning and other IIoT technology to do things like improve your overall equipment effectiveness (OEE) or monitor your production KPIs in real time?

Hey, me too! So buckle up, friend, and let’s get started.

But wait. Where and how do we get started, and what tools do we need to do that? And how do we know they’re the right tools for what we’re trying to do?
As operations technology (OT) and information technology (IT) professionals, we face challenges in adopting and implementing IIoT technology. A systemic lack of OT/IT interoperability increases our development time and costs. Risks associated with new technology adoption and cybersecurity leave us skeptical. And traditional automation vendors try to lock customers into proprietary technology, only exacerbating our interoperability problem. It is at this point where most of us have stopped our IIoT adoption—we’re excited about the possibilities, but paralyzed with fear and skepticism of the unknown.

However, as long as you know what a control tag is, then this article is for you. Armed with that knowledge, you can build an IIoT application with little to no monetary investment or opportunity cost; and you can do it in a couple of hours instead of weeks or months. Here’s how.

**Open interoperability**

Like Ethernet, today’s standards-based Internet technologies—like RESTful APIs—have infiltrated the traditionally proprietary and closed-off world of automation and process control. This shift is allowing IT software and OT hardware to communicate directly. Open-source edge computing and IIoT application development platforms like Node-RED have bridged the gap between OT and IT.
Rapid IIoT Application Development

silos, giving our valuable legacy industrial machines and equipment a path toward digital transformation.

RESTful APIs (Representational State Transfer Application Program Interface) are the software tools stitching together the Internet as we know it today. They document how software programs should request information and share resources using the HTTP/S protocol to request and deliver data in JavaScript Object Notation (JSON) format. Today, there are more than 17,000 RESTful APIs to everything from predictive analytics software hosted in the cloud to industrial automation controllers on our plant and factory floors.

RESTful APIs allow everything from cloud applications to local databases and spreadsheets to securely interface directly to industrial equipment—like Opto 22 SNAP PAC controllers—and exchange real-time production data. But perhaps more importantly, RESTful APIs enable legacy industrial equipment to access external digital data and resources to do things like autonomously improve their OEE and schedule their own service calls. RESTful APIs to an automation controller form the foundation of IIoT applications. They’re also one of the technologies that power Node-RED—the free, open-source software development platform for building Internet of Things (IoT) applications.
Node-RED provides an easy-to-use graphical interface displayed in a web browser, where prebuilt blocks of JavaScript code, called nodes, are dragged, dropped and wired together to build what’s called a Node-RED flow. Node-RED flows are what power your IIoT application. These nodes make IIoT application development simpler, easier to repeat and faster to scale. With a vast and continuously growing library of prebuilt code, Node-RED provides IIoT engineers with an easy way to connect edge computing systems—like automation controllers and I/O systems—to local or cloud-based machine learning and predictive maintenance applications.

For example, let’s say you want to create an application to poll Modbus TCP data from a device, log it to a SQL database and move it into IBM’s Watson IoT Platform. You’ll find nodes for all of those functions already developed and ready to deploy without having to write, debug or support software code, thereby reducing software development risk and accelerating time to market.

Drag, drop, wire together, deploy. Node-RED is that easy. And it’s recently become a standard feature on the secure, industrially hardened groov IIoT appliance from Opto 22.
Less buzz, more build
So how do you use these tools to build an IIoT application for your specific factory, process or plant?
Well, let’s start with something you’re probably already familiar with—a control tag. Now, you could be a ladder logic programmer, a flowchart programmer or a structured text programmer; frankly,
the IIoT really doesn’t care what language or environment you use to write your control programs, as long as it can get access to the data in your control tags. The standard control tag that we all know and love is really where we first begin bridging the gap between our legacy industrial assets in the physical world and our local or cloud-based digital applications that handle predictive maintenance and machine learning. Control tags are where our Big Data originates. For example, the screenshot on the previous page of an Opto 22 PAC control program displays a control tag that’s holding the value of a digital input point on a rack of I/O.

The controller running the control program and interfacing to the rack of I/O has a RESTful API built into it; so, with the proper authentication and permissions, just about any application—including basic spreadsheet applications, web browsers like Google Chrome and, of course, powerful cloud-based predictive maintenance and machine learning applications like IBM’s Watson IoT Platform—can directly read and even write to the control tag value in my controller. For example, in Chrome, I can make an HTTP/S request to the controller’s web server by inputting the URL required to request my digital input values from my I/O rack, specified in the controller’s RESTful API. Then the controller will respond with the tag values I’ve asked for in JSON format, which looks like the screen at the top of the next page.
But what does a web browser have to do with predictive maintenance and machine learning? The answer is: Not a lot. It’s actually the technology operating behind the scenes that has the real power. Because I can easily pull data out of my control system and view it in applications like Chrome, it means I can use other digital applications like Node-RED to pull data out of the controller, contextualize it with edge processing and move it into cloud applications like Watson—all without having to write a single line of software code. For example, I simply drag the SNAP PAC read node into my Node-RED flow, add a node to convert Boolean data values from my I/O rack into
human readable text, add a Watson node to push the data up to the cloud, provide a few configuration parameters to each node and my application is built as shown below.
Then the data from my control system shows up in the Watson IoT Platform like as shown below.
Leveraging open-source technology and Internet standards lets engineers focus on identifying opportunities to improve processes and rapidly develop solutions. With the majority of the code already developed and accessible through Node-RED, you can wire together an IIoT application to pull data from your industrial machinery and equipment and then move it into whichever predictive analytics application you like. Most of them know how to natively communicate using RESTful APIs, and quite a few already have Node-RED nodes developed for them.


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The Industrial Internet Consortium (IIC) has emerged as the preeminent initiative to develop the infrastructure of the Industrial Internet of Things (IIoT). By playing a leadership role in the IIC’s Smart Factory Task Group, B&R Industrial Automation is helping to make IIoT a practical reality for all manufacturing enterprises—not just the largest or most capital-intensive companies.

While the IIC addresses application requirements ranging from the electrical grid to agriculture to traffic control, the Smart Factory group focuses on requirements specific to manufacturing automation. Our group seeks to engage automation end users to assure the resulting
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framework is relevant to manufacturers. And we seek to leverage as many existing manufacturing standards as possible.

**Where to start with IIoT**

What are your initial IIoT hurdles? Security concerns? Having a realistic payback in mind? Knowing how to implement the technologies and processes needed? A viable timeframe? Is IIoT even achievable with available resources?

These are all legitimate concerns. And as with any major technology initiative, such as implementing track and trace, uncertainty arises when standards and best practices are not defined. The role of the IIC and the Smart Factory Task Group is to help define and clarify the architecture of IIoT—and it all begins with standards.

The IIoT cannot exist without interoperability, and that requires standards. It is essential to arrive at a consensus among many constituents, assure a level playing field, and avoid being overly prescriptive with rapidly evolving technologies.
The IIC does not intend to be a standards body, but rather to identify and aggregate standards into its frameworks and identify gaps that need to be addressed.

The Smart Factory Task Group addresses standards specific to manufacturing automation, but not necessarily required in other IIoT applications. These include real-time, determinism, precision and process requirements.

This is important work because of what can happen when standards lag implementation. When standards lag behind, the proliferation of non-interoperable technologies can flourish, as we’ve seen with the various flavors of industrial Ethernet. In contrast, the Internet itself demonstrates how commerce can flourish when technology standards are established upfront.

**Manufacturing requirements**

The Smart Factory Task Group is working to establish a framework to address specific manufacturing industry needs related to communication and real-time operating systems. This framework will be presented in a streamlined hierarchy that will enable machine-to-machine, machine-to-edge and machine-to-cloud communications.
Standards like OPC UA (Open Platform Communications – Unified Architecture) will play a central role in the IIoT and the Smart Factory Task Group’s framework. OPC UA has been embraced by virtually every automation supplier, and developers of industrial automation standards like MTConnect and ISA TR88.02 (PackML) are working together with the OPC Foundation to write companion specifications.

Because a term like “real time” can be relative to the application, real-time operating systems will receive special attention from the task group. Even though such operating systems are used in industries ranging from aerospace to energy, many manufacturing processes need to operate reliably within fractions of a second. For example, machine safety could require that motors respond to commands from the machine network and go into safe mode in less than 10 ms.

**Remote access**

What’s the difference between remote machine access and IIoT? In a word: scale.

Today, it is entirely possible to remotely monitor machines, perform diagnostics, acquire and calculate overall equipment effectiveness...
What You Should Know About the Industrial Internet Consortium

(OEE) data, upload production data and download recipes. But the IIoT analytics and optimization that promise the most productivity improvement will require continuous, rather than periodic, access to the machinery. That means a corresponding increase in security, which the IIC is addressing.

At B&R, we anticipate connected machinery to undergo threat assessments just as safety risk assessments are performed today—the difference being that threat assessments will occur on an ongoing basis as threats evolve.

Your input
What’s missing in the Smart Factory Task Group’s initiatives? You.

IIC membership is predominantly comprised of technology providers, along with large companies like Boeing and Procter & Gamble. What’s needed is input from the owners of the manufacturing assets to ensure that the technologies and standards being developed are relevant to their actual operational needs. Engaging these end users is a key mission of the Smart Factory Task Group’s charter, specifically through both IIC’s public forums and a new initiative involving IIC testbeds.
I encourage end users to attend IIC events that are open to the public. Doing so will help you gain first mover advantage and demonstrate thought leadership to your company’s stakeholders. If your IIoT strategy calls for gaining first mover advantage, strongly consider full IIC membership and participation in the Smart Factory Task Group.

For more information, visit B&R Industrial Automation at www.br-automation.com; and the Industrial Internet Consortium at www.iiconsortium.org.
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The Industrial Internet of Things (IIoT). It’s impossible to attend a conference or check your email without seeing the term. Though the IIoT generates a lot of buzz, it’s really a term that describes getting connected to the web.

IIoT-ready human-machine interfaces (HMIs) allow manufacturers to take data from the floor and share it with a local or cloud-based server, where it can be used company-wide, regardless of the user’s location. The translation of machine data to actionable information allows companies to make cost-saving decisions and allocate resources more appropriately.

Top 5 OEM Misconceptions About the IIoT

BY MIKE SHELDON
Applications engineer, Maple Systems

When it comes to the Industrial Internet of Things, OEMs have a unique set of concerns—and misconceptions—related to internal IoT decisions and those that can impact their customers.
But many OEMs are hesitating to implement IIoT and are not taking advantage of the available technology. Even if customers are not ready to integrate these systems right away, they will eventually want to implement an IIoT strategy to keep up with their competition. And when those customers decide to implement their IIoT concept, your machine should be ready without the need for downtime and replacements.

Despite the benefits machine IIoT readiness can bring to OEMs and their customers, some OEMs still do not recognize the full value of starting IIoT implementations early. Too often, they have fears about how difficult or costly the process is. With this in mind, the following are some of the most common OEM misconceptions about IIoT. Are any of these stopping you from making valuable upgrades to your machines?

**Misconception 1: Implementation is extremely costly**

There are ways of becoming IIoT-ready without major capital investments. For example, some IIoT-ready HMIs can range from $299 for compact applications to $1,990 for machines that need more robust systems.
Top 5 OEM Misconceptions About the IIoT

By adding IIoT-enabled HMIs to equipment, OEMs allow customers the flexibility to add the capability now or later without major upgrades or downtime. “Your customer can implement IIoT at any time by downloading the modified application, without purchasing airfare or sending products by mail to update,” says Larry St. Peter, CEO at Maple Systems. “This keeps your costs down, but also keeps your customer’s costs down too.”

Misconception 2: It’s better to wait for a consensus to develop before investing

Some OEMs feel that if they start upgrading now, they won’t be flexible in the future. As Lanette Mannon, Maple Systems’ marketing manager, explains, “Some OEMs are being conservative, seeing what others are doing before jumping onboard.” Though that mindset is understandable, there are HMIs that offer you flexibility by supporting a variety of communication protocols. MQTT, in particular, is a versatile tool for this—it is an emerging lightweight messaging protocol with cloud compatibility. Paired with an IIoT-ready HMI, MQTT enables secure communication with a wide array of PLCs, sensors and more, regardless of the device’s protocol. If your HMI supports many common protocols, you (and your machine) can remain flexible.
Misconception 3: The value of the IIoT doesn’t measure up to the hype

The IIoT concept is to use connectivity to get more out of your machines and make better business decisions. With IIoT-ready HMIs, there are numerous benefits for both the OEM and customer, such as:

- Customers get a view of how their systems are actually performing so they can optimize their production (and use of machinery) and automatically track maintenance or operations costs.
- A secure connection safely allows for advanced remote functionality such as email alarms, remote access, remote monitoring and remote programming. Plant managers can monitor machines from the palm of their hand, while email alarms alert staff immediately for expedited action.
- Offsite troubleshooting and configuration reduce travel expenses and costly downtime, saving money for both the OEM and customer.
- OEMs can track how their machines are performing. They can also use data to schedule predictive maintenance.
- Customers can take a more proactive sales stance with data on trends, users and orders. This could help them predict inventory needs more accurately and be better prepared.
- Some HMIs can store data using a SQL format if access to the Internet is interrupted to prevent data loss.

Beyond the immediate benefits, OEMs gain insight and can design
Top 5 OEM Misconceptions About the IIoT

future machines according to data collected on how each feature is used, where the machine shines and where it struggles. Knowing how customers actually use their machines allows them to better understand their customers and highlight popular features in marketing materials.

Misconception 4: Adding an IIoT-ready HMI will be complicated

Many OEMs often don’t know where to start. Forward-thinking HMI developers understand the confusion and some are taking steps to make IIoT implementation easier for customers through software systems that are simplified and condensed, making them easy to execute at many skill levels.

For example, Maple Systems recently introduced EasyAccess 2.0, an affordable software service that enables the remote monitoring and support of HMIs in the field. The software offers the functionality of an IIoT system with an easy-to-use, simplified interface. With EasyAccess 2.0, an OEM can update the functionality of the customer’s HMIs remotely, eliminating the need for onsite visits when the customer is ready to adopt IIoT capabilities.
CONTINUED

Top 5 OEM Misconceptions About the IIoT

**Misconception 5: It’s better to wait until customers request it**

With any type of technology, the old adage is true: The early bird gets the worm. When OEMs adopt IIoT-ready technology, they can start marketing the machine to potential customers as being IIoT-ready. Though customers might not be taking advantage of these features just yet, the functionality is there when they are ready. When customers decide they want to start reaping the benefits, it’s as easy as downloading an application. They don’t have to order new hardware, make a service call or spend a lot of money to make changes.

An OEM with systems that are upgradable in the field has the peace of mind of knowing that, when you’re ready, you can keep up with the competition. It’s really important that OEMs stay ahead of the curve now so that they can be competitive when the time is right.

*For more information, visit Maple Systems at www.maplesystems.com.*
Robots and motion systems are mainstream components in automotive, electronics, packaging, clinical, food and beverage, warehousing and general manufacturing applications. They perform operations such as pick and place, assembly, packaging and palletizing, screwdriving, labeling, gluing, dispensing, welding and polishing.

With the addition of a vision system, a robot is able to achieve a fuller level of autonomy, performing tasks with a greater level of speed and accuracy. A combination of a robot/vision system working together can perform higher-value operations than either would be able to accomplish alone. Rather than just manipulating an object, the robot, in conjunction with a vision system, is able to verify that it is working with the correct components in the first place, and can then verify that the operation was done completely and correctly through post-inspection.
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Smart Cameras + Robots = IoT

When looking to integrate a robot and vision system together, a number of challenges need to be addressed to ensure success. Physical challenges such as camera size, weight, placement and mounting are especially important to pay attention to because the camera is often mounted on the end of a robot arm. Cabling is another area of concern. Making sure you have high-flex cables capable of millions of motion cycles are a must. You also want to ensure your camera capability. The camera must have the required horsepower and algorithm set, as well as flexible optics and lighting all capable of performing the required tasks. Before beginning any job, make sure you have addressed these areas of integration from the start.

In addition to the challenges outlined above, there are additional user interface and integration challenges to be aware of. First, the integration needs an ideal programming environment for achieving your desired results. An ideal programming environment allows programming and control of the robot and the vision system within one integrated environment. Second, calibration of the vision system to robot coordinates, whether in 2D or 3D space must be finalized. Finally, the robot and vision system must share common standard communication protocols so they can communicate with one another,
Smart Cameras + Robots = IoT

as well as send and receive data with other systems on the factory floor—a key component of machine-to-machine communications, which underlies the Internet of Things (IoT).

Miniature, highly capable smart cameras are ideal for many applications that require the combination of a robot or motion system with a machine vision system. One example is Microscan Systems’ line of smart cameras called the MicroHawk MV. These cameras are extremely small and lightweight, and require just a single cable for power and I/O. They come equipped with built-in lighting, as well as built-in optics with fast programmable focus. Communications range from USB to serial to Ethernet, supporting major standards such as TCP/IP sockets, EtherNet/IP and Profinet.

A typical robot vision example application would be a smart camera mounted on the end of a robot arm tasked with verifying that all of the components on an assembly, such as an automobile engine, are present and correctly installed. The robot is used to fly the camera to different points around the engine, pointing the camera at each area of interest. Each inspection point is assigned a unique trigger. Upon receipt of that trigger, the camera takes a picture with the optimal sensor gain and exposure, as well as focus distance for that inspection. The camera then runs one or multiple tests ranging
from reading of 1D or 2D codes on labels, to presence/absence, quality inspection, counting and gauging. With each unique trigger, a unique result is passed back to a database and stored against that engine’s serial number.

Another example involves a miniature smart camera working in conjunction with a multi-axis motion system, working collaboratively to assemble multiple parts. A cellphone is a good example of an assembly application where multiple small parts need to be assembled with very high accuracy. The robot steps one part of the assembly under the camera, presenting a view of multiple key features on the part. At each location, the camera finds the exact location of a specific feature on the part with micron resolution. The robot then steps a second part of the assembly under the camera, which again finds and records the locations of companion features on this second part. Because the camera is calibrated to the robot coordinates, the location of all points is now known in the robot coordinate space for both parts of the assembly. Calculations are then made using a rigid body fit algorithm with this point set to determine the exact x,
y and angular offset of one part to the other. This offset is passed back to the robot, which then uses the data to assemble the parts together in exact detail.

There are numerous other examples where a miniature smart camera is the ideal choice based on form, fit and function—from surface-mount technology (SMT) assembly pick-and-place machines to desktop clinical analyzers, or when multiple cameras are required to be mounted very close together to cover the entire viewing area of a part. Additionally, because of the camera’s low cost and high performance, it can be mounted over a workspace to locate objects that the robot needs to find and pick up. A scenario for this type of application would be locating loaves of bread moving on a belt that need to be picked up and packaged, or finding parts in a bin.

Robots, when combined with a vision system, are highly capable of performing both sensing and manipulation tasks. Working together, the system can perform much higher-value operations than can be done with the robot alone. Miniature integrated smart cameras offer definite advantages over larger PC-based or traditional smart cameras because of their small size, light weight, variable sensing and programmable focus. They can be mounted out of the way on
robot arms or be placed in very tight spaces. Microscan’s MicroHawk was designed specifically to tackle the challenges of integration with different robot applications.

To learn more about integrating miniature smart cameras into robotic applications, watch Microscan’s on-demand webinar at http://awgo.to/microscan.

For more information, visit Microscan at www.microscan.com.
Though new machines are engineered to share information, machines manufactured even just a few years ago operate as self-contained entities. In other words, though the majority of machines on your plant floor are fitted with sensors measuring temperature, levels and cycle times, they were not designed to propagate this valuable data. So how can manufacturers collect data from the different types of machines they have on their plant floor and transform it into information that enables them to visualize and optimize their operations in a way that’s both cost-effective and practical?

Being able to collect data from the legacy manufacturing devices, analyze it and increase efficiency is a sure-fire way to optimize processes, make products more affordable for customers, and ultimately see a difference in the bottom line.

Outfitting Legacy Devices With a Digital Tap

BY CHARLIE NORZ
Product manager, Wago
The **smart** LTE solution combining serious value and flexible support.

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There are a few traditional ways to approach this problem, but they tend to be engineering-intensive. For example, if a machine already has a modern controller onboard, the program can be modified so that the important data is sent over a network. This sounds straightforward, but for many applications it can be daunting. First, a person with programming expertise for the controller used must be hired to update the program. If the program’s documentation is lacking, then the programmer might have to reengineer the code in order to copy the desired data into memory that the supervisory system can access. This process can be time-consuming and expensive.

Another approach is to fit each machine with a custom application that can monitor the specific machine. If you have multiple machines on your plant floor, or machines from different vendors, you might need to have a custom application for each one. This can be very labor-intensive to develop. Then, the supervisory system needs to be programmed to extract the data from the machine’s custom application. Each application needs to be individually maintained and archived. Sound cumbersome and tedious? That’s because it is. What if there were a way to collect and process data from different machine types using a universally standardized language?
OUTFITTING LEGACY DEVICES WITH A DIGITAL TAP

There is such a way and it’s called MTConnect—an open-source, royalty-free standard that leverages proven Internet protocols to transform data from manufacturing equipment into a standardized format. Essentially, it bridges the data harvested from machines to an application that then translates that data into legible metrics with which a machine’s status and activity can be tracked and monitored remotely.

The MTConnect standard describes three components: an adapter, an agent and an application. The adapter collects machine data, normalizes it and transfers it to the agent. The agent follows a prescribed XML schema that organizes the data in a standard format no matter what type of machine it is monitoring. The agent buffers the data and serves it to the application when requested. The application stores the data in a database and can display it in a way humans can understand. Using graphs or charts, the machines’ performances are displayed in easy-to-interpret formats for engineers and manufacturers.

A digital tap
Let’s clarify this with a metaphor. Imagine the machines on your plant floor are maple trees and the sap from the trees is their operating data. Looking at your plant floor forest can be overwhelming, but when using MTConnect technology, it’s easy. The MTConnect adapter and agent can be thought of as the spile, the metal tube that taps
Outfitting Legacy Devices With a Digital Tap

Imagine the machines on your plant floor are maple trees and the sap from the trees is their operating data. MTConnect can be seen as a universal digital tap that can be easily integrated into your existing machines without disturbing your production process.

MTConnect can be seen as a universal digital tap that can be easily integrated into your existing machines without disturbing your production process. It provides a standard platform that taps into this information, collects it and then allows for a connection to analytics software. This would look something like inserting the MTConnect tap into the tree, connecting to the data bucket in the application, then connecting to an HTML webpage and simply viewing the efficiency of the tree and how it performs with the other trees in the forest. The concept is really as simple as that. Manufacturers with complex machines and processes can now effortlessly digitize their plant floor.

Now that the ease of installing and integrating the MTConnect standard is understood, one might be asking what the real benefits are. The direction manufacturing and industrial companies are taking is following the trend of technology around digitization. It's becoming increasingly fundamental to have the ability to monitor, adjust and control every aspect of your plant in real time. Monitoring machines can reveal a host of problems or raise red flags before costly errors occur. It can benefit scheduling and logistics by having concrete...
numbers on cycle times. Essentially, MTConnect enables operators to visualize the workflow of the plant and optimize it, ultimately cutting costs down the road—a benefit anyone can stand behind.

The transition

Many machines are not equipped to connect directly to the MTConnect adapter and agent. However, the Wago-I/O-System has developed the Digital Tap to aid in making a smooth transition to a digitized plant floor. The Digital Tap comes complete with an industrial PFC100 input system integrated with the MTConnect adapter and agent. There is no programming involved. Simply tap into your machines’ data, such as stack lights, power usage and motor speeds, and configure these inputs via your web browser to begin real-time analysis. Along with this, you’ll need reliable software that is able to convert the data into easy-to-interpret charts and graphs—an application like Forcam Force, for example.

MTConnect provides hard machine data that enables manufacturers to monitor and track overall efficiency of the plant floor. Implementing this tool is the next logical step in optimizing your processes. The transition is seamless with the support of innovative and reliable companies aiming to help you tap into the future.

For more information, visit Wago at www.wago.us.
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So much has been written about the Internet of Things (IoT) and its subset, the Industrial Internet of Things (IIoT), that the hype seems endless. No wonder Gartner’s Hype Cycle ranked it as one of 2016’s most ascendant emerging technologies for the third year in a row. But it does boggle the mind to consider the potential that billions of devices capable of communicating with each other—most bypassing humans altogether—have to unleash new and transformative business models.

Often, however, a key enabler gets overlooked: the digital thread interconnecting all those “things.” This digital thread is the highly available,
How Smart Factories Are Getting Connected

Sometimes the best way to learn is to see how others are doing it. We have helped many customers in their transition to a smart factory, and now we want to share some of those stories with you. Visit our smart factory portal to see what worked for different customers, such as a semiconductor manufacturer that needed real-time dry pump monitoring, or a leading cosmetic company that wanted to improve production efficiency measurement.

Learn more at [www.moxa.com/smartfactory](http://www.moxa.com/smartfactory).
secure and ubiquitous connectivity provided by advanced industrial communications over industrial Ethernet, an open global standard.

This thread consists of real-time, continuously updated information that runs end-to-end through all industrial operations, even beyond walls to the ecosystem of suppliers and customers. It provides critical stakeholders with consistent visibility anytime, anywhere to operational data to make faster, better informed decisions. Everyone involved can be more aware, responsive and decisive as needed.

It’s important to realize that industrial connectivity isn’t the best-effort Wi-Fi like you have in your home, office or local café. In those cases, if data packets get lost or held up due to network congestion, other packets are sent and latencies of a few seconds are not problematic or even noticed.

When industrial machinery is involved, however, network data communications must be highly deterministic. This means that when packets containing commands to open or close valves, switches or other devices are sent, they get where they’re going quickly and when the receiving device or devices expect them. If a command doesn’t arrive in time, then a machine’s cycle can be
disrupted, stopping production or worse. If a valve isn’t closed when it’s supposed to be, safety can be at stake.

Here are five ways that advanced industrial communications can best interconnect the digital enterprise and, by extension, the enterprise with the IIoT:

1. **Redundancy.** In the event of a fault, a plant’s high-availability industrial communication can take over automatically without any production disruptions or safety concerns. System redundancy involves backup systems operating in parallel with immediate failover should the primary system go down. Media redundancy provides alternative communication paths, should primary ones be disrupted.

2. **Network segmentation.** Virtual local area networks (VLANs) enable the partitioning of one physical LAN into several smaller, logical LANs. These LANs help separate the networks connecting OT automation systems from IT systems for better security and optimized real-time performance. In case of a disruption, especially a security breach, the compromised LAN can be quickly isolated until the issue is addressed.

3. **Bridging IT and OT.** It’s good to connect IT and OT environments in secure and accountable ways that respect the strengths and requirements of each. A robust network backbone should be
established to create a structured and reliable interface between dedicated production and office networks. The former will include cell-to-machine and shop-floor-to-cell sub-networks, all with specific IP addressing for fully managed components and systems, plus the use of real-time, deterministic communication protocols.

4. **Facilitated data interchange.** Production often has varied data interfaces due to field-level devices from different suppliers. These elements must communicate their data to—and often get instructions from—higher-level control systems and human-machine interfaces (HMIs), web interfaces, PCs, tablets and even smartphones. OPC UA, an open standard, allows field devices to communicate with each other across Ethernet, thanks to its underlying TCP/IP communication protocol.

5. **Wireless, near and far.** Wireless industrial connectivity is growing fast. It offers greater configuration flexibility and speed and eliminates long lengths of costly cabling. It includes low-power, short-range near-field communication (NFC) technology used in radio-frequency identification (RFID) solutions for product authentication and asset tracking. Another NFC use is for machine diagnostics. Longer-range wireless using 802.11n Wi-Fi can facilitate communications up to 300 ft between access points, while 802.16 WiMAX has a range up to 30 miles. 3G and 4G LTE cellular and satellite communications can handle even greater distances.
It’s important to emphasize that, although the hype around the IIoT focuses on billions of interconnected devices, production environments will interconnect devices numbering many orders of magnitude less: from hundreds to many thousands of devices only.

Those must stay segregated and protected from IIoT’s billions of devices, because any one of them can and will harbor malware of some sort or another. That’s why always-updated cybersecurity protections are critical and defense-in-depth, layered strategies remain best practices.

Today’s digital enterprises, supported by advanced industrial communications, can simplify operations and lower both capital and operating costs. They can vastly improve the reliability, visibility and security of dynamic production environments to boost availability and asset utilization.

Ultimately, these digital enterprises will enjoy distinct competitive advantages. For example, with data running end-to-end through their operations, they can execute their business strategies faster, gain performance feedback and insights sooner, respond to market changes and opportunities more quickly, and improve their time to market with new products and services.