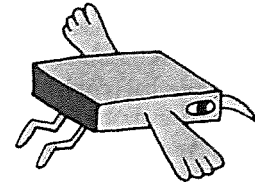


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INTERNET OF THINGS





# THINGS

Loads of IP-addressable sensors and other smart devices are descending on the enterprise. **Here's how to be ready to pull it all together.**

**By Robert L. Mitchell**

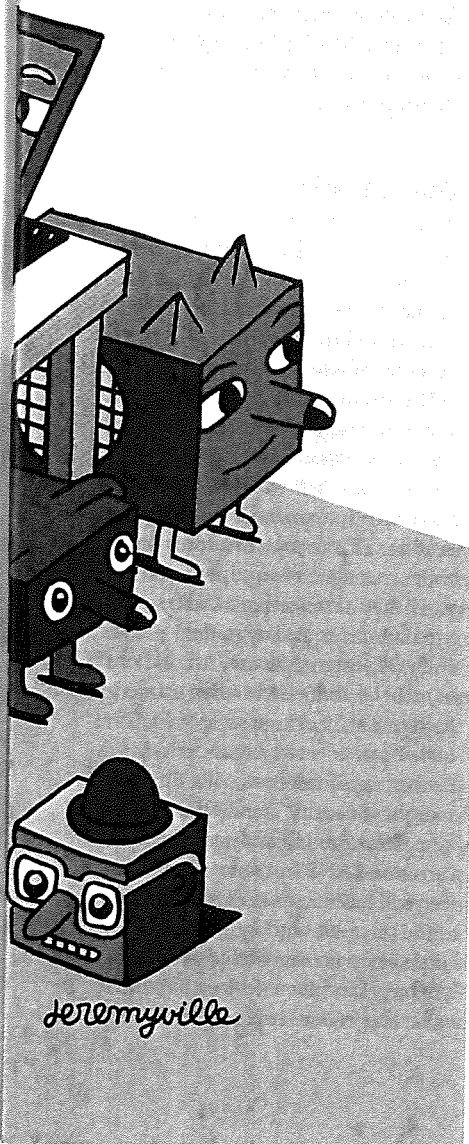
**A** S CIO AT BOEING, Ted Colbert is no stranger to the Internet of Things. For more than a decade, the aerospace giant has deployed thousands of communications-enabled smart devices to sense, control and exchange data across the factory floor, on the battlefield, and within the company's 787 Dreamliner aircraft.

For National Football League CIO Michelle McKenna-Doyle, however, it's a whole new ballgame. Currently the league is experimenting with instrumentation by deploying sensors on the playing field, the ball, and the players and their helmets; it's even exploring ways to track fans.

The Internet of Things presents two opportunities for IT, says Chris Curran, chief technologist and principal in the advisory practice at PwC. "The first requires the CIO to insert himself into the product design and management process," he says. "The second is a new discussion for the CIO to initiate." One concerns product instrumentation; the other is about "instrumenting" the business itself — equipping physical locations, vehicles, devices, equipment, people and so on with sensors and beacons to better understand, analyze and make decisions about the way the business processes perform.

To accomplish all of that, McKenna-Doyle says, "a tighter collaboration with customer-facing business partners is a must."

The Internet of Things (IoT) is set to explode, driven largely by the consumer market, where the number of smart "things" and everyday products equipped with IP-addressable sensors — from wearable smart bands to smart refrigerators — is multiplying exponentially. Research firm Gartner estimates that 26 billion IoT-ready products will be in service by 2020. That's an average of 3.3 devices for every man, woman and child on the planet. And that doesn't include the projected 7.3 billion smartphones and tablets.



JEREMYVILLE

While some of the first smart things were networked sensors used in industrial settings, the definition has broadened. Smart devices increasingly use IP or have access to an IP gateway that can feed data back over the Internet — and over corporate networks. Michele Pelino, an analyst at Forrester Research, describes IoT devices as “anything that connects objects or assets or individuals [and makes it possible to know their] status in a real-time way.” Gartner analyst Hung LeHong’s definition of the IoT includes any connected device or software that can sense and that you can control and use to exchange data. This includes apps that let people send recipes to their ovens, enable BMW owners to unlock their cars if they lose the keys or make it possible for Tesla electric cars to receive automatic over-the-air software upgrades, he says.

As with mobile phones before them, some of these new devices will walk through the office door with employees, while others will be embedded in products that connect to corporate systems from homes and other businesses. And the number of IoT applications spearheaded by lines of business will increase as organizations find new ways to improve productivity, streamline processes and fatten up the bottom line by instrumenting equipment, environments and people and analyzing the data streams generated by those systems.

Even seasoned veterans like Colbert are bracing for an onslaught. What’s different now, he says, is the accessibility of many different types of data, the speed at which the data can be gathered, and the tools a business can use to get its arms around that data. “The pace of development of sensors is moving much faster than folks can keep up with,” he says. And as the cost of developing and deploying sensors has dropped, businesses can capture more data faster and from more parts of more assets than ever before. “This is about solving hard business problems with better data,” Curran says.

It’s a sea change, says Vince Campisi, CIO at General Electric’s Global Software Center. “Before, even if we had the ability to get the cost of the sensor down, we wouldn’t have been able to transport, store and analyze the data.” Now, with the evolution of tools for managing and analyzing big data, he says, “we have both.”

Jim Noga, CIO at Partners HealthCare, reports that while networked sensors have been used in healthcare for years, of late he has seen a marked increase in both the number of medical appliances instrumented with sensors and the number of network-enabled sensors embedded into individual devices. “We’re also seeing more and more of these sensors that live on our operational network,” he says.

For IT, the cost of accommodating IoT initiatives is substantial. “These will be multimillion-dollar investments,” and they

## Advanced Package Tracking

**O**NE RESULT of the IT/OT synergy at FedEx has been the development of SenseAware, a sensor network that allows the shipping company’s customers to track the status of high-value packages in real time. Among other things, they can check the package’s location, the temperature and humidity level at that location, whether it’s in motion and whether it has been opened. Customers can also configure the system to alert them when certain specifications exceed set thresholds or when the package comes within a specified distance of its destination.

That’s a premium subscription service now, but the technology’s cost and power requirements will drop to the point where FedEx can offer it for every package, says Kevin Humphries, senior vice president of enterprise infrastructure services. The initiative illustrates the value of using data collected by the sensors in real time, rather than just analyzing it after the fact. “It’s not just about big data or access to real-time information. It’s what you do with it,” he says.

— ROBERT L. MITCHELL

will require significant R&D investments, says McKenna-Doyle. And business units will expect IT to “knit things together,” she adds.

Supporting IoT projects will require more than basic computing infrastructure changes, says Colbert. “IT will need to retool its computing services portfolio to allow a richer number of simple applications to expose data from the IoT,” he explains.

Here’s a look at four steps IT leaders and analysts say IT should be taking as the Internet of Things proliferates.

### 1 Ramp Up IT/OT Collaboration

Going forward, upfront collaboration with lines of business and associated operational technology (OT) organizations will be essential. As sensor networks move toward more open architectures, the OT organizations that ran the formerly closed, proprietary systems within each line of business will need to work more closely with IT to resolve a host of issues ranging from integration to security. “IT and OT need to work together to decide who manages, controls and monitors what,” says LeHong, “and it’s no longer clear-cut.” That creates a big opportunity for IT.

For example, if a vending machine can tell when an item is out of stock and send an order to the ERP system, does that mean IT needs another user license? And as OT moves to IP-addressable devices, IT must address network management and security

issues. IT may also need to handle software maintenance and upgrades — areas in which OT lacks expertise. All of those issues must be addressed “when things go on the Internet,” LeHong says.

The IoT presents two big security challenges, says John Pescatore, director of Emerging Security Trends at the security research, training and certification organization SANS Institute. Many IoT devices will be consumer-driven, and will therefore start out with weak security and little or no manageability. And even with enterprise-driven devices, IT will face a heterogeneous mix of systems. “IT

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MICHELE PELINO, ANALYST,  
FORRESTER RESEARCH

has to learn how to manage devices that aren't all on the same image running the same operating system and the same version of all apps," he says.

CIOs must rethink the network architecture, according to Colbert. "You have to manage the data, manage the networks, and have multiple layers of security in place to allow access to the people and things that need access," he says. "That's hard work in the complex web of networks you have in a large corporation."

There are challenges within OT. For example, Campisi says GE's Predix OT management platform works only with GE sensors, such as those embedded in its jet engines. The company has, however, developed partnerships to offer a more holistic look at optimizing airline operations, ranging from setting crew schedules to operating fleets more efficiently, he says.

But a consolidated management platform for the many different IoT devices out there doesn't exist yet, says Colbert. "There's no single pane of glass that can traverse all of the different types of technologies," he says.

That will change, says LeHong, as machine-to-machine cloud platforms such as Axeda, Etherios, MyKoots and ThingWorx emerge to fill the void.

Colbert agrees. "There will also be hubs, routers and gateways that will combine with cloud capabilities to bring together the disparate IoT," he says.

Right now, though, the underlying infrastructure to support it all is inadequate, says McKenna-Doyle. "These days, CIOs have to be the integrators of all of these specialty devices and capabilities," she says.

Fortunately, IT is very good at dealing with these types of issues. At Boeing, Colbert says, the IT organization has "locked arms" with the factory technical teams. But Curran says that level of upfront participation is the exception rather than the norm. "The tendency is for the product people to just build the product and then come to IT," he says.

CIOs can't afford to get involved after the fact, but that's an all too common state of affairs, says Forrester's Pelino. "The back-end stuff? The marketers don't think about that. This is something you have to be proactive about," she says.

And IT's involvement shouldn't stop there. Many projects create data silos, so IT can also add value by integrating data in back-end systems and performing analytics, Pelino says.

There's no reason IT can't take the lead in leveraging the Internet of Things for business benefit, says Don Fike, vice president and technical architect at FedEx Corporate Services.

"A good place to start is to take a look at your business processes and how they might be impacted by some of the sensor technologies and real-time capabilities," he says. "Step back and

say, 'How can this change my business process?'"

LeHong advises CIOs to take the business's top three products and core processes and think about how the IoT might help. "Can you create a better product or service or process?" he asks.

IT executives should also understand how IT can play a critical role in enabling the technology, operationalizing it and securing it. "The more you're aware of the dynamics, the more you can participate in the discussions," says Campisi, adding that when GE talks to businesses about Predix, the CIO is usually involved from the start.

## 2 Learn to Cope With Consumerization

If industrial sensors weren't enough to think about, IT organizations may be asked to engage with consumer devices they don't control, ranging from smart wristbands that monitor personal health to home thermostats. Some devices might walk in the door with employees or customers, while others might connect in from the home.

Smart things that employees bring to work present a risk-mitigation challenge. "Things will be more advanced in the future. And from a threat perspective, they could be designed to circumvent discovery," says Colbert, adding that that's a big concern for Boeing. IT will also need to develop services and policies for properly classifying data from these emerging smart things, and it will have to establish policy enforcement points to control access and enforce usage rights.

But a world in which employees bring their own smart things to work also presents opportunities. For example, Colbert says, "I wouldn't allow sensors to connect to my general-use network to provide employees' location and body temperature to support building maintenance. But providing a segmented network to support the use case? I'd be interested in that."

Other use cases that IT could propose range from programs to improve the

safety of manufacturing environments to wellness competitions that use data from employees' personal health monitors to track the progress of participants, he says. "Sensors are ubiquitous, and it would be silly to think that the only way to leverage the Internet of Things is with things I can control," he says.

Karen Austin, CIO at PG&E Corp., has overseen the installation of 9 million smart meters that help customers understand their power consumption. The utility holding company has also installed sensors in power and natural gas distribution systems that can monitor load/generation characteristics, report outages, and shut off valves and reroute power. Now PG&E is experimenting with ways to connect its smart meters to home networks. "All

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AND PRINCIPAL, PWC





## COVER STORY

of the devices in the home, from the dryer to the thermostat, are getting smarter," Austin says. "We want to communicate with those devices to allow them to be more energy-efficient." Adding that IT should think of the IoT as a two-way solution, she says, "You have to be able to handle that from a data and security perspective."

At Partners HealthCare, Noga faces the challenge of integrating data from consumer-based sensors such as IP-enabled blood pressure cuffs and weight scales into the overall IT architecture. That presents data exchange challenges. Moreover, home devices can't be tested for accuracy and recalibrated the way professional hospital equipment can. Because clinicians can't be sure that the data is correct, they must review all data before it's input into a patient's record. IT also preps the data using decision-support algorithms before clinicians see it. "No clinician wants to review hundreds of normal blood pressure readings," says Joseph Kvedar, director of the Center for Connected Health, a Partners HealthCare R&D organization.

But there are consumer products that meet professional healthcare standards, and the economics of using such tools are compelling. For example, healthcare products maker iHealth offers an FDA-approved blood pressure monitor that consumers can find at Best Buy. "We give patients a coupon to buy one, and there's no hub and no data charges. That starts to lower our costs," Kvedar says.

McKenna-Doyle would like to tap into IoT devices that football fans use in order to deepen the level of engagement between fans and their favorite teams. "The emerging [tech] for us is around wearable fitness for the conditioning and management of the overall health of players," she says. The next step might be to let fans with smart bands go online and, say, compare their heart rates and times in the 40-yard dash with those of star players. But capturing that data raises questions about privacy and governance. "There's a discussion as to whether that's medical data," she says. Data from IP-enabled smart devices needs to be classified so that IT can determine whether or not it needs reside on a private network.

### 3 Get Involved in R&D

The best way to get in front of IoT projects is to place IT at the forefront of product development. "IT can be the engine around which prototyping is done with these new sensor opportunities. It can be a big player in vetting ideas before a major investment is made," Curran says.

For McKenna-Doyle, that means supporting R&D initiatives for projects to embed sensors on footballs, players, the field and helmets. And IT has uncovered many challenges along the way.

Sensors can be used to track who's on the field, map play activity and gather game statistics. But how do you recalibrate field sensors that may get moved — or removed — between games? And how do you overcome bandwidth issues in a stadium packed with 70,000 fans? "This is all R&D," she says. "Most CIOs don't have a lot of experience in R&D, but if you want to be successful, you'd better start looking at how you can try some of this stuff."

"You need to have IT consultants who can talk to the OT people so they can build a business plan and present it to a governance body," says Noga. "We try to be supportive of the Center for Connected Health and provide a lab setting for them to do their testing."

## The Role of Rapid Prototyping

**U**SERS OF Hitachi Medical's MRI equipment didn't always notice the light indicating a cooling system failure. In some cases, by the time technicians discovered that a machine was overheating the magnets had melted, resulting in a \$75,000 part failure. Rather than wait for an embedded sensor, a Hitachi engineer wired in a Twine sensor and breakout box kit from Supermechanical. In a failure, the Wi-Fi-enabled device sends an alert to Supermechanical's free cloud-based service, which forwards a text message to the field technician. Total cost: \$149.

Integrating a Wi-Fi-enabled chip such as Electric Imp or Intel's Edison into every product might cost \$20 to \$30 per unit — an expensive investment, says Gartner analyst Hung LeHong. "But for \$150 you can build a business case," he says. The Twine kit, with its point-and-click Web service and sensor options, allows rapid experimentation. "It really is easy for even nontechnical people to prototype interactions," says Supermechanical co-founder John Kestner.

Meanwhile, cloud ecosystem providers such as ThingWorx and SmartThings are providing developer environments and APIs for device makers. And the trend is for each machine to include its own APIs, so people can build the mobile apps they need, says LeHong. The question, he says, is this: "Will IT build that — or not?"

— ROBERT L. MITCHELL

The Partners HealthCare IT unit also helps the center figure out whether the technology will scale. "Things work in the lab, but in the real world, when thousands of people are hitting on the system, we have run into issues. So we sit down with the CTO and his team and go over the architecture," Kvedar says.

### 4 Stay Ahead of the Curve

The most important thing is for CIOs to maintain strong relationships with business units — and keep in front of the competition. "It's a partnership," says Austin. And it's the CIO's job to establish good governance over the process to ensure that the business executes in a way that doesn't put the company at risk. "What the business needs is very important," says Colbert. "Innovate, but balance that by protecting the crown jewels of the company."

Plan ahead before you're approached for help with an IoT project, because there isn't time to do an extensive study, adds McKenna-Doyle. "You need to say, 'Here are the questions you need to ask,' and we need to have them covered," she says. "Be flexible and make sure everyone understands the risk/reward profile."

IT may feel intimidated by the speed at which this is moving, "but for CIOs who can see the value of the data from these interactions, this is a great time to have a seat at the table," she adds. "Now is the time to embrace this." ♦