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RFID JOURNAL

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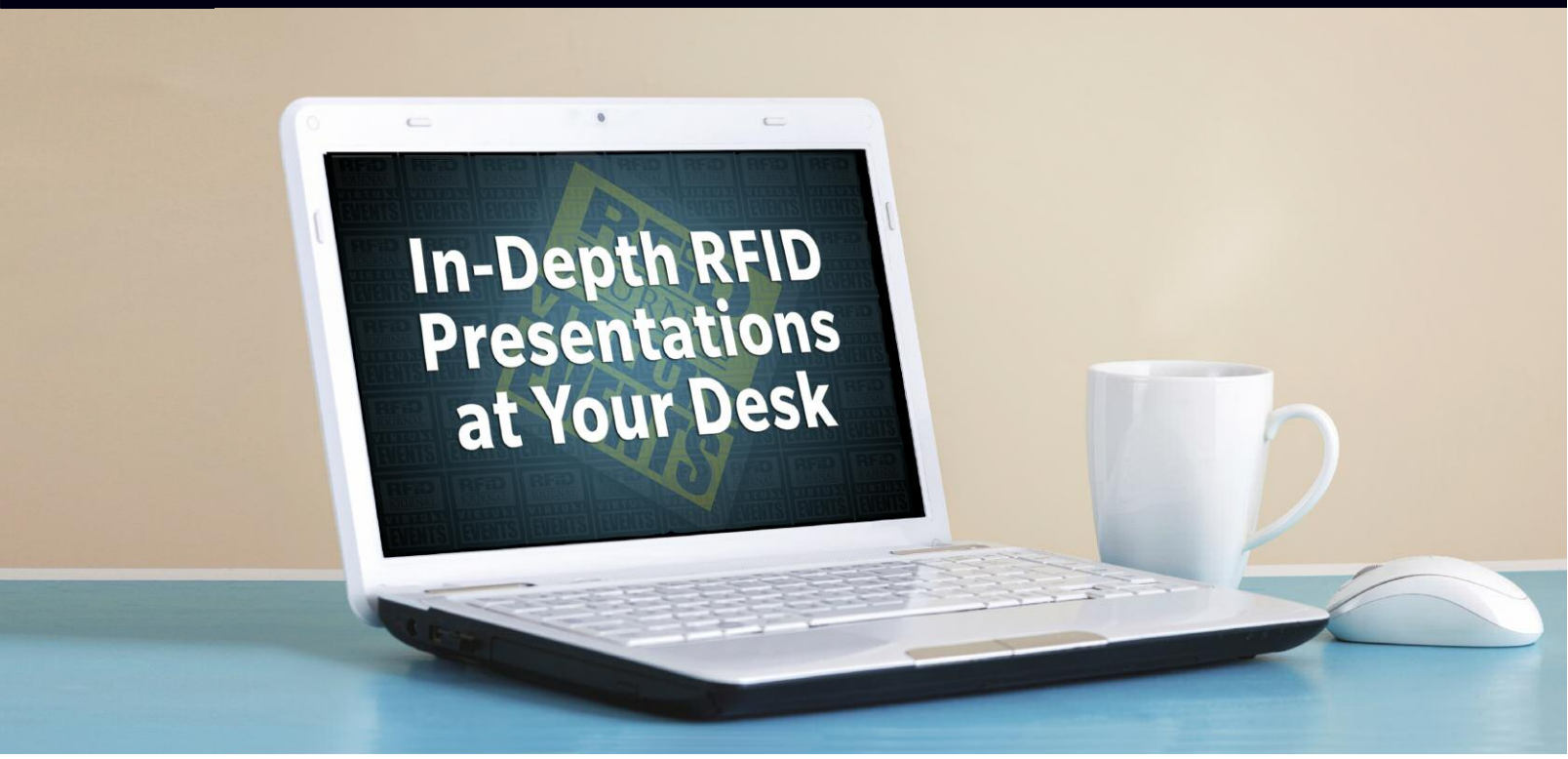

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RFID JOURNAL

Vol. 11, No. 5 Sept./Oct. 2014

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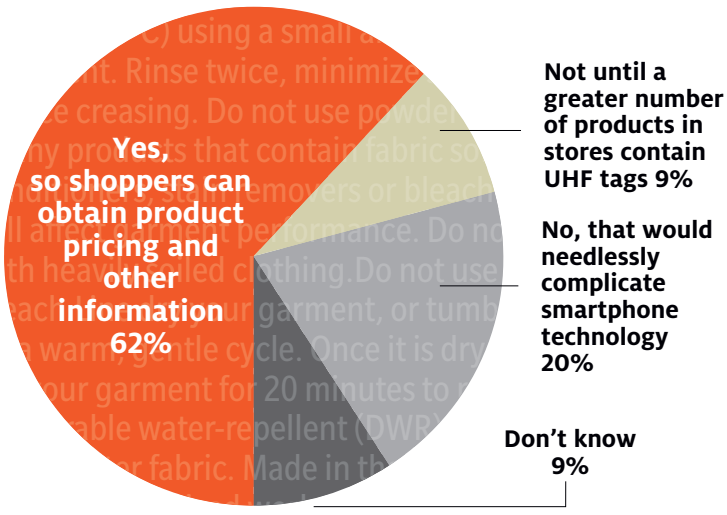

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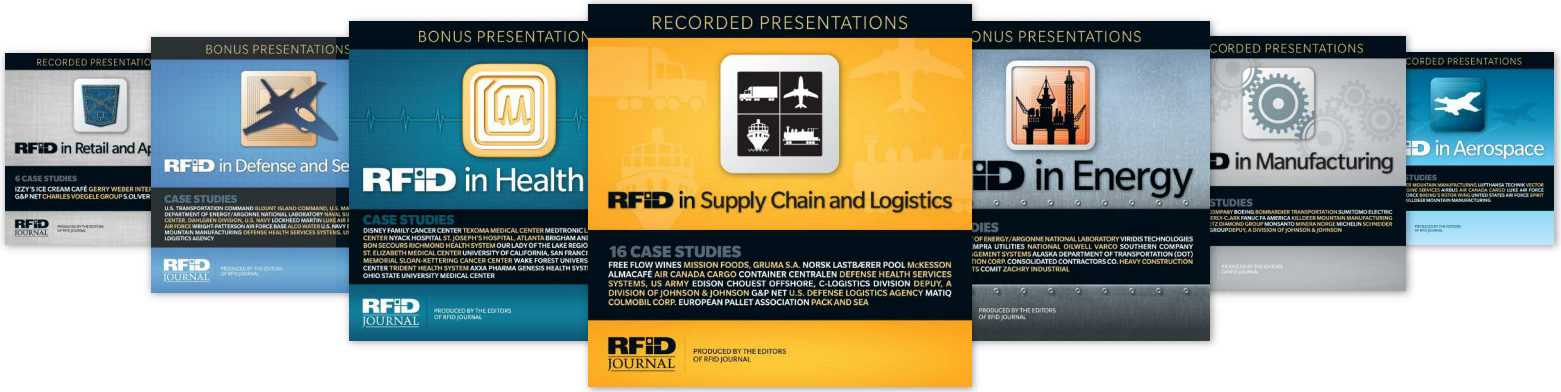

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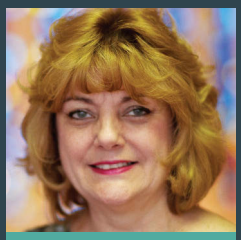

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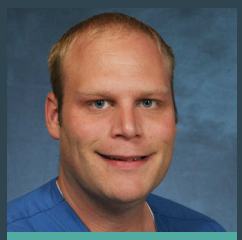

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Embracing the Internet of Things

POTTER STEWART, a U.S. Supreme Court justice, famously wrote in an opinion in an obscenity case that while he could not define pornography, "I know it when I see it." The Internet of Things is a bit like that. It's hard to define. Yet businesspeople and technologists see applications such as Google Glass and the new Apple Watch, and they get it.

PHOTO: TOM HURST | RFID JOURNAL

So we don't need to define the Internet of Things for companies to begin thinking about how and where they can use IoT technologies. It's important to understand that one day virtually all objects will be connected to the Internet, so they can be identified, monitored and controlled remotely and in many cases automatically, or so they can provide the user with information that otherwise would not be available. To help companies develop an IoT strategy, we provide a roadmap in this issue's cover story (see "How to Benefit From the Internet of Things—*Today*" on page 16).

The vast majority of objects will be connected via passive RFID for two reasons: Passive transponders are the cheapest radios available, and therefore the least expensive way to provide connectivity and interactivity; and passive radios do not require any maintenance. That means even inexpensive items can be tracked and managed with passive tags.

But passive RFID alone won't be enough. Companies that want to monitor the conditions of assets or the environment remotely will likely need to deploy active RFID sensors. In some cases, Near-Field Communication, ZigBee, Bluetooth and Wi-Fi connections will be required. But don't get too caught up in the type of radio you'll need to use. What's important is strategy—and as you'll see in our cover story, you can use IoT technologies to automate processes, build brand loyalty, and monitor the conditions of assets, people and environments remotely.

RFID is already connecting many things to the Internet. Business conference organizers, for example, are putting RFID transponders in badges not only to monitor which sessions people attend but also to allow guests to locate the people they want to meet in real time (see Vertical Focus, page 24). Readers positioned in booths could recognize visitors and match their information to data they entered previously, so exhibitors could present solutions that best meet attendees' needs. Exhibitors would know how long visitors stayed at a booth, and they could use this information to identify their best prospects for follow-up after the event.

Of course, more people are using mobile phones and tablets in the workplace and outside the office to connect to the Internet. Lightweight, low-cost RFID readers that plug into these devices enable them to be used for a variety of business applications, and when necessary the data collected can be shared via the Internet in real time (see Product Developments, page 30). RFID-enabling the devices we carry is just another example of the burgeoning interconnectivity that is the Internet of Things.

Mark Roberti, Founder and Editor

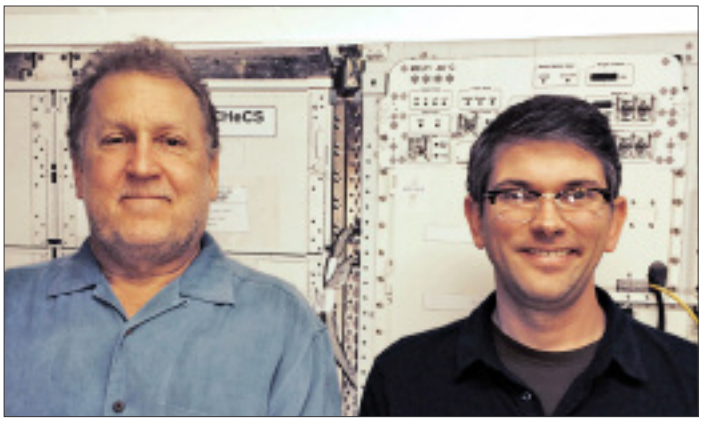
SENSORS

Enabling Ubiquitous RFID Sensors

Two NASA researchers have developed a means for low-cost passive UHF RFID-enabled sensors to transmit data when communication with a reader isn't possible.

THE NATIONAL AERONAUTICS and Space Administration (NASA) would like to put low-cost sensors on space vehicles to monitor structural and environmental health. For new vehicles, the benefit would be an unprecedented level of detailed systems information; for existing vehicles, the benefit would be the ability to capture wear-and-tear information at very low cost and without a lot of crew labor.

But it would be cost-prohibitive to retrofit existing vehicles with wired sensors, and it would require too much crew time. Battery-powered wireless sensors are an option, but it wouldn't be feasible for busy astronauts to change batteries in perhaps thousands of sensors every year or so.



NASA researchers Richard Barton (left) and Raymond Wagner

As NASA researchers Raymond Wagner and Richard Barton examined the issue, they realized they could greatly reduce the amount of energy required to run wireless sensors—extending battery life tremendously—by using RFID. Since passive ultra-high-frequency tags get their energy from an RFID reader, communication could be done with no power on the sensor side. But it would be difficult to ensure the sensors were always getting power from a reader without installing lots of readers around the space vehicle.

To address that issue, the researchers proposed a novel approach in a paper that will be presented this month to the 2014 IEEE International Conference on Wireless for Space and Extreme Environments. "NASA developed delay-tolerant network (DTN) principles to make disruption-prone links—say, from an Earth station to the surface of Mars—more stable," Wagner says. "We're applying the same principles to RFID to deal with the fact that a reader might not always be present to provide energy to the sensor for transmitting data."

The DTN communication protocol, now being standardized, involves one node in a network accepting and taking custody of a bundle of data, then passing it to the next node when possible. Some mesh networks do this today, but they don't always do so reliably unless they're DTN-enabled, and they require power to transmit bundles of information from one node to the next.

In the case of a sensor connected to a standard passive UHF RFID tag, the idea is that the sensor would use its battery power only for collecting data. Wagner and Barton say sensors could also harvest energy from the Sun or some other ambient source to capture sensory data. Either way, the sensor would write the data captured directly into nonvolatile RFID tag user memory. The sensor would also indicate how much data has been stored on the transponder.

When a reader interrogates the RFID tag, the transponder would tell the reader how much data is in a bundle and then transmit the data. Once the reader takes custody of the data, it would tell the tag the bundle has been received and the data can be deleted, so the sensor can write more data. This way, bundles of data can be transferred to the reader, ensuring data isn't lost even if the reader isn't always present when the sensor is collecting data. "We're trying to create a plug-and-play system for low-power sensors," Barton says. "The goal is to standardize this delay-tolerant communication system so anyone can develop a sensor and plug it into an RFID channel for communication. Innovators could create 'lick-and-stick' sensors that ideally require no intervention after they are installed."

The researchers plan to continue developing hardware to prove DTN communication between tags and readers is viable, and then formalize the protocol so it becomes part of the larger DTN standard. "The technology exists to do this today," Wagner says. "It's a question of getting RFID and sensor manufacturers to embrace a standard approach." They would like to use the International Space Station as a test bed to evaluate RFID sensors for vehicle retrofits. *—Mark Roberti*

PHOTO: NASA

PHOTO: TUFTS UNIVERSITY

Tufts researchers Usman Khan (left) and Babak Moaveni with the RFID-enabled quadcopter

INFRASTRUCTURE

Drones to Capture Data From RFID Sensors on Bridges

THE AVERAGE AGE of the 607,380 bridges in the United States is 42 years, according to a recent report conducted by the Obama Administration. One in nine bridges, or nearly 68,000, is rated as structurally deficient. Researchers at Tufts University in Massachusetts (a state where half of all bridges are deficient) are working on a way to use flying robots and RFID sensors to monitor the condition of aging spans.

Babak Moaveni, an associate professor of civil and environmental engineering at Tufts, attached wired sensors to beams and joints on a bridge on the Tufts campus to continuously monitor vibrations. Significant changes in vibration levels can indicate damage.

But it is impractical to run data and power cables for sensors across 600,000 bridges, so Moaveni teamed up with Usman Khan, a Tufts assistant professor of electrical and computer engineering, who has been working on algorithms that enable robots to collaborate and navigate an environment. Khan developed a platform for controlling and synchronizing unmanned aerial vehicles (UAVs).

The researchers envisioned a system for reading data from wireless sensors installed on bridges. Khan has demonstrated that a quadcopter can navigate from one location to the next based on reading a two-dimensional QR code. He has also shown that a quadcopter can host an RFID reader and identify a tag within a distance of 4 inches (watch the video).

The computer on the quadcopter is a simple microcontroller and cannot do a lot of computations. To overcome this limitation, Khan and Moaveni developed algorithms that allow the sensors to remove the spatial and temporal redundancy in their data. The next step is to have the quadcopter capture data from the sensors and perform another action, such as taking a picture, based on the data collected.

"We have done a proof of concept in the lab showing that RFID data can be captured," Khan says. "We have a vision and all of the pieces. The next step is to deploy the solution on a real bridge."

The researchers hope to get funding to purchase wireless sensors to continue their work. Commuters who cross the nation's bridges twice a day will benefit if they do. —*M.R.*

GAPPING THE BRIDGE

Casualties From Bridge Collapses

2014 in Vietnam:
8 dead, 30 injured

2014 in Brazil:
2 dead, 22 injured

2014 in the Czech Republic:
4 dead, 2 injured

2014 in Bolivia:
4 dead, 60 injured

2013 in Norway:
2 dead

2013 in Egypt:
4 dead, 12 injured

2012 in China:
3 dead, 5 injured

2011 in Indonesia:
20 dead, 40 injured, 33 missing

2008 in Georgia:
1 dead, 18 injured

2007 in Minnesota:
13 dead, 145 injured

—Rich Handley

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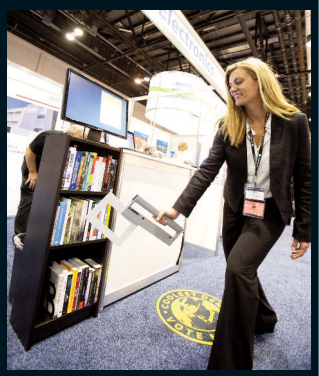

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FINANCE

Can Apple Disrupt the Global Banking Industry?

The company has changed music forever and had a big impact on publishing—and now it's taking aim at a growing segment of the financial sector.

WHEN YOU ARE A GIANT—especially a giant with a reputation for changing entire industries—your mere footsteps can effect change. On Sept. 9, Apple announced Apple Pay, a Near-Field Communication mobile payment solution that takes advantage of fingerprint technology in new iPhones. Within three weeks, eBay announced it would spin off its PayPal unit. PayPal is the leader in online payments and is pushing into mobile payments. But for months, eBay had been rebuffing investor Carl Icahn's demand that it spin off PayPal. PayPal has also begun to talk about embracing NFC for payments.

Square, a startup that provides a peripheral device and application that lets anyone process credit cards on an iPhone, announced it planned to allow merchants to accept Apple Pay transactions. But two major U.S. store chains—Walmart and Best Buy—announced that they would not support Apple Pay. The two are backing CurrentC, an NFC-based mobile payment solution being developed by a network of retail store chains called Merchant Current Exchange (MCX).

Apple certainly has a track record of disrupting industries. It transformed the way music is purchased and distributed. Prior to the launch of iTunes and the iPod, most people purchased their music on CD. But CD sales have been falling steadily, and according to Billboard, more people will purchase albums via download than on CD for the first time this year.

Apple has also had an impact on the way books are purchased, though its influence has not been as great as that of Amazon, which first disrupted the publishing industry with online book sales. But is it a given that Apple will transform the way people pay for goods? Hardly. There are numerous hurdles Apple will need to overcome before Apple Pay is widely embraced.

1 Europe and Asia are already embracing mobile payments.

Visa and other credit card companies have been working with Vodafone, Orange, Telefonica and other telecommunications companies to offer mobile payments across Europe. Several of these use NFC solutions, but others do not. In Asia, RFID payment systems are used in mass-transit systems and have spread to convenience stores and other shops. They tend to use older RFID technology that is not compatible with NFC.

PHOTO: ISTOCKPHOTO

2 Retailers want to control their own network.

Retailers proposed the idea of CurrentC (a play on "currency"), because they would like to control their own network and avoid having to pay additional fees. While Apple is not looking to take any cut of transactions made via Apple Pay, retailers might still prefer to use a network they control. This would enable them to ensure the privacy of their customers and the security of the network.

The initial founders of CurrentC were 7-Eleven, Alon Brands, Best Buy, CVS Pharmacy, Darden Restaurants, HMSHost, Hy-Vee, Lowe's Home Improvement, Publix Super Markets, Sears, Shell Oil, Sunoco, Target and Walmart, which together account for more than a trillion dollars in sales. The network has launched in beta mode, and additional retailers have signed on, including Bed Bath & Beyond, Circle K, Dick's Sporting Goods, Dunkin' Brands Group, Dillard's, Gap, Kohl's, Old Navy, Sears, Sheetz and ShopRite.

Very few of these retailers have installed NFC point-of-sale readers, so it remains to be seen whether they will stick with CurrentC or make the switch to Apple Pay, if it catches on.

3 PayPal could be a major competitor.

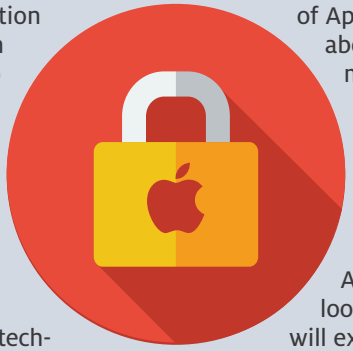
The goal of spinning off PayPal as a separate company is to give it greater flexibility to innovate and respond to market conditions. As soon as PayPal was spun off, eBay appointed Dan Schulman, former president of the payment card network at American Express, as CEO. Earlier this year, PayPal introduced One Touch, a mobile payment feature that allows a shopper with a PayPal account linked to his or her mobile phone to send money to family or friends or pay for goods with a single touch.

One Touch does not have an NFC component, but PayPal's president, David Marcus, said earlier this year that NFC was a technology PayPal was watching carefully. The company could easily create an app that works with the NFC devices in both the new iPhones and with Android phones, giving it a crossplatform solution both Apple and Android phones lack.

While Apple is not looking to take any cut of transactions made via Apple Pay, retailers might still prefer to use a network they control.

Apple Pay and Privacy

THE ADDITION OF Near-Field Communication to Apple's latest devices could mark a profound change in consumer views on radio frequency identification technologies. Until now, consumers have seen RFID mainly as something used by retailers to get more information on their customers. NFC has been in some phones for several years, but its addition to iPhones will greatly increase the number of phones with the technology. It's hard to imagine any smartphone manufacturer will not include NFC in future models.



The use of NFC for payments will give U.S. consumers their first real experience with the technology. They will see that the read range is short, so transactions can't be initiated unless the phone is within a few inches of the payment terminal. That should reduce consumer fears that they can be tracked with RFID technology.

The convenience of NFC payments and the security of Apple Pay should also reassure consumers about the technology. Apple Pay does not transmit a user's credit card information wirelessly, or even store it on the phone. Instead, Apple Pay stores a "token," a random serial number that the bank associates with the credit card. Stealing the token will not enable someone to make an unauthorized payment.

Of course, there is always the danger the Apple engineers and software designers overlooked some security loopholes that hackers will exploit. A widespread breach of Apple Pay's security could cause consumers to abandon NFC as a viable form of mobile payment. Makers of NFC technology are praying that doesn't happen. —*M.R.*

ILLUSTRATION: ISTOCKPHOTO

4 iPhones with Apple Pay will make up only a small part of the market.

Consumers will not be able to use Apple Pay with older iPhones, though they will be able to use it with an Apple Watch in conjunction with an iPhone 5, 5S or 5c. Still, that will be only a small fraction of the total number of smartphone users. Will retailers adopt a solution that requires new POS terminals if only a fraction of their shoppers can use it? Probably not—at least, not right away.

So Apple has the challenge of making Apple Pay common enough that retailers embrace it. Certainly, users of older iPhones will upgrade their phones eventually, and become eligible to use Apple Pay. But that could take years, and in the meantime, other solutions could take hold.

Google Wallet failed to catch on when it launched in 2011, because so few mobile phones had NFC payment capabilities. That is changing, and Google Wallet could reemerge as a competitor for Apple Pay, further complicating the mobile payments landscape.

Despite these challenges, Apple Pay has some advantages. Apple has created a whole product, rather than simply a piece of a product. It signed up banks, credit card companies and retailers to support Apple Pay, which means those who purchase an iPhone 6 or 6+ will be able to use Apple Pay immediately at some 210,000 retail and restaurant locations. That's not many compared with the total number of retail locations in the United States, but if those stores see customers using Apple Pay, it's likely other retailers will jump on board.

Bottom line: Apple Pay is no sure thing to catch on, but don't bet against Apple. *—Mark Roberti*

STRATEGY

Why You Need a Chief RF Officer

NOT MANY YEARS AGO, the only RF devices companies had were cordless phones and laptops with Wi-Fi. Today, many businesses have a plethora of RF devices, including contactless point-of-sale terminals, passive ultrahigh-frequency tags and readers to manage items or supply-chain shipments, active RFID tags to track larger assets, GPS devices to track vehicles, bar-code scanners and Bluetooth devices.

RF devices have been taken for granted because government regulators do a good job of apportioning the RF spectrum so cell phones, for example, don't impede the operation of wireless systems used by first responders. But the wireless explosion has caused some companies to implement policies regarding how new RF devices can be introduced. Boeing, for example, wants to prevent new RF technologies in its factories from interfering with existing RF devices and, potentially, with the testing of RF equipment on planes being built. Hospitals are finding that RF devices, including many medical devices, occasionally interfere with one another.

Boeing hasn't introduced a chief RF officer, but companies should consider creating this executive position. The CRFO would not just institute rules to prevent problems. His or her job would be to understand all the RF communication tools available and how they can be leveraged to create business value. Embracing Internet of Things technology means using many different types of radios to connect things to the Internet.

This is not to suggest that the CRFO would decide whether to use RFID to improve the supply chain or Bluetooth low-energy beacons to engage customers in stores. Those are business decisions. But having input from an RF technology expert could prevent companies from investing in duplicative technologies or systems that would interfere with one another. It also would enable businesses to make smarter decisions about how and where to deploy RF systems, including RFID technologies. *—M.R.*

ILLUSTRATION: ISTOCKPHOTO

ADOPTION

Brazil Is Poised to Become a Major Player in RFID

TO DATE, THE UNITED STATES has been a leader in the radio frequency identification industry. The concept of the Electronic Product Code and the original air-interface protocol standard were developed by the Massachusetts Institute of Technology. Moreover, American technology companies, including Avery Dennison, Impinj and Motorola Solutions, are among the largest providers of RFID hardware.

There are several European and Asian RFID companies, most notably Smartrac of the Netherlands. Now, Brazil is emerging as a potential player in the RFID industry. Centro Nacional de Tecnologia Eletrônica Avançada S.A. (National Center for Advanced Electronic Technology, CEITEC) is a government-backed company that has developed a passive ultrahigh-frequency chip based on the EPC standard. The company has ambitions to be a global player, and government incentives given to Brazilian companies to use the CEITEC chip in their RFID tags could give it an advantage locally that would translate into revenue to expand internationally.

Hewlett-Packard Brasil has been a leader in employing RFID within its own operations. The company is using RFID on its printer manufacturing line to improve visibility and to manage the recycling of printers (HP Brasil has won two RFID Journal Awards; see Keeping Tabs on Printers and Extracting New Value From Old Printers). It plans to add RFID transponders to PCs and laptops made in Brazil, giving it more knowledge of RFID than most high-tech companies.

HP Brasil is also developing a cloud-computing platform

At RFID Journal LIVE! 2014, HP Brasil displayed a cloud-computing platform designed specifically to enable RFID data to be stored in the cloud.

designed specifically to enable RFID data to be stored in the cloud. The platform, which is currently in the prototype stage and was displayed at RFID Journal LIVE! 2014 (in the United States and Brazil), features drag-and-drop functionality that would allow users to configure applications based on their business processes. It also will have business intelligence tools that will provide analysis of RFID data.

Acura Global and other Brazilian RFID companies are producing readers and tags. The Brazilian government often provides incentives to help local companies. Retailers, for example, that are tagging and tracking apparel could receive tax breaks. This could give the use of RFID a boost in Brazil.

Brascol, a wholesaler of baby and children's apparel, needed no such incentive. It embraced RFID for the business benefits. The company tagged 35,000 stock-keeping units, and is currently using 70,000 tags per day, which it purchases from a local manufacturer. It has achieved significant benefits and will soon require its suppliers to buy the tags and put them on items. RFID was part of Memove's business plan when the Brazilian retail chain launched in 2011 with RFID-enabled stores. The Brazilian military has been using RFID at logistics centers to increase the efficiency of distributing supplies to soldiers. Many other companies, such as Petrobras (the national oil company), Vale (a global mining company) and Veiling Holambra (a large horticultural cooperative), are using RFID in a big way. Expect to see Brazil continue to outpace many other areas of the world in adoptiing the technology. —*M.R.*

PHOTO: RFID JOURNAL

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HOW TO BENEFIT FROM THE INTERNET OF THINGS TODAY

RFID lets businesses make smart connections, to automate processes, improve customer loyalty and cut costs with remote monitoring.

By Michael Belfiore

It's no secret that having the right connections is critical to personal and professional success. Or that many people worldwide are devoted to staying connected with friends, family and coworkers, and, increasingly, with devices in their homes and workplaces. So it's no surprise that the Internet of Things (IoT)—a network that promises to connect everything and everyone everywhere to everything and everyone else—is a hot topic in business circles and the media.

The concept of ubiquitous connectivity—between people, machines or objects via the Internet—is seductive and the hype is growing. While the definition of the Internet of Things is still being debated, many companies claim they offer it and others want to know how to get it.

"The IoT is just the name we have given to what you get after 30 years of convergent

ILLUSTRATION: ISTOCKPHOTO

evolution in Internet, wireless communications, processors, memory, lightweight communications protocols, machine learning and sensors," says Scot Stelter, VP of RFID and Internet of Things Research at ChainLink Research. "The IoT, like the Internet, makes a huge variety of applications economically feasible and reliable for the first time."

The IoT is not one network, but many. Some of these networks exist today, some are being developed and some are yet to be imagined. Researchers in China, for example, are developing a platform to track and monitor food from farm to retailer, and enable consumers to access information, such as expiration dates (see Improving Food Safety and Quality in China). The city of Nice, France, is creating a "Connected Boulevard" system that will continuously gather data on traffic, parking, street lighting, waste disposal and environmental quality, to enhance services for residents (see The Future Is Now for Smart Cities).

"The IoT, like the Internet, makes a huge variety of applications economically feasible and reliable for the first time."

—SCOT STELTER, CHAINLINK RESEARCH

But all IoT applications have a common element: To connect the physical and digital worlds, the person, machine or object must be identified. And that's where radio frequency identification comes in. While RFID will not be the only technology to identify "things" and connect them to the Internet, passive ultra-high-frequency and Near-Field Communication technologies are emerging as the two most likely standards.

Millions of assets are already being tracked and managed with passive UHF RFID tags, because the tags cost much less than other wireless technologies and enable automatic processes. "There is no doubt that RFID is going to be a major part of the Internet of Things," says Steve Halliday, president of High Tech Aid, an RFID consulting firm, and RAIN RFID, an organization dedicated to promoting adoption of EPC UHF RFID.

Halliday also acknowledges that the IoT is difficult to define, in part because it is composed of many different technologies. "I've been involved in standards committees for the past two years that are still trying to define what the IoT is," he says. "You have to think about it in different layers." Down at the bottom layer, the foundation of the IoT, are RFID tags and other technologies that identify things and allow them to communicate. "A key part of the IoT is knowing what you're talking to," he says. "That tag can interface to all sorts of sensors—whatever it is you're trying to monitor—and can collect that data. Some of these RFID tags have real buses to the outside world available on them, so you can actually use them to send a command and control an actuator to turn something on or off."

NFC, which is now in both Apple and Android smartphones, extends the IoT's reach to millions of people, says Victor Vega, director of RFID and NFC solutions and marketing for NXP Semiconductors. The potential benefits for both consumers and businesses could soon extend far beyond the ability to replace credit

cards with NFC-enabled mobile phones for payments, he says.

The IoT can be a powerful way for businesses to communicate and collaborate with supply-chain partners and customers, improve processes and offer new services. A big benefit of the IoT is that it enables companies to collect and act on data in real time, says John Shoemaker, an executive VP at RFID provider Identec Solutions. "The Internet of Things is about capturing data and presenting it in a way that allows decision-making that can be proactive, effective and a way to predict other actions," he says. "Predictive analytics is going to be huge."

Businesses that want to develop an IoT strategy should start making the right connections now. Consider the following applications.

Automating Processes

RFID enables machines and objects to identify and authenticate each other, so they can allow the secure transfer of data between them. Companies can use this capability to automate replenishment, prevent theft, customize preferences, and manage maintenance and repairs.

Hospitals, for example, are using RFID-enabled cabinets, refrigerators and freezers from LogiTag or Terso Solutions to manage inventory of high-value medical supplies, such as stents, pacemakers and drugs. A passive UHF reader in a cabinet tracks when a tagged item is removed. Typically, a hospital staff member must swipe his or her RFID-enabled ID badge to unlock the cabinet and remove an item. Software is used to generate replenishment orders, maintain optimal inventory levels and monitor expiration dates. It can also trigger the vendor or distributor to bill the hospital for an item (see Terso Offers EPC-Enabled Medical Cabinets and New York Hospital Queens Tests RFID Inventory System).

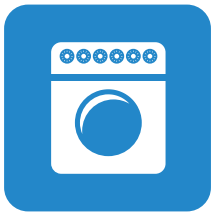
The RFID solution enables the hospital and the vendor to adopt a consignment business model, which benefits both parties, says LogiTag's CEO Shlomo Matityaho. "We think the future of this technology is mainly to connect and to eliminate several layers of the supply chain," he says. "The idea is to connect the point of use to the manufacturer or the logistics company. So then we can take several layers out." LogiTag also offers the StockBox, which has a small footprint and can be placed in areas where there's no space for a cabinet. It also enables automatic restocking (see Bnai Zion Medical Center Expands LogiTag RFID Solution for Automatically Tracking, Reordering Stock).

> "We think the future of this technology is mainly to connect and to eliminate several layers of the supply chain."
>
> —SHLOMO MATITYAHO, LOGITAG

Love's Travel Stops and Country Stores, a retailer that operates truck stops that sell fuel, food and supplies across 39 U.S. states, adopted the Fuel Island Management RFID-enabled antitheft solution provided by QuickQ. An RFID reader in a fuel pump automatically identifies and authenticates a tagged truck, and the pump locks up if the vehicle strays too far from it. This not only enables a truck driver

to fuel up more efficiently, it also prevents fuel fraud (a few unscrupulous truckers have, in the past, sold fuel to another driver on the company's account and pocketed the cash). In addition, the QuickQ solution includes DF-Connect payment software, which is linked to Love's point-of-sale system, to automate billing (see Love's Tries RFID for Automating Fuel Payments).

Consumer electronics manufacturers that install NXP's new NTAG I²C NFC chip in household appliances can improve their brands by enabling IoT applications for retailers and customers. The chip combines NFC technology with a built-in I²C interface, so users can communicate directly with a tagged device via a smartphone, and then access related information on the Internet (see Smarter Things).



> "There are devices out there with touch screens, and they have Wi-Fi and Bluetooth, but they're expensive. The majority of users won't pay for that."
>
> —VICTOR VEGA, NXP SEMICONDUCTORS

Vega offers the example of a smart washing machine. A new owner could use his or her smartphone to access the machine's serial number and quickly register the device with the manufacturer over the Internet. Then, advanced features on the machine could be accessed with a tap of the phone. If there were a problem with the device, an owner could retrieve detailed information about error codes and repair videos on the Internet. If necessary, a repair technician on a service call could tap his or her own phone to the washing machine to call up detailed customer information and repair history from the manufacturer, also via the Internet.

One of the benefits to manufacturers, Vega says, is that since the owner, technician and everyone else who interacts with the machine brings his or her own phone as an interface device, the screen and other potentially expensive interface elements don't have to be built into the machine. "I'm not putting the cost inside this low-end mass-market device," he says "There are devices out there with touch screens, and they have Wi-Fi and Bluetooth, but they're expensive. The majority of users won't pay for that."

Building Customer Loyalty

You're already using RFID to track and manage parts, products, work-in-process and other "things" within your own facilities and perhaps through your supply chain. You're gathering a wealth of real-time data that's helping you improve operations, lower costs and boost sales. But why stop there? Agricultural, logistics, manufacturing and retail firms are among those using the data to share information, such as the location, condition and origins of products, with clients and customers. That, in turn, engenders customer loyalty in a product or service.

Take, for example, Almacafé, a subsidiary of the National Federation of Coffee Growers of Colombia, which is using RFID to track specialty coffee beans from farm to warehouse, and during processing and bagging for export. This enables the Federation to compete better in the global market, because clients want to know the regions and conditions that pro-

duced the specialty beans. They also want quick access to order status, which they can get by logging onto BeanTrack, a Web-based application. In addition, coffee connoisseurs can check the origins of their brew at a Juan Valdez Café or the coffeehouse chain's website (see RFID Helps Ensure That Special Cup of Joe).

Brick-and-mortar retailers are also using RFID technology to engage customers in stores and compete with online shopping sites. U.S. jewelry company Ritani, for example, is deploying an RFID solution that enables retailers that sell its jewelry to automatically display information about merchandise and let shoppers share the items' images and descriptions with friends or family members before and after making purchases. The UHF passive RFID solution will also let store managers know how often a particular item was viewed and whether it was purchased (see Ritani Creates RFID Solution to Engage Shoppers, Increase Sales).

At 32 of Bon-Ton's U.S. department stores, shoppers in the shoe department can use their NFC phones to learn more about each style, as well as whether it's available at the store in a specific size and color—and if it's not, how to get it most efficiently (see Bon-Ton Brings NFC to Shoe Displays). Similarly, Made, a designer-brand online furniture retailer, is employing an NFC solution that lets shoppers at the company's London showroom access product information and create wish lists (see Online Furniture Retailer Adds RFID to Its Brick-and-Mortar Showroom).

In addition, NFC has become a popular marketing tool for myriad companies and organizations—including the Coachella Valley Music and Arts Festival, Vail Resorts and carmaker Lexus—that are using NFC phones, social media, and interactive ads and promotions to engage consumers and turn them into customers (see The New 'It' Tool for Branding Products and Services).

Remote Monitoring

RFID, often coupled with sensors, is enabling companies and organizations to monitor buildings, people and other things remotely. This makes it possible to improve efficiencies while reducing labor costs.

The Hong Kong Housing Authority, for example, has mandated the inclusion of RFID tags in building materials, including concrete blocks, wooden doors, aluminum window frames and metal gates, used in the region's public housing projects. RFID is employed to control the quality of building materials, track building processes and make maintenance systems more efficient. Contractors must collect logistics and manufacturing information; the electronic records are stored on the Internet, along with maintenance and repair logs. Housing Authority managers and others involved can access the information quickly to address quality-control issues as well as lifecycle management. RFID is also used to monitor the collection and proper disposal of construction materials. Here, too, the infor-

RFID, often coupled with sensors, is enabling companies and organizations to monitor buildings, people and other things remotely.

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mation is stored on the Internet, so contract managers and government departments can verify that there was no illegal dumping.

Telemedicine, which involves collecting patient data and transmitting it to doctors remotely, can reduce hospital visits, provide a way for health professionals to care for an aging population, and allow the elderly to continue living in their own homes. Researchers are developing various RFID devices and solutions that wirelessly communicate a patient's heart rate, temperature and other vital data (see Wearable Sensors for At-Home Patient Monitoring), as well as ensure that an elderly patient is taking his or her medicine (see Nyack Hospital Tracks Medication Compliance) and monitor daily activity to promote safe practices (see Helping Seniors Stay Independent).

In the United Kingdom, the Bath and North East Somerset branches of Bluebird Care are using an RFID solution to manage services supplied by home health-care providers. Aides are issued NFC mobile phones, which they tap against an RFID tag installed in a client's home, to indicate when they arrive and leave. The phone also allows for calls, text messages and Internet browsing, while the software collects data regarding visits and gives workers details about the tasks they must complete at each site (see Gentag and AHC Debut NFC RFID Solution for North American Home Health Aides).

These RFID Internet of Things applications are just the beginning. Startup company Proteus Digital Health, for example, is developing an RFID sensor pill that is powered by stomach acids. A stick-on patch on a patient's skin will act as a reader and pair with a smartphone. The system could track the dosage and time of medications taken, and send alerts to the patient and caregivers. "We seek to turn the moment you take your medicine into a digital interaction that connects you to your family and care team," says Robin Suchan, Proteus' communications manager.

Manufacturers could use RFID to enable machines to recognize humans. In aerospace plants, for instance, there are many tools workers must be certified to use, and workers may need to be recertified every year or two. An RFID-tagged tool could recognize a tagged worker and go to the Internet to check whether his or her certification were up to date; if not, the tool wouldn't allow the worker to operate it.

"There'll be over 20 billion UHF tags out there by 2020," Halliday says, noting that any of these tags could become part of the IoT. Similarly, NFC will become commonplace in myriad devices, enabling innovative IoT applications, Vega says.

There's no doubt companies can benefit from the Internet of Things today and in the not-so-distant future. Thinking about the IoT's likely impact on business and global industry, Stelter says, "is like trying to say what the business benefits are of the Internet." ■

> "There'll be over 20 billion UHF tags out there by 2020"; any of these tags could become part of the IoT.
>
> —STEVE HALLIDAY, HIGH TECH AID

Editor's Note: In the November/December issue, we will examine RFID Internet of Things applications that employ the Electronic Product Code Information Services (EPCIS) standard for sharing data among supply-chain partners.

vertical focus: business events

RFID Benefits at Business Events

By Jennifer Zaino

PHOTO: ISTOCKPHOTO

PHOTO: ISTOCKPHOTO

Monitoring attendees can help conference organizers plan and deliver better shows, and provide exhibitors with more qualified sales leads.

THE ANNUAL, THREE-DAY C2MTL (Commerce + Creativity in Montreal) event takes pride in its novel approach to helping business leaders solve problems. At this year's conference, in May, the organizers also implemented an innovative RFID solution from Connect&Go to improve attendees' experience. The solution discreetly monitored access to the event and fostered engagement among guests. It also tracked where attendees were congregating within the 100,000-square-foot Arsenal complex, to ensure there were enough food and beverage servers.

The roughly 4,000 attendees, mostly C-level executives, were issued identification badges embedded with an ultrahigh-frequency tag. Fixed RFID gates set up at the complex's entrance, conference rooms and main forum rooms facilitated a fully contactless and seamless flow. C2MTL wanted attendees to feel welcome and not

"When you're talking about tracking big areas like expo halls with 17,000 people going in and out, the organizers want to get a feel for what are the peak times or if they had dead times."

—DALE BOOKOUT, GLOBAL REGISTRATION SOLUTIONS

have security agents looming over them to check their badges to verify access. "Security was not necessarily an issue, but that said, because of the high value of the tickets, we wanted to make sure the right people were getting in at the proper access they paid for," says Martin Enault, VP, partnerships and technology at C2MTL, who notes a ticket cost $3,600 for a three-day package.

A main focus was reducing queues for sessions, Enault adds. The portals were positioned so only the agents could see lights indicating an invalid badge; they could then approach the individual discreetly, says Anthony Palermo, co-founder of Connect&Go and director and co-founder of RFID Academia.

RFID antennas were installed in the chandeliers in networking lounges, where there wasn't enough traffic *en masse* to justify setting up portals. The antennas detected who was in the area and transmitted their names and titles to a smartphone application, so attedees could know instantly of others' arrivals. They had to sign up to be tracked like this, Enault notes. It was not done without their knowledge.

"The business case for us was fairly simple," Enault says. "Using RFID enabled us to facilitate people meeting each other, and C2MTL is about connecting people and business together. It made networking easier. For us, that is ROI because the more deals being made here leads to more people wanting to come here and more partners for the event."

The information gained from having better insight into attendee flow at this year's event also will help C2MTL organizers plan for 2015, Enault says. Not all guests, for example, attended every conference session; some watched on screens outside conference rooms or were otherwise engaged. For all but a few key speeches, there were more seats than attendees in the rooms. "So we know we can sell more tickets next year without risking people not getting a seat in the conference rooms," Enault says. "The additional tickets we can sell for next year alone can pay for the entire RFID system."

In addition, the Connect&Go RFID system gave C2MTL the raw data—including time stamps to know how long individuals spent in various sessions and zones—to leverage in other ways. It can see, for instance, which sessions drew which types of attendees in terms of business function, or which topics got more traction, to help craft its next schedule to increase appeal to those demographics and interests. C2MTL also is working with a partner to slice and dice the information it gained from the RFID deployment with other data feeds, to understand things such as whether weather conditions during the event affected attendance at some points. "We want to use analytics to offer the best experience to our attendees, based on data accumulated at past events," Enault says.

RFID technology has been a presence at concerts, sports events and other consumer venues for several years, helping marketers engage with audiences, shoppers and vacationers (see The New "It" Tool for Branding Products and Services). RFID Academia developed the Connect&Go UHF Access & Monitoring System as an RFID keychain or bracelet for access control and marketing activation at consumer events. Deploying RFID technology in the business-to-business conference sector is still in the early stages, says Keith McKenna, VP of convention operations at Wyndham Jade, which provides convention housing and show registration services. Before RFID becomes commonplace at B2B events, conference organizers as well as exhibitors need to better understand how they can benefit from RFID-generated data. That, in turn, could override any concerns about deployment costs.

IT'S ALL ABOUT THE DATA

B2B event organizers that have employed RFID for attendee tracking value the data RFID can deliver to them about event flow, says Dale Bookout, owner of Global Registration Solutions, which provides show-management services. "When you're talking about tracking big areas like expo halls with 17,000 people

In September, HealthPort used in-booth RFID at the AHIMA Convention & Exhibit to collect as many leads as possible.

PHOTO: GLOBAL REGISTRATION SOLUTIONS

going in and out, the organizers want to get a feel for what are the peak times or if they had dead times," he says. That data can inform future plans, such as having an icebreaker event on the floor during down periods to drive traffic.

Some event organizers offer RFID-enabled kiosks, where attendees can scan their badges and post comments on social-media sites. There are also opportunities to leverage information collected from RFID technology for feedback, in conjunction with surveys typically given to attendees, says Lance Burnett, CEO and founder of systems integrator Stark RFID. "Assuming you are delivering the right content, then you look at who went where and did what at the show, and how they felt about it, and you can determine from there if they were heavily engaged and interested," he says. At trade shows, this information could be shared with exhibitors to help them better target their follow-up activities.

In fact, conference organizers can use RFID as a marketing tool to potential exhibitors, offering either to share the data they collect or to install readers at their booths. "You want to know that [the event] is worth it," Burnett says, "and the only way to really know that is to have true data about who's coming by and what they're doing."

In December 2013, Global Registration Solutions worked with an exhibitor to test an in-booth RFID application. With a traditional handheld scanner, the exhibitor recorded 12 sales leads. The RFID antennas automatically read visitors' ID badges, and its software reported on more than 200 prospects. "So there were over 200 people there that they would have had no idea about if they were just using a traditional handheld scanner," Bookout says. "Not only did they get the quantity, but they also knew when they were at the booth, where in the booth they were and how long they were there." That can inform everything

"Any conference that employs RFID and 'owns' the data should be extremely careful about what they do." It's fine to provide exhibitors with details regarding who visited their booths and how long they stayed there, but sharing that information with a competing exhibitor would be "going too far."

—ANTHONY PALERMO, CONNECT&GO, RFID ACADEMIA

from how future events are staffed at the booth to what products and services are resonating with buyers.

Global Registration Solutions is now marketing the RFID solution. In September, HealthPort used in-booth RFID at the AHIMA Convention & Exhibit, held in San Diego. Its main goal was to collect as many leads as possible, Bookout says. The show just closed, he adds, so "HealthPort hasn't had a chance to review their dashboard that contains all the 'bigger data'—who, how long, where, domestic versus international, trends in regions or registration types, peak hours."

Palermo agrees that opportunities exist for exhibitors to get value out of RFID-generated data. Connect&Go's software can, for example, assess how many times a particular tag was read by a certain antenna. If it's read multiple times in the space of a minute or so by an antenna positioned inside an exhibitor booth, it likely means the person has stopped for a closer look. "If it records someone stayed there for five minutes," he says, that could indicate the person is a good prospect for a follow-up sales call.

There's also an opportunity to use RFID "to showcase client products and solutions in a way that improves the experience and engagement opportunities with attendees," says Casey Cote, CEO of Omnience, an event-management company. An exhibitor, for instance, may have 10 or so solutions it wants to push. RFID antennas in booths can recognize attendees as they enter a space and match that to data they have previously entered about their needs to pull up the three most relevant solutions. "So it pushes their message to the attendee, but with the attendees' desire in mind," he says.

"Any conference that employs RFID and 'owns' the data should be extremely careful about what they do," Palermo says. It's fine to provide exhibitors with details regarding who visited their booths and how long they stayed there, he says, but sharing that information with a competing exhibitor would be "going too far."

TECHNOLOGY OPTIONS

Other technologies are competing with UHF RFID for a spot in the B2B conference world, including Bluetooth and Apple's iBeacon, Near-Field Communication and QR codes, all of which require use of a smartphone. AllianceTech, an event technology solutions provider, offers UHF RFID, as well as other technologies, depending on customer requirements. RFID is generally the choice today, especially for larger and bigger-budget events, says CEO Art Borrego. It works "when a conference organizer says it has a conference with over 500 attendees and wants to track visitors to general sessions and multiple breakout sessions that are happening at the same time unobtrusively," he says. "That is the key word."

The general consensus is there can be a place for NFC, QR code and iBeacon technologies at business events, but more as a supplement to UHF RFID rather than a replacement for it. NFC, which has a short read range, might be reliable for tracking small groups at breakout sessions, but "RFID tracking doing long-range is most preferable" for events that draw big crowds, says C. Russell Brumfield, founder of Wizard Event Technology Partners.

"As popular as smartphones are, everyone doesn't really have one yet," says Wyndham Jade's McKenna. So, regardless of how many applications there are that leverage such technologies for things like attendee tracking, he says, "by relying on those, you're at risk of not looking at 100 percent of your attendee base."

In addition, you can't count on attendees who have smartphones to turn them on and use one of the technologies. "You hear of tracking people with Bluetooth and other ways, but you have to rely on people turning on Bluetooth, on attendees downloading the app," Bookout says. "You don't have control over that, and if you can't control that you can't have accurate reports."

Some companies are trying new ways to leverage UHF RFID technology in the B2B events space. At the CommunicAsia conference in Singapore in June, organizers deployed

a UHF ground mat antenna from Times-7 to track attendee movements, says CEO Antony Dixon. The mat technology was developed for track runners or drivers to record timing at racing events. This approach "means that you don't have to erect portals or trussing," he says. "It's ease of deployment—faster, more convenient and less intrusive visually. And there's no compromise on performance."

The mat also presents a branding opportunity, Dixon says. "A company can brand the mat with whatever the marketing message is," he says. "The intention is to develop a way to make it easy to do that and reusable, too," for renting to clients for different events. AllianceTech also offers Times-7 ground antennas as an option for customers.

At a recent car show, Stark RFID worked with a major auto manufacturer to provide visitors with tagged mobile phone earbuds. UHF RFID readers were positioned around a range of cars on all sides on a giant stage. When consumers approached the driver's side, for instance, they heard content about driver-side features. For dealership representatives, the application triggered information in context of their business relationship with the company. Burnett says this application can be applied in the business event space as well.

COST VS. VALUE

Conference organizers are wary of the cost of implementing an RFID solution. In most cases, they contract with providers to install RFID equipment and RFID-enable badges for an event. "RFID is not at the point yet where it can be set up by the customers themselves," Borrego says.

RFID-enabling badges isn't a big expense, McKenna says, but configuring multiple reader access points to cover general session halls, conference rooms and other areas, so the show organizer itself sees value from RFID, can get expensive. "A lot of associations that do shows are nonprofits," he says, "and that does limit their amount of spending on certain things. "

As the RFID B2B events space matures, it remains to be seen if and how exhibitors will access attendee data. Event organizers could provide the data as a service or for a fee. Exhibitors could work through conference organizers to have RFID installed in their own booths, or they could deploy the technology on their own. Installing RFID readers in booths is still a sizeable cost compared with the use of traditional handheld scanners, McKenna says.

Trade show exhibitors that see the value of RFID could propel adoption, Borrego says, because they carry enough weight to propel the introduction of RFID into the experience. "They buy the booth space and they pay the show producer," he says. "They can tell the show producer they need to track their visitors to their booths, and that they want RFID in the badges to report and understand unique visitors to the booth, by product, and to better qualify lead scans."

There's also the prospect of shifting much of the RFID infrastructure burden to the venues themselves. Stark RFID is "working with a major hotel and conference center to potentially outfit their whole facility full-time with RFID hardware, so that when they have an event or trade show, they have that service available," Burnett says. "So they can charge a premium or use it as a distinguishing factor to bring in that conference or trade show."

RFID is slowly making inroads into the B2B event sector, McKenna says. Some organizers want to differentiate their events, driving more attendee engagement and exhibitor interest in an age when businesspeople's travel budgets may be restricted and webinars beckon as low-cost alternatives. The good news, he says, "is that we have yet to have any clients that have gone into RFID that have stopped using it."

Event organizers should consider the useful and innovative ways to leverage RFID for B2B events, rather than focusing primarily on implementation costs, says C2MTL's Enault. "RFID opens other doors than simply access control," he says. "If you think about the budget first, you are not usually seeing the big picture and the different revenue and other value you can create based on RFID."

"RFID opens other doors than simply access control. If you think about the budget first, you are not usually seeing the big picture and the different revenue and other value you can create based on RFID."

—MARTIN ENAULT, C2MTL

MOBILE RFID READERS

WHAT YOU NEED TO KNOW ABOUT

When paired with smartphones or tablets, these lightweight, low-cost devices can be used for a variety of business applications.

BY BOB VIOLINO

One of the biggest trends in the business community today is the huge growth of mobile devices in the workplace. Many organizations provide employees who work outside the office or away from their desks with smartphones or tablets. In addition, a growing number of companies have launched "bring-your-own-device" programs, which allow employees to use their consumer smartphones or tablets to communicate and collaborate with customers and colleagues and access corporate networks and data.

The mobility trend is fueling the growth of radio frequency identification readers that plug into smartphones and tablets. There are two main types of these products on the market: small, lightweight devices that attach to smartphones and tablets and turn them into RFID readers, and light, low-cost RFID readers that become full-fledged readers when partnered with smart devices. They all support the passive ultra-high-frequency EPC Gen 2 protocol, to meet the volume of tags being deployed in the field, says Michael Liard, an independent analyst who

FACING PAGE

Nedap Retail's !D Hand reader is a Bluetooth-linked device designed for the retail industry.

PHOTO: NEDAP RETAIL

"These are not typical handheld readers or bar-code scanners; these are devices employees use in their everyday lives."

MICHAEL LIARD, RFID ANALYST

focuses on RFID technology. The readers can be used for a variety of business applications, including access control, asset tracking, authentication and verification, food safety and traceability, inventory management, logistics and transportation.

"This technology has been in development for quite some time, and we've now seen the creation of a market opportunity with the continued penetration of consumer-grade devices" in the workplace, Liard says. "We're seeing more employees, whether it's [production] line workers or shop-floor managers or retail associates, using these mobile devices as part of traditional auto-ID capture solutions."

A key factor in the rising demand for RFID reader products for mobile devices is that many workers are already comfortable with the form factors and functionality of their consumer phones or tablets. "These are not typical handheld readers or bar-code scanners; these are devices employees use in their everyday lives," Liard says. "So there is a measure of comfortability and ease of use."

Also bolstering demand is the fact that it can be cheaper for companies to buy mobile RFID readers for consumer devices than to purchase conventional handheld RFID readers. "The total cost of ownership is lower with these types of devices," Liard says. "And if people bring their own devices into these environments, that also enables cost savings."

In addition, the devices can provide customer service benefits for retailers and other companies. "Employees in a store may be more approachable" than if they're using traditional RFID readers, Liard says. "If shoppers see a device that is similar to the device in their own pockets, there's a measure of psychological comfort in terms of customer experience and service."

When choosing a mobile RFID reader, you need to consider the devices supported and form factor. Some readers are designed for use in virtually any industry; others are geared to specific verticals, such as aerospace or retail stores. See the table on page 33 for some leading providers of RFID readers for mobile devices.

PHOTO: MICROELECTRONICS TECHNOLOGY INC.

PLUG-IN READERS

Small, slim, compact, convenient, ergonomic, efficient and affordable—these are some adjectives RFID providers use to describe plug-in devices that attach to smartphones and tablets and transform them into RFID readers. "Handheld RFID readers are typically expensive, bulky, narrow use-case devices, require battery charging management, require significant training and are not flexible for customization of software applications," says Darryn Prince, RFID business head at mobile reader provider Microelectronics Technology Inc. (MTI).

MTI's Mini Me product allows users to read and write ISO 18000-6C tags with an Android device, Prince says. Commercially available USB on-the-go (OTG) extension cables can be used to position a Mini Me away from the host device to extend the read range. "Since Mini Me provides the [interface] between the tag and mobile smartphone or tablet, the tag data uses the wireless networking capabilities of the mobile host [for example, cellular, Bluetooth or Wi-Fi] to communicate the data to the

PHOTO: **MTI's Mini Me product allows users to read and write ISO 18000-6C tags with an Android device.**

Some Leading Providers of RFID Readers for Mobile Devices

Company	Product	Devices Supported	Size and Weight	Read Range	Connection and Battery	Industries	Applications	Cost (US $)
Asterisk asreader.com	RFID AsReader	iPhone and iPod Touch; EPC Gen 2 UHF reader/writer	2.5 x 5.6 x 0.7 in. (64 x 141 x 18 mm) 3.2 oz (90 gms)	3.3 ft (1 m)	iOS and MFi interface; lithium-ion battery	Health care, manufacturing, logistics, retail	Access control; tracking products	$1,200
MainTag maintag.com	WaveBox Cube	iPad and Android-based tablets; EPC Gen 2 UHF reader/writer	4.5 x 1 in. (115 x 25 mm) 16 oz (450 gms)	20 ft (6 m)	Bluetooth; lithium-ion battery	Aerospace, aviation	Asset management for inventory and maintenance of airplane cabin passenger and security equipment	$1,000
Microelectronics Technology Inc. mtigroup.com	Mini Me RU-827	Android USB OTG host-mode powered smartphones and tablets; EPC Gen 2 UHF reader/writer	1.5 x 1.3 x 0.6 in. (38 x 33 x 15 mm) 0.5 oz (14 gms)	Up to 1.6 ft (.5 m)	USB HID; no batteries to charge or replace (uses battery of smart device)	Applicable to many industries	Access control, asset tracking, authentication and verification; event management; inventory and document management	$199
Nedap Retail nedap-retail.com	!D Hand	Windows CE devices and iPod, iPhone and iPad; dual EPC Gen 2 UHF and NFC reader	8.8 oz (250 gms)	3.2 ft (1 m)	Bluetooth; rechargeable lithium-ion battery	Retail	Cycle counts, goods receiving, product search and other store processes that can be executed with RFID	Available on request
Technology Solutions (UK) tsl.uk.com	1128 Bluetooth UHF RFID Modular Rugged Reader	Laptops, smartphones and tablets with Android, iOS or Windows OS; EPC Gen 2 UHF reader/writer	13.4 oz (380 gms)	Up to 13 ft (4 m)	Bluetooth; rechargeable lithium-ion battery	Logistics, warehousing and distribution	Asset management (including roll cages and vehicles); storing maintenance and inspection records	$1,350
U Grok It ugrokit.com	U Grok It Smartphone RFID (the Grokker)	iPhone, iPod Touch, iPad; iOS 4.3 and later Android phones and tablets; EPC Gen 2 UHF reader	6 x 3.8 x 1.5 in. (153 x 95 x 38 mm) 6 oz (170 gms)	6-10 ft (2-3 m)	Proprietary connection with standard audio port; rechargeable lithium-ion battery	Health care, livestock and retail	Asset and inventory management; open software development kit available on website	$500

Mobile RFID readers are relatively new—most of the products have been introduced within the past two or three years—and it is likely new RFID providers will enter the market in the near future.

home office or into the cloud," he explains.

"We have customers now using and evaluating Mini Me in nearly all UHF RFID market segments and applications, including access control, interactive experiences, inventory management, document control, event management, authentication and verification, identification and tracking," Prince says.

MainTag's WaveBox Cube was designed to enable fast inventory of aircraft cabin passenger security equipment using an iPad. It attaches to an iPad's protective case and communicates with the tablet via Bluetooth. FlyTag manager, the inventory software embedded in the iPad, displays a 3-D view of the cabin and all tagged assets, and gives access to each item's information stored on an RFID tag (part number, serial number, expiration date, presence), according to Alexis Beurdeley, VP of MainTag.

PHOTO: **The WaveBox Cube was designed to enable fast inventory of aircraft cabin passenger security equipment using an iPad.**

The WaveBox Cube can be used for several other applications in various sectors, Beurdeley says. The agriculture, food and pharmaceutical industries are "highly interested in this device," she says, noting that the device can monitor inventory of a large number of RFID-tagged items in a matter of seconds.

The use of a tablet offers a larger, high-definition screen than handhelds, Beurdeley says. "The WaveBox Cube was designed to be attached to a smart tablet in a way that it wouldn't affect the use of the tablet or related operations," she says. "As the tablet or other smart device controls the WaveBox Cube, it sends encoding or reading orders and stores the collected data. This data can then be sent remotely to a back-end database using Bluetooth, Wi-Fi, Ethernet or cellular data flows."

Asterisk's AsReader "connects directly with the iPhone/iPod Touch to provide a very lightweight solution that fits into a shirt pocket," says Jim Curry, director of marketing and sales. Read/write buttons are installed on each side of the product, to enable flexible operation by right- or left-handed users, he says.

The product is suited to either in-facility or field use. The data it collects can be uploaded to corporate databases via Wi-Fi or cellular networks. It's been adopted by several industries, Curry says, including automotive, medical production and retail.

U Grok It's reader, the Grokker, can be used like a conventional handheld reader in inventory and asset-management environments, says Carrie Requist, CEO and co-founder. But, she adds, because the product is light and intuitive to use, it expands areas where RFID can be used, beyond the reach of conventional handheld readers. The product was designed for natural one-handed operation, since users of handhelds are most often in environments where they move around. This leaves the other hand free to open doors, pick up items and move items out of the way, while still being able to scan and see and hear the Grokker's feedback, she says.

The Grokker can scan and buffer if the user is in an area with no connectivity, or it can send data in real time over Wi-Fi or cellular networks, making it suitable for field installers, traveling salespeople and utility workers, Requist says.

Android and iOS app developers "can now look at RFID as a feature they can implement in their apps instead of RFID always having to be the central determining feature of the solution," Requist says. "For example, legal office apps can add the ability to track and find files.

PHOTO: MAINTAG

U Grok It allows companies to benefit from RFID without having to invest in a major implementation and without requiring their RFID usage to be full time to justify the investment."

U Grok It's reader is designed for natural one-handed operation.

LIGHTWEIGHT READERS

These RFID readers may be light to hold, but they are no lightweights when it comes to doing the job—as long as they're paired with a smart device.

Nedap Retail's !D Hand reader is designed for the retail industry, says Danny Haak, product manager for RFID. He says several hundred stores in Europe are using the device.

The !Hand does not plug into a smart device. "The fact that it is a Bluetooth-linked device allows the store employees to carry a mobile device around for payments and customer assistance, and only pick up the RFID reader part when necessary," he says. Bluetooth is fast enough not to limit the RFID reading performance in any way, he adds.

"Due to lanyards or other carrying methods, people don't feel it as two separate devices," Haak says. "When people don't need the !D Hand RFID reader, they don't have to carry it, but still have access to all the stock data in their mobile device. Only when they need to do a cycle count, they can pick up the reader."

TSL's 1128 Bluetooth UHF RFID reader works in harsh environments.

Technology Solutions (UK) Ltd.'s 1128 Bluetooth UHF RFID modular ruggedized reader is unique in the market in that it's designed to be used in harsh environments (for example, at operating temperatures of -4° Fahrenheit to 140° Fahrenheit). The company offers custom wrist- and belt-mount accessories for easier handling.

The 1128 UHF reader supports a diverse set of applications, including logistics, warehousing and distribution, reading/writing data on pallets and roll cages before loading onto vehicles, and storing maintenance and inspection records. The device can access the latest mobile applications and take advantage of the smart device user interface and functionality, says David Evans, TSL managing director.

Mobile RFID reader providers believe that as RFID adoption grows and businesses deploy more smart devices in the workplace, their products will become an essential tool to help companies get an ROI.

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RFID JOURNAL

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The 1128 Bluetooth RFID reader is capable of scanning thousands of items at one time, so it's also suitable for hospital asset tracking and retail inventory management, Evans says. "We have seen a huge demand in the retail sector," he says. "We partner with industry leaders such as Tyco Retail Solutions, Checkpoint and Xterprise to market the solution."

RIDING THE RFID AND MOBILITY WAVE

Mobile RFID readers are relatively new—most of the products have been introduced within the past two or three years—and it is likely new RFID providers will enter the market in the near future. In 2012, startup Flomio, with funding from Kickstarter, introduced the FloJack, a pocketsize, one-ounce dongle that serves as a Near-Field Communication reader when plugged into newer Apple and Android devices. The company recently announced that it is discontinuing that product and replacing it with the FloBLE, due out in mid-November, which founder Richard Grundy says will provide a better user experience.

Flomio targets the "do-it-yourself market, primarily developers and hackers," Grundy says. "We sponsor hackathons and other developer events with the intent of evangelizing RFID technology adoption in all applications. We've found that the events industry has been the first to adopt our products, given their size and fast deployment."

Readers designed for mobile devices have provided enhanced antenna performance, says industry analyst Liard, but he expects vendors will work on making them even better, including offering different shapes to accommodate devices of various sizes and using superior materials to improve performance. "If you look at traditional handheld readers," he says, "one of the challenges has been around antenna design and performance" and ensuring that users can get sufficient read accuracy from various angles. "As phones get larger, wider, smaller or thinner, you have to accommodate that."

Asterisk's AsReader is suited to either in-facility or field use.

Mobile RFID reader providers believe that as RFID adoption grows and businesses deploy more smartphones and tablets in the workplace, their products will become an essential tool to help companies get a return on investment from an RFID deployment. "Enterprises use U Grok It to increase the ROI of their RFID solution by being able to have more people interact with the RFID tags, such as salespeople on the showroom floor and maintenance people," Requist says.

"In the coming years, most retail fashion stores will switch to RFID, followed by all the other retail chains," says Nedap's Haak. "The growth potential of the !Hand is enormous."

The AsReader already has a significant share of the handheld RFID reader/writer market in Japan, according to Asterisk's Curry, who notes that the company is just launching the product in the United States and Canadian markets. "We anticipate significant growth in these two markets," he says.

Antenna designs will have to come in different shapes to accommodate devices of various sizes.

PHOTO: ASTERISK

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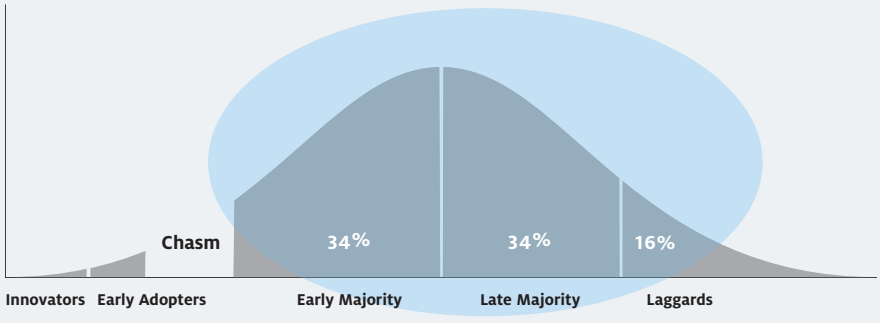

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Security in the Cloud

Here's how to protect RFID applications from hackers.

By Ken Traub

IN OCTOBER, I attended the inaugural meeting of RAIN RFID, an organization dedicated to promoting adoption of EPC ultrahigh-frequency RFID. Bill McBeath, chief research officer for ChainLink Research, reported that 60 percent of new RFID deployments are cloud-based. This is not surprising. Cloud computing is a natural fit for RFID applications, given their widely distributed nature and the massive amounts of data they collect.

But these applications are vulnerable to the well-known security risks of cloud computing—and more. That's because they are accessed by human users and RFID readers. A reader tracking goods on a retail shelf, for example, might autonomously connect to the cloud via the Internet to deliver its data.

Despite the ongoing reports of database hacking, there are effective, albeit not guaranteed, ways to secure data in the cloud (just Google "cloud security"). Companies developing cloud-based RFID applications must implement those countermeasures, and then take the following steps.

Secure the communication protocol between a reader and the cloud. Use a secure protocol like HTTPS and configure each reader with an access credential, similar to a password. That way, the cloud application can accept data only from an authorized reader. In addition, set each reader to authenticate the cloud—for example, by examining a digital certificate presented by the cloud application—so it doesn't send data to a "man-in-the-middle" attacker.

Protect the access credential. Unlike a password, a reader's credential must be stored in nonvolatile memory on the device for use each time it connects to the cloud. To prevent an attacker from breaking into the reader's network connection and stealing the credential, encrypt the credential. Examine every way a network connection could be made to or from the device, and make sure it is secured. In addition, ensure that only authorized personnel have physical access to the reader.

Give each reader a different access credential. This limits the damage if a reader is compromised. It also makes it easier to identify and isolate the compromised reader.

Grant reader credentials limited abilities within the cloud application. If the reader's job is to send tag reads to the application, the reader's credential should allow only that operation, not other operations such as reading the data or generating reports, which may be needed by other system components connecting to the cloud. That way, if a reader credential is compromised, the attacker may be able to flood the system with bad data, but at least he or she will not be able to read any of the good data or do other harm.

Prepare a backup plan. If all these measures fail, you will need a workable procedure to change each reader's access credentials. Think about how that procedure will work before—not after—you deploy hundreds or thousands of readers!

Ken Traub is the founder of Ken Traub Consulting, a Mass.-based firm providing services to companies that rely on advanced software technology to run their businesses. Send your software questions to swsavvy@kentraub.com.

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Second to None

These RFID applications can give retailers the upper hand.

By Bill Hardgrave

IN MY PREVIOUS column, Building on Retail's RFID Foundation, I began the discussion of second-order (SO) use cases of item-level RFID. Forward-thinking retailers will use these SO applications to create a competitive advantage. I also identified distributed-order management, which can help retailers execute an omnichannel strategy, as a key SO application. Here are four more SO applications retailers would be wise to consider.

Enhancing the customer experience. Do you remember the "magic mirrors" and "smart dressing rooms" introduced 10 years ago? The concepts were sound, but they were ahead of their time. Without inventory accuracy, these RFID-enabled interactive devices, designed to help customers shop for clothing and related accessories, don't work. Now, their time has come, and there are many ways retailers can use them to engage shoppers and boost sales.

Cycle-counting strategies. Before RFID, retailers typically conducted cycle counts just once or twice per year. With tagged merchandise, retailers can cycle count once a day, twice a week or once a month. Or they can use zonal monitoring to take real-time, all-the-time inventory. Retailers can develop cycle-counting strategies—that is, determine how often to count each category or store—based on issues such as shrinkage and time of year. An appropriate cycle-counting strategy that can, and likely will, vary by category, store and season will be key to effective, ongoing inventory management and accuracy.

Conversion. Are customers looking at the new line of dresses hanging near the store entrance? Are they trying on those dresses? Buying them? The transition from shelf or hanger to dressing room to purchase is often referred to as "conversion." Retailers typically rely on observation and counts of items taken into dressing rooms to determine conversion. These manual methods are time-consuming and error-prone. RFID can provide real-time, complete insight into customer traffic flow and shopping habits.

Loss prevention. Originally, the RFID Research Center listed loss prevention as one of the foundational use cases because loss is something all retailers face. But we now refer to the foundational use case as loss detection and the SO use case as loss prevention. Why? Because it is easy for retailers to use RFID for loss detection (see my column Will RFID Kill EAS? to find out how to do that), but it will be the innovative retailer that uses the data to prevent shrinkage.

These are only a few of the many unique and amazing things retailers can do when they use item-level RFID. Most likely, the best and most creative uses of RFID in retail have yet to be imagined.

Bill Hardgrave is the dean of Auburn University's Harbert College of Business and the founder of the RFID Research Center. He will address other RFID adoption and business case issues in this column. Send your questions to hardgrave@auburn.edu. Follow him on twitter at @bhardgrave.

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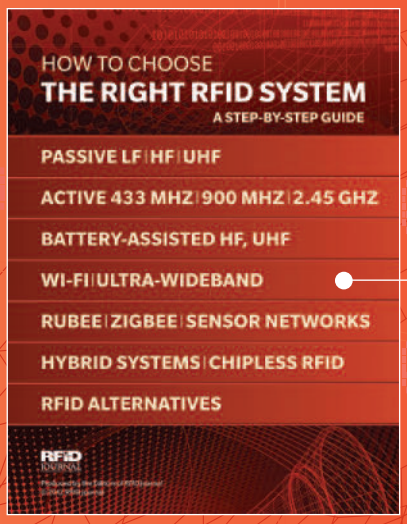

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The Language of Business

Companies should leverage standards to achieve supply-chain visibility.

By Ian Robertson

THE MAIN GOAL of companies deploying RFID systems in their supply chains is to achieve visibility of shipments. Often, the aim is to share data with partners to achieve "joint visibility"—that is, both the supplier and its retail or manufacturing partner can track the movement of goods or parts through the supply chain and optimize operations based on this information.

The Electronic Product Code standards were developed for precisely this purpose. They include an air-interface protocol that enables tags and readers to communicate, a standard for the format of data on the tag and other standards that allow companies to share information. Collectively, the data-sharing standards are called the EPC Information Services. But EPCIS is not actually a service. Rather, it is a set of protocols that differ slightly for different industries.

There are several other GS1 standards that can be leveraged to achieve supply-chain visibility. The Serialized Global Trade Item Number (SGTIN), used mainly by the retail and consumer packaged goods industries, identifies the item being shipped.

The Serial Shipping Container Code (SSCC) identifies pallets and other logistics containers. Customers often require that their own identification format be used on pallets so they can identify the pallets upon receipt, which is a nightmare for suppliers who must use multiple formats. An SSCC enables both supplier and customer to uniquely identify the pallet without multiple formats. This can also simplify systems design.

The Global Returnable Asset Identifier (GRAI) is useful for industries that ship goods in returnable transport items (RTIs) owned by the supplier. The GRAI indicates what type of asset is being transported and the supplier to whom it should be returned. Since the GRAI is serialized, each RFID-tagged RTI can be tracked through the supply chain and the data shared via EPCIS. Both trading partners can know where the asset has been, when it arrived and when it left. The supplier can use this information to determine cost, based on the amount of time the asset was with the customer, and to monitor when cleaning and/or maintenance is required.

The Global Individual Asset Identifier (GIAI) is designed for assets rented on a long-term basis. The GIAI identifies the asset owner through a company prefix, the type of asset and a serial number.

So how do you know where an asset has been? The Global Location Number (GLN) identifies a specific facility, storage site or trading partner. When a tag is read, software systems can be set up to share, through the EPCIS, not just the time the tag was read but also the location.

This alphabet soup establishes standards for identifying items, containers, pallets and locations, enabling these things to be tracked systematically and efficiently. In many ways, they are the language businesses speak to one another.

Ian Robertson is CEO and president of Supply Chain RFID Consulting, a Texas-based firm providing services to companies that want to understand how to use and implement RFID internally and with partners. Send your supply-chain questions to ian.robertson@s-c-r-c.com.

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