DEDICATED TO RADIO FREQUENCY IDENTIFICATION AND ITS BUSINESS APPLICATIONS

RFID JOURNAL

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May/June 2012



# Honoring Excellence


**And The Winners Are:**

**Cisco**

**Intel Corp.**

**BP**

**HP Brazil**

**Omni-ID**

**Bill Hardgrave**

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## features

COVER STORIES: AWARD WINNERS














VERTICAL FOCUS: EDUCATION



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## columns



COVER PHOTO: TOM HURST

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## Coming soon to RFIDJournal.com

**Virtual Events:** These live interactive programs offer a convenient way to learn why and how companies are employing RFID to improve the way they do business. Presenters will answer your individual questions.

- RFID in Retail: Retailers worldwide are using RFID to track individual items and improve inventory accuracy, so they can have products on shelves when customers want to buy them.
  *June 12, 11 am to 1 pm EDT*
- RFID in Aerospace and Aviation: Designed for airports, airlines, aircraft manufacturers, maintenance firms and others that want to use RFID to improve supply chains and reduce costs.
  *June 26, 11 am to 1 pm EDT*
- RFID in Defense: Suppliers to the U.S. Department of Defense can meet tagging mandates *and* achieve benefits, both internally and across supply chains.
  *Sept. 13, 11 am to 1 pm EDT*
- RFID in Harsh Environments: Companies in the oil and gas, chemical, mining, construction and energy industries are using RFID technologies to increase operational safety and efficiency.
  *Oct. 2, 10 am to 12 pm EDT*

**RFIDconnect.com:** See why nearly 9,000 people have joined RFID Journal's online community.

### Most-Read Stories In April

- Kiss Another RFID Company Good-Bye
- RFID Helps Disney Employees Get Into Character
- RFID-Enabled Lexus Ad Debuts in Pages of *Wired* Magazine
- Hanmi Pharmaceutical Uses RFID To Automate Picking, Shipping
- That 'Internet of Things' Thing

### Top 10 Search Terms On RFIDJournal.com

1. Walmart
2. NFC
3. Cisco
4. American Apparel
5. E-Lock
6. Cost
7. Disney
8. Hospital
9. Library
10. RTLS

## Worldwide RFID Deployment Map

RFID Journal's interactive map shows how widespread RFID adoption has become. The dots are color-coded according to industry, including aerospace, agriculture, apparel, defense, health care, logistics, manufacturing, pharmaceutical and retail. You can get more information about a particular deployment by clicking on one of the dots—a pop-up will appear.

To put your company's RFID deployment on the map, click here and fill out the form. It takes only a few minutes.

## The Inside Scoop

What are end users saying behind the scenes? Why should the RFID community be optimistic about the industry? Who's spreading misinformation? Get insight and perspective at the RFID Journal Blog.

## Ideas Exchange

RFID Journal maintains an Ask the Experts forum, where you can submit questions about RFID technology and its applications. Your questions will be answered by RFID Journal editors or outside experts. Recent questions include:

- Can RFID readers and tags from different companies communicate?
- Could RFID be used in a jail setting?
- How can RFID be applied in the coal-mining industry to track truck deliveries?
- Where can I find multifaceted RFID middleware?
- How does anticollision work?

# Excellence Found

IN APRIL, RFID JOURNAL HOSTED its 10th annual RFID Journal LIVE! conference and exhibition. I know beforehand each year, of course, who the guest speakers will be and which RFID providers will showcase their technologies. Yet, I'm still impressed by the many ways companies have found to use RFID to improve the way they do business, and each year, I'm amazed to see how far the technology has evolved.

PHOTO: TOM HURST | RFID JOURNAL

For the past six years, RFID JOURNAL has been bestowing the RFID Journal Awards on those companies that have demonstrated excellence in the way they use RFID. I always look forward to reading the entries, because I don't know what to expect. I'm often surprised and wowed by the creative ways companies are employing RFID to boost efficiencies or enhance their products or services. This year's submissions included some of the largest and most sophisticated deployments to date—so, once again, the independent experts who judged the entries complained that it was tough to choose one winner in each category. (That's a problem I'm happy to live with.)

Fortunately, in the coming months, you can learn about some of the excellent entries that didn't make the final cut; look for case studies about these RFID projects in "This Week's Featured Story" on our Web site. And in this issue, you can read about each winner's deployment.

Cisco Systems earned the Best RFID Implementation Award for its solution to track and manage more than 1 million IT assets at 70 U.S. data centers and labs. The project managers reveal how the solution more than met the company's expectations, improving inventory accuracy and reducing the time required to locate assets. They also share the secrets to their success.

When Intel Corp. introduced its new platform at LIVE! 2012, it created quite a buzz, so I'm guessing some attendees weren't surprised to see the manufacturer walk away with the award for Best Use of RFID to Enhance a Product or Service. The platform will enable electronics companies to add new features and capabilities to computers, tablets and other electronic devices.

The award for Most Innovative Use of RFID went to BP for its solution to make maintenance operations at oil refineries safer and more cost-efficient. Interestingly, the idea for the system came from a plant operator who was using another RFID application.

Hewlett-Packard Brazil is our first two-time winner. In 2007, the manufacturer won the Best Implementation award for using RFID to track printers through production and distribution. This year, it won the Green Award for leveraging the RFID information in the tagged printers to recycle plastic components.

Bill Hardgrave received the Special Achievement Award for his pioneering research on the real-world impact RFID has on apparel retailing. And Omni-ID took home the Best in Show Award, which goes to the company with the best new product at this year's LIVE! event. Its Visual Tagging System issues on-the-fly instructions to workers.

I hope you'll submit your project for next year's awards competition. We look forward to writing about your company in these pages.

Mark Roberti, Founder and Editor

TECHNOLOGY

# The Object Is the Antenna

An antennaless tag turns any metal object into an RFID transponder.

From left: Michael Reich, Cherish Bauer-Reich and Layne Berge with

RESEARCHERS AT THE NORTH DAKOTA State University (NDSU) Center for Nanoscale Science and Engineering (CNSE) have developed an antennaless RFID tag that essentially turns a metal object into the device's antenna. "I came up with the idea when I was working with the U.S. Department of the Navy, which wanted a thin tag that could go on metal," says Cherish Bauer-Reich, a research engineer at CNSE. "Most RFID tags used on metal have a spacer, but tags that stick up from the surface of an object being tracked are prone to being damaged or knocked off."

The challenge was coming up with a tag that could lie flat on just about any metal object and remain readable. If the antenna of a conventional passive ultrahigh-frequency tag touches the metal surface of the object being tracked, the tag is hard to read. On nonmetal objects, the RF energy from a reader creates an electrical charge that is captured by a passive tag and used to reflect a signal. But when a tag is on a metal object, the RF energy creates an induced charge on the metal, negating the charge captured by the tag.

Rather than limiting the induced charge, which is the way most metal-mount tags work, Bauer-Reich came up with the idea of using it to power the chip. But she had to get the induced charge to flow into the RFID microchip. Her solution was to use magnetic material to force the charge through the chip. She designed a small metal loop that straddles a strip of magnetic material. When the object is zapped with energy from the reader, an electric field is created. The magnetic material helps capture the charge induced on the metal and diverts it into the loop, where it powers the chip.

Michael Reich, a senior research engineer at NDSU, helped choose and test a variety of special materials. The researchers decided to use off-the-shelf ferrites. Layne Berge, an undergraduate student, built and tested prototype tags. The team now has a working prototype, which uses an Alien Higgs 3 RFID chip. The tag can be read on aluminum plates, coffee cans and electronic devices with metal cases, from distances of 3 to 6 feet. While this isn't as good as a conventional metal-mount tag with a spacer to keep the antenna away from the metal, Bauer-Reich believes that with further refinement—changing the properties of the magnetic material, for example—the team will be able to increase the tag's read range.

The patent-pending technology is available for licensing. "We're hoping to find companies that are interested in working with us to take the concept to the next level," she says. "The tag could be optimized for particular applications. For instance, the DOD is interested in tagging ordnance [military supplies]. A tag designed to work on ordnance could be optimized to get a longer read range." —*Mark Roberti*

CONSTRUCTION

# Managing Hazardous Waste

Researchers at Staffordshire University have developed an RFID system to ensure contractors dispose of plasterboard in designated landfills.

PHOTO: COUNTRYSTYLE GROUP

EACH YEAR, THE UNITED KINGDOM produces 1 million metric tons of plasterboard waste. Only about 7 percent of this is recycled, and the rest ends up in landfills. But the gypsum in plasterboard—sometimes called gypsum board or sheetrock—can mix with organic waste to produce hydrogen sulfide gas, a colorless and poisonous mixture that can cause significant health problems.

In November 2008, the U.K. government began requiring contractors to separate plasterboard from other waste materials, so the plasterboard can be disposed of at one of four "mono-cell" landfills. But currently, there is no way to monitor whether contractors are complying with these regulations. Tony Atkins, a member of Applied Computing in the Faculty of Computing, Engineering and Technology at Staffordshire University, and colleagues Lizong Zhang and Hongnian Yu, have developed a system for tracking plasterboard to monitor compliance.

The system involves tagging shipments of plasterboard for a new building or one that is being renovated, to track how much plasterboard is used. Plasterboard waste—either "offcuts" from new construction or old plasterboard that is removed—is loaded into containers equipped with passive ultrahigh-frequency RFID tags. When these are filled, the system estimates the volume and weight of the waste, based on the container size. That tonnage is compared with the estimated waste, based on an analysis of the building's blueprint and amount of new plasterboard brought to the site. If there is less plasterboard removed than consumed, it might indicate that some of the plasterboard being removed was disposed of improperly.

GPS would be used to track the shipment to ensure the waste is hauled to the correct disposal site. (The process of filling the container with plasterboard could be videotaped, and the RFID transponder could store a link to the video on the Web.)

"Our system lets you calculate the volume and tonnages, and do the track-and-trace to show that you are a responsible contractor and have disposed of this waste properly," Atkins says. "This is not a requirement today, but it could become a requirement because the amount of construction waste continues to increase every year."

Atkins envisions using ant colony optimization—algorithms that determine the most efficient route given a set of variables—to find the most efficient and cost-effective way to truck containers of plasterboard waste to recycling facilities or special landfills. This would help reduce the cost burden on contractors.

"We have talked to a recycling plant in this area about our systems," Atkins says. "Ideally, it should be adopted by the companies that produce the plasterboard. We plan to see if they are interested in adopting our system. If legislation changes to require proof that plasterboard has been disposed of properly, contractors might be more interested in using it. The technology already exists to make it feasible." —*M.R.*

## Bulging at the Waste

**Metric tons of hazardous waste generated by the United States annually:**
**260,108,000**

**Metric tons of hazardous waste generated by the Philippines in 2008:**
**164,939,000**

**Metric tons of hazardous waste generated by the Russian Federation in 2009:**
**141,019,000**

**Metric tons of hazardous waste generated by Germany in 2008:**
**22,323,000**

**Metric tons of hazardous waste generated by China in 2009:**
**14,300,000**

**Metric tons of hazardous waste generated by the United Kingdom in 2008:**
**7,285,000**

*—Rich Handley*

ADOPTION

# Vendors Must Steer a Path To Mass Adoption

Solution providers need to gain broad usage of RFID in one industry and then adapt vertical applications to other sectors.

PREVIOUSLY IN THIS SECTION, we have written about Geoffrey Moore's technology adoption life cycle and how it applies to radio frequency identification. Specifically, we have looked at how close the RFID industry is to meeting the criteria he says are essential for a technology to achieve mass adoption: a global standard, a problem no other technology solves, a whole product, a "gorilla" (dominant provider) and a critical mass of end users.

RFID technology has matured and is being adopted by many companies in myriad industries. But in an interview for the special 10th anniversary edition of this magazine (March/April 2012), Moore, author of *Crossing the Chasm* and *Inside the Tornado*, raises the possibility that RFID might never go mainstream—that it could remain forever in what he calls the "bowling-alley" phase of the technology adoption life cycle. There is a chasm

ILLUSTRATIONS: ISTOCKPHOTO

between early adopters of a new technology and the majority of companies that adopt later, once the technology has gone mainstream, Moore says. When a technology crosses that chasm by proving its benefits, it enters the bowling alley.

"The bowling alley represents that part of the technology adoption life cycle in which your product gains acceptance from companies within the mainstream market but has yet to achieve general, widespread adoption," Moore writes. "The goal of bowling-alley marketing is to keep moving forward toward the tornado [mass adoption], to progress from niche to niche, developing momentum. Each niche is like a bowling pin, something that can be knocked over in itself, but can also help knock over one or more additional pins."

Is it possible that RFID will remain in the bowling alley? Yes. "For many customers, there is still plenty of life left in the old paradigm [technology] you are displacing," Moore writes. "They might see the attraction of the new paradigm you are offering, but they have no compelling reason to move. Since infrastructure changes of any kind always entail hidden consequences, this part of the market instinctively holds back."

Some high-value technologies get exploited economically, but they never become mass market, Moore tells *RFID Journal*. "Unix workstations are an example," he says. "[Unix] is very valuable technology with a long life cycle, but [it] never became ubiquitous."

But it is just as possible that RFID will knock down those bowling pins—if solution providers pursue the right strategies. Some vendors insist on trying to sell generic solutions. But during the bowling-alley phase, Moore says, it's important for solution providers to focus on one vertical industry in which RFID can provide a huge benefit, such as apparel retail, because the technology cannot achieve mass adoption until it proves its advantages in at least one sector.

Solution providers also must make RFID easier to deploy. Currently, end users have to deal with the physics of radio waves, changes to operational practices, integration of new data and so on. What's more, they often need to buy tags from one provider, readers from another and software from a third (at least with passive systems).

Once these issues are addressed, RFID will be ready to transition from the bowling alley to mass adoption. To take that step, the technology, ironically, must revert to being more generalized. A solution designed specifically to address the challenges of apparel retailers, for example, must be able to solve business problems in other industries as well.

There seems little question that active RFID technology could go mainstream. It is being used in many hospitals to track medical equipment. There is a problem other technologies can't solve (a need to track assets in real time) and vendors offer whole solutions. But two factors continue to prevent more hospitals from deploying—lack of agreement on a standard and lack of a dominant player. Once those last two factors change, the health-care bowling pin will fall, and active RFID-based real-time location systems will become generalized for manufacturing, energy and other sectors.

Complexity is the main challenge for passive ultrahigh-frequency systems to overcome on the path to becoming a mainstream technology. Apparel retailers are using GS1's second-generation Electronic Product Code standard to improve inventory management. UHF technology has become easier to deploy. Tags are easier to read, readers have improved, and there's a greater variety of form factors and antennas for different applications. The software for tracking inventory and other applications also has advanced.

But companies have to purchase tags from one vendor, readers from another and software from yet another, and then hire a systems integrator to put it all together and integrate it with

Retail apparel is the kingpin on the path to mass adoption of passive UHF RFID solutions.

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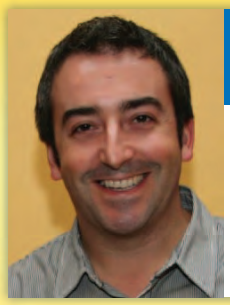

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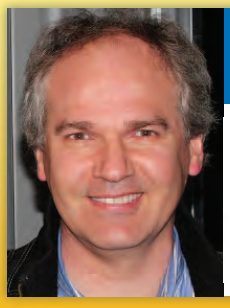

Tom Romanich

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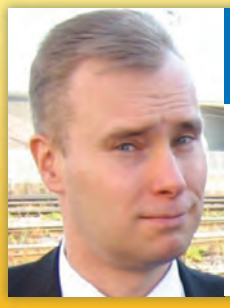

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back-end solutions. It seems likely that a group of companies will create a partnership and do enough deployments together that the solution will become highly repeatable, and less complex. This group will provide the whole product and emerge as the gorilla.

So retail apparel is the kingpin on the path to mass adoption of passive UHF RFID solutions. And a solution for tracking clothing could easily be applied to retailers selling electronics, jewelry, shoes and sporting goods. Retailers likely will get a lot of value out of RFID systems.

The question, then, is whether the hardware and software developed for the retail sector can be generalized to track anything—inventory, parts, people, returnable transport items, tools, work-in-process and more. The answer is almost certainly yes. Passive UHF RFID likely will become ubiquitous for tracking medium and small, inexpensive items in industries such as energy and manufacturing (large high-value equipment will be tracked with active solutions). RFID tags, readers and software all started as generic products that were later tailored to the specific needs of early adopters. Insights gained from the process of customizing solutions will be incorporated into generic products.

Another determining factor is that RFID is becoming easier to deploy in environments and on products less friendly to radio waves. Most radio-based systems improve over time as the technology evolves. Early Wi-Fi systems were slow and unsecured, and had spotty data transfers. Cell phone systems used to drop calls frequently. But coverage has improved, and the technology has evolved to a state in which cell phones are highly reliable.

Likewise, today's RFID tags can be embedded in metal pipes, welded to metal, mounted to metal servers and storage devices in data centers and so on. Readers will no doubt continue to improve as well. While the technology will never be perfect—no technology ever is—it is likely that its reliability will be well beyond what most companies need to achieve business benefits.

Software also can be adapted. Many RFID software solutions already incorporate tools for configuring a variety of business-process applications. RFID software also might be absorbed into enterprise resource planning (ERP) applications or displaced by them—that is, ERP systems could evolve to encompass what RFID software does today.

It's worth noting that bar codes started out in the retail sector and are now used in the aerospace, chemical, defense, electronics, pharmaceutical and transportation industries. RFID Journal believes RFID technology will become ubiquitous—as long as vendors pursue a strategy of focusing on a vertical, achieving market dominance in that sector and then using that leverage to transition to other verticals. *—Mark Roberti*

A solution for tracking clothing could easily be applied to retailers selling electronics, jewelry, shoes and sporting goods.

ILLUSTRATION: ISTOCKPHOTO

## Six Tips for Marketing In the 'Bowling Alley'

**Geoffrey Moore argues in many of his books that providers of a new technology must adopt a marketing strategy appropriate to the technology's current adoption phase. Here are some insights he provides for marketing in the bowling-alley phase.**

1. ***Focus*** on a particular vertical industry. (Think of Apple's emphasis on the desktop publishing industry in the early days of desktop computing.)
2. ***Pick*** a niche—one in which a pressing need is unfulfilled, so there is a compelling reason to invest in a new technology solution.
3. ***Dominate*** that industry or niche, because pragmatists want to buy the solution everyone else is using.
4. ***Commit*** to completing your customers' wish list, and build out your solution to meet all their needs.
5. ***Market*** to businesspeople, because the technology can deliver an economic benefit. The IT department is not interested in investing in a new, relatively unproven technology.
6. ***Adopt*** a solutions-oriented business model, in which each solution requires a significant amount of customization. (A project-oriented business model, in which the vendor makes money on each project, is appropriate for the early-adopter phase. A product model, in which the solution is standardized, works in the tornado phase.)

# Honoring Excellence

On April 5, we presented the sixth annual RFID Journal Awards for outstanding achievement in radio frequency identification, at RFID Journal LIVE! 2012, our 10th annual conference and exhibition. You can read about each end user's RFID project in the following stories. You'll also learn how Omni-ID's ProView Visual Tagging System lets businesses update instructions automatically, on the fly, and why Bill Hardgrave got the retail community excited about RFID. This year, we introduced a new award for Best RFID Thesis, to recognize researchers. Cecilia Occhiuzzi was the winner.


**The Winners:**

**Cisco** *Best RFID Implementation*

**Intel** *Best Use of RFID in a Product or Service*

**BP** *Most Innovative Use of RFID*

**HP Brazil** *RFID Green Award*

**Omni-ID** *Best New RFID Product*

**Bill Hardgrave** *Special Achievement in RFID*

You can view all the presentations and acceptance speeches in the video library on our site. From left: Mike Haley, BP; Gaetano Marrocco, accepting for Cecilia Occhiuzzi; Mark Roberti, RFID Journal; Marcelo Pandini, HP Brazil; Shahrokh Shahidzadeh, Intel; Bill Hardgrave; Maryanne Flynn and Ted Baumuller, Cisco; and George E. Daddis Jr., Omni-ID.

PHOTO: TOM HURST

# RFID JOURNAL LIVE! EUROPE

30 OCT. 2012 • LONDON, ENGLAND — UK

Dexter House

# LEARN HOW TO TRACK AND MANAGE EVERYTHING

## Hear Real-World Case Studies from the Leading End Users

RFID Journal LIVE! Europe—UK, *RFID Journal's* first event in London, will focus on educating end users about how radio frequency identification (RFID) technology is delivering real business benefits across multiple applications in retail, manufacturing and logistics operations.

This one-day program will share how to attain the full benefits of RFID-enabled technology, and provide companies with a greater understanding of how RFID can be used to improve production processes, increase visibility, lower labor costs, reduce theft, track inventory and transform the supply chain.

BY ATTENDING LIVE!—UK 2012, YOU WILL:

- Hear speakers from leading end-user companies candidly discuss new applications for RFID, the business benefits they deliver and how to overcome implementation challenges
- Learn from a range of sessions, including how to leverage RFID to enhance visibility and traceability, as well as supply chain management and improving operational efficiency
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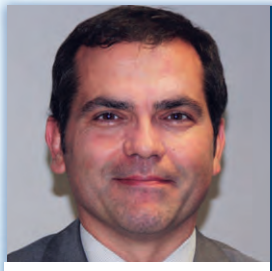

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BEST RFID IMPLEMENTATION

# Cisco's Business-Driven RFID Strategy

## The network giant adopts the technology to manage fixed assets at 70 U.S. data centers and R&D labs.

*By John Edwards*

**CISCO SYSTEMS DIDN'T GET** to be the world's largest networking firm by ignoring technologies that could help it operate smarter and more efficiently. So it's not surprising that the San Jose, Calif.-based firm turned to radio frequency identification when it needed a better way to manage and safeguard one million-plus servers, network gear and other fixed IT assets at 70 U.S. data centers and research-and-development labs.

Yet, the networking giant chose to approach implementation from a business angle, considering people, policy and business processes before researching RFID technologies and vendors and defining an enterprisewide technical solution.

Cisco's Fixed Assets Lifecycle RFID project got under way in January 2010, when the company's senior executives reached a strategic decision to create an improved approach to asset tracking and management. "We wanted to be able, in a very time-effective manner, to do an inventory of our internal fixed assets networking gear," says Maryanne Flynn, Cisco's director of operations, who was selected to co-manage the initiative with Ted Baumuller, the firm's director of IT, marketing and Cisco.com. "We had been using bar codes, but they are a little bit more difficult to leverage because you need to have a line of sight to the bar-code reader." Direct, visible communication isn't always possible in a data center where equipment racks, cables and people often get in the way.

Assets can be tracked with handheld readers.

After the executives green-lighted the project, a cross-functional steering committee was formed to represent the interests of the organization's various business and technology areas, including finance, IT, operations and R&D. "We started by looking at our internal policies and processes," Flynn says. "We wanted to find out from our stakeholders—the people who manage these assets on a daily basis—what were some of the pieces of the process that didn't work for them."

As one set of planners tackled stakeholder concerns, another team began researching and interviewing leading RFID systems integrators, hardware and software vendors, using market knowledge and insights gleaned from RFID Journal articles and webinars. "We thought passive RFID would be a much more cost-effective and highly efficient way for us to track and audit our inventory of networking gear," Flynn explains.

A 15-member evaluation committee developed and reviewed requests for in-

formation as well as proposals, oral presentations and solution demonstrations from roughly a dozen RFID providers. The team selected RFID Global Solution as its systems integrator. "The choice of our RFID partner was really based on the fact that they had a good understanding of the business process behind the technology," Flynn states. "It wasn't just about getting good read rates."

Cisco's planners ultimately settled on technologies from a small group of vendors. Motorola Solutions was tapped to provide its FX7400 fixed readers, AN480 antennas, and MC9090-Z and MC3190-Z handheld readers. For certain portal configurations with extra-wide door widths, Impinj was selected for its Speedway Revolution R420 readers. For asset tags, Cisco chose the Omni-ID Prox, Flex and Prox-NG passive RFID tags. The Prox-NG was designed specifically to meet Cisco's requirements for a single form factor global tag that could be used worldwide.

### Deployment Under Way

In November 2010, with its technology planning complete, Cisco began deploying its RFID asset-tracking solution at nine U.S. R&D labs and data centers, in a six-month controlled release field trial. The test implementation was designed to help engineers and business experts evaluate the system's accuracy and functionality. The trial would also provide meaningful insight on the deployment process' efficiency and effectiveness, the receptivity of Cisco's lab engineers to a new business process and answers to what change-management activities would be necessary to further promote adoption. Another goal was to gather baseline and post-install metrics on the accuracy and labor time involved in IT asset-inventory management.

Flynn reports that project managers learned a number of lessons from the trial deployment, such as the need to have total consistency in product-naming conventions for both asset types and data fields, as well as the value of setting portal and tag configurations that register the best possible read rates. Other insights helped improve equipment ordering, inventory stock-level optimization, and training and support requirements.

By completion of the test phase, RFID equipment had been installed at entry and exit doorways and inside interior hallways at more than 35 data centers and R&D labs, primarily in the San Jose, Dallas and Research Triangle Park, N.C., metro areas. "By the end of July, we will have outfitted about 70 internal data centers in the U.S. with this RFID equipment," Flynn says. "We will eventually deploy in other countries, but the plan for that hasn't yet been solidified."

**Cisco has developed brand-new processes and a methodology for deploying RFID equipment from the assets' infancy through their maturity.**

The final system has been rolled out slowly. "We wanted to make sure things worked before we deployed them *en masse*," Flynn says. "The implementation approach we took was to outfit 10 sites at a time, and make sure the people who work at the data centers really understand the technology before we go on to the next site."

### In Operation

Three primary business processes are affected by the Fixed Assets Lifecycle project: equipment receiving, inventory management and asset sharing. Cisco has developed brand-new processes and a methodology for deploying RFID equipment from the assets' infancy through their maturity, which enables greater visibility and control of the assets, as well as sharing and reuse, cutting capital expenditures.

When a purchase order for a new piece of equipment is created in Cisco's financial-management application, information about the incoming asset is automatically transmitted to RFID Global Solution's Visi-Trac application. "That information consists of things like who bought the asset, when it was purchased, the manufacturer it was purchased from, and the make, model number and location it is to be shipped to—it includes all kinds of rich information about the asset," Flynn says.

As soon as the equipment arrives at Cisco's central receiving facility, it is tagged, and employees at the facility associate the tag's ID number with the asset in Visi-Trac. That information is then automatically forwarded to Cisco's enterprise asset-management database, Tivoli Asset Management for IT software, so asset databases in the data centers are synchronized with the asset-management database at corporate headquarters.

After the asset arrives at a location, its tag is automatically read as the object passes through a portal. Employees also can use a handheld reader or enter a seven-digit human-readable code into the Visi-Trac system. If, instead of being received by Cisco's central receiving facility, an item is shipped directly to a location, the group that ordered the asset tags the item and registers its location in the application. If no one enters a tag

ID and location into the system within a specified period of time, the system reminds the person responsible for that asset to do so.

Besides automatically tracking object movements, the system allows users to create specific permissions and receive alerts. A lab manager might indicate, for instance, that a particular piece of equipment is not permitted to leave the facility. Should the tagged item turn up at an exit, the system would immediately notify the manager.

The RFID solution improves inventory management, allowing assets to be found almost instantly, Flynn says. Inventory audits are conducted with automated RFID technology, rather than manually with bar codes and Excel spreadsheets. Cisco has slashed its cycle count time for conducting inventories from several weeks to just a few hours, reducing inventory labor and cost.

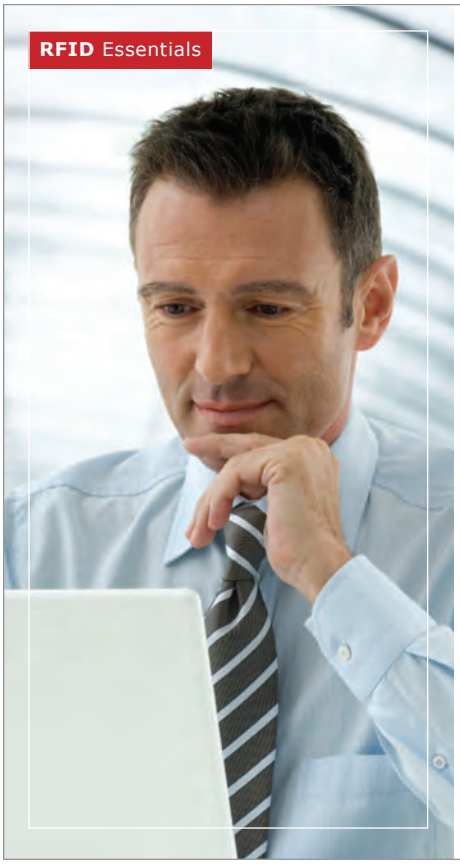
Asset availability information is now readily accessible to Cisco data center and R&D lab managers, allowing equipment to be repurposed and shared between engineering teams.

### Exceeding Expectations

The Fixed Assets Lifecycle RFID project has more than lived up to its designers' expectations, Flynn says, noting that Cisco already has observed significant improvements in inventory accuracy, an increased ability to find assets on the first pass and a faster cycle count during audits. Prior to deploying RFID, when conducting a first-pass audit on existing assets in one of the company's labs, 45 percent of expected assets were discovered on the first pass, while the remaining assets had to be found manually during an inventory process that could take several weeks, she says. With the RFID system in place, more than 98 percent of expected assets were found on the first pass with RFID handheld readers—a 118 percent improvement—and the remaining 2 percent were discovered shortly thereafter.

The system has also reduced the audit cycle count for a typical-size lab from more than one week to less than two hours—a 95 percent improvement in the time it takes to comply with and supply reports for mandatory audits.

Flynn credits the project's success to careful planning and testing, as well as ensuring the final system fully meets real-world business needs. She believes that end-user involvement is critical to the success of almost any enterprise RFID initiative. "Really make sure you're engaging with the people you're trying to help," she says. "Involve them in the process design and process solutions before you foist the technology on them."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BEST USE OF RFID IN A PRODUCT OR SERVICE

# A New Tool for Electronics Companies

Intel has linked RFID to its microprocessors in computers, tablets and other devices, enabling myriad applications—from manufacturing to supply chain and retail.

*By Jill Gambon*

**INTEL CORP. WAS ALREADY** the world's largest manufacturer of microprocessors when, in 2005, it began looking for ways to differentiate its products. The company thought it could enhance computer security and functionality by adding a "secure vault" to store a variety of information, such as personal identification and manufacturing records. This April, at RFID Journal LIVE!, Intel introduced a platform that enables a secure vault—and many other applications, from locking electronics devices to deter theft during transit to customizing devices in sealed boxes at the point of sale. The platform promises to have a wide-reaching impact on the consumer electronics industry, from manufacturer to retailer, says Shahrokh Shahidzadeh, senior principal technologist at Intel, who spearheaded the project.

A key feature of the new platform is an ultrahigh-frequency RFID chip embedded in the device's motherboard and wired directly to the microprocessor. The chip is designed with extra memory dedicated to the processor, creating what Intel describes as "processor-secured storage," where data can be stored safely and activated when needed. The data on the chip can be written to or accessed by the Intel processor via an inter-integrated circuit (I2C) interface, which is a semiconductor industry standard, and from an external handheld or fixed RFID reader.

Intel gave the reference designs for the new platform to the hardware vendors that are making Windows 8 tablet computers, which are expected to hit the market later this year.

## RFID Inside

When Intel began its secure vault project, RFID was considered mainly a supply-chain technology, but the company recognized that RFID chips were fundamentally memory chips, with an added RF air interface. Intel was looking for a way to add secure memory near the processor to store critical device identification data, and RFID chips emerged as a viable solution. Intel decided if it could add a wired interface to an RFID chip, the chip could be attached to a circuit board and communicate directly with a computer's central processing unit.

The company picked UHF RFID for the project for its relatively low power consumption and long read range. In addition, UHF chip memory can be programmed multiple times. As the project advanced, it became clear that a new chip would have to be created to meet the emerging requirements: The chip had to have memory dedicated to the processor and the ability to access that memory wirelessly. It also had to be scalable, so it could be used in everything from mobile phones to servers.

Intel worked with several semiconductor firms on the initial concept design for the project. For the chip development, the company partnered with Impinj, a Seattle-based maker of UHF chips and readers. The two companies share a common RFID history: In 2008, Impinj bought Intel's RFID division, which included Intel's widely used R1000 RFID reader chip.

The RFID chip is embedded in a device's motherboard and wired directly to the microprocessor.

PHOTO: TOM HURST | RFID JOURNAL

Impinj created two new RFID chips for the project: the Monza X-2K Dura and the Monza X-8K Dura, with 2 kilobits and 8 kilobits of memory, respectively. Both chips have lockable memory blocks and support two independent antennas—a short-range loop antenna on the circuit board and a long-range dipole antenna inside the electronic device's enclosure. This allows the chip to be read from both the near field (on a manufacturing line, for example) and at long range (within a warehouse).

A cross-section of Intel employees were involved over the course of the project, including representatives from the engineering, management, manufacturing and supply-chain groups, software architects, radio frequency designers, CPU and platform designers, and security and privacy experts. In addition to the chip and hardware design, software and firmware that enable communication between the processor and the RFID chip had to be developed. Chris Diorio, chairman and CTO of Impinj, also served as a key consultant to the project.

### Developing, Testing, Demonstrating

A project of such scope involved a number of obstacles. The engineering and design were complicated. Integrating the antennas proved particularly challenging due to the devices' space constraints. Performance of the RFID chips was affected by the amount of metal in the devices, which limited the read and write range. "It was an underdog project," Shahidzadeh recalls.

Over time, many of the issues were resolved as RFID technology matured and the overall performance of readers and tags improved. As the technology advanced, people began to see new ways it could be put to use. "The performance of chips and readers got better, and the impossibility faded away," Shahidzadeh says. "And as we made progress, possibilities for new uses opened up."

Several groups within Intel helped devise likely scenarios for use of the RFID-microprocessor integration, along with associated business cases and potential benefits. Intel then worked with its technology partners to develop prototypes to demonstrate how the platform would work.

Intel put the platform through vigorous testing to prove that the integration

of the chip and the antenna could work within the small form factor of a portable computer. The company built thousands of tablets to demonstrate the concept to customers, retailers and other end users. Windows and Android software developers also used the prototypes to incorporate RFID functionality into their application stacks.

Throughout development, Intel gathered input from electronics manufacturers, retailers and customers, and that feedback drove changes, such as the amount of memory on the chip and the security features. "As we listened to our customers, the requirements evolved," Shahidzadeh says.


Chris Diorio (left) and Shahrokh Shahidzadeh at the RFID Journal LIVE! conference.

Nearly two dozen potential uses for the platform have been identified for further development and review. With the chip connected directly to a microprocessor, RFID can be used in entirely new ways, Diorio says. "Typically, when people think of UHF RFID, they think of identifying pallets and boxes. The concept here is that RFID can communicate directly with the device that is hosting it—with the microprocessor of a PC, a tablet computer or mobile phone—even when the power is off," he says.

### Benefits Throughout the Value Chain

How much impact the processor-secured storage will have on the consumer electronics industry—and Intel's bottom line—will be determined during the months and years ahead, as tablets and other products containing the new chips hit the market. Intel maintains its customers and other supply-chain partners will soon be adapting their distribution and retail processes as a result of the chip's capabilities. Device makers and retailers, for instance, will be able to reduce the number of unique product configurations they stock, because they'll be able to customize applications and other features at the point of sale by sending code to the chip via an RFID reader, based on the specifics the customer wants. The upshot: lower supply-chain costs and higher customer satisfaction, Shahidzadeh says.

Manufacturers will be able to use radio frequency signals to "lock" the devices before they are shipped, rendering them useless and thus a less attractive target for theft. Under this scenario, a tablet or other device could be programmed during manufacturing to be in a sort of digital coma until it receives an activation code from an RFID reader at the checkout counter in a retail store. If a consumer has a tablet shipped to a home or office, the device could be activated by downloading a line of code from an e-mail message sent by the manufacturer. Alternatively, the chip's memory could store a key that would enable partial functionality, so the tablet could be used to demonstrate limited features. And then, once the device receives the activation code, it would be fully operational. This same feature could be used to activate software applications and other services. In addition, warranty and repair information could be recorded on the chip, providing the product's life-cycle history.

The chips also open the door to location-based access control, which means permissions to use particular documents or files can be determined by where the machine is being used, once the identification stored in the chip's memory is authenticated. A bank, for example, could limit access to sensitive customer documents by making them available only in certain locations—an employee would not be able to access customer records on a notebook PC or tablet while sitting in Starbucks, for instance, but could get into the files from designated bank offices.

Shahidzadeh envisions a time when every electronic gadget or portable computing device will have new features and capabilities thanks to the RFID chip embedded in its circuit board. "This is something every electronic device should have," he says. "It has unlimited possibilities."

PHOTO: TOM HURST | RFID JOURNAL


MOST INNOVATIVE USE OF RFID

# BP Refines Maintenance Operations

The international oil and gas company developed an RFID solution that streamlines processes, making work safer and more cost-efficient.

*By Samuel Greengard*

**BP OPERATES 11 OIL REFINERIES** worldwide and each must undergo scheduled maintenance. During these operations, called turnarounds (TARs), parts of a facility are closed for up to 30 days, so the company can inspect, clean and repair equipment. In addition, BP performs plant upgrades and other improvements. TARs are labor-intensive, expensive and potentially hazardous operations.

Before any TAR-related work can be performed, the designated section of the plant must be shut down, then purged of hydrocarbons and allowed to cool. This ensures there are no lingering pockets of hydrocarbons or other explosive or flammable materials. In the end, each part of the refinery is "isolated" from connected equipment, to prevent material from one part of the facility from entering another.

These isolations involve a number of processes, including disconnecting pipes at the flanges (the components that connect the pipes) and fitting blinds (large metal discs) into the flanges. This effectively shuts off the pipes, so engineers can tackle the maintenance work safely.

What makes the task so challenging is that the isolations must take place in a specific sequence, and blinds must be matched to specific pipe flanges. A recent TAR, for example, required 6,400 isolations—and the entire process had to be carried out at the beginning of the TAR and then reversed before the plant could be brought back into operation. Simply put, every blind must be fit correctly and then extracted in the proper order.

In September 2010, BP introduced an RFID solution called Isolation Tracker at its refinery in Gelsenkirchen, Germany, to make isolation processes faster, more accurate and safer. The solution controls TAR tasks, ensuring work processes occur in the correct sequence and maintenance workers isolate the right equipment. It also maintains accurate records and provides updates in near-real time.

Isolation Tracker has reduced contractor costs and generated revenue from increased plant uptime—saving approximately $1 million per turnaround, according to Mike Haley, a consultant in the chief technology office of BP's Information Technology & Services group. The mobile application has become part of the toolset used for TARs and is already in operation at a second BP refinery in Germany. "This project has helped create a new standard for the way we work in the plant," Haley says.

### Leveraging RFID Know-How

BP is no newcomer to RFID. For the past several years, the company has used an RFID-based mobile application called Task Tracker to manage assets and tasks, including the maintenance of pipes and other equipment at its refineries and platforms. The idea of using a mobile RFID application for TAR isolations came from a plant operator at the Gelsenkirchen refinery. "He recognized that by extending the use of the mobile application with integral RFID, we could address a much bigger opportunity to work faster and more accu-

Maintenance fitters and electricians receive their assignments, at the plant, on handheld computers with integrated RFID readers.

PHOTO: BP

rately, reduce paper and improve the safety level of isolations," Haley says.

The spreadsheet and paper-based system the company was relying on contributed to a less-than-efficient workflow, Haley notes. "At other sites, where we used bar-code tags, we found that they would not last more than a few years," he says. "This meant that we would have a maintenance task ahead of each shutdown or large maintenance activity just to make sure the bar codes were still in place and readable."

The first step, Haley says, was to establish an internal crossfunctional team, to understand the requirements and identify benefits and challenges. The BP CTO team served as the internal project consultancy and helped identify technology solutions. Other participants included an IT manager and project leader who focused on implementing the project on site and testing various systems; maintenance and operations managers; and a software developer who handled local mobile software development and integration with the company's SAP enterprise resource planning (ERP) system. BP used a Syclo Agentry platform for the mobile application, as well as to connect to SAP. An outside consultant wrote the SAP-based back-end control-of-work (CoW) software to fit BP's requirements and standards.

BP installed a Wi-Fi network and applied roughly 150,000 Tectus high-frequency RFID tags on flanges, blinds and other equipment, according to Haley. Each tag was tested and printed with an I-Safe Atex Zone 1 nonerasable stamp, for use in hazardous environments. Then, each tag was crossreferenced and checked to match the equipment asset record in a SAP plant-maintenance ERP application. As a result, each maintenance work order created contains the RFID number of the associated asset.

Maintenance fitters and electricians receive their assignments, at the plant, on eCom iRoc Atex Zone 1 Intrinsically Safe handheld computers with integrated HF RFID readers—they no longer have to go to the control room to receive each assignment. They initiate each task by scanning a tagged asset. The tag triggers the work order assigned to the worker, and the specific tasks associated with that piece of equipment appear on the handheld's screen. The worker confirms the start of the task. If the wrong asset is scanned, no work order appears and the task cannot be initiated, preventing mistakes. The solution also eliminates the trial-and-error process of deciding which blind fits a particular pipe flange, Haley says.

Once the worker completes the job and enters the relevant information in a handheld, an inspector is alerted to inspect the work and sign off wirelessly. The back-end CoW system is updated in near-real time. The lead operator in the control room monitors the status of all the isolations on a CoW Cockpit screen, and alerts the TAR maintenance crews when it's safe to commence work. "The system recognizes that multiple tradespeople may be involved, and tasks can be dependent on each other," Haley says. A blind, for example, cannot be fit until its pipe has been purged and the pump has been electrically isolated.

### Refining the System

BP conducted extensive testing off-line before deploying the technology at the refinery. The project team also focused on system integration, to ensure that a new dashboard designed to track activities would update in real time, so the control-room operator could use it to manage work in the plant. The team also tested various RFID tags and handheld reader combinations to find the most reliable pairing.

Not surprisingly, the field trial presented a number of formidable challenges. First, there was the task of attaching the RFID tags to large metal blinds and pipe flanges and making sure they would stay in place. "We tested industrial-strength glues before we finally found a glue capable of permanently attaching the tags to the solid metal blinds," Haley says.

The flanges presented a different problem. "We couldn't glue tags on, because some pipe flanges are covered with a removable insulation," Haley says, explaining that tagging the insulation was not a reliable option because the insulation could be replaced or reinstalled in a different place following a TAR. The BP team solved the problem by encircling the entire pipe flange and insulation with a thin, tamperproof wire and affixing the tags to it. "The wire stays in place whether the insulation is on or off the pipe," Haley notes.

**"The dense, heavy-metal environment of an oil refinery makes ubiquitous wireless coverage impossible."**

Then, there was the problem of connecting to the Wi-Fi network within the refinery and relaying data back to the control room. Unfortunately, the eCom iRoc handhelds couldn't pick up the Wi-Fi signal throughout the plant. "The dense, heavy-metal environment of an oil refinery makes ubiquitous wireless coverage impossible," Haley says.

In fact, during the trials, workers had to wander around the facility to locate Wi-Fi signals. Since there was no way to extend the signal into every crack and crevice of the refinery, BP adopted a decidedly low-tech solution: It posted signs indicating where wireless reception was available. Ultimately, this approach saves considerable time and aggravation while speeding the process, Haley says.

### RFID Fuels Results

It took nearly one year to develop, test and fully implement the RFID solution. Maintenance workers received classroom training, and many found the system intuitive, Haley says. Since Isolation Tracker was deployed, no isolation problems have been reported. This reflects increased safety and efficiency. The system has been proposed as a standard for all BP refineries, Haley notes.

BP is now looking for ways to expand the scope of the project. The original application has already been extended further into the CoW system used in conjunction with SAP, Haley says. With this integration, the company has a more comprehensive view of maintenance activities. BP also is testing the solution at a production facility near Edinburgh, Scotland, and if this project goes well, the firm plans to introduce the RFID solution at offshore oil platforms in the North Sea.

Haley expects the RFID system to become faster and better during the next few years, as the company adopts the next generation of handheld devices and further refines its processes. "This project set a new standard for mobile applications," he says. "It makes the workplace safer and ensures accurate collection of data in our industrial setting. This project has been very important in showing that applications built on a good RFID infrastructure really deliver value."

RFID GREEN AWARD

# Extracting New Value From Old Printers

## HP Brazil is leveraging the RFID information in its tagged ink-jet printers to recycle plastics.

*By Jennifer Zaino*

**ELECTRONICS MANUFACTURERS** that implement green strategies for recycling their products, so potentially toxic components don't end up in landfills, can have a huge impact on the environment and people's health. That's a message Hewlett-Packard has taken to heart. The company's corporate-wide commitment to recycling and reuse has led the manufacturer to recover more than 2.3 billion pounds of products since 1987.

To do its part, HP Brazil, in 2009, set up drop-off centers around the country, where customers could return ink-jet printers for recycling. The following year, it established the SmartWaste project, to leverage the RFID infrastructure it deployed to track printers using passive ultrahigh-frequency tags with Electronic Product Codes (HP Brazil won the 2007 RFID Journal Award for Best Implementation for tracking printers through production and distribution; see "Keeping Tabs on Printers"). The goal was to use the tag information to manage reverse logistics for end-of-life products. "We realized we had enough tagged printers in the market to use them," says Marcelo Pandini, HP Brazil's country operations manager.

The forward-thinking company also believed the RFID-based recycling program would support compliance with the Brazilian government's National Solid Waste Policy (PNRS) legislation, enacted in August 2010, which makes electronics manufacturers responsible for collecting products and packages that can be reused. Brazilian officials estimate it will take four years until the legislation is enforced, and there are no mandates about what technology, if any, should be used to control the process, Pandini says. But thanks to RFID, HP Brazil is prepared to share recycling information with the government. "I think using a standard like EPC that already exists and is controlled by a nonprofit like GS1 could be one good option [for managing the recycling program]," he says.

Meanwhile, HP Brazil has been taking advantage of the valuable tag information on each printer. From July 2011, when the company implemented the SmartWaste solution, to the end of February 2012, it has collected 35 tons of plastics for reuse. The EPC and serial numbers on each tag link to a database with a wealth of information about each printer, including its recyclable materials, the majority of which are acrylonitrile butadiene styrene (ABS) and high-impact polystyrene (HIP) plastics.

"Our principle in recycling is to reintroduce such material into our supply chain again," for use in new printer products, Pandini says. "To do that, we need more information control about what comes back with what we are recycling."

The tag data lets HP Brazil calculate the percentage of RFID-enabled printers purchased and returned during the past few years, to inform projections for market demand. It also helps the manufacturer figure the percentage and total weight of returned plastics it may be able to reuse to meet that demand. "That information is usable to us to measure

HP Brazil doesn't need to have employees stationed at the recycling center to monitor the process.

PHOTO: HP BRAZIL

how many tons we potentially have to take from the market, and how many from our own material," Pandini says.

### Working With a Non-RFID Partner

The SmartWaste project was a one-year effort, with the first six months focused on design and planning at HP's RFID Center for Excellence, in São Paulo, and the last six months on the pilot and implementation at the Oxil recycling center, an HP partner, in Paulinia-São Paulo. HP Brazil didn't have employees stationed at the recycling center to monitor the process, and didn't want to interfere with the recycling operation or add requirements. But because the printers were already tagged, the company's cross-functional team was able to develop a system to read the tags at the recycling center and transmit the data to the manufacturer.

The printers are collected from drop-off centers and sent on pallets to the Oxil recycling facility, where they are depalletized. Before the printers move onto the disassembly line, where parts are separated manually by type of materials, such as plastic, metals, paper and electronic components, the RFID tags are interrogated by Mercury5 readers from ThingMagic (a division of Trimble). The plant's conditions are very different from the clean, humidity-controlled environment of the manufacturing floor, Pandini says. What's more, the printers are old and often dirty, contributing to a dusty environment.

"When we are talking about a regular manufacture operation, you can maintain and keep RFID or any equipment working," Pandini says, noting that on-site technicians and engineers are typically available to intervene if a problem arises. "When you go to a recycling center, it's a totally different story. There are fewer resources, technical expertise is reduced because nobody wants to put

too much cost into this kind of operation—there's a different perspective of disassembling a used old product vs. building a brand new one."

To meet the environmental challenges, HP Brazil secured the Mercury5 readers in locked, steel-enclosed cases, and reinforced the readers' antennas to keep them dust-free. Additionally, it provided recycling center personnel with simplified instructions for making minor adjustments if necessary.

To collect the tag data, HP Brazil did not want to engineer connections between its back-end systems and Oxil's legacy systems, so the team developed data-collection software in the readers, which identifies the EPC number and sends it and other related information over the Internet via a wired connection to HP Brazil. The data is transmitted to business intelligence software that's integrated into a manufacturing product database, which contains information about each tagged printer.

**"This just proves that the technology can be used for the whole cycle of a product's life, not just to control the beginning."**

Oxil takes control over whatever recyclable components HP Brazil determines it does not need for reinsertion into new printer products. "Controls are in place to make sure that proper disposal is part of the agreement of what we don't take back for our own usage," Pandini says. "Our partner has to do everything according to the laws and regulatory agreements."

### Smart Business

The environmental business strategic team can view customized information on dashboards, to assess the amount of materials recovered. On-screen graphs, for example, can show the amount of each material recycled, including ABS, HIPS and metals and the number of products recycled per month. The information helps forecast how much recycling material is available for production. Up to 40 percent of the materials in the company's new products is recycled from old printers, Pandini says.

But multiple reuses of recycled materials could present a challenge down the road, when printers that already include recycled materials are returned. The EPC data on the tag will identify these printers and provide information HP Brazil can use to determine which plastics can be reused again and which will need to undergo some adjustment process or be disposed of properly. "The issue, technically speaking, is there is a challenge in terms of material, its constitution and the preservation of engineering properties of a particular plastic," Pandini says. "Today, that's not impacted, because it's just one or two recycles. But that will change." HP Brazil has research and development efforts under way to create formulas for segregating and reusing the different types of plastics in its printers multiple times.

"The great part is that RFID tags are still alive from five to six years ago," Pandini says. "You take a read and the information is there. This just proves that the technology can be used for the whole cycle of a product's life, not just to control the beginning—the supply chain of producing and shipping to customers—but to help manage taking back recyclable materials."

PHOTO ILLUSTRATION: ISTOCKPHOTO

## Wasted Recycling Opportunities

**ONLY 13 PERCENT** of electronic waste worldwide is currently recycled, many times without safety procedures in place, according to the United Nations International Telecommunication Union.

In a May 2011 report, the Environmental Protection Agency estimated that in the United States alone, 2.37 million short tons of electronic products were ready for end-of-life management in 2009, but only about one-quarter of them were collected for recycling that year.

Brazil generates 195,090 tons of municipal solid waste each day; in 2010, only 13 percent was recycled, according to the Business Commitment for Recycling (CEMPRE).

Brazil loses R$8 billion (US$4 billion) annually by failing to reuse recyclable materials, according to a study by the Institute for Applied Economic Research commissioned by the Ministry of the Environment. *—J.Z.*

BEST NEW RFID PRODUCT

# RFID Issues Instructions On the Fly

## Omni-ID's "visual tags" tell workers what to do with the assets and work-in-process being tracked.

*By Paul Prince*

**MANY COMPANIES** use printed cards, labels or work orders in their daily operations. In a factory, for example, goods traveling down an assembly line might be accompanied by printed instructions that tell workers what color paint to apply or what parts and options to add. At a warehouse, a card attached to a tote might list the items a worker must pick to fill an order.

But sometimes a company needs to change instructions in mid-operation for a specific product or order, or perhaps across an entire plant. That can mean halting production while new cards are printed, and then having a worker swap the old paper instructions for the new ones. Manual paper-based systems are not only labor-intensive, they also are time-consuming, costly (think of all that paper and ink) and error-prone.

Omni-ID developed a more efficient solution: The ProView Visual Tagging System lets businesses use RFID to track assets and work-in-process—and update instructions automatically, on the fly. The system features a bistable LCD screen with an active ultrahigh-frequency (869- to 928-MHz) RFID tag and an EPC Gen 2 passive inlay. Omni-ID offers four models of ProView tags, with display screens available in three widths: 2 inches, 4 inches and 6 inches. A ProView tag controller transmits the instructions, via a proprietary air-interface protocol. An Omni-ID printer driver lets the software program being used to print cards and labels display the text or graphics immediately on a ProView tag's screen. (Any standards-based EPC Gen 2 interrogator can read or encode a ProView tag's passive inlay.)

Text and graphics can be displayed on the LCD screen.

Several businesses are carrying out

Omni-ID's booth at the RFID Journal LIVE! conference.

pilot implementations of the ProView system, including an automotive assembly plant, a major appliances manufacturer, a hospital and a logistics services provider, according to Ed Nabrotzky, Omni-ID's CTO and VP of marketing. The logistics provider installed ProView display tags on wheeled containers at a 1-million-square-foot sortation facility. "This was the only tagging system on the market that allowed us to put operator-readable information on moving assets in real time," says a material-handling manager employed by the logistics service provider.

"We project an ROI on the system costs in just over 14 months, based on hard savings in consumables," the logistics manager says. "We expect further 'soft savings' in utilization of manual labor, efficiency and quality-of-service metrics as the system helps us improve our operations. Any cyclic process—especially one that encounters frequent changes, relies on operators to make decisions based on printed instructions or where consumables are used repetitively for labeling—can benefit greatly from this technology."

Nabrotzky sees similar benefits for the health-care industry. A ProView tag attached to a wheelchair, for example, could display a patient's name, instruct an orderly where that patient is scheduled to go and issue an alert if the patient is taken to the wrong place.

In the upcoming P-series tags (the current tags are B series), due for release in mid-June, the EPC Gen 2 inlay is integrated with a 433-MHz active transponder built into the display tag's printed circuit board (PCB), which enables a number of functions.

An EPC Gen 2 reader, for example, could be used to send a wake-up protocol to a P-series tag, allowing its circuitry to remain dormant when appropriate, thereby extending the tag's battery life. Another benefit of integration of the EPC inlay with the PCB is that an EPC Gen 2 reader could be used to trigger a change in any text or graphics preprogrammed into the tag. For instance, when a ProView tag attached to an item arrives at workstation 1, an EPC Gen 2 reader could wake up the tag and cause it to display preprogrammed instructions specific for workstation 1. If the item arrives at the wrong workstation, the reader could detect that error and instruct the tag to display an image of a stop sign.

**"This was the only tagging system on the market that allowed us to put operator-readable information on moving assets in real time."**

In addition to improving efficiencies, ProView Visual Tagging System is a green solution. At the sortation plant mentioned earlier, the system has eliminated the need to print 900,000 sheets of paper formerly printed annually. Says the logistics manager: "The elimination of paper in our process contributed toward our sustainability goals and mandated targets to reduce environmental impact."

SPECIAL ACHIEVEMENT

# Giving RFID Credibility

Bill Hardgrave led an independent team that proved the business benefits of using RFID to track apparel items.

*By Mark Roberti*

**BILL HARDGRAVE,** an academic, didn't set out to get the retail community excited about RFID, but he has done just that. It all started in 2003, when Wal-Mart asked Hardgrave, then a professor of information systems at the Sam M. Walton College of Business at the University of Arkansas, to work on an IT project for the company. It was around the same time that Wal-Mart began exploring RFID, and Hardgrave was invited to evaluate that initiative. His business perspective and insight proved invaluable, and within a few months, the RFID project was consuming the bulk of his time.

In 2005, Hardgrave founded the RFID Research Center at the university. It featured a 10,000-square-foot lab, in an area of a working warehouse. "We saw the need for an independent laboratory that could help companies understand RFID and test tags on various products," he recalls.

Under Hardgrave's guidance, the RFID Research Center conducted a 29-week study, during which university researchers collected the out-of-stock rates on approximately 4,000 stock-keeping units at 12 Wal-Mart stores equipped with RFID technology, as well as at 12 control stores without the technology. The study, released in October 2005, indicated that RFID helped reduce out-of-stocks by an average of 16 percent.

Bill Hardgrave at RFID Journal LIVE! 2012

The business benefits derived from RFID-tracking pallets and cases, certified by an independent academic lab, could not be ignored. The study helped propel RFID adoption, and put the RFID Research Center on the map. Before long, many other companies were knocking on Hardgrave's door, and his team helped test technologies for myriad applications—from cold chain to tool tracking—always with a focus on the real-world benefits RFID could deliver.

Then, in 2009, the RFID Research Center released the results of some groundbreaking studies, conducted with Bloomingdale's, Dillard's and JCPenney. These studies showed that RFID-tracking apparel items could improve inventory accuracy in retail stores from 65 percent to 95 percent or better—and they proved the technology could deliver a return on investment. Once again, the business world took note. The studies led to enterprisewide deployments by major clothing retailers and encouraged many other retailers to run pilots.

Hardgrave has earned a level of respect in the business community that is shared by few. While he is now dean of Auburn University College of Business, in Alabama, he still consults regularly on RFID deployments and speaks at events worldwide about how companies can use the technology to improve the way they do business.

The RFID Research Center's work under Hardgrave's guidance brought an unprecedented level of credibility to the RFID industry. For all this, he is being honored with this year's RFID Journal Special Achievement Award.


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# RFID Goes to School

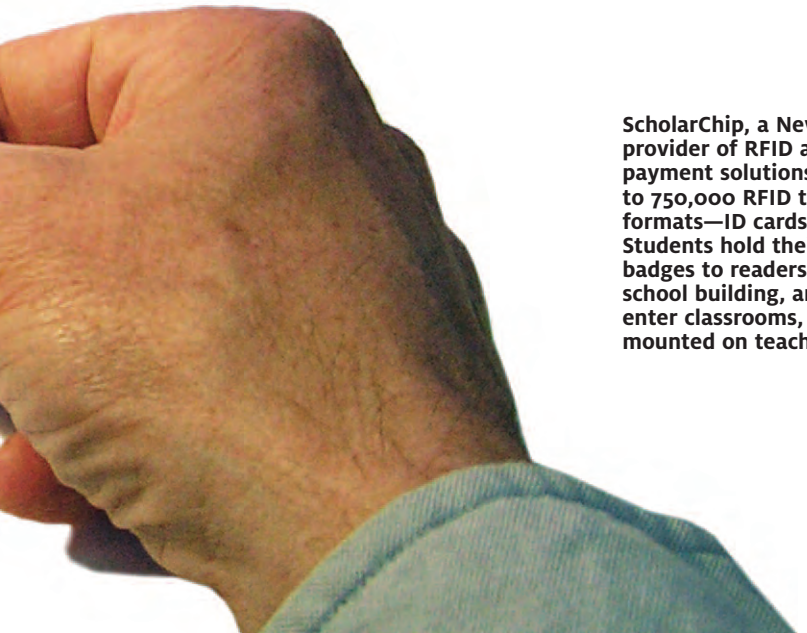
The technology earned mixed grades when first deployed in schools. Now, its use is growing, slowly but steadily, with applications focused on improving teacher efficiency and ensuring student safety.

*By Mary Catherine O'Connor*

IN THE UNITED STATES and many other countries, governments acknowledge that students are their best assets. But approaches to improving education vary widely, with issues ranging from school types to classroom sizes and teaching methods. Still, there are several issues on which governments and educators agree: We must improve attendance rates, keep kids and teachers safe, and devote more time to teaching and less to administrative tasks.

To address these issues, schools, including colleges and universities, are beginning to implement RFID identification, attendance and alert solutions. When schools first introduced personal-identification applications, parents and privacy advocates were afraid that students' safety could be compromised. Technology providers acknowledged those concerns and have taken steps to secure personal information, as well as to explain how the technology works. As a result, more schools and parents understand the benefits of tracking children, and RFID's use in the education sector is growing, slowly but surely.

Meanwhile, some schools are adopting RFID solutions to better manage valuable assets. Mexico's Universidad Regiomontana, for example, is using RFID to prevent theft of laptop computers it issues to staff and faculty. The Paul L. Foster School of Medicine, in Texas, is tracking state-of-the-art equipment to improve inventory management. And universities in the United Arab Emirates are RFID-tagging diplomas, to ensure the documents' validity. In addition,



**ScholarChip, a New York-based provider of RFID attendance and payment solutions, has issued close to 750,000 RFID tags in various formats—ID cards, fobs and stickers. Students hold their RFID-enabled ID badges to readers as they enter the school building, and again as they enter classrooms, where readers are mounted on teachers' desks.**

some parents and educators have developed innovative applications to help students learn and improve their health (see "RFID's Extracurricular Activities" on opposite page).

### Automating Attendance

In early 2005, Brittan Elementary School, in Northern California, invited a now-defunct startup to install an RFID-based automated attendance-tracking system. The school wanted to test whether the technology, which would collect the identification number encoded to the RFID-enabled school IDs issued to students, would give teachers more time to teach and provide accurate records on student whereabouts, which would prove useful in the event of a student disappearance or other emergency.

**The incident spurred a national debate on whether RFID should be deployed in the education sector and, if so, how to address privacy concerns.**

But the school earned poor marks for failing to make parents aware of the technology test, how the system would work and what steps would be taken to ensure their children's privacy and security. The student IDs contained passive ultrahigh-frequency tags, which can be read from several feet away. Although the IDs contained no student data, some parents feared a predator could read the tags and collect information that could endanger their kids.

Parents who opposed the system raised the issue with the American Civil Liberties Union. The organization, in turn, joined with technology and privacy watchdog groups the Electronic Frontier Foundation and the Electronic Privacy Information Center and sent a joint letter to the school's board requesting it reconsider its use of the technology. The groups' involvement and the letter attracted national media attention. The school quickly decided to remove the RFID equipment and hasn't deployed any type of RFID technology since.

The incident also spurred a national debate on whether RFID should be deployed in the education sector and, if so, how best to address privacy concerns. Legislators in California and Rhode Island introduced bills designed to regulate the use of RFID in education, but none of the bills passed into law. In 2008, California made skimming (surreptitiously reading) RFID-based identity cards a criminal offense.

ScholarChip, a New York-based provider of RFID attendance and payment solutions, credits its success to "a lot of education for parents," including handouts that describe how the technology works, says CTO Maged Atiya. The reaction to the technology has been positive, he adds, noting that many parents are familiar with the technology because their employers require them to use RFID key cards to access their workplaces. ScholarChip uses high-frequency (13.56-MHz/Mifare) passive tags that have a read range of just a few inches. "We made clear that these are passive tags, without a long read range, as compared to the active tags used in electronic tolling, such as E-ZPass," he says. Only a unique ID number is encoded to the card; the numbers associated with student names and other information is safeguarded in secure databases.

ScholarChip has issued close to 750,000 RFID tags in various formats—ID cards, fobs and stickers—to students in schools ranging from small private and charter schools to the School District of Philadelphia, in which it works with 68 secondary schools representing roughly 35 percent of the district's student population. Students hold their RFID-enabled ID badges to readers as they enter the school building, and again as they enter classrooms, where readers are mounted on teachers' desks.

ScholarChip's software sends the tag num-

# RFID's Extracurricular Activities

**Here's a sampling** of innovative RFID applications that are helping students learn as well as stay fit. You can find out more about these applications at *rfidjournal.com*.

Children at the Louisiana School for the Deaf are learning sign language by playing with RFID-enabled toys. A child uses an RFID reader to scan a toy's tag, bringing up a computer video of someone demonstrating the sign for that item. (See "*Deaf Children Learn to Sign by Toying With RFID*.")

In New York City's Special Education District 75, children previously unable to speak due to autism and other disabilities are starting to put together sentences, thanks to the Logan ProxTalker. The device comes with RFID "sound tags"—each containing a word or phrase, and usually a corresponding image—and a reader. When a child moves a tag over the machine, it announces the word that tag represents. (See "*RFID Gives Voice to Nonverbal Children*.")

Boltage's mission is to make walking or biking to school a way of life. To that end, the multistate program uses RFID to monitor which kids walk or bike to school, so it can reward those who are adopting healthy habits. The prototype system was called Freiker, for FREquent bIKER. (See "*RFID Motivates Schoolkids to Bike It*.")

BaeJong-soo, a professor at Seoul National University, in South Korea, has developed an RFID homework helper for local elementary school students who are stumped by math concepts. RFID tags are embedded in a textbook. When a student holds a small handheld device containing an RFID reader over a specific lesson, it triggers an explanatory audio file that plays through a speaker in the device. (See "*RFID Technology Meets Education*" *on YouTube.com*.)

ber, along with the time and location it was read, over a secure virtual private network to the school's electronic student records system. Here, the tag numbers are associated with each student's attendance record, explains Timothy Loranger, IT director at Franklin Towne, a charter high school in Philadelphia with nearly 1,000 students.

When that school deployed the technology in 2007, its goal was to reduce the amount of time teachers spent taking attendance, which had been a manual, paper-based system, and to save administrators' time logging the attendance records. Now, students can also use their ID cards as debit cards to purchase food in the school's cafeteria. Parents go online to replenish their payment accounts, and students simply hold their cards up to readers at the cashier stations to pay for meals.

**To help reduce truancy, the city of Vitoria da Conquista, in Brazil, is investing US$600,000 in an RFID-based Smart Uniform project.**


"We used to have long lines in the cafeteria, and now it takes less than 20 minutes for students to get to the cafeteria, get food and sit down," says assistant principal Eugenia Koo. "Instead of waiting in line, they can use more of their lunch period for relaxing and recharging and getting ready for the rest of their day." The software also calculates and applies discounts for students enrolled in government-free or reduced-lunch programs.

In addition, there is some evidence that students are less likely to cut class, since they know their attendance is closely monitored. The system enables the school to send automated notifications to parents when students are absent or late for class. Since 2007, Franklin Towne's average daily attendance has increased from 86 percent to 96 percent—one of the highest rates in the state, Loranger says. "Parents have embraced the system," he adds.

To help reduce truancy, the city of Vitoria da Conquista, in Brazil, is investing US$600,000 in an RFID-based Smart Uniform project, designed to track public schoolchildren. A survey by the Brazilian Federal Department of Education revealed that Vitoria schools have the highest dropout rate in Brazil. So far, 20,000 students have had RFID tags sewn into their uniform shirts. When children enter and leave school, they walk through an RFID portal that reads the tags, which contain their name and a personal ID number. The information is transmitted to software on the school's server, and the software sends a text message to parents' mobile phones, letting them know their children have arrived at or left school. Parents are also alerted if their kids have not shown up 20 minutes after classes begin. Although it's too soon to know how effective the solution is, Coriolanus Moraes, municipal secretary of education, says by 2013 all 43,000 students from city schools will be wearing RFID-embedded uniforms.

## Safeguarding Students

Brazil's RFID solution also promises to improve students' safety, because parents will know in real time that their children have arrived at school, as well as what time to expect them home. In the United States, Zonar's RFID-based fleet-management solution is designed to ensure that elementary and secondary school kids who ride school buses arrive and depart safely. The Electronic


**In the United States, Zonar's RFID-based fleet-management solution is designed to ensure that elementary and secondary school kids who ride school buses arrive and depart safely.**

Vehicle Inspection Report system (EVIR) includes handheld readers and RFID-tagged engine and safety components, to verify that school bus drivers perform safety inspections each day. Zonar also works with schools to implement its ZPass solution. Students are issued personal ID cards with embedded passive 125-KHz RFID tags, which have a very short read range. They are instructed to hold the card up to a reader mounted inside the school bus door as they enter and exit the bus, and to wait for a beep that tells both student and driver the card has been read. The data is transmitted to the school in real time.

Schools across the United States are drawn to the system for the safety, accountability, security and administrative efficiency it provides, says Chris Oliver, Zonar's VP of sales and marketing. The ZPass solution has been installed in 3,000 buses, with the cards issued to roughly 150,000 students. Zonar recently introduced a subscription-based mobile application parents can use to log into the ZPass system to see when their children's tags were last read, and they can set up the system to receive a text message each time the tag is read, showing the child's location.

Another solution, KidGopher, ensures that only appropriate custodians are allowed to pick up students at the end of the school day. Parents or other authorized guardians are issued an RFID-enabled card they present to a teacher at the school, who reads the card using a handheld device. A photo of the guardian then appears on the teacher's iPad, which authenticates the guardian. The RFID solution, deployed at North Springs Elementary School and Catawba Trail Elementary, both near Columbia, S.C., gives parents and teachers peace of mind that students will be safely escorted off campus. The system also links into child-safety databases, says KidGopher CEO Neil Willis. Should law enforcement determine that a parent or

**At West Cheshire College, in England, RFID tags serve double duty: They're used to quickly and accurately take attendance, and locate students and faculty in real time, in the event of an emergency.**

guardian is a potential abductor, the KidGopher system alerts teachers and instructs them not to allow the suspect to pick up or make visual contact with the student.

## In Case of Emergency...

The ability to quickly and accurately track student and teacher attendance is a key reason West Cheshire College, a vocational school in northwest England, turned to RFID technology in 2010, as it was planning and building two new campus facilities. But it also wanted the ability to know where students and faculty were located in real time, in order to find them quickly in an emergency. In addition, the school hopes to analyze data to better understand traffic flow and facility use in its new, high-tech buildings. "There is a wealth of powerful data and research to uncover yet regarding how learners learn through using modern state-of-the art buildings," says Kevin Francis, building services area manager at West Cheshire College. "We aim to be at the forefront of knowing our learners better."

The college deployed a real-time location system (RTLS), from Zebra Location Solutions. Full-time students are issued RFID badges when they register for classes, to be worn on lanyards along with their student IDs. West Cheshire College relies on government funding for a large part of its operating budget, and the school must provide records of how much time its students spend in class. The RTLS makes record keeping automated and accurate. Teachers are also issued RFID tags, which automatically track their attendance and work hours. The majority of the college's operating budget is spent on teacher salaries, and the school must also account for the teachers' time.

The RFID tags serve double duty, because they can also track students and staff members, including those who have first-aid train-

ing, for emergency situations. Customized evacuation plans are designed for students with special physical or cognitive needs; in an emergency, administrators can use the RTLS to monitor their whereabouts.

"On a year-by-year basis, the public sector funding allocation process demands that taxpayers' money is spent with due diligence in all sectors; part of our responsibility is ensuring that we develop systems that improve the efficiency of the services we run," says Francis, who counts the RTLS among these efficiencies. "If we can become more efficient in our delivery model, we can better service the needs of learners and better address our ultimate objective, which is to support learners to develop skills and qualifications in areas to enable them into employment or higher education. If we retain more learners and more of them achieve, that is a win-win and a massive ROI for all concerned."

PinPoint, from RF Technologies, is being used in two Wisconsin schools to give staff members a fast and effective way to summon help in an emergency, such as an eruption of violence in class. Staff members are issued RFID-enabled pendants worn on lanyards or carried in pockets that communicate with the school's Wi-Fi network. Pressing a button on one of the devices transmits a distress signal to the school's central office. By analyzing the tag's signal, the system can determine the staff member's location in the school.

## Lessons Learned

In 2008, a Chicago high school failed to inform parents, teachers and students about an RFID-based system to ensure that only authorized pupils leave the campus during lunch. When students discovered the RFID tags embedded in their IDs, they protested. After the school newspaper ran an article describing the RFID technology and how it works, and explaining how the school was using it, the protests ended.

Before Brazil's Vitoria schools adopted its RFID-tracking solution, the city's education department held several meetings with parents to explain how the attendance system would work and what actions would be taken to avoid privacy issues, says Ronaldo Costa Jr., IT manager of the city's department of education and coordinator of the Smart Uniform project. Parents were very positive about being able to monitor their children in real time, he adds.

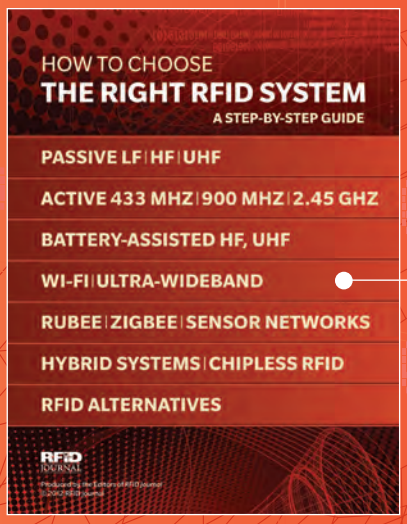
Clearly, it's essential to inform parents, teachers and older students about any RFID-tracking solution being deployed at a school, as well as to explain how the technology works and what mechanisms are used to protect students' identities. For the most part, privacy concerns are being addressed, according to the educators and vendors interviewed for this story.

**It's essential to inform parents, teachers and older students about any RFID-tracking solution being deployed at a school, as well as to explain how the technology works.**

Parents are increasingly interested in how they can use technology to monitor their children's safety in school, says ScholarChip's Atiya, who is working with schools to begin using ScholarChip badges in combination with school bus systems, to track students getting on and off buses each day. A smartphone with Near-Field Communication (NFC) capabilities will be mounted in each bus; students will hold their RFID badges up to the phones, which will act as RFID readers through the NFC interface. Parents are asking when the application will be available, Atiya says. They want to make sure their children get to and from school safely.

*Additional reporting by Edson Perin, in Brazil.*

See the complete table of contents at
www.rfidjournal.com/howtochoose




# How to Choose the Right RFID Technology for Your Application

Choosing the proper radio frequency identification system for your application can be a daunting task. Now, for the first time, *RFID Journal* provides a guide to choosing the right system for your needs, and explains the pros and cons of different RFID solutions for different applications.

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# Encrypt Instead of 'Kill'

A dual-mode EPC RFID tag works in the supply chain and secures data after an item is purchased.

*By Junyu Wang and Xi Tan*

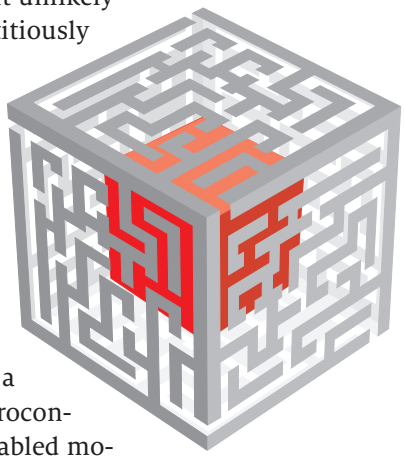
Wang and Tan

MANY COMPANIES are using RFID tags with Electronic Product Codes to track goods for supply-chain management. Some businesses are also employing EPC RFID tags to thwart counterfeiting and for product authentication. But these tags do not use on-chip cryptography algorithms to enhance security, because cryptography algorithms would draw too much power, impeding the long read ranges and high read rates needed to track items in the supply chain.

EPC RFID tags can be disabled at the point of sale (POS) using a "kill" command, to protect consumers' privacy. But that means the tag can no longer be used to access information about the product, or to manage warranties, returns and end-of-life applications.

At the Auto-ID Lab at Fudan University, we have developed a dual-mode EPC tag that addresses both issues. It has an on-chip cryptography algorithm and can work in either normal EPC mode or secure mode. When a dual-mode EPC tag is used for supply-chain management, the on-chip crypto engine is shut down to save power and the tag behaves just like any other EPC tag. Then, at the POS, using a "crypto-en" command, the tag can be changed to secure mode, in which the crypto engine is enabled. Just like the kill command, the crypto-en command is not reversible. But in the secure mode, consumers can access information on the tag.

We implemented different crypto engines for RFID tags, including Tiny Encryption Algorithm, International Data Encryption Algorithm, Hummingbird 1 and 2, and Advanced Encryption Standard. Mutual authentication protocols and channel encryption methods are applied for secure tags. The secure tags have a much higher power consumption than conventional EPC tags, reducing read ranges to less than 10 centimeters (4 inches). Consumers can use handheld or mobile devices to read the tags at a relatively short range, making it unlikely that someone nearby could surreptitiously read the tag.



We also have developed a low-power, low-cost EPC reader system-on-chip that can be easily embedded in mobile phones, using a common serial communication interface. The highly integrated chip, manufactured using complementary metal-oxide semiconductor (CMOS) technology, includes a transceiver, protocol processor, microcontroller and power amplifier. EPC-enabled mobile phones can verify tags with the support of a trusted scalable service platform, which can be maintained by a third party.

Most mobile phones eventually will be equipped with Near-Field Communication (NFC) technology for payment and other short-range applications. The dual-mode EPC tag can coexist with NFC, so consumers will be able to use their mobile phones to access information about tagged products.

The prototype system is scheduled for demonstration at the Internet of Things 2012 conference, in October, in Wuxi, China.

*Junyu Wang and Xi Tan are associate directors of the Auto-ID Lab at Fudan University, in Shanghai, China.*

ILLUSTRATION: ISTOCKPHOTO

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# Serialization Roadmap

A top-level tagging plan will help apparel suppliers identify items now, and pave the way for tracking more products in the future.

*By Ken Traub*

A GROWING NUMBER of apparel retailers are adopting item-level RFID to manage their inventory, which means more apparel suppliers will be asked to tag goods at the point of manufacture. My November/December 2011 column, "Identifying Items," discussed four ways apparel suppliers can assign a unique serial number to each item they want to track, using a passive ultrahigh-frequency RFID tag—a process called "serialization."

A supplier that manufactures each clothing product on a single manufacturing line can choose any one of the four options. But many suppliers manufacture in several plants or use third-party service providers. To avoid duplicating serial numbers—whether you choose one serialization method or a combination of all four—you need what GS1 US calls a "top-level serialization plan."

A top-level serialization plan is a written statement identifying the method that will be used to assign serial numbers for a given product, as well as the range of numbers. If the supplier will be using more than one method, the plan assigns a different range of serial numbers to each method, so the numbers will never be duplicated.

Let's say, for example, Supplier X does most of its tagging on in-house manufacturing lines, but supplements with a service bureau when demand is high. Supplier X writes a plan that says products tagged in-house will be assigned numbers one at a time, and the range of serial numbers will be 0 through 137 billion—half the available range in 96-bit tags. The plan assigns the service bureau a smaller range of serial numbers, 138 billion through 206 billion. In addition to avoiding duplication of numbers, the plan provides a common point of reference for all parties concerned.

Supplier Y, on the other hand, would like to use the unique "tag identifier" (TID) serial number burned into RFID tags by the tag manufacturer to track items. But Supplier Y wants the freedom to use tags from different manufacturers, as well as retain the option to assign its own serial numbers down the road. Supplier Y writes a plan that creates eight ranges of serial numbers, allocating some ranges for TIDs and reserving the other ranges for the future. Supplier Y must work with each tag provider to designate TIDs, but now there is a ready-made plan suppliers can adopt. In March, three leading RFID companies announced a coordinated approach that designates a range of TIDs for each chip maker (see "Three RFID Chip Makers Agree on Serialization Approach").

These are just two examples of top-level serialization plans. GS1 US is publishing a guide titled "EPC-enabled RFID Serialization Management" that explains all four options in detail, as well as how to create a plan. Each apparel supplier has the flexibility to develop its own plan. The point is: You need a plan.

*Ken Traub is the founder of Ken Traub Consulting, a Mass.-based firm providing services to software product companies and enterprises that rely on advanced software technology to run their businesses.*

ILLUSTRATION: ISTOCKPHOTO

# RFID Goes Bananas

The latest advance in RFID technology helps keep fruit fresh.

*By Kevin Ashton*

THE FIRST TIME I traveled to Bentonville, Ark., to visit Wal-Mart was in 2000, when the company's VP of fresh produce invited me to talk about whether RFID could solve one of his biggest problems. He explained that bananas are a popular item in any grocery store—nearly everybody buys them—and both the price and the ripeness must be just right. To ensure that no bunch is too green or too brown, bananas are packed so they ripen in transit. If everything goes according to plan, they arrive at the store delicious and ready to buy. But this creates a logistics nightmare—timing is everything, and being too early is as bad as being too late. Besides, bananas don't know anything about traffic, and they don't sit in the back of the truck asking, "Are we there yet?"

When bananas arrive in bad condition, disaster strikes. The whole truckload has to be rejected, which means sending a full truck of fruit to someplace it can be disposed of safely, and leaving stores perilously close to running out of one of customers' favorite items.

The Wal-Mart VP wanted to know if there was a way to use RFID technology to help improve the meticulous choreography of the banana supply chain, as well as the supply chains of other produce. The answer was maybe—because banana ripening isn't just about timing. Other factors must be considered, the most important of which is a gas called ethylene. The bright yellow color of grocery store bananas is a result of artificial ripening by ethylene—naturally ripened bananas tend to be greener.

So, while RFID tags could help track, trace and time the bananas, they would be able to do a much better job if they were equipped with sensors that could detect the gases associated with ripening. RFID plus sensing looked like the perfect solution. The only trouble was, the sensors cost thousands of dollars. Or they used to.

In a great example of the ongoing innovation we are seeing in the RFID industry, Timothy Swager, a chemistry professor at the Massachusetts Institute of Technology, recently announced a 25-cent sensor—based on carbon nanotubes—that can detect ethylene and relay its data to the outside world via an RFID tag. The devices, which Swager has patented and hopes to commercialize, can be attached to produce crates and used to ensure that only perfectly ripe fruit arrives in stores, helping to eliminate the estimated 10 percent of waste caused by incorrectly ripened fruit every year.

This is not just a breakthrough in banana technology. Swager's nanotubes, which were funded by the U.S. Army via MIT's Institute for Soldier Nanotechnologies, mark the beginning of a trend that has been a long time coming: the fusion of RFID and sensors—an area that, it must be said, is ripe for innovation.

*Kevin Ashton was cofounder and executive director of the Auto-ID Center.*

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