DEDICATED TO RADIO FREQUENCY IDENTIFICATION AND ITS BUSINESS APPLICATIONS

RFID JOURNAL

www.rfidjournal.com

May/June 2013

2013 RFID JOURNAL AWARDS

Honoring Excellence

PAGE 10

And The Winners Are:

Hanmi Pharmaceutical

Boeing

Infinite Biomedical Technologies

The City of Grand Rapids, Michigan

Kevin Ashton

Impinj

Photo: Boeing's Rebecca Shore Accepts The Award For Best Use of RFID To Enhance A Product Or Service

PLUS

RFID JOURNAL VIRTUAL EVENTS

IN-DEPTH RFID PRESENTATIONS AT YOUR DESK

Our webinars and virtual events are **FREE** to attend—but space is limited, so register early.

UPCOMING WEBINARS AND VIRTUAL EVENTS

RFID in Defense

Sept. 10, 2013 • 11:00 AM - 1:00 PM EDT

This virtual event will examine how the U.S. Department of Defense is achieving benefits through the use of RFID, as well as how its suppliers are meeting tagging mandates and achieving benefits, both internally and across supply chains.

RFID in Harsh Environments

Nov. 19, 2013 • 11:00 AM - 1:00 PM EST

Companies in the oil and gas, chemical, mining, construction and energy industries are using RFID-enabled technologies to increase operational safety and efficiency, as well as improve financial results. During this virtual event, learn how RFID can be used for asset tracking, personnel safety and equipment maintenance, as well as for speeding up production and shipping processes in harsh and complex environments.

For the most up-to-date calendar, visit **www.rfidjournalevents.com.**

For sponsorship information, please contact:

Alan McIntosh: Director of Sales
amcintosh@rfidjournal.com
(212) 584-9400 ext. 4

Matthew Singer: Director of Sales
msinger@rfidjournal.com
(212) 584-9400 ext. 6

RFID JOURNAL
THE WORLD'S RFID AUTHORITY

Find us on:

RFID JOURNAL

Vol. 10, No. 3 May/June 2013

features

COVER STORIES: AWARD WINNERS

VERTICAL FOCUS: ANIMAL HUSBANDRY

departments

columns

COVER PHOTO: TOM HURST | RFID JOURNAL

tune in online

Coming soon to RFIDJournal.com

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 Defense: Hear how the U.S. Department of Defense is achieving benefits through the use of RFID, and how its suppliers are meeting tagging mandates and achieving benefits, both internally and across supply chains.
  Sept. 10, 11 am to 1 pm EST

- RFID in Harsh Environments: Learn how construction and energy companies are using RFID technologies to track and manage assets, improve operations, maintain equipment and provide safety solutions.
  Nov. 13, 10 am to 12 pm EDT

rfidconnect
POWERED BY RFID JOURNAL

Find products that can help you deploy RFID successfully. Here's an example: Voyantic's **Tagformance UHF Measurement System** is designed to evaluate the functionality and performance of EPC Class 1 Gen 2 RFID tags. It can, for example, help you locate the optimal placement

Most-Read Stories in May

- Hospitals in Japan, China Seek to Save Lives via Pocketsize Reader
- Airbus Guides EADS Divisions' RFID Adoption
- GEA CowView Locates Cattle via Active RFID
- Temporary RFID System Tracks Flow of Shoppers
- IER's Expedited Self-Payment Kiosk Speeds Up Checkouts

Top 10 Search Terms On RFIDJournal.com

1. NFC
2. RTLS
3. Health care
4. How does RFID work
5. Library
6. Museum
7. Walmart
8. American Apparel
9. Cold chain
10. Jewelry

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

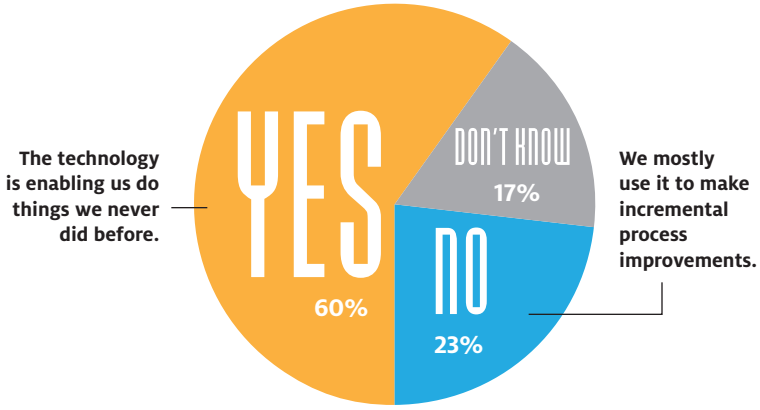
RFID Journal maintains an Ask the Experts forum, where you can submit questions about RFID technology and its applications. Your questions will be answered by RFID Journal editors or outside experts. Recent questions include:

- How can I monitor unauthorized patient departures?
- Do you have any information about the use of RFID in gas stations?
- Is RFID being used by water utilities?
- Where can I see RFID in action?
- Is UWB Better Than Wi-Fi-based RFID Systems?

POLL RESULTS

Is your company using RFID to introduce innovations?

Cast your vote. Each week, RFID Journal takes the pulse of the RFID community. See what other people are thinking—and make your opinion count.



RFID IN HEALTH CARE

Dec. 4, 2013 • Georgetown University Hotel & Conference Center • Washington, D.C.

IMPROVE YOUR HOSPITAL OPERATIONS WITH RFID TECHNOLOGY

Radio frequency identification is being used by hospitals and health-care facilities as a valuable tool for improving asset-utilization rates, reducing the incidence of lost or stolen equipment, dramatically cutting the amount of time nurses waste searching for equipment, improving patient outcomes and much more. RFID in Health Care, *RFID Journal's* ninth conference focused on this sector, is designed for executives at hospital or clinics considering using RFID technology within their facilities.

BY ATTENDING THIS EVENT, YOU WILL:

- Hear early adopters share the results of real-world deployments
- Get answers to your questions regarding the benefits that can be achieved
- Gain valuable insights into the proper RFID technologies to employ for various applications
- Learn best practices and find out how to avoid common pitfalls
- And so much more!

Register now and save with early-registration pricing, at www.rfidjournalevents.com/healthcare.

For maximum savings, use promo code **HCEC**.

CONNECT WITH THE RFID COMMUNITY ONLINE, 365 DAYS A YEAR!

The most robust virtual community of RFID professionals

CHECK IT OUT TODAY!

› Product searches:
Find the right product to meet your needs.

› Forums:
Post questions and have discussions with other business professionals.

› Blogs:
Post your own blog, or comment on others.

› *RFID Journal* event daily planner:
Schedule meetings and plan your itinerary.

› And so much more!

SET UP YOUR PROFILE TODAY—VISIT www.rfidconnect.com

rfidconnect
POWERED BY RFID JOURNAL

RFID JOURNAL
THE WORLD'S RFID AUTHORITY

When Clichés Become Reality

EVERY TECHNOLOGY PROVIDER claims its solution will help companies "get to the next level" or "transform operations," offering a "step change" that will give them a huge competitive advantage. In many cases, these clichés are just empty marketing promises, but in the RFID industry, they are beginning ring true. Consider, for example, how the winners of this year's RFID Journal Awards are using the technology.

Mark Roberti presented the award for Best RFID Implementation to JongHoon Lim, executive director of Hanmi Pharmaceutical and CEO of Hanmi IT.

PHOTO: TOM HURST | RFID JOURNAL

Hanmi Pharmaceutical received the award for Best RFID Implementation (see page 12). The South Korean company produces more than 500 different medical products and ships 60 percent of its output directly to hospitals and pharmacies. It needed to improve its shipping accuracy and gain better visibility into its supply chain.

Hanmi developed a cost-effective way to apply RFID transponders to individual pill bottles and packages containing blister packs. Since the company launched the RFID-enabled inventory management and shipping system in 2009, its average tag-read success rate has reached 99.9 percent. Its ordering and shipment process accuracy also has hit 99.9 percent, and its time efficiency has improved by 300 to 400 percent. Now, *that's* a step change.

Boeing won the award for Best Use of RFID in a Product or Service (see page 16). Boeing's commercial airplanes—indeed, all airplanes—undergo daily, weekly and monthly maintenance checks to ensure they're flight-ready. Manually inspecting life vests, oxygen generators and other loose emergency equipment in an aircraft's cabin is a labor-intensive and costly process.

Boeing developed a service called RFID Integrated Solutions, which it hopes will become part of all airlines' maintenance programs. Today, airlines conduct separate manual checks to ensure there is a life vest under each passenger seat, it hasn't been tampered with and it functions properly. These checks can take 10 hours. But with the Boeing solution, an airline can use one RFID-enabled process to perform presence, security and serviceability checks in only a few minutes. *That's* process transformation.

Infinite Biomedical Technologies was the recipient of the Most Innovative Use of RFID Award for an RFID system enabling a prosthetic limb to operate more effectively and naturally (page 20). And the city of Grand Rapids, Mich., took home the RFID Green Award for a system that reduces waste and increases recycling (page 24). *That's* getting to a higher level.

Kevin Ashton was honored with the Special Achievement Award for his tireless work in promoting RFID technology while he was executive director of the Auto-ID Center at MIT, from 1999 to 2003 (page 28). And Impinj's new xArray reader system walked off with the award for Best in Show, which acknowledges the best new product at RFID Journal LIVE! The xArray system provides wide-area monitoring through its beam-forming antenna array, which creates a 40-foot-diameter read field when installed at a ceiling height of 15 feet (page 30).

So if you're still thinking—"Is RFID really a game-changing technology?"—the answer is, it can be if you use it wisely.

Mark Roberti, Founder and Editor

HEALTH

RFID May Prevent Sunburn

An NFC-powered sensor and smartphone application could soon warn sun worshippers when it's time to find shade.

WE'VE ALL HEARD THE WARNING: Overexposure to the sun's ultraviolet (UV) rays can cause skin cancer. Gernot Schmid, an engineer at Seibersdorf Laboratories, an Austrian provider of laboratory and analysis services as well as solution-driven research and development, and his team have developed a concept for a convenient, low-cost way to alert users when it's time to get out of the sun: a "smart UV sensor" and an application that runs on a mobile phone equipped with Near-Field Communication (NFC) technology.

"In general, a precise UV assessment requires sophisticated and expensive measurement equipment, because skin sensitivity is highly dependent on the wavelength composition of the radiation, mainly on the proportion of UV-A to UV-B," Schmid explains. "That proportion depends on several factors, such as sun elevation, clouds, ozone layer conditions and reflectivity of the environment."

Scientists have developed computational prediction models of the UV spectrum for every place on Earth under standardized conditions. Based on the data from these models—coupled with the actual date, time and location—it is possible, Schmid says, to estimate the UV exposure of an individual using sensors and filters that mimic wavelength-dependent skin sensitivity.

Available personal UV monitors are costly and require batteries. "The majority of functions and components required for standalone UV measurement devices—analog front end for measurement signal processing, microcontroller, memory, GPS module, real-time clock and user interface—are already integrated in smartphones," Schmid says. "So, we asked ourselves, 'Why not use a smartphone for the UV assessment?' All we need is a smart UV sensor and a way to transmit data to the phone, where it can be processed and displayed."

Schmid and his team developed a concept for a UV sensor, or photodiode, and a smartphone application. It would use NFC to transmit raw measurement data from the smart UV sensor to the smartphone, because the technology is wireless, intuitive and simple (just tap, no pairing required). NFC also could wirelessly supply sufficient energy to power the smart UV sensor, which would help keep the cost of the device down.

The smart UV sensor would have to be positioned with the photodiode facing the sun. When the device was brought close to the smartphone, the application would launch automatically and display the maximum time the user could stay in the sun without risking sunburn. Each user could enter a personal profile, including skin sensitivity and the sun protection factor of his or her sunscreen.

The key challenge in commercializing the concept is the development of a small, low-cost UV sensor and matching filtering system that mimics skin sensitivity accurately. "Currently, there are no sensors available fitting both requirements," Schmid says. "Once this issue is solved, further development is pretty straightforward," he adds. That's good news for anyone who doesn't want to worry about skin damage while soaking up the sun. —*Mark Roberti*

PHOTO: ISTOCKPHOTO

NINTH ANNUAL EVENT

RFID JOURNAL LIVE! EUROPE

15 OCT. 2013 • DEXTER HOUSE • LONDON, ENGLAND

TRACK AND MANAGE EVERYTHING WITH RFID

Radio frequency identification technology is being deployed at large and midsize companies to improve efficiencies, enhance visibility, reduce shrinkage and achieve other significant business benefits. Co-located with RFID in Europe, this one-day event is designed to help companies considering using RFID technology to address real business challenges, determine the best RFID technology for their needs, learn best practices from early adopters, find the right technology partners and move forward.

RFID JOURNAL LIVE! EUROPE IS THE ONLY EVENT AT WHICH 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 that include leveraging RFID to enhance visibility and traceability, improving supply chain management and boosting operational efficiency
- Meet the leading end users, experts and RFID solution providers
- And so much more!

Register now and save with early-registration pricing, at www.rfidjournalevents.com/europe.

For maximum savings, use promo code **LENH**.

CO-LOCATED EVENT

RFID in EUROPE

PATENTS

Update on the Round Rock Patent-Infringement Lawsuit

Little progress has been made in the courts, but some RFID providers and end users are taking steps to deal with the issue so they can deploy EPC technology.

AS WE REPORTED last year, a patent-licensing company called Round Rock Research is suing end users of RFID technology, including American Apparel, Dole Food, Fruit of the Loom, Hanesbrands, JCPenney, Macy's, PepsiCo, Gap, VF Corp. and Walmart, for infringing on 10 U.S. patents relating to the use of ultrahigh-frequency RFID (see Courting Confusion). On Apr. 5 of this year, the attorneys for Round Rock and all the companies being sued submitted a Joint Status Report to the U.S. District Court for the District of Delaware.

The status report reveals little new information. The judge suspended the legal proceedings pending a reexamination by the U.S. Patent and Trademark Office (USPTO) of 10 patents held by Round Rock and requested a status report every six months. The USPTO has finished reviewing four of the 10 patents and declared them valid. This does not mean anyone infringed those patents. It simply means there was no "prior art"—no existing invention—that would render those patents invalid.

The status report says, "In view of the continued reexamination proceedings for the remaining six patents-in-suit, the parties do not request lifting the stay at this time. Round Rock reserves its right, however, to request lifting the stay

PHOTO: ISTOCKPHOTO

upon further completion of the reexamination proceedings." The next status report is due Oct. 4, though it is not clear when the USPTO will complete its review of the remaining six patents.

Meanwhile, leading providers of RFID technology are taking steps to address the issue. Checkpoint Systems has signed an agreement with Round Rock to license the patents. The terms of the agreement have not been disclosed, but sources say if a company purchases hardware and software through Checkpoint, Round Rock Research will not sue them for patent infringement. IBM is covered under the terms of a previous settlement with Round Rock.

In the short term, the deal gives Checkpoint a competitive edge with retailers seeking to take advantage of item-level RFID. According to one observer, within three months the other major companies focused on selling RFID systems to retailers will be forced to settle.

Checkpoint's decision to settle with Round Rock could pressure other companies to do likewise, but Avery Dennison, Impinj, Motorola and several other RFID providers have teamed up to fight the Round Rock lawsuit. The companies declined to discuss their legal strategy, but a patent consultant says it's likely they are aggressively researching prior art to try to invalidate the patents. "I'm sure they have some very smart people working on this," the consultant says. "And they have the advantage that they know the technology inside and out, so if there is prior art, they will likely find it."

End users, too, are taking steps to address the issue. In March, Walmart sent a letter to suppliers tagging products for the retailer to inform them it was "curtailing its EPC program pending resolution of the existing litigation." Walmart said it planned to "defend the lawsuit vigorously."

RFID Journal has learned that some companies tagging auto parts for Walmart have been told to stop tagging individual items. Companies that were putting tags on individual jeans and basics continue to do so, though it is not clear whether Walmart is reading the tags and using the data gathered from them.

Some in the industry have been surprised by Walmart's actions, particularly given how fervently the retailer championed RFID in the past. RFID Journal believes Walmart took this stand because Round Rock is seeking a percentage of the benefits the retailer achieves by using RFID, rather than a straight licensing deal. Walmart was sending a message to Round Rock that it would rather forfeit its use of EPC technology than pay a percentage of the benefits. In addition, losing the case would make the world's largest retailer a prime target for holders of other technology patents—RFID and otherwise—to seek a percentage of the benefits. The letter was a preemptive attempt to let all patent holders know Walmart won't use new technologies if it would be forced to share the rewards.

It's hard to say how this case will be resolved. But one of two outcomes is likely. Either the Round Rock claims will be thrown out, or the RFID technology providers will negotiate a royalty with Round Rock, allowing Walmart to reinstate its EPC program.

Unlike Walmart, most end users of the technology have not been dissuaded from moving ahead. Macy's has said Walmart's decision to curtail its EPC efforts will have no effect on its RFID program. American Apparel continues to roll out the technology, as do many other companies.

In early June, President Barack Obama issued several executive orders and proposals aimed at reducing frivolous lawsuits (see Obama Administration Patent Proposals Could Benefit RFID Industry). But companies in the United States understand that lawsuits are part of doing business, especially when it comes to adopting new technology. Regardless of how the Round Rock case is resolved, it will not be the end of the legal issue. As one patent consultant tells us, there are many other parties that hold RFID patents. "This is going to be part of the business landscape for a while," he says, "as it is with almost all new technologies." —*Mark Roberti*

Checkpoint's decision to settle with Round Rock could pressure other companies to do likewise, but Avery Dennison, Impinj, Motorola and several other RFID providers have teamed up to fight the Round Rock lawsuit.

PHOTO: TOM HURST

Honoring Excellence

ON MAY 2, WE PRESENTED the seventh annual RFID Journal Awards for outstanding achievement in radio frequency identification, at RFID Journal LIVE!, our 11th annual conference and exhibition. You can read about the end users' RFID project in the following stories. You'll also learn how Impinj's reader can monitor a wide area in real time, and why Kevin Ashton is "the man who changed the world." In addition, you can view all the presentations and acceptance speeches—including those of the finalists—in the video library on RFID JOURNAL's Web site.

Hanmi Pharmaceutical | Best RFID Implementation

Boeing | Best Use of RFID to Enhance a Product or Service

Infinite Biomedical Technologies | Most Innovative Use of RFID

The City of Grand Rapids, Michigan | RFID Green Award

Kevin Ashton | Special Achievement

Impinj | Best New RFID Product

BEST RFID IMPLEMENTATION

RFID Makes Order Out of Chaotic Distribution Chain

Hanmi Pharmaceutical developed an automated picking and shipping system, to ensure hospitals and pharmacies get the medical products they need.

By John Edwards

For Hanmi Pharmaceutical, South Korea's largest pharmaceutical producer, achieving a high level of shipping precision and accuracy is more than a goal—it's essential. Lives literally depend on Hanmi's ability to continuously maintain an impeccable delivery chain.

Established in 1973, Hanmi has based its reputation on developing and supplying a wide range of high-quality pharmaceutical products. "The firm currently produces more than 500 different types of medical products, including solid formulation, tablet, liquid formulation and parenteral injection, among others," says Jay Jun, manager of strategy and planning at the company's Hanmi IT division.

But distributing all those products has been a challenge. Unlike the U.S. pharmaceutical market, which is dominated by three major distributors, the South Korean pharmaceutical market is splintered among hundreds of small-scale wholesalers. Many of these firms lack the ability to fully track and manage inventory shipped to local hospitals and pharmacies. In addition, local customers often bypass distributors and purchase their drugs directly from the manufacturer. Hanmi ships 60 percent of its pharmaceuticals directly to hospitals and pharmacies.

Hanmi wanted to lower its erroneous shipment rate, as well as raise the accuracy and speed of its production processes. The firm also wanted to gain greater insight into a fragmented and sometimes chaotic distribution environment. In 2011, Hanmi deployed a sophisticated RFID-based automated picking and shipping system, to help the company keep pace with customer demand.

Today, Hanmi's 1,000 regional sales representatives conduct weekly onsite inventory checks with RFID ATiD 870 handheld readers. The inventory data from each customer site is transmitted to Hanmi headquarters, so the drugmaker can assess inventory levels of specific products and detect any expired pharmaceuticals. The system also enables Hanmi to create reliable production forecasts, keep customers adequately supplied, develop a more efficient return and recall process, and detect any abnormal or malicious distribution activities by drug wholesalers.

Getting Started

Before Hanmi's representatives could begin using handheld readers to inventory customers' stockrooms, the company had to develop an effective and affordable way to RFID-tag its entire product line at the item level. Hanmi's first step toward creating a comprehensive RFID environment was to evaluate the practicality and cost of building

RFID-tagged items are placed in totes that move along a conveyor through a shipment verifier—an RFID tunnel reader. Hanmi Pharmaceutical's ordering and shipment process accuracy has reached 99.9 percent.

PHOTOS: HANMI PHARMACEUTICAL

such a system and then integrating the technology into its existing production and distribution chain operations. "We started exploring the feasibility and benefit of RFID in 2005," Jun says.

To begin the process, Hanmi formed a project evaluation committee, which included company planners and government experts. The panel was charged with developing a master plan for designing and implementing a comprehensive RFID system. Project leaders immediately started exploring various technology and design options. A cross-functional team was later formed to investigate specific project aspects, including technology selection, software integration, usability, scheduling and budgeting.

Shortly after the research and analysis phase ended, the committee approved a project cost estimate and applied for government funding. The South Korean government agreed to cover approximately half the project cost, expecting that RFID-generated efficiencies would help curtail soaring pharmaceutical costs and thereby kick a major dent in national health insurance expenses. The government has since mandated that all the nation's pharmaceuticals must be readable via RFID or bar code by 2013.

"The complexity of the Korean pharmaceutical supply chain, married with government support, strongly motivated Hanmi to strive to find a feasible solution that could ensure the full traceability of the entire range of its products," Jun says. The company identified RFID as the only technology that could help the firm meet its objectives. "There is an obvious limitation of traceability with a bar-code scheme, and we were seeking something more efficient," he notes. Hanmi IT, already well-staffed with skilled RFID engineers and technicians from other company projects, was charged with implementing the system.

Designing the System

With the project fully green-lighted, Hanmi IT engineers and technicians began building an automated picking

The RFID system helps Hanmi keep up with rapidly growing production demands.

system based on EPC Gen 2 passive ultrahigh-frequency RFID tags and readers. After studying and testing various tags, Hanmi IT selected LS Industrial Systems' (LSIS) Satellite and Linear tags, incorporating Impinj's Monza chips.

The system was designed to identify products on an item-level basis and then, without the need for any human involvement, collect, box and ship the products. As orders arrive, individual products are automatically picked, sorted and dispensed into a tote. The RFID tags are mechanically attached to each product container during packaging. Once placed into a tote, the items move along a conveyor through a shipment verifier—an LSIS RFID tunnel reader incorporating an Impinj Guardrail antenna. If a product's tag can't be read, the item is physically tapped or blown off the assembly line. The items are then collected and rerouted through a shipment reverifier (another tunnel reader). At this point, a human inspector carrying a handheld reader also may examine the product. If the tag read fails again, the item is set aside for retagging. After the verification process is completed, the shipment is automatically packaged and sent to the loading deck to await delivery to its final destination.

Hanmi IT was also tasked with supplying the system's software. To control complex production-line tasks and processing of the data streams flowing in from the system's readers, Hanmi IT installed its Edge Plus software. A middleware product, UniA Plus, connects the RFID environment with Hanmi's back-end systems. Using the RFID event data collected by Edge Plus, UniA Plus also creates a connectivity environment for various types of client devices, including RFID handheld readers, smartphones, tablets and PCs.

Testing and Tweaking

As the system neared completion, Hanmi began planning a trial to evaluate the system's performance and usability. "During the pilot period, we focused on what RFID does and how it works," Jun says. The company also began studying how the system could be fully integrated into its legacy software, including the firm's enterprise resource planning, warehouse-management and order-management systems.

The trial was both intensive and thorough, Jun says. He estimates that Hanmi IT poured at least 70 percent of its total resources into validating the system's processes and effectiveness. Almost 100,000 tags were used during the testing process to evaluate the performance of readers positioned at numerous locations, as well as to maximize tag placement on various types of pharmaceutical containers.

As Hanmi IT configured and tested the system, it faced challenges that stretched the limits of existing RFID technology. One of the designers' primary goals was to achieve reliable readability with item-level granularity. Yet, with so many different types of products distributed in discrete packaging materials, including metal foil packs, plastic bottles, glass containers and paper cartons, inconsistent read results seemed inevitable.

To surmount this problem, which threatened the success of the entire project, the designers worked hard to find ideal tag locations on all the company's many kinds of pharmaceutical containers—positions that would ensure virtually 100 percent readability. Using a

PHOTO: HANMI PHARMACEUTICAL

trial-and-error approach, it took the designers nearly six months—and a redesign of some of the containers—to create "ping points" that worked reliably.

"The paper carton container is a good example," Jun says. "The contents inside most cartons consist of tablets or capsules enclosed by metal foil," and the metal reflects and scatters RF signals, making the tag hard to read. "To avoid this problem, we partitioned the container's interior into two compartments," Jun says. The updated paper carton features one metal-lined compartment that safely holds the pharmaceutical product while the other compartment is reserved for tag placement. Testing showed the new design worked as expected, with read rates approaching 100 percent accuracy.

The overall project, formally launched in 2009, was completed and placed into operation in 2011. The system is used at two Hanmi production sites, as well as at the manufacturing facilities of several of the company's business partners. "We have installed the RFID system in our five outsourcing manufacturers and one independent pharmaceutical company, all in Korea," Jun says. A Hanmi production site is China hasn't yet installed the technology.

Keeping Pace With Demand

In the two years since Hanmi deployed its RFID system, the company has improved accuracy and efficiency significantly. But those gains have not come easily. "For the first year, we could hardly appreciate the practical value and effectiveness, nor estimate the substantial cost-efficiency of the system," Jun says. Production actually slowed during the system's first months of operation, due primarily to a lack of adequate worker training.

After months of hard work and some on-the-fly experimentation, Hanmi gradually began to see both accuracy and efficiency improvements in its production and shipping processes. "In terms of efficiency, the biggest change would be to expedite the lead time and streamline the manufacturing process," Jun says. "Previously, the entire checking procedure was executed by hand along with the naked eye, which significantly slowed the process without guarantee of accuracy."

The company's average tag-read success rate has reached 99.9 percent, Hanmi says. Its ordering and shipment process accuracy also has reached 99.9 percent, and its time efficiency has improved by 300 to 400 percent. While cost savings haven't yet been calculated quantitatively, Jun believes that improved order accuracy, a streamlined return and recall process, and fewer returned goods have all contributed significantly to the company's bottom line.

Despite rapidly growing production demands, the system is helping Hanmi sustain stable throughput and delivery schedules, Jun says. In addition, a South Korean government investigation of drug expiration date controls recently found that Hanmi's drugs were the nation's best-managed pharmaceutical products. The recognition, Jun says, was possible only because of Hanmi's ability to deploy representatives equipped with handheld RFID readers to detect expired goods within stores.

While Jun says the RFID system is meeting Hanmi's expectations in all areas, the company is still looking to make improvements. The firm's plans include deploying a standardized information-sharing platform, dubbed KEIDAS, which Jun describes as a "plug-in type of RFID package solution" consisting of eight EPCglobal standard service components. Set to debut next year, KEIDAS includes a variety of central applications, such as inventory control, product authentication and product expiration date management. "The platform, associated with the EPCglobal standard EPCIS [EPC Information Services], plays an intermediary role in sharing production and logistics events," Jun says.

Hanmi also plans to deploy PRISMA (Precise RFID Item-Level Stock Management Automation), a motorized EPC UHF RFID reader that glides along a rail to automatically locate and count products within a warehouse, distribution center or retail store. Hanmi IT developed PRISMA and plans to begin using the robotic RFID inventory system at its sites, and to offer the system to several of its business partners later this year (see Robotic RFID Reader Automates Inventory Tracking).

Hanmi has investigated the potential of smart cabinet and smart shelf technology. The company pilot-tested smart shelves at five pharmacies and a smart cabinet at one hospital in 2011 and 2012, but has not yet decided whether to deploy either technology permanently. For now, Hanmi's field representatives are continuing to count inventory at local hospitals and pharmacies using handheld RFID readers.

Hanmi Pharmaceutical and Hanmi IT developed an RFID system that would eliminate weak points in the pharmaceutical maker's production and distribution system, effectively closing gaps through which they'd been losing both effort and money. Jun believes companies in many industries can successfully follow Hanmi's lead, as long as they partner with a systems integrator that understands their unique needs. "To save money and time," he says, "we strongly recommend other prospective companies to fully consult with a company with... hands-on experience."

BEST USE OF RFID IN A PRODUCT OR SERVICE

Boeing Program Automates Aircraft Maintenance Tasks

RFID Integrated Solutions, certified by the FAA, promises to help airlines save labor, time and money.

By Jennifer Zaino

COMMERCIAL AIRPLANES must undergo a number of daily, weekly and monthly maintenance checks to ensure they're flight-ready. These manual checks include inspection of life vests, oxygen generators and other loose emergency equipment in an aircraft's cabin—a process that is labor-intensive and costly.

Before a plane's first flight each day, for example, airline personnel must confirm the presence of life vests under seats (unless the plane uses seats as flotation devices). Another inspection, to verify the integrity of life vest security seals, a theft deterrent and antiterrorism measure, is typically conducted before every flight on aircraft operating within or flying internationally into the United States. Inspections to verify the serviceability of life vests are performed every few hundred flight hours or every several months, during what the Federal Aviation Administration (FAA) refers to as A-checks or C-checks. For these inspections, maintenance personnel must remove every life vest from its container to check its expiration date. On a wide-body airplane, this task can take an entire 8-hour shift.

In spring 2012, Boeing introduced its RFID Integrated Solutions program, designed to automate maintenance tasks on emergency equipment, as well as to track and manage other aircraft items and components. Boeing has been working on developing RFID-based maintenance capabilities for a number of years, and the final step was for the FAA to certify that RFID tags can serve as the authoritative source for maintenance compliance requirements, such as confirming the inspection of onboard emergency equipment. The program also has gained preliminary acceptance by the Japan Civil Aviation Bureau, General Civil Aviation Authority of the United Arab Emirates and the Civil Aviation Authority of Singapore.

"With the maintenance program we built, we now can use RFID data as a trusted source of information and sign off on maintenance task cards using that data in the form of an 'as-flying configuration' report generated by the RFID system," says William "Phil" Coop, Boeing program manager.

RFID Integrated Solutions, designed to be integrated into an airline's overall maintenance program, promises to reduce the cost of aircraft maintenance. Manual checks for life vest presence, security and serviceability are performed independently, for example, and conducting all those tasks on a wide-body aircraft could take 10 or more labor hours. With the Boeing solution, an airline can use one RFID-enabled process to perform presence, security and serviceability checks independently or simultaneously. It would take only a

The RFID Integrated Solutions program includes five applications. Most customers seem interested in beginning by using RFID to manage life vests, oxygen generators and other loose emergency equipment in an airline cabin.

PHOTO: BOEING

few labor minutes to conduct all tasks simultaneously, Coop says. Boeing's conservative estimate is an 85 percent lead-time reduction, though the company says it's typically better than that.

Securing FAA Approval

Getting to this point wasn't easy. Boeing began investigating RFID in the late 1990s, and since 2003 the company has been using the technology to track parts during the manufacture of commercial aircraft. In 2004, Boeing and Airbus, the two major commercial airplane manufacturers, teamed up to develop standards to use RFID to mark individual parts and keep maintenance records on RFID tags. They believed RFID could deliver benefits to the entire industry—airplane manufacturers could improve operational efficiencies, and airlines could reduce the time it takes to repair and maintain planes. In 2007, Boeing teamed with Japan Airlines (JAL) to demonstrate that RFID could speed the inspection process of oxygen generators onboard a 777 commercial airline.

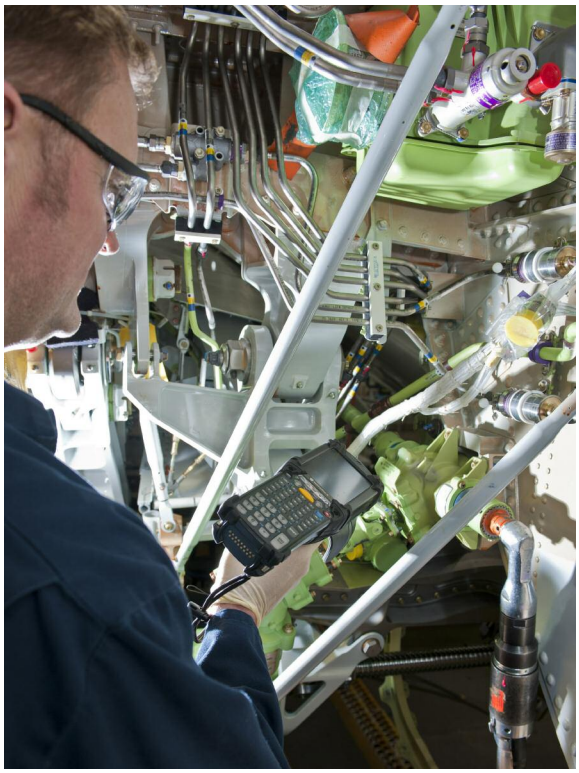
Then, in 2008, the FAA issued its Advisory Circular (AC) 20-162, which approved the use of passive tags on planes as long as they were not interrogated in flight or when an aircraft is on an active runway or taxiway, but nixed the use of data derived from RFID tags as the authoritative source for maintenance compliance requirements. At the time, much of the RFID industry was focused on developing tags and applications for the retail sector, and the FAA did not think that technology was robust enough to serve as a guideline for the airline industry.

When Boeing conducted the JAL tests, the company says it wasn't considering an aftermarket application, so it never went to the FAA for anything more than general guidance, which came in the form of AC 20-162. In 2010, based on the FAA circular and additional regulatory guidance, Boeing partnered with Fujitsu and other RFID providers to develop a complete turnkey infrastructure, including passive ultrahigh-frequency RFID hardware, middleware, software and integration. The hardware selected specifically for its effectiveness in the aircraft environment includes Fujitsu high-memory RFID tags and Motorola Solutions MC 9190Z handheld readers.

To demonstrate operational survivability in the tough circumstances that can characterize airline industry maintenance environments, Boeing put the

RFID tags and readers through a battery of tests—first in a lab (it soaked the tags in acid), then in the Mojave Desert (to ensure reader performance for all global frequencies), and finally in flight and at an Alaska Airlines maintenance base in Seattle. "We ensured our processes and procedures have safeguards to say in what circumstances this technology should not be used," Coop says.

Boeing modified the UHF RFID tags with a special coating, an encapsulation Coop says guarantees a life expectancy of 12 years under normal operating conditions. That helped allay concerns about deterioration after a couple of years that could lead to unreliable data recordings. "Things like that that we put in the maintenance program drove the FAA to accept our proposal," Coop says. "Boeing also provided a very comprehensive plan to ensure the integrity of the program, of the data, of the integration and methodology for use by our customers."



A mechanic reads an RFID tag on a hydraulic motor in a 737 wheel well, during line maintenance.

Providing Customer Service

Boeing plans to provide its RFID Integrated Solutions customers with kits to retrofit their aircraft, either on their own or using the airline company's third-party maintenance, repair and overhaul (MRO) facilities. The company also will provide clients with a set of maintenance processes to follow and will train operators who will be using the technology for conducting inspections. The RFID program includes technology oversight and management of the solution and processes for the life of the customer's contract. "We work with [the client] to not just manage what we sell up front but to continuously improve it as well and integrate new features," Coop says. "We become a partner with the airline to maximize its use of the product and keep everything safe and on the leading edge."

The program is designed to be fleet-agnostic. Boeing has demonstrated the service for airline customers with Boeing 747s, 777s, 717s and 737s, as well as Airbus A330s, A340s and A380s. The company says it will conduct an engineering assessment before launching the service with a customer to identify every anomaly in a plane configuration that might demand system design changes; there's a 5 percent to 20 percent variation from fleet to fleet, Coop notes.

Customers in Australia, Singapore and Taiwan are piloting the program and have outfitted some of their aircraft with RFID. But until an airline's full fleet is RFID-enabled—and the program is granted final acceptance by their country's regulatory authority—airlines must continue performing manual inspections as well, as part of a bridging program. "Airlines must maintain that until their last plane is retrofitted and returned to service," Coop says. It takes 12 to 18 months to retrofit a fleet of 100 planes. Following the fleet retrofit, airlines must maintain their manual processes as a backup for automated RFID data collection in the event of system failures.

The RFID Integrated Solutions program includes five applications. Most customers seem interested in beginning by using RFID to manage life vests, oxygen generators and other loose emergency equipment in an airline cabin, Coop says. For the emergency equipment management application, Boeing uses primarily 512-bit to 1-kilobyte RFID chips to store configuration, presence, security and serviceability data that may include part and serial numbers, manufacture date, expiration date and location on the airplane.

Once customers gain trust in the system, they can extend the deployment to another interior management application that focuses on items such as seat covers and linens, as well as large bulk items that are tracked in and out of the cabin. There also are two component management applications: One tracks rotable parts—airplane components that are removed for overhaul at a certain point in their maintenance life cycle and then installed in another plane. The other tracks repairables—components that can be fixed several times before they are retired. An airframe degradation management appli-

PHOTO: BOEING

cation is designed to track data about major components' structural repairs. Boeing uses high-memory RFID tags, ranging in capacity from 8 kilobytes to 4 gigabytes, to store point-of-use life cycle data about a part, component or section of the airplane, including its pedigree and identity, changes in configuration, identity or characteristics (such as hazardous materials or weight), and maintenance history, such as actions taken and conditions noted.

Enabling Just-in-Time Inspections

Another benefit of the RFID Integrated Solutions program is that it allows airlines to manage assets just in time rather than just in case. Take, for example, oxygen generator emergency equipment inspections, to calculate likely expiration timeframes. These inspections are typically conducted roughly every 18 months during C-checks, when a plane is in a hangar and entirely open. "It's a very labor-intensive task, requiring significant access to the installations through multiple access panels in the aircraft cabin," Coop says.

The inspectors calculate when the generator will expire. If the expiration date falls within a few months of the next C-check, the generator may be replaced to ensure it does not remain in service beyond its allowable service life. Coop calls this an expiration "safety net." Sometimes, the process leads to the disposal of generators that could remain in service for some time. "If you do your inspection of oxygen generators during heavy checks only, you wind up removing generators with about 20 percent of their life remaining, simply because the next heavy check is far enough away that the generator will expire before then," he says.

With Boeing's RFID system, oxygen generators can be inspected "without disturbing anything," Coop says. Once the data is captured and contained in the operator's back-end maintenance planning system, "we know exactly when each of those assets will expire," he adds. Oxygen generator replacements can be managed individually on a just-in-time basis during line-maintenance activities, rather than during base-maintenance C-checks. "This puts value-added capacity back into the C-check and makes use of often underutilized aircraft down-time on the line," Coop says. In addition to extending the generator life cycle by 20 percent, it can also reduce oxygen generator inventory by more than 50 percent.

"Once the system is in place, airlines can maintain their same routine schedules for performing inspections and just get them done quicker," Coop says. "And once they have established a good rhythm and reliability metrics, they can start to minimize some of those tasks."

Ensuring Trust

The logical next step beyond maintenance execution, Coop says, is to use accumulated RFID data for deeper maintenance planning and scheduling events. Boeing would like to make it possible to do away with routine emergency equipment inspections by building a robust back-end system that provides an alert when a component needs attention. "If we can build processes and inspections around only what is absolutely necessary, and then let the system tell us when anything else needs to happen, we can drastically minimize the number of inspections an airline has to do," Coop says.

Boeing also envisions extending the system to provide chain-of-custody and supply-chain visibility. It's not uncommon, Coop says, to see roughly half of any airline's supply parts inventory virtually unaccounted for, and if you don't know what you have, you don't know what you need. "I know if I have 100 components of a certain part number—can I use the data at any given time to tell me what those parts are doing?" he says. "Are they giving me value-added time or are they sitting in a queue, in transport or in storage?" Determining what's actually on hand and where, and eliminating unnecessary purchases, he says, could save some airlines billions of dollars.

Meanwhile, Boeing is working with the FAA to develop a framework for other organizations that want to develop their own RFID-based maintenance programs. The FAA is expected to release an operational suitability report using Boeing's RFID Integrated Solutions as a model for technical due diligence. The report will help companies understand the RFID fundamentals without divulging specifics about Boeing's approach, or, as Coop describes it, "the basic requirements that will need to be met—the 'what'—but not the secret recipe for success—the 'how to'—developed by Boeing.

"There are some companies out there right now that would like to believe this is like Walmart, that you can use cheap, throw-away tags like those used to control inventory in the retail or shipping industries and go put that on parts and suddenly everything is great," Coop says. "But Boeing wants to make a strong statement, supported by the FAA AC 20-162 advisory circular and upcoming operational suitability report, that it is not that easy and there cannot be a pennywise, dollar-foolish approach. At the end of the day, failure is not an option. These systems must be accurate and dependable."

MOST INNOVATIVE USE OF RFID

RFID Helps Amputees Manipulate Prosthetic Hands

MORPH, developed by Infinite Biomedical Technologies, lets users control their environment.

By Jill Gambon

After Sean McHugh lost his right forearm in a construction accident 11 years ago, he was fitted with a prosthetic arm and hand. But simple acts, such as picking up a wine glass, putting on a coat or carrying a briefcase, were complicated undertakings, often fraught with frustration or mishaps. His grip might change unbidden or require a taxing effort.

McHugh tried two types of prostheses: One was cable-operated, and the other was myoelectric, which means it used a sensor to convert muscle movements to electrical signals to open and close the hand and vary grips. Both had limitations in terms of reliability and ease of use.

That changed last year when McHugh was fitted with a myoelectric prosthesis equipped with a built-in radio frequency identification reader. He keeps several RFID tags in his shirt pocket, on his belt and in other convenient locations, and each is programmed to affect a specific position, such as a pinching grip. To get his prosthetic hand to move the way he wants, he simply passes it over the appropriate tag. He is now able to control his right hand, making it easier to put a gallon of milk in the refrigerator and carry out other routine tasks.

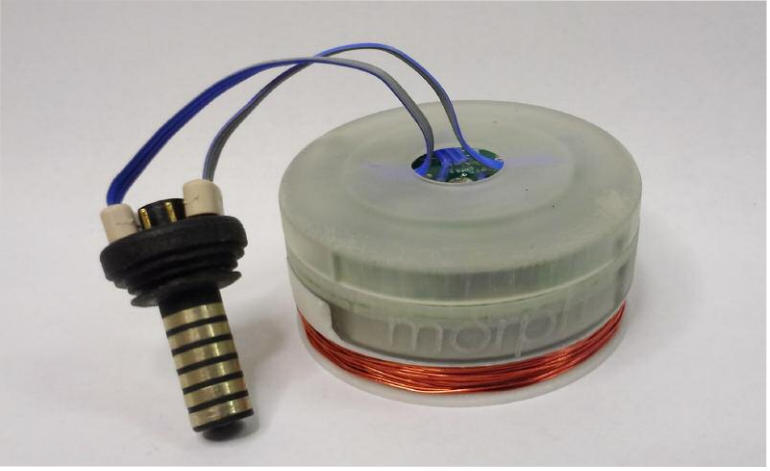
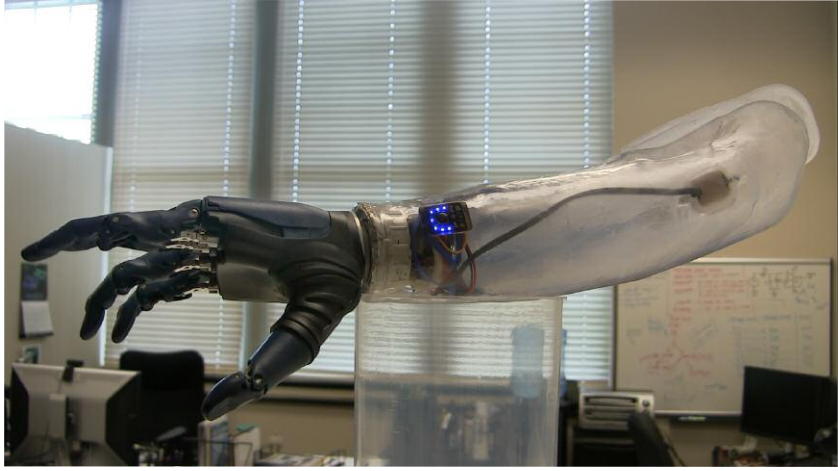
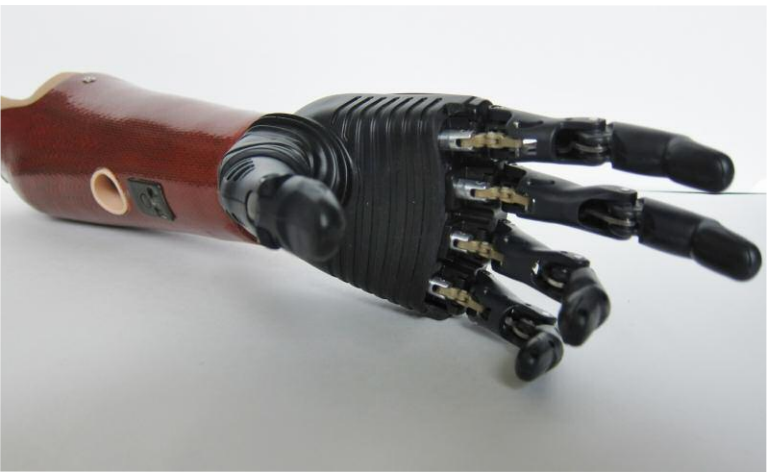
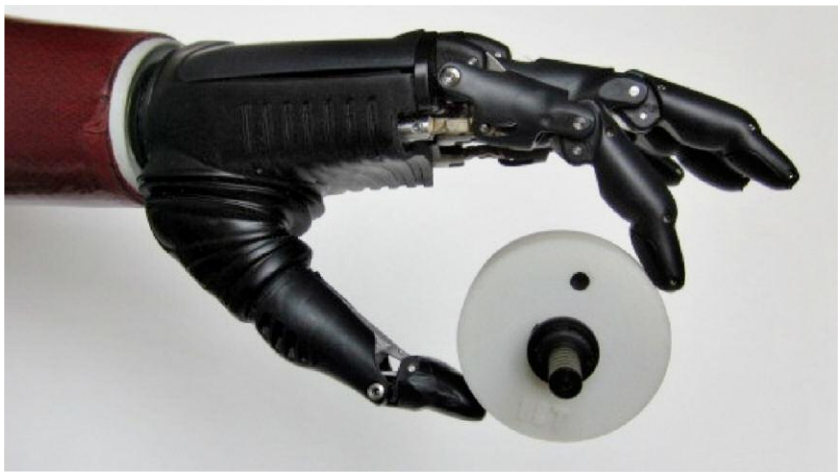
McHugh was one of several amputees chosen to test the prosthetic device, called MORPH (Myoelectrically Operated RFID Prosthetic Hand), and provide feedback to the researchers at Infinite Biomedical Technologies, which developed the system. "The day I got the prototype, it was a joyous occasion," McHugh says. "It changed my future. It's a wonderful feeling to reach for something and have my hand go in the right position. This saves me time and gives me confidence. It replaces disability with ability."

Infinite Biomedical Technologies, a Baltimore-based medical device maker spun out of Johns Hopkins University in 1997, describes its mission as finding innovative breakthroughs to improve prostheses. And the company believes it has done just that with its MORPH product. "The power of RFID is that it allows the patient to take control of their environment to whatever degree they want," says Ananth Natarajan, co-founder and board member of the privately held firm.

Mission Control

Nitish Thakor, the company's co-founder and a professor of biomedical engineering at Johns Hopkins, came up with the idea for using RFID to make it

PHOTO: INFINITE BIOMEDICAL TECHNOLOGIES

The MORPH is installed near the wrist of the prosthesis, attaching to the hand via a coaxial plug. When a user moves the hand near a tag programmed to trigger a specific grip or position, it sends a signal to the microcontroller to form the associated position.

easier to control myoelectric prostheses and improve daily life for amputees. Planning and design of the initial MORPH prototype began in 2009. Graduate students from Johns Hopkins' biomedical engineering program worked on the software and hardware development and design. Interns helped with the embedded systems and the graphic user interface.

The MORPH is installed near the wrist of the prosthesis, attaching to the hand via a coaxial plug. It contains two circuit boards. A small (21- by 19- by 6-millimeter), 125 kHz low-frequency RFID reader, from ID Innovations, is attached to the master board. That board also contains a microcontroller, which receives the tag information from the reader, and a Bluetooth reader, used to program the RFID tags. The other circuit board contains a custom-designed antenna. The device has a read range of 11 centimeters. Since only the tag's unique ID is transmitted between the tag and the reader, minimal data transfer occurs.

The system uses LF tags in different shapes and sizes from multiple vendors. Business card-size tags (RFID125-ISO-5) from Olimex, for example, can be used in the home or office for activities such as preparing food and typing at a keyboard. Button-size tags (EM4102) from Trossen Robotics can be clipped to clothing or tucked in pockets to help position the hand for tasks like putting on a jacket or hat.

The MORPH uses two software packages, developed by Infinite Biomedical. One is embedded in the microcontroller and controls the device's operations. The software prioritizes commands from the tags, which mimic muscle signals from a user, and based on that input, it controls the position of the artificial hand. When a user moves the hand near a tag programmed to trigger a specific grip or position, it sends a signal to the microcontroller to form the associated position. Interference or noise from other RFID tags within read range is not a problem, because MORPH reacts only to tags that have been programmed to work with it.

The other software lets the user program the RFID tags. It runs on the user's computer and communicates with the microprocessor via Bluetooth. The software can be used to modify the hand and finger positions associated with each RFID tag.

Feedback

After almost two years of planning, design and testing, the researchers had their first working prototype. For the next 18 months, they put the device

PHOTOS: INFINITE BIOMEDICAL TECHNOLOGIES

through rounds of evaluations with amputees and medical professionals who specialize in prosthetic rehabilitation. The feedback they gathered on functionality, consistency and performance guided further refinements.

Information gleaned through a pilot study with two amputees, for example, led to an overhaul of the MORPH design. The participants made it clear they were not interested in replacing their myoelectric prostheses with a different device. Instead, they wanted to increase the options for controlling the existing prostheses in different environments or conditions. "We had a unique collaboration with patients and clinicians," Natarajan says. "That allowed us to try a lot of things."

In addition to collecting feedback from prototype users, Infinite Biomedical conducted evaluations, including a Jebsen Hand Function test, a standardized test used by health professionals to evaluate how people with hand disabilities complete routine tasks, such as writing or picking up a bottle cap. One user performed six out of seven tasks faster using the prosthesis with the MORPH-enabled hand than with a conventional myoelectric prosthesis, according to the company. The other performed four out of seven tasks faster. In another test that involved switching between different grips to perform tasks, both amputees achieved faster results using the MORPH-enabled hand. Based on the studies and data collected, Infinite Biomedical estimates use of the MORPH can result in a time-savings of 20 percent. The company says the improvements result from the fact that the read rate for the RFID tags is 100 percent, while myoelectric limbs can easily misinterpret muscle signals and offer inconsistent results.

"The change is dramatic," says Natarajan. "This changes people's lives."

One user performed six out of seven tasks faster using the prosthesis with the MORPH-enabled hand than with a conventional myoelectric prosthesis.

Getting a Grip

Infinite Biomedical CEO Rahul Kaliki managed the process of bringing the MORPH to the market; it began shipping in May 2013. Each MORPH unit comes with 20 tags, but a customer can use as few or as many tags as he or she wants to program the different grips and hand positions. "People start with a small set of tags and they experiment," Kaliki says. "Our job is to give them many options with the tags."

MORPH is compatible with prostheses from various manufacturers and can be retrofitted for use with existing commercial myoelectric limbs. This means amputees already using a prosthetic can add a MORPH device and improve functionality of the limb. Customers can visit Infinite Biomedical's offices and have the MORPH installed there, a process that takes roughly 10 minutes. Or, prosthetists can install the unit in their offices. Customers receive training to get to know how to use the tags.

In most cases, it takes an hour or less for a person to learn to use the MORPH once it's installed in their prostheses, but there is a longer learning curve in determining how to effectively integrate the RFID tags into daily routines, says Martin Vilarino, an Infinite Biomedical research engineer. "The goal is to find the places where these tags offer the maximum potential," he says. "We think this is a great area for creativity, where users can learn to use the product in a way that is tailored to them. Our goal has always been to create a personalized solution, that while used differently by each individual, accomplishes the same goal: reducing effort and increasing satisfaction."

The company plans to continue improving the MORPH and expects to add features such as vibration motors and buzzers that would activate when a tag is programmed successfully or when it comes within range of the reader. This would let the user know the system is working properly and could be deactivated if the customer prefers. Researchers at Johns Hopkins are also investigating the possibility of using tactile feedback and tags with sensors.

McHugh, who works in sales in the home-automation industry, is using a MORPH-enabled prosthesis, manufactured by RSLSteeper. He hopes future iterations of the device will help him increase his wrist motion.

Providing feedback that has impacted the product's features has been hugely satisfying for McHugh. It has not only led to a device that better fits his needs, but it has also opened new possibilities of things he can accomplish using his prosthesis. "As an end user, you are not typically involved in research and development," he says. "This has given me the opportunity to dream."

PHOTO: INFINITE BIOMEDICAL TECHNOLOGIES

RFID JOURNAL LIVE! BRASIL

CORNERSTONE SPONSOR

Nov. 6-7, 2013 • Espaço APAS – Centro de Convenções, São Paulo, Brasil

LEARN HOW COMPANIES IN BRASIL ARE BENEFITING FROM RFID

The world's leading companies are using RFID in large-scale deployments to improve efficiencies, enhance visibility, reduce shrinkage and achieve other significant business benefits. LIVE! Brasil is designed to help Brasilian companies considering using RFID technology to address real business challenges, determine the best RFID technology for their needs, learn best practices from early adopters, find the right technology partners and move forward.

- Hear end users discuss where they are achieving real benefits
- Attend sessions presented in Portuguese
- See the latest solutions from the leading technology firms
- Attend RFID Journal University and learn the basics to get started with RFID

EXHIBITORS INCLUDE:

CEITEC S.A semiconductors · hp · identix · Mühlbauer High Tech International · TAGEOS · voyantic

REGISTER EARLY FOR MAXIMUM SAVINGS!

To register, visit www.rfidjournalevents.com/brasil.

The Economic Benefits of Going Green

The city and residents of Grand Rapids, Mich., are benefiting from RFID-based recycling and garbage-collection solutions.

By Minda Zetlin

Like people in cities and towns worldwide, the citizens of Grand Rapids, Mich., generate a lot of trash. The garbage is hauled to a county incinerator, and then some of it is transferred to a landfill. "The county incinerator has a maximum amount it can burn per day," says James Hurt, public services director for the city. "Anything beyond that capacity is transported to a landfill." The incinerator has controls to reduce emissions, he adds, but trash burned in the incinerator contributes to air pollution.

In 2010, the Midwestern city developed an ambitious three-phase plan that uses RFID to reduce the amount of trash sent to the county incinerator and landfill, while lowering costs and improving operations. The first phase, implemented in 2010, encourages residents to recycle by rewarding them with points redeemable for discounts and free merchandise at local businesses. The second phase, deployed in 2012, manages garbage collection and charges households only for what they throw out, decreasing the amount some residents pay. The final phase, currently in development, will be a system to collect food scraps and yard waste for composting, further allowing residents to reduce their garbage outflow.

With the first two phases rolled out successfully, the city is already seeing solid environmental and economic benefits. "The city has a sustainability plan," Hurt says. After some initial skepticism, residents are embracing both programs. That's due, in part, to an approach that benefits participants, he says. "We also have a community that truly cares for the environment," he adds. "I would liken it to a core community value."

Beyond the environmental benefits, Grand Rapids has lowered its incinerator fees and improved operational efficiencies. Hurt projects annual savings going forward of approximately $1.2 million a year.

PHASE 1: Rewards for Recycling

Since 2010, Grand Rapids has been using RFID-enabled carts and trucks to manage recycling. Each SmartCart, made with recycled materials by the local firm Cascade Engineering, is fitted with an ultrahigh-frequency Gen 2 EPC Snap-In tag from Xtreme RFID, a Cascade subsidiary. The tag's ID number is linked to a customer's account. The trucks are

PHOTO: CITY OF GRAND RAPIDS

The RFID-enabled trash-collection system monitors which residents have paid for service.

PHOTO: CITY OF GRAND RAPIDS

equipped with mechanical platforms that lift and empty the carts, so drivers don't have to hoist the recyclables manually. The trucks are also equipped with an RFID reader and antenna from AMCS Group, which captures the tag's ID number as the cart is tipped. That information is transmitted to a GPS-enabled computer mounted on the truck's dashboard, and then to the city's back-office application via mobile communications. Capturit, another Cascade subsidiary, provides the onboard computers and software for the project.

Grand Rapids uses the information to identify which areas have high and low recycling rates, to better understand recycling practices and trends throughout the city. The city also rewards residents who recycle through an innovative program called myGRcitypoints. "You register your cart, and each time you put it out to the curb it assigns you points," Hurt says. The points are based on the total weight of recycling collected on a day's route—the heavier the truck, the more points everyone gets. Thus, it's to residents' advantage not only to recycle their own trash, but to encourage their neighbors to recycle as well.

The points can be exchanged for special offers at local businesses, such as a free sticky bun with brunch at an eatery or the opportunity to name a new beer at a brewery. People also can use the points to improve their neighborhoods. Grand Rapids recently ran a campaign in which it invited residents to donate their points to their favorite park. The winning park received nearly 1 million donated points—and $50,000 from the city for improvements. Some 47,000 households are currently using SmartCarts for recycling.

PHASE 2: Upgrading Trash Collection

For about four decades, most Grand Rapids residents prepaid for trash pickup by purchasing 32-gallon garbage bags, which the city sold at a variety of stores and other locations, for $2.50 each. Charging by the bag created a financial incentive for residents to minimize trash, but administering the program and distributing bags to stores throughout the city was labor-intensive. "We were stocking and delivering one million bags a year throughout the community," Hurt says. The bags also added more plastic to the trash stream, and burning plastic in incinerators releases heavy metals into the air.

In 2012, Grand Rapids spent six months creating a pay-as-you-throw trash-collection system. The city up-

graded its fleet of waste-collection trucks and purchased some new ones. "There are two types of trucks—semi-automated, where the driver gets out, wheels the cart to the tipper, operates a lever and dumps the trash, and fully automated, which has an arm that grabs the cart and dumps the container so the driver doesn't have to get out," says Mike Lewis, business unit leader at Xtreme RFID. All the trucks are equipped with RFID readers and antennas, and onboard computers. The city also invested in SmartCarts for trash collection, and Capturit developed software and databases to manage the new system.

Then, Grand Rapids began to roll out the pay-as-you-throw program to the city's approximately 65,000 households. It's offered as an alternative to using the city's plastic bags and replaces a subscription service, which some 10,000 households had used. Residents have accounts that they refill with funds by phone or over the Internet. Trucks collect trash weekly, and residents pay only for what they actually throw out. If a resident puts a garbage cart at the curb, the truck will empty it at a cost to the resident of $2, $4 or $6, depending on its size. If the resident doesn't put out a cart, there is no charge.

The new system encourages residents to lower their own costs by recycling more and throwing away less, Hurt says. "With a subscription, you're paying the same price as everyone else," he says. "This way, you're paying for the service when you use it. If you go away for a week or two, you don't pay for service. If your cart is half full and you don't put it out that week, you don't pay for service."

The trucks' onboard computers act as enforcers by telling drivers when not to pick up trash. "The city has the ability to 'stop lift' those customers who haven't paid for trash pickup," says Mark Harvey, national sales director at Capturit. If a driver inadvertently attempts to empty a cart on the stop list, the reader will capture the tag's ID number and the onboard software will prevent the truck from completing the lift. Residents can sign up to receive e-mail or text low-balance reminders.

Grand Rapids anticipated residents might be skeptical of the pay-as-you-throw system, and, some folks did stockpile bags or opt for a private service. But the city had a plan to encourage adoption: make pay-as-you-throw more appealing than buying bags. It set the price for a 32-gallon cart at $2 per tip, whereas a pack of 10 32-gallon bags for city waste disposal cost $25. It also made the bags less convenient to obtain. Instead of selling them at locations throughout the city, they were available only at the Public Services office.

At the same time, the city launched a massive promotional campaign. "We did a fair number of community meetings, mailings, media releases and billboards," Hurt says. "We did radio shows and demonstrations with carts."

Today, roughly 36,000 customers are using the pay-as-you-throw service. Since a portion of the city's households are apartments in buildings that handle trash collection for their residents, it seems clear that more than half the households that can use the program are doing so. And that number is climbing. "We have signups every day," Hurt says.

Grand Rapids' recycling and trash programs are already having a positive impact on the environment. In 2012, recycling was up roughly 4,000 tons a year, and garbage was down a corresponding 4,000 tons. As a result, the city is diverting less waste to the landfill.

With more residents using carts instead of the city's garbage bags, air quality benefits. "Part of our overall goal is to reduce the amount of plastics being burned," Hurt says. "We're not burning a million bags a year anymore."

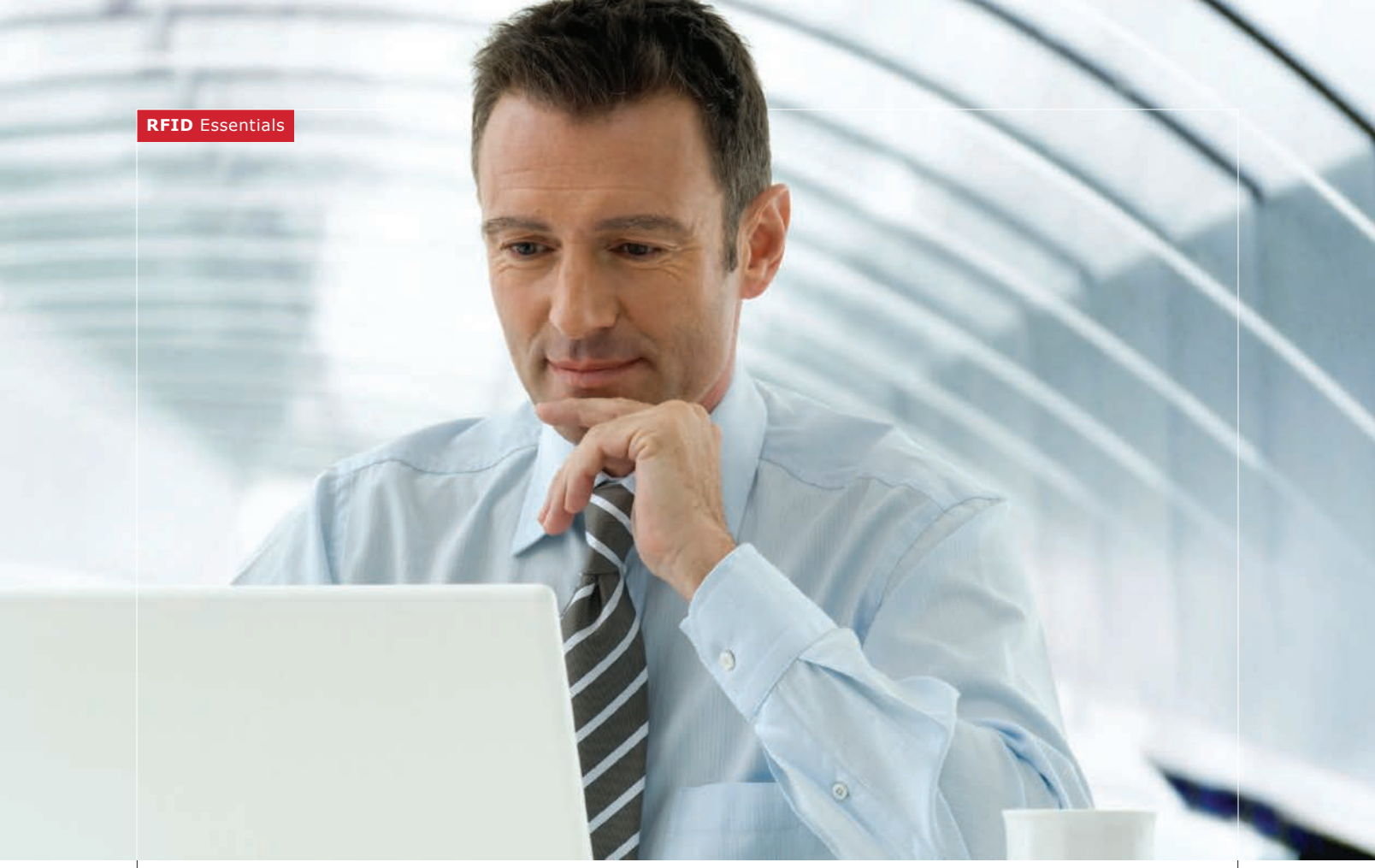
The pay-as-you-throw program also is saving the city money. Less garbage means lower incinerator fees. Since the city began using trucks with automated lifts and onboard computers that tell drivers which addresses to skip, trash collection has become more efficient, saving on fuel and equipment, as well as driver time and risk of injury. In addition, eliminating the subscription service saves the city from sending out more than 40,000 invoices each year. Hurt anticipates the program, with total costs of $2.4 million, will have paid for itself within five years.

PHASE 3: Composting

The program's success is due, in large part, to the participation of people from many parts of the city's government, Lewis says, including operations, customer service and finance, as well as input from the drivers. "The mayor and the city manager were involved," he adds. "A lot of departments within the city had input into scoping out the service and selecting it."

A team of representatives from all these areas continues to talk once a week, to discuss any problems and plan for the next phase of garbage reduction: composting food scraps and yard waste. "We're looking to have something in place for fall 2013," Hurt says.

Ultimately, Hurt wants to see Grand Rapids produce as little trash as possible. "Zero waste stream—putting nothing in the trash—that's a goal," he says, though he acknowledges it may be a tough one to reach. But he believes Grand Rapids and other cities can vastly reduce the amount of trash they produce. "I'd love to see only 10 percent of what we throw away go in the incinerator," he says.



Learn How RFID Can Help Your Business

WITH RFID ESSENTIALS WEB-BASED TRAINING

RFID Journal's **RFID ESSENTIALS** is an interactive, Web-based training course developed by top industry experts that puts you, the learner, in the driver's seat. Real-world applications requiring critical thinking help you understand how to use RFID to improve operating results. **RFID Essentials** can help your enterprise accelerate deployment by educating employees early in the planning process.

Professionals in IT, finance, operations and engineering can learn the basics of RFID, how to use the technology in operations—such as supply chain, asset tracking and access control—and how to find a return on investment.

IN THIS COURSE, YOU CAN:

- **Learn at your own pace, in lively, visual, interactive exercises**
- **Complete all nine modules in about eight hours, or focus on the modules most relevant to your goals**
- **Acquire knowledge that you can act on, to help your organization move forward**

Find out why Fortune 500 companies, as well as the U.S. Transportation Command, have chosen RFID Essentials to get moving!

Try a 15-minute sample for free!
For more information, **visit www.rfidjournal.com/essentials.**

POWERED BY RFID Revolution®

SPECIAL ACHIEVEMENT

The Man Who Changed the World

Kevin Ashton worked tirelessly to make his vision of inexpensive, ubiquitous and standardized RFID a reality.

By Mark Roberti

Kevin Ashton is widely acknowledged for coining the term the "Internet of Things." But he contributed far more to the radio frequency identification industry than just a clever phrase. Ashton was largely responsible for promoting low-cost, passive ultrahigh-frequency RFID technology and network standards for sharing the data. In 2003, RFID Journal called him "the man who could change the world."

When Ashton was working as a brand manager for Procter & Gamble back in 1998, he often visited stores to see how his products were selling. To his frustration, he found that one of his hottest shades of lipstick was frequently out of stock. The tubes of lipstick all looked the same, and store associates rarely picked them up to see which ones needed replenishment.

He heard about RFID while trying to understand "smart" store loyalty cards with chips. He thought: "If only we could attach those devices to our products, they could tell us what is out of stock."

Ashton began investigating RFID technology on his own time and discovered research being conducted at the Massachusetts Institute of Technology by Sanjay Sarma and David Brock. The two engineering professors wanted to put cheap RFID tags on objects and link them to data stored in secure Internet databases.

Around the same time, the Uniform Code Council (UCC, now GS1) was working to identify the "next-generation bar code." Alan Haberman was leading that research, and Ashton met him at an RFID standards conference in Antwerp, Belgium. He introduced Haberman to Sarma and Brock, and within a few months, the UCC, Procter & Gamble and Gillette had put up money to fund research and development of an "electronic product code."

Ashton was named executive director of the Auto-ID Center, established at MIT to carry out the research. He raised millions of dollars from corporate sponsors worldwide—including Coca-Cola, Metro, PepsiCo, Tesco, the U.S. Department of Defense and Walmart.

He also traveled the world energetically promoting Electronic Product Code technology as a way to transform the global supply chain and reduce out-of-stocks. Ashton spoke at conferences and made pitches to corporate chieftains. He rubbed some the wrong way—especially at companies selling more expensive passive high-frequency tags. But by 2007, EPC was being embraced by some of the largest companies on the planet.

Ashton is currently a general manager at electronics maker Belkin. But he never abandoned RFID. He writes a regular column for *RFID Journal* magazine, in which he shares his wit and spot-on insights. RFID Journal is pleased to honor him with our Special Achievement Award for convincing the world that RFID—particularly, passive UHF EPC technology—could make the Internet of Things a reality.

BEST NEW RFID PRODUCT

RFID Gets xArray Vision

Impinj's new reader is installed in ceilings, where it can keep an eye on tagged assets and inventory in stores, hospitals and shipping facilities.

By Paul Prince

Most retailers take inventory once or twice a year, often closing the store and marshaling an army of employees with bar-code scanners. But those that have adopted RFID now take inventory weekly, daily or every morning and evening, because a few employees equipped with handheld readers can do the job more efficiently. The result—improved inventory accuracy and reduced out-of-stocks—has been very beneficial, but the process still takes sales associates' time away from other tasks, and it's possible for a handheld, with its relatively short read range, to miss some items. So, some retailers began to wonder, what if we had an RFID system that could automatically monitor a wide area of the store in real time, 24/7?

Impinj worked with a retailer to develop and test such a solution, says Tracy Hillstrom, senior manager for the company's reader product line. It's called the xArray. Install the reader in a ceiling, plug it into a Power-over-Ethernet (PoE) connection, and you'll always know not only which items are on the sales floor but also on which shelf they sit and whether they have been moved.

The xArray packs an Impinj Speedway Revolution 420 reader and an antenna array into a unit that measures 18 inches long and wide and 2.5 inches thick. When installed at a ceiling height of 15 feet, the device creates a circular read field 40 feet in diameter divided into eight sectors, with each sector subdivided into six read zones. Directly below the antenna is another read field comprising a circle 10 feet in diameter, divided into four overlapping oval-shaped read zones. The result: The xArray can read all the passive EPC Gen 2 tags within a 20-foot radius and discern in which of the 52 separate read zones each of those tags is located.

The retailer that worked with Impinj on this project installed one unit at the transition point between the store's back and front rooms, and mounted a second unit above the sales floor. "They said they could see better on-shelf availability and accuracy by using this product, rather than have someone use a handheld," Hillstrom says. "The store had what the customers were looking for, and you could see this uptick in revenue growth that in some cases could be 5 or 10 percent."

Since developing the system, Impinj says logistics companies have expressed interest in xArray's ability to monitor wide areas. "I talked with some

PHOTO: IMPINJ

Attendees at RFID Journal LIVE! 2013 watch a demonstration of Impinj's xArray reader.

of our customers that do a lot of LTL [less than truckload shipping]," Hillstrom says. "They want this kind of thing because at the end of the day, when a pallet moves from side A of their cross-dock facility to side B and makes it onto the wrong truck, it costs them a substantial amount of money to get that turned to the right place, and they've missed their commitments to their customer."

Currently, those logistics companies are using RFID portals. "They don't want antennas built around the door like you have today with traditional dock door systems," Hillstrom says. "That's based upon a confined read zone, and all of that is too hard for them to manage. The antennas have to face out, and they tend to get damaged in that kind of environment. So for them, it's not the right solution. They want an overhead solution. They want to be able to track their pallets, to see where they are and be able to confirm they went in the right dock door." In addition, she says, if they RFID-tag forklift trucks and personnel, logistics companies could use the xArray system to know which vehicles and drivers are moving the pallets.

"The other place we are seeing a strong play is in health care," Hillstrom says. Some hospitals are considering Wi-Fi-based real-time location systems to track infusers, wheelchairs and other assets, but they would need to install more access points to support such a system. What's more, she says, Wi-Fi RFID tags can be expensive, and they present battery-management issues.

When discussing the xArray with hospital administrators, Hillstrom notes that a passive EPC Gen 2 tag costs just a few dollars. "That's when their brain explodes," she says. "First of all, they think, it gets all these tags off their Wi-Fi…. They've got to put in infrastructure anyway, so for them to put in an easy infrastructure drop-in with a PoE solution, it's not that big a deal. Then, they talk about tagging more—'What could I do if I could tag all that cath lab equipment that goes obsolete or gets recalled and I've got to dedicate a person to do nothing but check if one is obsolete? And how about if I could find that faster and easier? What would that mean for our business?'"

Impinj customers may have to wait a year before they find out. The company plans to launch xArray commercially some time in 2014. Meanwhile, a select group of authorized resellers and systems integrators participating in its early-access program will each receive two xArray units.

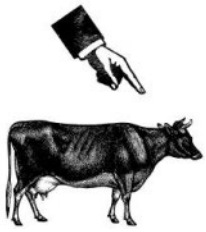
"Once they get the units, they'll start to do prototyping and demos with their customers," Hillstrom says. "We're signing them up now, and we'll learn from them. The reality is, we can start producing in two months, but if solutions are not wrapped around xArray, nobody is going to be ready to sell it. End customers are going to want the interfaces. It's not enough to just get the tag reads and some basic information about them. You've got to turn that data into dashboards that allow end customers to make business decisions, and that's what our solutions providers do."

PHOTO: TOM HURST | RFID JOURNAL

Farmers Learn to Milk RFID

The technology is slowly gaining traction as a way to identify cattle, deer and other livestock for disease management and prevention. But without government mandates, it will likely take other business benefits to spur adoption.

PHOTO: MICHIGAN'S DEPARTMENT OF AGRICULTURE | ILLUSTRATION: ISTOCKPHOTO



"It's important we make it very clear that RFID is not a regulatory requirement for this program."

—NEIL HAMMERSCHMIDT, USDA

In the United States, cattle tend to be bought and sold more often than most other livestock, so when there's an outbreak of bovine tuberculosis or bovine spongiform encephalopathy (mad cow disease), it's difficult to identify the point of origin and other potentially diseased animals. The U.S. Department of Agriculture (USDA) had been administering the National Animal Identification System, a voluntary livestock-tracking program, but the program suffered from a lack of participation and was eventually discontinued. Some ranchers preferred not to share information about their business with the government, and many small farmers said the cost was prohibitive. The program recommended but did not require the use of radio frequency identification ear tags, which have been demonstrated to be more effective than plastic ear tags or bar codes that tend to get covered in mud and become difficult to read.

But when cattle can't be traced accurately to specific locations, herd testing often is expanded to determine any possible exposure to disease. The USDA cites that bovine TB investigations frequently exceed 150 days. "Tracebacks today might take us several months to complete because of a lack of information," says Neil Hammerschmidt, USDA program coordinator for animal disease traceability.

That situation is about to change. This year, the USDA published its rule for animal disease traceability, to make it easier to track and trace livestock. Addressing farmers' concerns, the rule applies only to livestock moved interstate and offers a choice of official identification: Producers can use low-cost National Uniform Eartagging System metal ear tags, or RFID tags—low-frequency (conforming to the ISO 11784/85 standard), high-frequency or ultrahigh-frequency—from authorized manufacturers.

"When there is the potential for disease in the future, this means we will have the ability to better respond to it," Hammerschmidt says.

The USDA expects a high level of compliance with the rule during the next few months. Whereas Australia, Canada and Uruguay have mandated the use of RFID for cattle tracking, the USDA is allowing the industry and states to decide which approach they will adopt. (Argentina and Brazil are among the countries that also offer RFID as an option for identifying cattle.) "It's important we make it very clear that RFID is not a regulatory requirement for this program," Hammerschmidt says. "The states get to implement it as they like," and other states cannot require RFID ear tags be used for cattle moving into their jurisdictions.

"As we mature into this plan, a high percentage of animals will have an official identification, so the time intervals that were weeks or months can come down to a matter of days or weeks," Hammerschmidt says. "The shorter you can make it, the less chance the disease will spread, which is a value for the producers." And, reducing the number of herds that would require testing because of increased precision about the origin of an infected animal is certainly more economical.

Michigan cattle ranchers can attest to the benefits of RFID. In 2000, the state lost its USDA-granted bovine tuberculosis-free status. Today, all except 11 counties have regained the designation, thanks to a 2007 mandate to use LF RFID technology to improve animal traceability for controlling and eradicating the disease. (The 11 counties have a problem with infected deer herd, which transmit the disease to cattle.)

Since the state began requiring the use of RFID tags on cattle prior to the animals leaving the premises—being moved to another farm, the livestock market or slaughter—as well as for testing in its TB zones, cattle producers have purchased approximately 3.5 million RFID tags, says James Averill, director of Michigan's Department of Agriculture and Rural Development's Animal Industry Division. The 15-numeric-character tag identifies a single animal for its lifetime both, electronically and in print. Cattle producers have to provide their premises number when they order tags; that information is recorded in the state's database, along with records of which

Michigan, the only state to mandate the use of RFID to improve animal traceability for controlling and eradicating disease, is seeing benefits from using the technology.

PHOTO: MICHIGAN'S DEPARTMENT OF AGRICULTURE

cattle have been moved within or from TB zones and where, their TB tests and slaughters.

RFID has helped the state accomplish bovine TB testing much more efficiently than the old means, which involved trying to grab hold of the animal's head to read a printed metal tag and possibly having to scrape mud off the tag, on the day of the tuberculin injection and again three days later to check the site for a response. "With RFID, it's just using a handheld wand" to read the animal ID, which is then correlated with the test results, Averill says.

In addition, RFID has helped improve the image of Michigan ranchers. "Wisconsin, at one point, required TB testing pre- and post-entry for cattle entering the state, so it was nearly impossible for our cattle industry to sell there," Averill says. "RFID opened that window up," with Wisconsin reducing the requirements for moving cattle there because of the strides Michigan has made at home with testing and traceability.

Tracking and tracing cattle, as well as deer, pigs and sheep, for disease management and prevention is a key driver of RFID in the livestock industry. But without government encouragement or mandates, many farmers still choose other methods to monitor their herds. They are more likely to adopt RFID only if they can achieve other business benefits from its use. Gaining greater value, however, may involve a switch to ultrahigh-frequency from the predominant LF technology, says Michael Liard, VP of auto-ID at VDC Research. Meanwhile, innovative RFID solutions are helping to keep animals healthy while they're on the farm (see "The Care and Feeding of Animals" on page 39).

From Farm to Fork

RFID-tagging can deliver economic and operational benefits to the livestock industry if it provides "more of a picture of supply-chain visibility through animal identification—not just, 'Here's when it was born and some limited information about it,' but really embrace the concept they use in the marketplace of farm to fork traceability," Liard says. "We have to extend the value proposition further down the supply chain and tie it to the message of visibility plus safety and security."

Potential economic benefits stem from "getting a better handle on the history of the animals and being able to do data mining, to tie together and understand how all the information fits together," says Dale Blasi, a professor at Kansas State University who oversees research at the KSU Beef Stocker Unit. In addition, he says, the industry can gain some economic value by exploiting opportunities to provide assurances about the origin of beef and other meat products.

Nortura, a cooperative of some 30,000 farms, is Norway's largest meat producer. In 2006, it began an RFID initiative aimed at using the technology to improve efficiencies in all its production and logistics processes. The organization's ultimate goal is to enable retailers to use product information, such as the region animals are from and what they ate, for marketing and advertising, and to let consumers check product details by scanning tagged packaging in stores with their mobile phones (see From Farm to Fork).

In Pennsylvania, the nonprofit Center for Beef Excellence, in cooperation with the state's Department of Agriculture, is spearheading a voluntary RFID animal ID program for the producers of its 455,000 beef cattle. The program helps producers with herd management and traceback, but aims to do more, says Ann Nogan, the center's executive VP. "It's designed to address the consumers' concerns about where their beef is coming from," she says, "and it equips the producers with the ability to confidently say they are addressing those concerns."

In January, the program began providing free LF tags from Allflex to producers who provide their premises identification. The tags are nonremovable and nontransferable from the animal to which they are attached, and owners must agree to keep records of each tagged animal for a minimum of five years. The center maintains the serial numbers of tags it delivers to each producer, each tied to related information about the animal and farm.

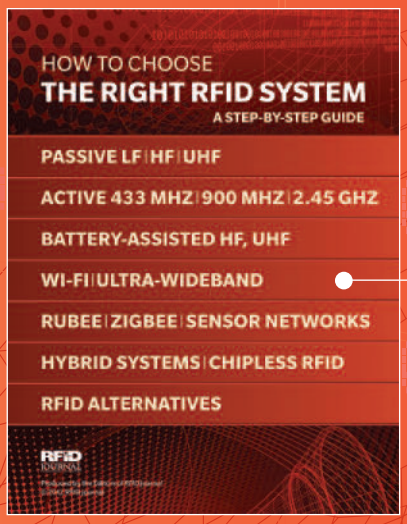
"The paperwork can establish a paper trail for them to show the cattle were locally sourced," Nogan says. So, at on-farm retail markets or conventional farm markets, producers have the data that allow them to reliably tell consumers that the beef is locally sourced. It's a verbal confirmation, and it's not a method that would work at grocery stores and supermarkets, but it's a start, she says. "I do think the local concern to have local products in general is being driven by consumers, as they become more educated," she adds. "They want to know what they are getting and they seek to have that local product.... There are a lot of unknowns with some foods from the global product supply line, and we are fortunate to be able to say we provide one of the safest, most quality beef products possible."

The RFID-enabled farm-to-fork traceability idea is valuable from the public health and

The Center for Beef Excellence, in cooperation with Pennsylvania's Department of Agriculture, introduced an RFID program to enable traceback—and address consumers' concerns about the source of their beef.

PHOTO: CENTER FOR BEEF EXCELLENCE

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.

Save yourself hundreds of hours of research time with this new guide for just **$395**, **or only $199 with a new membership to *RFID Journal*.**

www.rfidjournal.com/howtochoose

RFID JOURNAL
THE WORLD'S RFID AUTHORITY

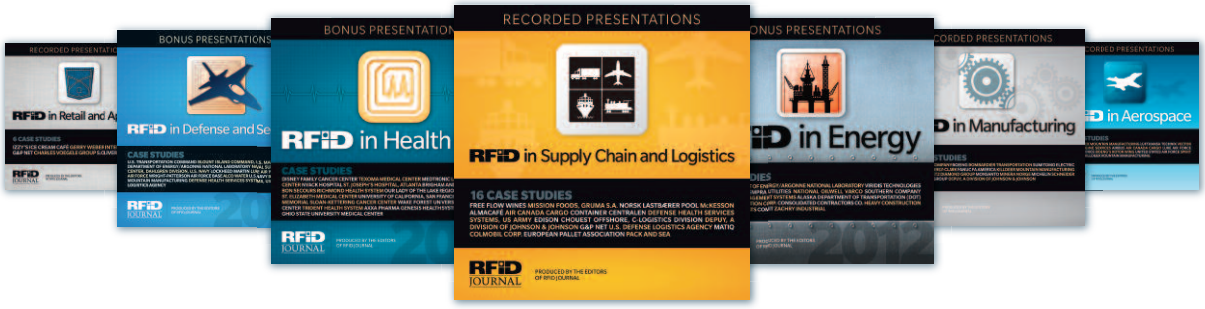
RFID End-User Case-Study DVDs

RFID Journal has created a series of DVDs containing presentations by end users, recorded at various live and online events.

RFID Journal holds several face-to-face conferences every year, as well as a number of online virtual events and webinars. These events feature end users speaking objectively about the business reasons that they deployed an RFID system, the technical hurdles they overcame in doing so and the benefits they now achieve as a result, as well as presentations by academics, vendors and other experts. Many of the sessions were recorded, and we have compiled these recordings into seven DVDs that are available for purchase for only $99 or free with a one-year premium membership to *RFID Journal*.

Hear presentations from *RFID Journal* events, including:

- RFID in Health Care
- RFID in Energy
- RFID in Defense and Security
- RFID in Aerospace
- RFID in Manufacturing
- RFID in Retail and Apparel
- RFID in Supply Chain and Logistics



TO LEARN MORE, VISIT www.rfidjournal.com/store/case-studies

food safety standpoint, says Michigan's Averill, though it is challenged in that "when it comes to buying practices in supermarkets, consumers are not yet willing to pay extra per pound for traceability of products such as hamburger." But, he adds, "they are slowly coming around, especially in local markets where consumers want to know where the product comes from."

Beyond Traceability

In 2010, a European project called Farm to Fork was launched to determine how RFID—in particular, UHF technology—can help the perishable-goods supply chain. One participant is Buttercross Farm Foods, a pork producer and retailer in Market Drayton, England, which is tracking meat through processing and, eventually, to its stores (see Ambitious European Project Traces Food from Farm to Fork).

Indeed, just as many governments are working to encourage livestock producers to use LF tags to monitor their herds, there is growing interest in moving to passive UHF technology. "UHF RFID has a longer read range and is a bit less expensive than LF," Liard says. In addition, he says, "The EPC standards are in place not just for the communication of information, but for the sharing of information, particularly if you think of the supply chain and global visibility." But, he notes, it's an education hurdle to migrate to UHF because there's a core understanding of LF technology.

The Care and Feeding of Farm Animals

PHOTO: MKW ELECTRONICS

In Europe, dairy cattle and breeding sows must be allowed to reside in groups and move around freely within them, in oversize barns or sheds, rather than being confined to a single space. Those groups can get pretty big: It's not uncommon for 500 sows to band together. This means it can be a tricky to see if an animal is lame or has stopped eating, or to locate one that needs medication.

Farmers in Austria and Germany are monitoring cows and sows with an RFID-based real-time location system (RTLS) from MKW electronics. The system, which includes ear tags, are designed to help them stay aware of their animals' activities. The tags are also suitable for sheep and goats. "With our active RFID RTLS system and pattern recognition, we have sensor technology to give to the farmer an indication if an animal is ill or in heat," says company founder Wolfgang Auer. "Without RFID and RTLS, the farmer and his employees have to physically look at the animals, which takes a lot of time."

CowView, from GEA Farm Technologies, also is designed to monitor animal behavior. The solution uses ultrawide-band RFID tags and readers to detect when a cow is in heat, moving around or lying down, and it alerts farm management when it detects changes in typical patterns, which could be early indicators of an illness.

GreenFeed, from C-Lock, is designed to prevent bloat in ruminant animals, a category that includes cows, deer and buffalo. These animals have an extra stomach, or rumen, which acts as a holding vat for feed until its regurgitated and rechewed. But carbon dioxide and methane build up in the cow's digestive system during the rumen process. "The way cattle release gas generated in rumen is through belching," says Scott Zimmerman, director of engineering at C-Lock.

GreenFeed measures gas emissions, so farmers can identify which cows need to have their diets adjusted for greater feed efficiency. When a cow with a low-frequency ear tag visits a feeding station, typically several times daily, a reader identifies the animal and sensors measure its methane and carbon dioxide levels. It also helps them determine which cows may have health problems, by identifying those with low methane levels, often a sign they're not eating.

Farmers can review the data online. "There's no way it would work without RFID," Zimmerman says, because you'd have to manually track which animal is visiting the feeder, clock the time and then associate gas emissions for that animal over time. —*J.Z.*

New Zealand's Pathfinder Group used EPC RFID to track deer from the farm through to the point their meat was delivered as venison cuts to two retailers in Hamburg, Germany.

New Zealand's National Animal Identification and Tracing (NAIT) project recently mandated that cattle and deer producers identify their herds with LF tags. But the country's nonprofit Pathfinder Group has been urging the adoption of EPC technology for several years now. "Fundamentally, exports—food and meat products from New Zealand—are part of our backbone," says Gary Hartley, the organization's secretary. "UHF does perform in livestock and meat traceability apps, both at the hardware and data levels. We can use global identifiers for not only live animals, but cartons of finished meat cuts to provide very robust traceability at locations along a supply chain." For product recalls, he says, the industry needs traceability systems that provide for the extended supply chain from start to finish; "otherwise, it's just too hard."

The NAIT system, in fact, makes a provision for UHF-related data fields as primary identifiers, Hartley notes, so moving in that direction doesn't require complete systems refitting. The Pathfinder Group recently published a report on the use of EPC RFID standards for livestock and meat traceability, discussing a project it ran in which UHF ear tags were placed on deer at a New Zealand farm so the animals could be tracked through to the point their meat was delivered as venison cuts to two retailers in Hamburg, Germany. "When they were moved off the farm, onto the truck, in the process we read all the tags of the deer that were precoded with EPC unique identifiers," Hartley says, noting that those readings were date- and time-stamped.

Of course, other tags had to replace the ear tags on the deer because, as Hartley puts it, a deer at some point ceases to be a deer. But, there is always a parent-child relationship between the unique RFID number at the next stage of the process and the one at the preceding stage. "From the whole deer to the carton of finished venison cuts, we were able to create a parent-child relationship starting with the original numbers that were on tags in the animals' ears," he says.

Every time a significant event happens, "going from the boning room where the animal is chopped up, to being put into boxes, to the chiller room, to the shipping container, to being transported overseas to Hamburg, with doors opening and cartons being taken out, we read the unique ID on the cartons," he says. "The way the EPC standards are written, we can understand things like what it is, where it's happening, what's happening, what's the business process that's happening, and what is the next scheduled step in the process, so we have traceability and audit."

Data from the RFID tags is the real key, of course, and leveraging the GS1 global data standard throughout the journey from live farm animal to cartons of finished meat at a retailer "just makes more sense to us than using different IDs at different stages of the supply chain," Hartley says. "To us, that creates inefficiency and potential risk around redundancy of data. So on the one hand it is about UHF versus LF regarding which form of RFID is more fit-for-purpose at different parts of the supply chain, but the key to all this in our view is the data story."

In Scotland, efforts are under way to pursue the use of UHF tags for cattle identification.

PHOTO: PATHFINDER GROUP

"Many farmers would like to carry more information on the tag than is available with low frequency, and that takes us to UHF," says Bob Yuill, deputy chief executive of the Scottish Agricultural Organisation Society and manager of the ScotEID database system for animal traceability. "It reads at distances up to 7 yards, the antennas are directional, and it reads groups of animals with no problems with collision." Tags must be able to handle more information because every Scottish bovine already has a unique identification number registered on the U.K. government cattle database, and the structure of that ID cannot fit into the ISO 11784 LF standard, according to Hamish Stuart, technical advisor on the ScotEID project.

The ScotEID system was used originally to track only sheep, which are identified with LF tags, but it was created with the intent that it ultimately would track all livestock. The ScotEID project recently received $1.5 million in government funding. "We now have a data system that is tracing sheep using LF technology, and have to find the best technology for cattle, and that is why we are investigating UHF," Stuart says. The thought is to tag cattle with UHF technology to track its movements, recording them in the database as part of a broader plan to eradicate bovine viral diarrhea in Scotland. "It's 14 to 20 days behind by the time you track everything in paper," Yuill says. "When you use automated systems, like we already use for sheep with RFID, it's basically real time."

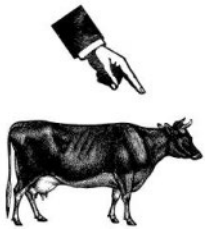
Some Scottish cattle farmers are using LF tags for management purposes, and some dairies are using the technology to trigger feed systems. In a significant year-long field trial of RFID to track cattle from birth to slaughter just announced by the Scottish government, both UHF and hybrid LF/UHF tags will be in the mix.

In Denmark, most cattle are fitted with LF tags, as required by federal mandate, and while farmers are not required to track their pigs electronically, many have also tried LF tags to improve their visibility into each pig's whereabouts, and to provide an automated record of every animal's history, its travels to electronic feeding stations, and medical treatments or vaccinations. The Danish Agriculture & Food Council's Pig Research Center recently completed a PigTracker project, to determine whether UHF tags, which have a longer read range and make it easier to track animals that move quickly in multiple directions, are a viable alternative (see PigTracker Project Finds UHF Tags Effective for Swine).

Since the project concluded, more farms have begun to use UHF technology. "Working with smaller pigs, it's like sheep, like working with flocks—these pigs go into this truck or were moved from A to B or were vaccinated," says Niels Peter Baadsgaard, a veterinarian serving as the center's chief scientist for veterinary research and development. "That's the nice thing about UHF. You can adjust the energy to cope with both individual readings and group readings."

Despite some tough economic times for those in the livestock industry that make the proposition of investing in new materials and systems difficult, KSU's Blasi says there is an uptick in activity in the use of both LF and UHF RFID technology. "With the advent of the animal disease traceability program, many producers and veterinarians are recognizing that visual ID tags are too cumbersome, slow and prone to error, and people are just going to say it's just not time-efficient to do that," he says. Whether UHF overtakes LF in livestock applications remains to be seen, he says, but the potential is there. "Some of the attributes of the higher frequency, some of the things that can be done with it—the read range, the ability to link up on the Internet and utilize data management—it's not only for identification but can provide a comprehensive package of offerings."

Liard believes that passive UHF RFID would likely afford a lower total cost of ownership and faster return on investment than conventional LF technology for animal identification. The data collected and shared via UHF technology could deliver benefits beyond traceability, he says, including improved product recall management, quality assurance and access to new markets through certification programs.



"Many farmers would like to carry more information on the tag than is available with low frequency, and that takes us to UHF."

—BOB YUILL, SCOTTISH AGRICULTURAL ORGANISATION SOCIETY

RFID JOURNAL

MARKETING SERVICES

CUSTOMIZED MARKETING SOLUTIONS THAT GET RESULTS!

WHY SPEND ALL OF YOUR MARKETING DOLLARS ON A LARGE AGENCY, WHEN YOU CAN HAVE CREATIVE CAMPAIGNS DEVELOPED MORE EFFICIENTLY—AND AT A MUCH LOWER COST—BY INSIDERS IN THE RFID INDUSTRY?

WE CAN HELP YOUR COMPANY:

- Raise Brand Awareness
- Create a Product Launch Plan
- Increase Web Site Traffic
- Generate Qualified Leads
- And so much more!

We help clients achieve REAL results while remaining focused on their ROI. Our expertise crosses all key marketing channels, including e-mail, Web, search, print, public relations, social media, events and telemarketing.

For more information, visit **www.rfidjournal.com/marketing**

Managing User Memory

How to read and write data on Gen 2 RFID tags.

By Ken Traub

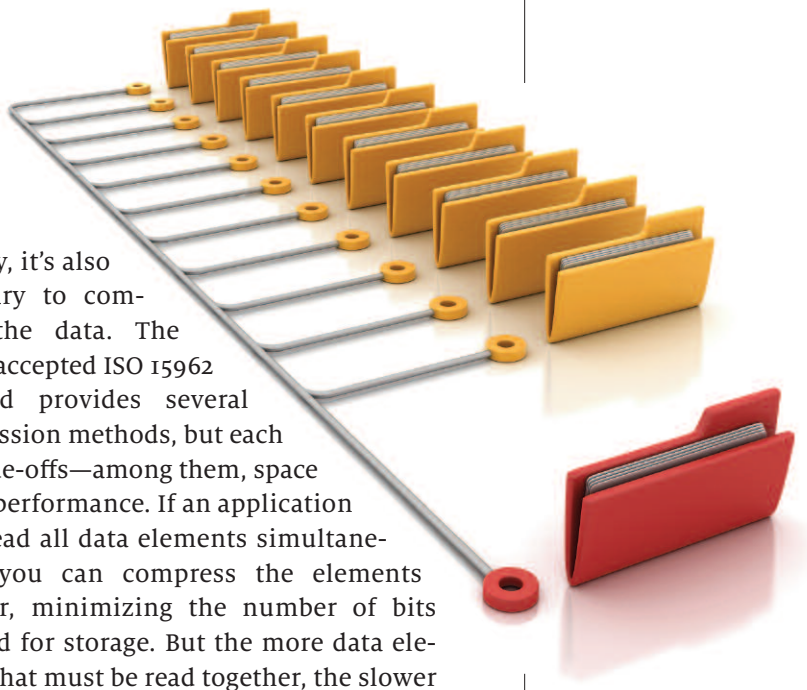


ILLUSTRATION: ISTOCKPHOTO

SOME GEN 2 RFID tags have 96 bits of EPC memory, just enough to contain an Electronic Product Code that serves as a unique identifier of the object to which the tag is affixed. Any additional information about the tagged object can be associated with the EPC in an external database. Other tags have a user memory bank of 96, 128, 256 or more bits of memory, so data can be stored on the tag. A tag on a package of perishable goods, for instance, could carry the product expiration date and batch number, and a tag on a shipping container could include the mailing address of the recipient. A tag on an aircraft part or oil pipeline valve could store the asset's maintenance history; each time the asset is inspected, a new piece of historic data is added to the tag's user memory.

But setting up user memory so you can effectively read and write data to a tag is challenging, so it's important to work with a software vendor or systems integrator that has experience managing the following issues.

User memory is stored in 16-bit blocks, and you must decide what data to store in each block. Then, you need to configure the software that controls your reader—either middleware or an application embedded in the reader—so it knows which data to access depending on the application. How you "lay out" your data in user memory is critical because layout can affect performance. A reader must send commands to the tag to access user memory, a process that takes time and can lower read rates.

Because user memory has limited storage capacity, it's also necessary to compress the data. The widely accepted ISO 15962 standard provides several compression methods, but each has trade-offs—among them, space versus performance. If an application must read all data elements simultaneously, you can compress the elements together, minimizing the number of bits required for storage. But the more data elements that must be read together, the slower the read rate. If an application needs to read only a few data elements at a time, a better option is to compress the elements in separate user memory blocks. This approach requires fewer commands, so it yields better performance, though it uses more memory overall.

In a closed-loop application, you can use a proprietary format to encode data in user memory. But if you need to share the data with your business partners, you'll have to use one of the standards designed for supply-chain applications: GS1's Application Identifiers, for consumer supply chains; ANSI Data Identifiers, for the manufacturing industry; or Text Element Identifiers, for aerospace. Each provides dozens of commonly used descriptive data elements, such as expiration date, batch number, dimensions and weight, and defines standardized codes that identify each data element in user memory.

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. Send your software questions to swsavvy@kentraub.com.

Getting to the Tipping Point

Apparel retailers and manufacturers will soon be engaged in a "virtuous cycle" that will lead to item-level tagging throughout the supply chain.

By Bill Hardgrave

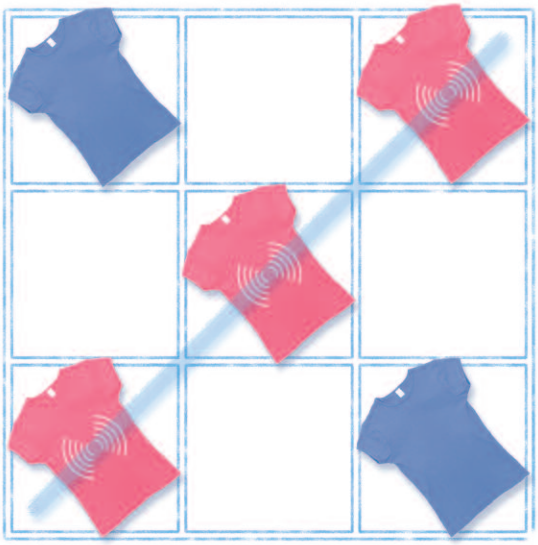
MOST APPAREL and footwear retailers that are using radio frequency identification to improve inventory accuracy and reduce out-of-stocks are tagging items at their own distribution centers or stores. While this approach works for pilots, it is not a time- or cost-efficient way to deploy the technology enterprisewide. The only sustainable strategy is to tag items at the point of manufacture (or as close to the source as possible).

As more retailers move from pilots to deployments, it is time to get suppliers engaged. Of course, this is easier said than done. The business case for suppliers is only now being developed. In 2011, a report released by the University of Arkansas' RFID Research Center and Auburn University outlined 60 potential use cases for item-level RFID in the supply chain, but these have not yet been fully tested.

Nevertheless, a phenomenon I call the "virtuous cycle" promises to propel item-level RFID throughout the apparel and footwear supply chain. Here's how it will unfold.

ABC Shirt Maker is RFID-tagging men's T-shirts, SKU 123, for Retailer XX. ABC Shirt Maker also sells SKU 123 to many retailers that are not using RFID. So instead of RFID-tagging items at the source when other labels are applied, products for Retailer XX are diverted and tagged either before the products leave the manufacturing facility or at the supplier's DC. This adds another step—and more cost—to the manufacturing process, which is either absorbed by the supplier or passed on to the retailer (and consumer).

Then, several other retailers ask ABC Shirt Maker to tag SKU 123. Suddenly it's cheaper to tag all SKU 123 items. Now, retailers that are not using RFID are receiving "free" tagged items. Retailers MM and PP have been considering piloting the technology, and the free tagged items provide the incentive to install an RFID infrastructure at their stores. After these retailers begin using RFID and recognize its benefits, they ask other suppliers to tag additional SKUs. And so on and so on, until all suppliers are RFID-tagging all apparel and footwear for all their retailers.



The tipping point—when it is cheaper to RFID-tag all SKU 123 items, rather than to divert and tag some products for select retailers—varies from supplier to supplier. I have worked with several suppliers that hit the tipping point when they began tagging approximately 30 percent of a given SKU. Other suppliers report their tipping point was a little higher than 50 percent and some say it was as low as 20 percent.

We have not yet entered the virtuous cycle, but we are close. Item-level RFID is gaining momentum and will continue to accelerate during the next few years. If you are a retailer or supplier, embrace RFID. Fighting it will only leave you woefully behind and, perhaps, unable to catch up.

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

ILLUSTRATION: RFID JOURNAL

RFID JOURNAL VIRTUAL EVENTS

During our free virtual event, hear how retailers worldwide are using RFID to track individual items, improve inventory accuracy, and have products on shelves when customers want to buy them.

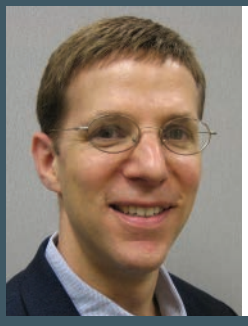
RFID in Retail

June 20, 2013 – 11 AM to 1 PM EDT

FEATURED SPEAKERS INCLUDE:

Justin Patton
RFID Research Center Managing Director

UNIVERSITY OF ARKANSAS
SAM M. WALTON COLLEGE OF BUSINESS
RFID Research Center



Alan Sherman
Senior Director of Global Marketing

OAT
A division of Checkpoint

Peter Townsend
Founder and Senior VP of Strategy and Shopper Insights

Jay Craft
VP Product Development

vf®

Mark Roberti
Founder and Editor

RFID JOURNAL
THE WORLD'S RFID AUTHORITY

This virtual event is **FREE** to attend—but space is limited, so register now: **www.rfidjournalevents.com.**

DEPLOYMENT GUIDE SPONSOR:

Checkpoint®

The RFID Marketer's HANDBOOK

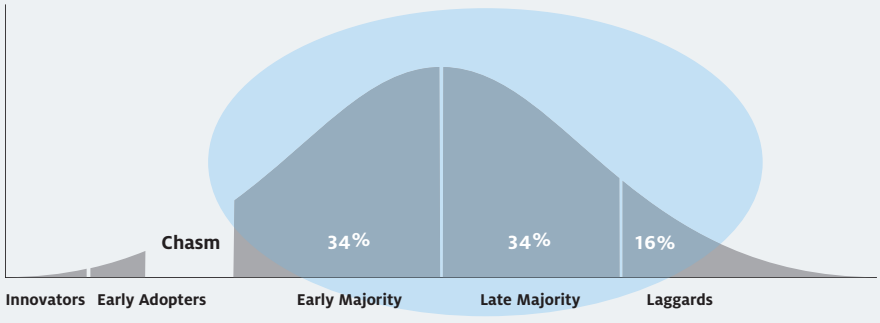
SMART STRATEGIES FOR FINDING POTENTIAL BUYERS AND CONVERTING THEM INTO CUSTOMERS

Based on a new survey of RFID end users, this guide reveals:

- The state of adoption by industry and region
- Who the RFID buyer is
- How companies make RFID investment decisions
- The applications end users are pursuing

POTENTIAL MARKET SIZE TODAY

Almost 85 percent of companies won't invest until RFID crosses the chasm



LEARN SMART STRATEGIES FOR REACHING RFID BUYERS TODAY

ORDER YOUR COPY FOR JUST $199, AND START GENERATING MORE SALES.

www.rfidjournal.com/store/rfid-marketers-handbook

Monitoring Aging Infrastructure

An RFID tag's antenna can serve as a sensor to detect cracks in concrete and other construction materials.

By Rahul Bhattacharyya, Prasanna Kalansuriya and Sanjay Sarma

A RECENT ARTICLE IN *The New York Times* points out that 70,000 bridges in the United States are structurally deficient. It is imperative that structural anomalies on aging infrastructure be detected and corrected in a timely manner, to avoid disasters such as the 2007 St. Anthony Falls Bridge collapse in Minnesota.

To maximize the chance of detecting the onset of surface cracks in concrete and other construction materials, sensors must be deployed pervasively. Structural engineers have focused primarily on wired strain gauges and accelerometers to detect structural faults. These sensors work well, but the management of lead wiring can be prohibitive. Wireless counterparts exist, but they are cost-intensive and so do not lend themselves to pervasive deployment.

At the Auto-ID Lab at the Massachusetts Institute of Technology, we are developing a solution using ultrahigh-frequency RFID tags. The tag's antenna serves as a sensor capable of detecting a surface crack. The development of a crack severs the tag's antenna, manifesting in a drop in strength of the signal with which the tag responds to a reader. The tag's unique ID is associated with the crack's location. We believe this is an ideal approach, because RFID tags can be manufactured in mass quantities for very low cost, and they have a proven track record for large-scale object tracking in many industries.

The crack-detector tag is deployed on the concrete surface in two stages. First, the tag's antenna, which is made of conductive copper ink, is painted onto the concrete surface. The copper ink forms a strong bond with the concrete. Next, the tag's integrated circuit is connected electrically to the antenna.

We can create a crack-detection grid using an array of such RFID tag sensors on a concrete surface. When a crack propagates, it cuts the antennas of some of the tags in the grid. By observing which tags register a drop in signal strength, it is possible to identify the length and direction of the crack's propagation to determine where structural repairs are needed.

While the design idea is feasible, it is still in the development stage. We are considering several deployment challenges before this technology is ready to be field-tested. We are investigating the use of polyester coatings to protect the grid, which is attached to the concrete, from moisture, acid and animal attack. We are also trying to extend the read range of the sensor grid to 13 to 20 feet, so we can monitor the tags using RFID readers deployed on vehicles passing near or under the concrete surface. Other challenges include improving the grid's spatial resolution and sensitivity to cracks of different widths.

Rahul Bhattacharyya is associate director of the Auto-ID Lab at the Massachusetts Institute of Technology. Prasanna Kalansuriya is a visiting researcher at the Auto-ID Lab. Sanjay Sarma is a professor of mechanical engineering at MIT and a co-founder of the Auto-ID Lab.

ILLUSTRATION: ISTOCKPHOTO | RFID JOURNAL

RFID IN HIGH TECH

Oct. 2-3, 2013 • Hilton San Francisco Airport Bayfront Hotel • San Francisco, Calif.

LEARN HOW RFID IS BEING DEPLOYED IN THE HIGH-TECH VALUE CHAIN

Radio frequency identification technologies are delivering benefits along the entire value chain in the high-technology sector. Industry leaders are using RFID technology to track printed circuit boards, providing visibility and processes efficiencies at manufacturing plants. Device manufacturers are utilizing embedded RFID technology to provide new capabilities, such as premise-aware security and in-transit device locking, in order to reduce theft and diversion. And companies hosting large data centers are employing RFID to track assets.

RFID in High Tech was designed by *RFID Journal* to help companies in Silicon Valley understand how RFID is being used today to improve operations and enable product differentiation in the highly competitive world of consumer electronics.

THIS IS THE ONLY EVENT WHERE YOU WILL:

- Hear speakers from leading end-user companies candidly discuss how they are using RFID to achieve business benefits within their operation
- Learn from visionary speakers pioneering new applications enabled by embedded RFID technology
- Meet the leading end users, experts and RFID solution providers
- And so much more!

REGISTER EARLY FOR MAXIMUM SAVINGS!

To register, visit www.rfidjournalevents.com/hightech.

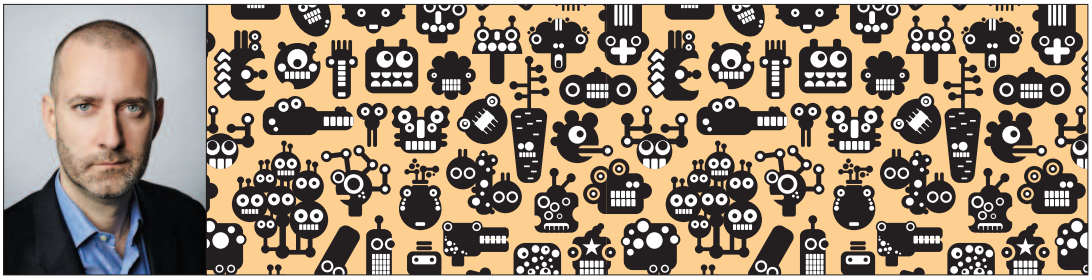
CORNERSTONE SPONSOR

RFIDglobal SOLUTION

We're Not KDDing

Next up: making sense of all the Internet of Things data.

By Kevin Ashton



IT WASN'T SO LONG AGO that the Internet of Things was futuristic. Today, it's high tech's equivalent of the "Harlem Shake." Just as thousands of people worldwide seemingly overnight created dance videos to accompany the song and uploaded them to YouTube, suddenly every tech company, consultant and journalist is "doing" the Internet of Things. Not only that, but just as with the Harlem Shake, they are doing their own versions—from the "Web of Things" to the "Industrial Internet" and, my personal favorite, the "Internet of Everything," which apparently is the Internet of Things plus people and data. Well, duh.

The Harlem Shake, which went viral early this year, no doubt will be replaced soon by another Internet craze and then another. The Internet of Things will last for millennia, but it is already being replaced by the next futuristic idea. That's because the Internet of Things is taking shape in the present. "Smart" cities are popping up in Europe and Asia. Want a "smart" home? You can purchase Belkin's WeMo Internet of Things technology at Best Buy, Costco or Target for less than $50 (full disclosure: I led the development of this product).

So, what comes next? KDD: knowledge, discovery and data mining. Actually, the idea of KDD is not new—in August, the Association for Computer Machinery is holding its 19th annual KDD conference. But the term hasn't yet been co-opted and misused, and the field is alive with change.

For centuries, the dimensions of data analysis were somewhat constrained. There was a single data set from a single source—say, payroll data from a particular company for the past 10 years—and statisticians would analyze it using conventional mathematical tools. Computers made this process faster, easier and more accurate by putting the data into a "database," where it could be analyzed electronically. Computers and computerized data became more common, and eventually data was moved online and to the "cloud," and another term emerged to describe all this information: "big data."

The rise of the Internet of Things means the world of big data is changing quickly. Data now streams from real-time sensors distributed globally and networked together, gathering noisy signals. Big data is now made of what Deborah Estrin, professor of computer science at Cornell NYC Tech, calls "small data": lots of tiny, almost insignificant bits of information. Making all this data useful is a job for machines that must be programmed to comb through ever-changing deposits of data (data mining), find significant pieces and patterns (discovery) and synthesize them into something useful (knowledge). This technology, also known as "data science" or "machine learning," is the frontier of computing. A network that senses data needs a network to make that data make sense.

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

ILLUSTRATION: ISTOCKPHOTO