DEDICATED TO RADIO FREQUENCY IDENTIFICATION AND ITS BUSINESS APPLICATIONS



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- James Bond's Smart Gun Misfires
- VA to Reassess Contract, Proposals for Nationwide RTLS Deployments
- Southwest Accepts RFID Device to Track Cargo Temperatures

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- 2 Walmart
- 3 Security
- Airbus
- 5 Active RFID
- 6 Asset Tracking
- 7 Privacy
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Worldwide RFID Deployment Map



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

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



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- Where can I find laundry tags able to withstand high temperatures?
- Can RFID reduce instances of lost luggage?
- What kind of memory is used in RFID chips?
- How should antennas be polarized around doorways?

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A Time for Leadership

I'VE BEEN A HISTORY BUFF since I was a kid, and I've long considered the question of whether trends result in the rise of leaders or leaders create trends. I have always believed it is the confluence of trends and great men or women that changes the course of human events. As a business technology journalist, I'll cite two related examples to explain why my view has not changed. It was John Chambers' vision for



Cisco combined with the emergence of the Internet that made Cisco a powerhouse company. And it was the vision and leadership of Steve Jobs combined with a trend toward ubiquitous cell phone networks and mobile computing that gave rise to the iPhone.

We are nearing an inflection point with radio frequency identification. The technology has matured, and mainstream companies in many industries have demonstrated that it can be used to achieve real business benefits. Airbus has pioneered the use of RFID across the enterprise, to bring benefits to all

areas of its operations. CEOs who have vision will recognize RFID's power and make a strategic decision to leverage the technology throughout their companies to beat the competition. A few are already moving in that direction.

Macy's, for instance, is seizing the opportunity to outflank online competitors by offering true omnichannel retailing, allowing a customer to buy an item by smart phone and pick it up at a store, or buy it online and return it to the store. The key to executing omnichannel retailing successfully is inventory accuracy, which only RFID can provide cost-effectively (see Tuned In on page 38). Group Health Cooperative, in Seattle, wants to be the medical center of the future. To help fulfill that goal, the health-care company deployed an RFID-based real-time location system at its newly constructed Puyallup Medical Center. The system is designed to reduce patient waiting times during clinic visits by bringing services to a patient's care room, as well as providing clinic staff members with real-time visibility into the locations and status of patients, care providers and equipment.

But most CEOs haven't paid much attention to RFID. It's my belief they can no longer afford to ignore the technology, so I wrote this issue's cover story, "It's Time for CEOs to Take the Lead" (see page 12). The article explains the 10 facts CEOs must understand about the challenges and benefits of RFID, so they can establish a corporate strategy for deploying the technology wisely.

A recent technology innovation, which links an RFID chip to the microprocessor in a consumer electronics device, could have a profound impact on the industry (see Vertical Focus on page 22). A CEO who understands all the benefits the new design could deliver including streamlining operations, reducing theft and improving sales—could certainly start a trend.

Keep in mind that embracing a new technology in a new way requires a leap of faith. But that's what makes great leaders and business successes—seeing the trends and leading your organization in a fresh direction to seize an unprecedented opportunity.

Mark Roberti, Founder and Editor



Understanding Influenza

An innovative research project is using RFID sensors to better understand how the disease is spread through schools and communities.

ON ELECTION DAY, students and teachers at Borland Manor Elementary and North Strabane Intermediate schools in Pittsburgh's Canon-McMillan School District received an unusual assignment. They were asked to wear a three-ounce radio frequency identification sensor, or mote, in a clear plastic pouch around their necks.

The students—and others from 10 Pittsburgh public schools, grades kindergarten through 12—are part of a twoyear research project, funded by the U.S. Centers for Disease Control and Prevention, called Social Mixing And Respiratory Transmission in Schools (SMART Schools). The study is being conducted by researchers at the University of Pittsburgh Graduate School of Public Health, the Johns Hopkins Bloomberg School of Public Health and the University of Liverpool. The aim is to help researchers better understand how influenza spreads through contact among children, even when they are not in school.

"Schools are a setting that can contribute to the increased spread of diseases in the general community," says Jeanette Rainey, Ph.D., senior epidemiologist at the CDC. "If we can better understand how influenza spreads in schools, that may help us develop better strategies to prevent disease not only among school-aged children but also in the general community." In the spring, students from 10 schools were outfitted with Crossbow Technology motes programmed by the researchers to "wake up" every 20 seconds and broadcast a signal. The motes also record the ID of any other mote from which they receive a signal, the time the signal is received and the strength, which indicates the distance between the two motes. Students also received a diary in which to note their interactions with family members and others outside of school who did not wear motes.

"We looked at a variety of technologies that might provide information that is more objective and reliable than surveys asking the kids who they interacted with," says Derek Cummings, a Johns Hopkins Bloomberg School of Public Health researcher working on the project. "This also gives us an opportunity to evaluate the reliability of surveys."

Preliminary results showed that each child interacted with an average of 109 children during the school day, with most interactions occurring at midday. High-school students interacted more than middle-school kids.

On Election Day, students were given the motes to wear when they were not in school. The goal was to see how many interactions students have with others from their school when school is closed. The researchers plan to let students wear the motes for a weekend and, if possible, during a snow day, to simulate a school closing due to influenza.

"The central question is, on an off day, is there enough contact through play dates and the things kids do to sustain transmission at high levels, or is there is a dramatic decline that would make closing school an effective response," Cummings says.

The researchers say collecting this data will enable them to evaluate the most effective interventions for controlling the spread of an influenza outbreak, such as limiting movement between classes during the school day, increasing vaccination campaigns, instituting educational programs, changing sick-leave policies or implementing initiatives encouraging hand-sanitizer use.

"We plan to use the data to create models of influenza transmission both within schools and within entire communities," Cummings says. "We can then simulate different interventions to see which work best."—Mark Roberti



Sphere of Influenza

Number of people in the **United States** who die from the flu annually:

3,000 to 49,000

Number of people in Germany who die from the flu annually:

14,000

Number of people in Canada who die from the flu annually:

4,000 to 8,000

Number of people in the **United Kingdom** who die from the flu annually:

2,000 to 4,000

Number of people in Australia who die from the flu annually:

3,000

Number of people in Denmark who die from the flu annually:

1,000 to 3,000

-Rich Handley

SECURITY

Premise-Aware Security

McAfee demonstrates that an RFID chip embedded in an Intel tablet can be used to restrict access to data or computer networks based on the device's location.



AT RFID JOURNAL LIVE! 2012, in April, Shahrokh Shahidzadeh announced that Intel, working with Impinj, had

developed a standardized platform for linking an embedded RFID chip to an Intel microprocessor in any electronic device (see "Game Changer?" on page 22). One of the applications Shahidzadeh discussed was location-based, or premise-aware, security. The chip is designed with memory that creates what Intel calls "processor-secured storage." Data, such as passwords and security keys, can be stored in this secure vault and activated when needed with an RFID reader, based on predetermined rules. A tablet's camera, for instance, might be deactivated in a research-and-development lab.

McAfee, an Intel company that provides consumer and enterprise digital security solutions, worked with Shahidzadeh to create a live demonstration of location-based security at its Focus Security Conference in Las Vegas, in October. Sumant Vashisth, McAfee's director of engineering who is in charge of the company's ePolicy Orchestrator (ePO), a scalable security platform that allows firms to centrally manage all their McAfee enterprise security applications, worked on the proof-of-concept application. It showed how a doctor visiting one hospital could automatically access medical records for patients admitted to that facility. When visiting a different hospital, the doctor could access records for patients at that facility, but not those at the other hospital.

"This is still a new concept, and we are still thinking through how we might apply it," Vashisth says. "But we leveraged the RFID transponder and integrated it with a McAfee agent that talks with ePO. We set up a couple of RFID readers to get location using the RFID transponder, and we got the security policy using ePO. It worked beautifully."

Vashisth says the proof of concept received more positive feedback than he expected. "We already had a followup meeting with a major computer manufacturer and IT services providers, and we have meetings scheduled with other customers to discuss this," he says. "They are encouraging us to take it to the next step right away. So we're looking at how and when we might take it from concept to product." —*M.R.*

perspective THE STORY BEHIND THE NEWS

ADOPTION

The Secret Life of RFID

Retailers that don't reveal information about their deployments are slowing adoption and reducing their own ability to benefit from the technology.

WHEN I WAS a young reporter based in Hong Kong, I met a curmudgeonly British journalist who had covered World War II and the Vietnam War for *The Times of London*. He'd made Hong Kong his home, and he lived mostly on his reputation. Chatting over a beer, he would tell me: "The best stories never get reported."

What he meant, of course, is that the real dirt never gets revealed, because the people involved are too powerful. Still, I'm reminded of his comment every time I hear about a successful radio frequency identification deployment that a retailer prefers to keep secret, because the company feels there is nothing to be gained by letting its competitors know about the benefits the technology is providing.

Only a few retailers, including American Apparel, Macy's and Walmart in the United States, and Charles Vögele and Gerry Weber in Europe, have publicly discussed their RFID deployments. Yet, "19 of the top 30 retailers are actively investigating, piloting or using RFID today, that I am aware of," says Bill Hardgrave, dean of Auburn University's College of Business and founder of the University of Arkansas' RFID Research Center. These include both department and specialty stores, says Hardgrave, who has worked with many leading U.S. retailers.

It's certainly understandable that companies don't want to let their rivals in on a good thing. Retail is intensely competitive, much more so than, say, health care. Every little edge might help. But keeping RFID deployments secret is unnecessary and potentially self-defeating. That's because the basic RFID applications—inventory management, replenishment, product locating and shrinkage reduction—enable retailers to execute better on their existing strategies. They may give retailers a slight edge. If you don't have the right products on your shelves when customers want to buy them, they'll go shop somewhere else. But they do not change a retailer's existing strategy in a way that would provide a significant competitive advantage.

Retailers compete on image, style, quality, price and getting the customer into the store. If they have the right image, style, quality and price—and, presumably, they feel they do—RFID will help them take better advantage of that mix. That, in turn, will help draw customers in—and ensure they walk out with the items they came for.

When retailers don't discuss publicly how they are using basic RFID applications, it slows adoption and reduces their own ability to benefit from the technology. If CEOs hear that more retailers are using RFID, they will begin to investigate the technology.

If suppliers knew how many of their retail customers were actively pursuing RFID projects, they could gear up to meet tagging requirements—most retailers are RFID-tagging items in their distribution centers rather than at the source of manufacture, which is costly and inefficient. It also would make it easier for suppliers to use RFID to achieve internal benefits.

If RFID tag and reader manufacturers knew how many retailers were deploying the technology, they would have more confidence to invest in expanding production. That would lower equipment costs for all retailers and ensure a steady supply of product (retailers have been experiencing delays getting both RFID transponders and handheld readers).

As tagging at the item level becomes more widespread, it will be easier for retailers to use RFID to execute on their existing strategies—that is, RFID won't be the differentiator, but it will help with an existing strategy of differentiation. For example, if a retailer's goal is to sell goods at the lowest prices possible, it can use RFID to reduce supply-chain waste and costs. Or, if the goal is to sell expensive goods to highend customers, the retailer can use RFID to enhance the shopping experience. This is something CEOs should be thinking about now, as they plan to deploy these basic applications (see "It's Time for CEOs to Take the Lead" on page 12).

The savviest retailers will go a step further and find new and creative ways to use RFID to get a competitive edge. A true omnichannel retailer, for instance, could disrupt online retailers, such as Amazon and Zappos, by offering same-day deliveries from nearby stores (see "RFID as a Disruptive Technology" below).

Some companies, notably Macy's and Walmart, understand it is important for tagging to become widespread and are speaking publicly about their plans. While they are not revealing *all* the benefits they are seeing or *every* way they plan to use RFID, they understand that competitive advantage doesn't come just from the technology, but from how a retailer uses the technology. *—Mark Roberti*

BUSINESS

RFID as a Disruptive Technology

Bill Hardgrave makes the case that companies can get the most value out of RFID by using it to disrupt the competition.

SPEAKING IN LONDON at RFID Journal LIVE! Europe—UK on Oct. 30, Bill Hardgrave, dean of Auburn University's College of Business and founder of the University of Arkansas' RFID Research Center, said radio frequency identification can be used as an evolutionary, radical or disruptive technology, and companies can get the most value by using RFID in a disruptive way.

Hardgrave described evolutionary technologies as those

that are built on existing technologies and deliver only minor changes to the status quo. Evolutionary technologies bring some improvement to the business—lower costs, for example—but the improvement is modest and the results are largely predictable.

Radical technologies, he said, bring revolutionary or transformational change. They enable companies to achieve significant improvements in existing processes or enable new processes. The results can be unpredictable, because the radical technology is not based on an existing technology and the process change is new.

A disruptive technology, Hardgrave told the audience, "changes the basis of competition. It enables us to do things we were unable to do before. The technology lacks refinement. We don't understand the performance issues and [the disruptive technology] might not have a practical application. It's a solution in search of a problem."

Early RFID adopters, including Walmart and other retailers, viewed RFID as an incremental technology, a better bar code, Hardgrave explained. They tagged pallets and cases and used RFID to read the tags faster or automatically, but in many instances they did not even use the unique serial number in the tags. Many people described RFID tags as "bar codes on steroids," he noted.

"If you think of RFID as just the evolution of bar code—a very stable, existing technology—then it's just a

tweak of what you've been doing," he said. "Retailers were tracking pallets and cases with bar codes, and they just overlaid a stable process with RFID."

The technology did deliver incremental benefits. A study by the RFID Research Center showed that RFID could reduce out-of-stocks by approximately 20 percent. "That's significant," Hardgrave said, "but it is incremental."

Using RFID to track goods in the supply chain provided visibility into the movement of goods, and retailers began to realize that the big issues leading to out-of-stocks occurred in the store and at the item level. This led to a shift in thinking. "Around 2006 or 2007, the term 'bar code on steroids' started to fade out," Hardgrave said. "Companies' thinking changed as we learned what RFID could do. Pallet and case tracking opened our eyes to the benefits that could be achieved at the item level... Instead of just looking at out-of-stocks, we could do things like improve inventory accuracy, improve shelf replenishment, reduce shrinkage, manage dressing rooms better and so on."

The RFID Research Center study showed that the top 10 U.S. retailers had inventory accuracy at roughly 65 percent, and RFID could boost that to the upper 90s. Using RFID to improve inventory accuracy created an opportunity for retailers to effect radical or transformational change, because so many aspects of a store's operations depend on accurate inventory, including replenishment, reordering and merchandising. "It is not an incremental change,"



Hardgrave said. "It allows us to address issues that have plagued retailers forever."

RFID can bring even greater change, Hardgrave explained, if retailers go a step further and use it as a disruptive technology. One way several retailers are trying to do that is by using RFID technology to support omnichannel retailing, which means a customer could purchase an item online and pick it up in store, or buy online and return the item to the store. True omnichannel retailing will allow brick-

and-mortar retailers to disrupt online retailers by offering same-day delivery and other services online retailers can't offer (see Tuned In on page 38).

The online retailers disrupted conventional retailing by having better inventory accuracy (visibility is usually lost at the store and online retailers don't have stores). Sales online have been growing faster than store sales for the past few years, because online retailers can usually deliver what you ordered within a few days, which beats going to a store to find it is out of the item.

"If a brick-and-mortar retailer does omnichannel right, it could disrupt online retailers," Hardgrave said. "That's because they will know exactly what they have in the store. So if someone in New York City orders an item online, they can deliver it from a store a few blocks away the very same day. Pure online retailers have to deliver from a centralized warehouse, so they will struggle to compete with a true omnichannel retailer." -M.R.





Features

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We've had a decade of learning how to deploy RFID. Now, corporate leaders must develop an ENTERPRISE STRATEGY for implementing the technology, to ensure their companies will be COMPETITIVE—and SUCCESSFUL in the future.

It's Time for CEOs to Take the Lead

BY MARK ROBERTI

DURING THE PAST IO YEARS, we've seen thousands of companies and organizations worldwide adopt radio frequency identification to solve myriad problems. They've deployed RFID in factories, hospitals and stores, on oil rigs and cruise ships, and at construction sites and ski resorts. They've tracked large pallets and small items, vehicles and apparel, workers and raw materials. And they've used many different types of RFID technology, including active and passive systems.

Yet despite the diversity of industries and solutions, most of these companies have shared several experiences. They've deployed RFID on a project basis, learning about the technology, identifying a business problem that RFID could solve, piloting a system and evaluating the benefits. That was—and still is—the right approach for first-time users of RFID technology.

But many of the end users leading these pilots also have

shared the frustration of struggling to get their RFID projects approved. Some were told the company couldn't afford to fund the project or the technology was too risky. Others were thwarted by concerns from coworkers who didn't want to disturb the status quo or risk their jobs if the project didn't work out. In fact, many projects never got green-lighted.

And there was little, if any, support from the top. In most cases, the CEOs did not have much knowledge of or interest in RFID. And if they were aware of the technology, they considered it a nuisance—an additional expense, something they wished would go away.

Now, suddenly, RFID is on the radar of many CEOs, as major aerospace and automobile companies, energy and IT firms, health-care organizations, hotels, manufacturers, retailers and others deploy the technology on a large scale. Among those adopting an enterprise strategy for RFID are: Airbus, Boeing, BP, Cisco Systems, Daimler, Gerry Weber International, J.C. Penney, John Deere, Macy's, Rewe Group, Starwood Hotels and Resorts, and the Veterans Health Administration.

CEOs need to get up to speed quickly on the challenges and benefits of RFID, so they can establish a corporate strategy for deploying the technology wisely. Those who do will position their companies to compete aggressively for years to come. CEOs who do not pick up the RFID reins will see their companies continue to struggle with inefficiencies, rising rate, communicate, gather data, interact with customers, buy, sell and operate. In other words, the Internet permeates every corner of an organization. Some have managed the transition extremely well (think of how Cisco uses the Internet in every area of its operations), and some have not (think of all the retailers still struggling to develop a successful strategy to combat online merchants).

RFID will affect every aspect of the way a company does business—from how it moni-



RFID will affect EVERY ASPECT of the way a company does business. CEOs who get this will give RFID projects the PRIORITY needed to ensure success.

costs and decreasing market share.

Here, then, are 10 facts CEOs must know about RFID, to ensure the technology delivers major benefits across the enterprise.

FACT 1

RFID's success starts with you.

Many CEOs seem to believe RFID is just another technology, like customer relationship management software, data analytics software or cloud computing, that will be deployed during their tenure. If they are convinced RFID will deliver a return on investment, they sign off on a budget for the deployment and go on to the next issue. CEOs who take this approach will not see RFID deliver big benefits and are likely to see projects fail.

RFID is comparable in scope to the Internet. The Internet is not something that could be deployed and forgotten. It had and is still having a huge impact on the way companies collabotors its supply-chain partners to how it interacts with customers. CEOs who get this will give RFID projects the priority needed to ensure success. That includes adequate funding and a focus on change management (see Fact 4).

FACT 2

RFID isn't a strategy; it's a technology that should support your company's strategy.

In the early days of the Internet, many Wall Street analysts would ask CEOs on earnings calls what their Internet strategy was. The thinking was a brick-and-mortar retailer had to launch its own online site, partner with an existing one or devise some other strategy to fend off dot-com competitors. Only now are retailers (and analysts) realizing that the Internet isn't a strategy. It's part of a broader infrastructure that allows a company to execute on its strategy more effectively and



The Ideal Person to Lead Your RFID Team

The single biggest decision a CEO needs to make about radio frequency identification is not what kind of technology to use or what application to adopt, but who should head the RFID team. Here are the skills and qualities your RFID team leader should possess.



Passion. Deploying RFID on a large scale means bringing wholesale change to your organization. The team leader must be passionate about how the technology can improve the way your company does business, so he or she can get others to buy into changing the way they do things. Without passion, the team leader will not be able to weather the political backbiting (see skill 3).



Seniority. The team leader needs to be high enough in the organization to have the clout to push through change. This individual should report directly to the CEO, to avoid undercutting by other senior executives. The CIO, for instance, might argue in high-level meetings that RFID should be made a lower priority than some pet project of his or hers. Once you choose a team leader, everyone must know that you have put your trust in that person.

3

Political skills. Let's be clear: RFID can be perceived as a threat to everyone in the organization. If you decide to RFID-enable your warehouse, for instance, the warehouse manager may feel vulnerable. The team leader needs to bring operational people into the decision-making process so they will embrace the technology. Otherwise, they will resist change or even sabotage the RFID system. Appoint a team leader who understands political resistance to change and can deal with it diplomatically. You do not want anyone attempting to ram change down the organization's throat.



Broad experience within the business. Many companies choose the CIO to head their RFID efforts, because he or she is in charge of technology. But unless the CIO has a strong business background, that is a mistake. The ideal RFID team leader has worked in a variety of areas of the company, such as supply chain, manufacturing and customer service. This helps in two ways. First, the leader will understand the challenges people in those parts of the business face and the objections to change they will have. Second, it means the leader will likely have contacts and relationships in those business areas, which will be helpful in building trust and getting people on board.



Project-management skills. RFID applications can be complex, requiring a year or more to deploy. The project manager must be able to set milestones and ensure they are met, keep the organization focused (many people will work on an RFID project as part of an existing job), address problems before they get out of control and adhere to budgets. —M.R. sometimes in new ways.

RFID is not a strategy, either. It's a tool that can help you compete more effectively by supporting your company's core strategy. If you are a retailer focused on giving customers goods at the lowest price imaginable, you could use RFID to reduce supply-chain waste and costs. If you are a high-end retailer that sells expensive goods with a personalized touch, you could use RFID to reduce theft and improve customer service (being able to answer questions about product availability and location with 100 percent accuracy might well be part of that).

Some manufacturers might adopt RFID to remain competitive by lowering costs. RFID could help them reduce safety stocks of parts, eliminate production delays caused by parts reaching the line late, and prevent errors by ensuring the right tool is used consistently. Other manufacturers might focus on putting RFID into products, either to reduce counterfeiting or to increase functionality and thereby appeal to more consumers.

FACT 3

The key to a successful enterprisewide deployment is choosing the right leader and supporting that person.

This seems straightforward, even simple—just create a steering committee from different departments within the enterprise and put the CIO in charge. That might work, but it might not, because a team leader needs to possess a special set of business and people skills (see "The Ideal Person to Lead Your RFID Team" on page 15). The RFID team leader should be someone with business acumen and the ability to focus on the business benefits of using RFID. He or she should be skeptical of transformation claims, require proof that the technology can deliver benefits and have the vision to see the potential benefits, even when they aren't apparent to everyone else.

A qualified team leader will face numerous challenges from within your organization. The leader you choose will not succeed unless it's clear to everyone in the company that he or she has your complete support.

FACT 4

Change management is critical.

There is no doubt that over the past 10 years, the biggest reason some RFID projects have failed to deliver benefits is that companies have failed to manage change. Several hospitals, for example, deployed an RFIDbased real-time location system (RTLS) to track IV pumps and other assets, but never trained nurses—or gave them just cursory training on how to use the system. Consequently, after struggling to use the RTLS to find equipment, the nurses gave up and returned to looking for assets the old way, by walking the floor.

Change is hard. People will resist it. Your employees need to understand the benefits of the RFID system and why the change is required. They need to be trained to use a new RFID system or do their jobs a new way. And they need management to insist on doing things the new way. (For more steps to ensure a smooth transition as you deploy or expand an RFID system, see Best Practices: RFID Change Management.)

FACT 5

RFID is not more expensive than bar codes.

Many CEOs reflexively say RFID is much more expensive than bar codes, so there's no reason to switch. Bar codes, after all, can be printed on a package or label for virtually no additional cost, whereas tracking goods with RFID could cost 25 cents per item. There are two problems with this comparison. First, it factors in only the cost of the data carriers (bar-code labels and RFID transponders) and not the cost of capturing the data. It's expensive to employ store associates or warehouse workers to scan bar codes. Numerous studies in the apparel retail sector, for example, have proven that taking inventory with RFID is faster and more accurate than scanning bar codes. So while RFID doesn't reduce costs, their stores or warehouses. Their inventoryand warehouse-management systems might tell them that, but the reality is few CEOs know how inefficient their operations are. Studies conducted by Auburn University and the University of Arkansas with many U.S. retailers, for example, found that, on average, inventory accuracy is 60 percent or less. Those same studies have shown that RFID can improve inventory accuracy to more than 95 percent.

There is no doubt that over the past 10 years, the BIGGEST REASON some RFID projects have failed to deliver benefits is that companies have FAILED to manage change.

it enables companies to take inventory weekly, rather than once or twice a year, without a lot of extra labor costs; that improves inventory accuracy, which can lead to higher sales.

The other problem with comparing the cost of bar codes and RFID is it prevents companies from exploring RFID's potential benefits. The CEO of a consumer goods manufacturer, for instance, might assume that putting a 20-cent tag on a case of shampoo is too expensive, because the profit margin on that case is only \$1 and RFID would eat up 20 percent of it. But RFID might allow the company to collect data that would improve efficiencies, which could save 25 cents per case, increasing the margin by 5 percent.

FACT 6

Your company is not as efficient as you think.

Many CEOs say they don't need RFID because they have 99 percent inventory accuracy in Without RFID, there is no cost-effective way to track physical objects, such as inventory, parts, IT assets, vehicles and containers. With RFID, warehouse managers can improve inventory accuracy and reduce the time workers spend looking for misplaced goods. And they can manage other operations more effectively, such as shipping and receiving processes. That, in turn, reduces errors and improves customer satisfaction.

FACT 7

Prioritizing your RFID projects is important.

RFID, like the Internet, is an enabling technology. And just as the Internet can be used to exchange e-mail, share documents, provide information to the public, sell goods and services and support many other applications, RFID can help companies improve myriad operations and services. Once you become aware of all the benefits RFID can pro-



vide, there's a tendency to want to tackle all your business problems at once. But it's important not to try to boil the ocean.

Instead, establish a vision for using RFID throughout your operations, but begin with small tactical projects that are relatively easy to deploy (and are therefore likely to succeed) and will deliver a near-term ROI. In other words, don't invest in a system that will solve one problem but not work for other applications. You want to be able to roll out successive projects in stages, with each project delivering tangible benefits and advancing the company's extremely complex, and the chances of success are small.

Neither extreme is true. RFID is no longer a technology in its infancy. Technology innovations and standards have made it easier and more reliable to deploy both passive and active systems. But each deployment is different and will involve complexities that must be resolved. As with any technology project, it's essential to choose the right partners. There are many skilled systems integrators with solid RFID experience who can help you determine where and how to deploy the technology.



RFID is no longer a technology in its infancy. Innovations and standards have made it EASIER AND MORE RELIABLE to deploy. But each deployment is DIFFERENT and will involve complexities that must be resolved.

overall business strategy (see Fact 2).

When you're focused and disciplined about prioritizing projects, you increase the likelihood that each new project will be managed properly and deliver the expected benefits.

FACT 8

The technology part is neither as hard nor as easy as people say.

If a CEO is getting a pitch from an RFID solution provider, he or she will likely hear that RFID is easy to deploy and there will be no hiccups. If the CEO is talking to an uninformed consultant or an executive at another company that is considering deploying RFID, he or she will likely hear that the technology is

FACT 9

It's all about the data, not the technology.

RFID JOURNAL writes about RFID technology in all its forms, but it's important to understand that when we refer to RFID infrastructure, we are using the term as shorthand for automatic data-collection tools. RFID is all about the data, which can give managers a complete picture of the location and movement of everything in the real world in real or near-real time. RFID provides visibility into the "what," "when" and "where" of pallets, cases and items. RFID also adds the "why" and "how"—and that transforms a data-collection tool into a powerful knowledge-gathering resource (see The Age of Visibility and RFID: The Key to Knowledge).

FACT 10 You need vision if you really want to benefit from RFID.

The RFID industry and RFID technology have come a long way over the past 10 years. Many adopters have achieved benefits, but most of kind of benefit. The project was killed, which was an unfortunate decision. Today, many retailers using RFID in stores are reporting unprecedented benefits. American Apparel, for instance, is adopting RFID at every store, because the technology has proven to increase inventory accuracy and reduce the incidence of shrinkage due to employee theft or error. Internal shrinkage has dropped by up to 75 percent at some RFID-enabled locations, and by an average of 55 percent overall.

Airbus uses RFID across its value chain to bring visibility and benefits to all areas of its

Having vision means being able to SEE your company doing things that aren't POSSIBLE to do today without RFID. It means being willing to start investing in the COMPANY OF TOMORROW today.

these benefits have been incremental. RFID has the potential to deliver a great deal more—if you have a vision of how RFID can bring transformational change. That might mean undermining Amazon by using your visibility into inventory accuracy in stores to provide sameday deliveries to customers that order online. Or maybe it is a patient-friendly hospital that uses RFID to ensure services are delivered in a timely and efficient way. Or perhaps it's becoming the manufacturing company that delivers the correct items at the right time every time.

In fact, RFID's benefits can be off the charts. RFID JOURNAL writers and editors have encountered numerous examples of pilot results that were dismissed because they were too good to be true. In one case, a retailer saw a 20 percent increase in sales, but the CEO refused to believe any technology could deliver that operations. Among the many benefits the airplane maker has achieved is a 90 percent decrease in the amount of time employees spend receiving goods into inventory. Tufts Medical Center, in Boston, deployed an RFID inventorymanagement system that enabled the hospital to save \$1.5 million over a two-year period, and improve patient safety. Cisco Systems, which is using RFID to manage fixed assets at 70 U.S. data centers and research-and-development labs, saw a 118 percent improvement in its ability to count assets during audits.

Having vision means being able to see your company doing things that aren't possible to do today without RFID. It means being willing to start investing in the company of tomorrow today. And it means communicating that vision to everyone inside the company, so they buy into it and embrace the benefits the technology will deliver.

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By Jennifer Zaino

A new design that links an RFID chip to the microprocessor in a consumer electronics device makes way for many killer apps.



FOR THE MOST PART, the consumer electronics industry has been sitting on the sidelines, watching as myriad companies in other sectors adopt radio frequency identification and derive benefits from the visibility the technology provides. Yes, there have been some RFID pilots and deployments, most notably Hewlett-Packard Brazil's tagging and tracking of individual inkjet printers from production through distribution. And there has been the promise of using RFID for life-cycle tracking of computers, TVs and other electronic products—that is, RFID-tagging electronics during production, tracking them through delivery to retailers, using the item-level tags to manage inventory, warranties and repairs, and, lastly, ensuring old devices are disposed of properly.

HP Brazil has demonstrated that it is possible to leverage tag information to manage recycling (see Extracting New Value From Old Printers). But using RFID to manage consumer electronics "from cradle to grave" has remained just a promise—until now. In April, Intel unveiled a reference design for an ultrahigh-frequency RFID chip that's embedded in a device's motherboard and wired directly to the microprocessor. (Intel won the 2012 RFID Journal Award for Best Use of RFID in a Product or Service; see A New Tool for Electronics Companies.)

The design could jump-start RFID adoption by consumer electronics makers and retailers because it enables numerous benefits, including streamlining operations, deterring theft and improving customer satisfaction. The new Windows 8 tablets are likely to be the first devices to feature this design.

Intel worked with Impinj, which developed two new RFID chips for the design: the Monza X-2K Dura and the Monza X-8K Dura. Both chips have a

"The work that Impinj has done with Intel takes the early promises of EPC and RFID to a whole other level not just for inventory or asset control, but also being able to use the same RFID tag to provision services on those devices."

-SUE HUTCHINSON, GS1 US

secure memory bank with nonvolatile (read/write) and immutable (read-only) storage that is low-power and cost-effective. The RFID chip is accessible by the processor through a standard inter-integrated circuit (I2C) interface and from a handheld or fixed RFID reader, enabling wireless bidirectional communications. The secure storage can hold information such as personal identification and manufacturing records.

"The work that Impinj has done with Intel takes the early promises of EPC and RFID to a whole other level—not just for inventory or asset control, but also being able to use the same RFID tag to provision services on those devices," says Sue Hutchinson, director of portfolio strategy for GSI US. Manufacturers, for example, could use an RFID reader to disable an electronic product during transit, to deter theft. Once the item reaches a store, a retailer could use an RFID reader to enable the device while it's in a sealed box.

NXP Semiconductors, last year, introduced a similar interactive tool for consumer electronics—the Ucode I2C, a UHF EPC Gen 2 chip that can be embedded in a device's printed circuit board (PCB). Its I2C serial bus also enables quick communication between the RFID chip, which sends its instructions wirelessly to or from an RFID reader, and the microprocessor. As with the Intel/Impinj approach, a reader can access the chip's memory even when the device's power is off.

"We believe the I2C feature should enhance the RFID adoption rate, since it adds further value at multiple stages of the product's life cycle," says Gerry Hubers, marketing segment manager of Murata America, which makes the MagicStrip UHF RFID module that can be mounted on a PCB. The module can use Impinj or NXP chips and take advantage of these suppliers' key features. "Using the RFID channel as the communication path," Hubers says, "the CE product can be easily programmed, or reprogrammed, based on the end-customer requirements. This step can be done just prior to shipping, late-stage configuration, for that specific customer. Taking this approach could eliminate dedicated inventory for selective customers, since product is programmed just prior to shipment."

The Benefits Chain

Why is the RFID-microprocessor integration design considered a potential game changer for the consumer electronics industry? Here's a closer look at the benefits it could deliver to manufacturers and retailers.

Streamlined operations. Some consumer electronics companies have been RFID-tagging DVD players, TVs and other items to meet retailers' requests, says GSI's Hutchinson. They typically tag the device's faceplate, and retailers use the tag for inventory management. Others are attaching the RFID tag inside the case of the finished product, for warranty service or returns processing, says Impinj VP of marketing Kerry Krause. Either way, most consumer electronics companies consider RFID-tagging a cost of doing business.

If, instead, the RFID chip were embedded in the circuit board, manufacturers could use its unique serial number to achieve internal benefits, beginning with tracking work-inprocess (WIP). Of course, the RFID chip doesn't have to be embedded in a device's motherboard to use the technology to track WIP (see Keeping Tabs on Printers).

But with RFID embedded in the circuit board, manufacturers also could reduce inventory and the number of configurations they make and manage. Take a mobile phone manufacturer, for example, that ships some units to Sprint and others to Verizon, suggests Victor Vega, marketing director of RFID solutions for NXP Semiconductors. Instead of having to build two separate versions to accommodate the different feature sets, "you can wirelessly configure production batches in accordance with various order-fulfillment requirements," he says. "For example, the same electronics 'engine' may be set up differently for the first 100 units than for the next 100."

Configuration management could be a boon for retailers as well. A retailer could

reduce its inventory without the risk of disappointing customers by running out of stock. It could, for instance, order all its tablets configured for the English language. If a customer requests a different language, the retailer could use an RFID reader to send instructions to the RFID chip, which would pass the information to the microprocessor to make the change. Theft deterrence. There's no reason to steal an electronic device that doesn't work. With RFID-microprocessor integration, manufacturers could use a wireless command to "lock" devices before they are shipped, and retailers could reactivate them with an authentication code once they reach the store or point of sale. That would discourage items from "falling off the truck" or being swiped



IT DIDN'T TAKE LONG for folks to consider smartphones and tablets essential to their way of life. In short order, we've become used to the convenience and freedom these devices provide so much so, that we often find Bluetooth, the predominant technology that enables wireless connectivity, a hassle. You have to turn a Bluetooth device on, scroll through menus and settings, and enter a passcode to get it to pair with the available service.

Near-Field Communication (NFC), a short-range wireless

technology that enables device-to-device data transfers, takes the hassle out of connectivity. Mobile phones equipped with NFC let you connect with a tap, whether you're paying for a product or exchanging information with another NFC-enabled mobile phone. Acer, HTC, Motorola, Nokia, Research in Motion (RIM), Samsung and Sony are among the vendors offering NFC phones. Similarly, NFC-enabled hybrid laptop-tablets, such as the Windows 8-based HP Envy x2, let you connect to other NFC devices with a tap, so you can easily share photos, contacts and more. Tablets based



on Microsoft's Windows 8 and Google's Android operating systems also feature NFC connectivity. Asus, Lenovo, RIM (with its own OS), Samsung and Sharp are among the vendors planning or offering NFC tablets.

Now, a wave of peripherals is arriving to take advantage of these NFC-enabled devices. HP, for example, in September, released its Touch to Pair Mouse, which can connect automatically with an NFC tablet or PC via a tap. (It also can make the connection via Bluetooth if the computer or tablet doesn't have NFC.) But perhaps the biggest trend in NFC accessories is headphones, wireless speakers and other audio devices (most are compatible with Bluetooth phones and tablets). Sony, this summer, introduced the MDR-1RBT NFC headset and its NFC SRS-BTM8 wireless speaker, which need only be tapped with an NFC smartphone to play music. Nokia and JBL worked together to add NFC to the JBL PlayUp Portable Wireless Speaker for Nokia, for a one-tap-from-a-phone connection to songs.

> RIM's Blackberry Music Gateway is an accessory for its smartphones or tablet-tap it on top of an NFC RIM device and it streams audio wirelessly from that device to a car or home stereo. Similarly, Belkin's Music Box module lets you remotely stream music and playlists from a wireless Bluetooth mobile phone or tablet to a stereo system or active speakers. The module uses NXP Semiconductors' NTAG203F NFC integrated chip, which includes a Field Detect output. This feature enables both autopairing and autopowering, says Victor Vega, marketing director of RFID solutions for NXP, so you don't

have to manually switch on the device.

"Now electronics may be powered off for green purposes, and the tap then asserts an output on the NFC chip's Field Detect, implying the tag is in the vicinity of an NFC device, which is conversing with the tag," Vega says. "This then activates a Power Management Unit, which then powers up the device automatically. Then the Bluetooth pairing is accomplished automatically, and the script in the device automatically launches music streaming. So now, it's literally 'tap 'n' go.'" —J.Z. from distribution centers and store shelves. The embedded RFID tag could still transmit its unique identification number through backscatter, so the disabled device could be traced as it moves through the supply chain.

Product identification. In Intel's design, the information required to authenticate a device can be secured in immutable storage. NXP's solution uses a unique Tag Identifier, which can't be altered even if the Electronic Product Code serial number is copied, to authenticate a product. "Wireless authentication and validation essentially come for free," Vega says, "and [the Tag Identifier] helps curb fraudulent activity as well." A counterfeiter, for example, would not be able to exchange a fake device for a real one at a retail store or an authorized manufacturer service center.

But if a legitimate customer needed to return a device or have it serviced, the authentication information could be captured to verify the product and connect it to the original sales record and warranty data, speeding up



NEAR-FIELD COMMUNICATION (NFC) may be the key to winning the ongoing battle for market share among gaming console manufacturers and video game makers. The short-range wireless technology enables device-to-device data transfers, bridging the divide between physical and virtual play—and kids of all ages love it. To learn how NFC allows gamers

to interact with each other and real-world objects, see NFC Technology Brings New Life to Games.



the process. If a device couldn't power up, a clerk still could read the contents of the RFID chip, including data saved in the error log that could provide a clue to the fix. Storing the product's warranty and repair information on the RFID chip would provide a record of the product's life-cycle history.

Customer satisfaction. An online or brickand-mortar store could boost sales by offering a free software upgrade, and make the change while the device is still in its factory-sealed carton. Or a retailer could advertise a tablet that includes two months of free service from a company such as Netflix, which could be recorded in the RF chip at purchase, says Shahrokh Shahidzadeh, senior principal technologist at Intel, who spearheaded the project. "When the buyer turns on the tablet, a pop-up appears and he is one click away from the service."

There are many other ways to customize a product, Vega says. Wi-Fi credentials could be preconfigured for an instant connection. All the information could be stored in the RFID chip; when the recipient powers up, the microprocessor would look for new information, extract it and import it back into the device. Or a customer who's buying a device as a gift could ask the retailer to upload a personal message on a selected background graphic. "Everything will look like it was made for them that way at the factory," he says.

From Promise to Reality

While consumer electronics manufacturers embrace the notion of using an EPC RFID tag to provide visibility benefits all the way from the point of manufacture through the supply chain, retail and post-consumer use, Hutchinson says, it's still too early to say if or when they'll embed RFID chips in their devices' motherboards.

It might be PCB providers and other component manufacturers that kick-start the CE industry in this direction, posits Michael Liard, RFID analysis director at VDC Research. They could differentiate themselves by offering manufacturers a regular board or an embedded RFID chip model. "That could be seamless for the manufacturing processes," he says. "If they apply it as a value add, and it's not disruptive to existing processes, it might be an easier sell."

The incremental cost of embedding RFID compared with the potential revenueenhancement opportunities must be considered, Vega says. "If two tablets are the same price, but you could customize one of them, wouldn't you pick that one? Is there a value to that? I think so," he says. "Is it worth a quarter or 20 cents or whatever the chip would be for that additional feature for the manufacturer, retailer and consumer? I think so."

If manufacturers embed RFID chips in their devices' motherboards, will retailers take advantage of the new feature? They have competing priorities, says John Devlin, practice director of RFID and authentication at ABI Research. "They have finite budgets each year and a fast-developing area for them is around mobile." RFID is in the mix, but "they have to choose carefully and prioritize where they go."

It's practically a no-cost opportunity for retailers to reduce inventory and cut down on fraud, Vega says. Some retailers already have handheld equipment that recognizes both bar codes and RFID, so the upgrade to support these capabilities would be straightforward. Or, he says, they could start small, with a kiosk where shoppers could go to customize, register or return their devices. The manufacturer might take on the cost of that installation, he adds.

That said, buy-in at the retail level isn't necessary to start the ball rolling, Krause says. Things will shift into gear as "electronics manufacturers decide to embed the RFID tag into their devices for whichever apps give them the biggest return," he says. "That may be locked-in-transit or configuration management or enhanced return merchandise authorization, service and returns. I would expect evolutionary progress on this front."





IF YOU DON'T HAVE a barista serving up a perfect cup of your coffee or hot chocolate, how do you ensure customers brew a beverage that's worthy of your name? The answer, says Keurig, which makes single-cup brewers and beverage packets, is RFID.

In September, Green Mountain Coffee Roasters, which acquired Keurig in 2006, introduced the Office Vue V1200 coffee brewer equipped with My Brew RFID technology, developed by Keurig. Each device has a built-in reader that scans a passive EPC Gen 2 ultrahigh-frequency tag embedded in a single-brew beverage packet (a sealed prepackaged cup). Each tag is programmed with a specific recipe code for,

say, Nantucket Blend coffee or Dark Chocolate hot cocoa. When a packet is inserted into the brewer, built-in software chooses the appropriate settings—water temperature, time and airflow, for example—for the selected beverage.

Keurig wants customers to have a positive experience by "optimizing each and every brew," says Dave Manly, VP and general manager of the company's Away From Home Marketing and Digital Direct division. "Only authorized Keurig products can be used in the brewer... ensuring the quality that our consumers have come to know and love each time they see the Keurig brand."

The VUE V1200 is designed for use in offices and waiting areas. As the company gains more experience with RFID, Manly says, Keurig will determine whether the home market calls for coffee machines with the technology. -J.Z.

oduct developments

WHAT RETAILERS NEED TO KNOW ABOUT

Smart Fixtures, Shelves and Labels

By Mary Catherine O'Connor

RFID JOURNAL • November/December 20

Innovative in-store RFID solutions provide a convenient and cost-effective way to manage fastselling items and frequent price changes.

HOSPITALS ARE USING smart cabinets equipped with radio frequency identification technology to monitor medical supplies and pharmaceuticals, and factories and construction sites are setting up smart cribs to manage tools (see RFID Smart Shelves and Cabinets and A Guide to RFID Tool-Tracking Solutions). In both cases, RFID is helping companies and organizations track high-value items that are costly to replace when they are misplaced or stolen or, in the case of pharmaceuticals, when they expire and are no longer effective or safe to use. The smart cabinets and cribs also reduce the time workers spend looking for lost items.

Now, RFID providers are developing smart fixtures, shelves and labels for apparel, supermarket and other retailers that allow them to benefit from the technology without adopting it throughout the store. While major retailers have begun RFID-tagging apparel items to improve inventory accuracy—and J.C. Penney has announced plans to tag 100 percent of its merchandise-many retailers, especially smaller ones, will not transition to RFID overnight. These solutions are designed to provide a convenient and cost-effective way to manage frequent price changes and fastmoving products, including inexpensive items such as T-shirts and some consumer packaged goods (CPG). Improving these operations can reduce labor and increase sales.

Here's what you need to know about smart fixtures, shelves and labels. For more information, see the vendor table on page 31.

SMART FIXTURES

Some specialty apparel items have a very short shelf life, because customer demand is determined by events or seasons. RFID-enabled fixtures and software that track RFID-tagged items give retailers and manufacturers realtime in-stock visibility, to ensure all the merchandise shipped to a store is placed on sales-floor displays in a timely manner, says Bill James, VP of business development at Seeonic, which offers the SightWare solution.

Creative Apparel Concepts is a Minneapolis-based apparel manufacturer that produces branded logo apparel for more than 125 colleges and universities. Before major game weekends, retailers in college towns stock up on these products to meet spikes in demand for items with home-team logos, as well as short-term demand for shirts promoting the visiting team. "Sometimes 100,000 sports fans will come to town for a weekend, and they buy like crazy," James says. "They go to the apparel racks and stuff flies off."

But, James adds, "believe it or not, merchandise shipped to the stores doesn't always get put on the floor." Creative Apparel Concepts has been working with Seeonic for the past year to ensure an undisclosed retail partner adequately stocks sales fixtures in one of its stores.

During the week preceding a major sports event, the retailer places RFID-tagged T-shirts and other logo merchandise on a SightWareenabled fixture, which has an integrated EPC Gen 2 reader. The reader, which includes ThingMagic's Impinj-based reader module and Seeonic's patented antenna system, transmits the tag data wirelessly to its cloud-based Seeniq software platform, which gives Creative Apparel Concepts real-time inventory counts.

After a game, Creative Apparel Concepts can quickly access the final sales data, and see which sizes and styles sold best. Typically, it takes up to two weeks to access sales data from RFID-based electronic shelf labels—either LCD displays or electronic paper—let retailers adjust product prices with the click of a button.



Having sales information in real time lets the company react more quickly to fans' changing style preferences and stock stores appropriately to maximize sales.

The retailer places RFID-tagged T-shirts and other logo merchandise on SightWare-enabled fixtures.

the retailer. Having sales information in real time lets the company react more quickly to fans' changing style preferences and stock stores appropriately to maximize sales.

While the SightWare solution is being used at just one retail location, James says, Creative Apparel Concepts and its retail partner are currently in discussions about expanding the technology to multiple locations.

Fluctuations in customer demand can vary from store to store and are not always tied to a season or event. A major U.S. automotive battery supplier is using Seeonic's technology to track inventory levels at repair shops, parts dealers and other retail partners several times each day. This helps the manufacturer ensure its complete product range is in stock at all times (see Battery Supplier Deploys RFID to Manage Product Inventory).

SMART SHELVES

In the near future, manufacturers and retailers are not likely to RFID-tag individual beverages,

personal-care products and other fast-moving consumer goods. But they would like the item-level visibility RFID can provide, to make restocking more efficient and reduce out-ofstocks.

NeWave Sensor Solutions says its RFID-based Smart Shelf solution provides item-level visibility without relying on item-level tagging. Its technology is based on what the company calls an item-level antenna. "For decades, the industry was using off-the-shelf antennas coupled with unique readers and tags," says NeWave CEO Joe Ryan. Smart Shelf features a patented EPC Gen 2 ultrahigh-frequency RFID antenna integrated into a store shelf system. An EPC Gen 2 UHF passive tag is mounted on the shelf beneath each product. The tag placements on the shelves are dictated by the retailer's planogram, a diagram showing the number and position of each product on a shelf.

When a shelf is fully stocked, the products block the tags from being read. Each time a product is removed, the antenna reads the tag ID and sends it to the NeWave software, so the retailer can see the real-time stock level. The system also works with shelves that include a spring-loaded "pusher."

Two major U.S. supermarket chains and a top-selling brand of energy drinks are currently running pilot projects with Smart Shelf technology, Ryan says.

In addition to tracking inventory in real time, retailers can use the NeWave solution to reduce theft. A retailer can set the NeWave software to trigger an alert if it detects a "shelf sweep," the quick removal of many items from a shelf simultaneously. Shelf sweeps often involve the theft of a shelfful of a single, high-value item, such as razor blades or baby formula.

SMART LABELS

Like restocking, changing product prices on retail store shelves is a time-consuming process. RFID-based electronic shelf labels—either LCD displays or electronic paper—let retailers adjust product prices with the click of a button. Each e-label is mounted on a store shelf and linked wirelessly to a central computer network.

Altierre, a San Jose, Calif.-based technology company, has developed an RFID-based electronic shelf label solution that can use either LCD displays or electronic paper price tags. Each tag contains a proprietary battery-powered 2.45 GHz RFID tag. The new e-paper tags provide sharper, higher-quality graphics and text compared with the graphical LCD screens.

Some Leading Providers of Smart Fixtures, Shelves and Labels

COMPANY	PRODUCT	FEATURES	COST ESTIMATE
ALTIERRE www.altierre.com	Wireless dynamic pricing solution	RFID-enabled LCD displays and electronic paper tags automate price changes; can display grapics and text; tags have a five-year battery life	Roughly \$15,000 total installation per supermarket with LCD labels; e-paper tags cost more
NEWAVE SENSOR SOLUTIONS www.newavesensors.com	Smart Shelf	EPC Gen 2 UHF RFID tags and readers integrated into a store shelf provide item-level product visibilty without the time or cost associated with item-level tagging; NeWave software can trigger theft alert	One-time equipment cost of approximately \$185 to \$225 per shelf; \$50 to \$100 subscription fee per month, per store
SEEONIC www.seeonic.com	SightWare	EPC Gen 2 UHF-enabled fixtures track RFID-tagged apparel items for real-time inventory management; cloud-based software	Software as a Service model
ZBD www.zbdsolutions.com	Electronic shelf labeling solution	RFID-enabled electronic paper displays automate price changes; can display bar codes, images, logos and nutritional information; tags have a five- year battery life	Not available

Technology that can track inventory and stock levels more autonomously and accurately holds great promise for retailers. Both have a five-year life expectancy.

The system enables two-way communications between the LCD or e-paper tag and Altierre's software, which is integrated with the store's existing product and price database. The labels, which contain internal clocks, can be preset to adjust the product's price based on the date and time, completely automating the process.

"Fundamentally, the way we approached the solution is by extending the reach of the Internet to the store shelves," says Altierre CEO Sunit Saxena. "We looked at a number of different technologies to communicate with the labels, including Wi-Fi and Bluetooth, but with those we needed to sacrifice either power or range." None of the RFID tags on the market met these needs adequately, he says, so Altierre developed its own RFID solution, which includes access points that communicate over hundreds of channels to avoid collision on specific bands—this is particularly important when the retailer needs to change the price of many different items simultaneously.

In addition to slashing labor costs through dynamic price adjustments, the labels also allow retailers to communicate more information to customers than a small paper label could. The labels, for example, might toggle through multiple displays that provide not only cost but also nutritional information, suggested pairings or special offers and coupons.

Altierre says more than 1,000 U.S. and European retail stores—including E.Leclerc supermarket, in France, and select Walgreens drugstores and Kohl's department stores, in the United States—are using its smart-label solution.

SMART INVESTMENT

The retail industry is primed and ready for more ways to automate the tracking of individual products inside stores, says Justin Patton, managing director of the RFID Research Center at the University of Arkansas. Technology that can track inventory and stock levels more autonomously and accurately holds great promise for retailers, he adds, especially if the



In addition to tracking inventory in real time, retailers can use the Smart Shelf solution to reduce theft.

systems offer additional benefits, such as improving customer satisfaction or short-term product promotions.

Smart fixtures and shelves let retailers and manufacturers improve visibility of specific products or product categories, without having to deploy an expensive, storewide RFID technology infrastructure. But even when a store is RFID-enabled, movable fixtures can be used to see if merchandise sells better at, say, the front of the store than another location.

In addition to tracking "fast fashion," like college sports T-shirts, Seeonic's James says retailers and manufacturers are interested in using smart fixtures to monitor small, highvalue, high-margin items, such as cosmetics, fragrances and jewelry. That's because inventory can be taken in the morning and the evening, with no labor or training involved.

James says retailers can see a return on investment within a year, thanks to increased sales resulting from more consistent product stocking. The store that is working with the Seeonic equipment with Creative Apparel Concepts, for example, found it was stocking too many large and extra-large T-shirts, which is what its general clientele tends to purchase, and not enough small and medium shirts, which is what university students want. Consequently, the store now stocks and sells more smalls and mediums.

Retailers, particularly grocers and drugstore chains, are drawn to electronic shelf labels, says Sean Deale, retail industry analyst at RetailNet Group, because "executing price changes is incredibly labor-intensive." In addition to reducing labor costs, he says, these solutions let workers spend more time helping customers locate products and restocking shelves.

Altierre says its solution can be installed in several hours, with a typical cost to a supermarket of approximately \$15,000 with LCD labels, which cost approximately \$5 each when purchased in bulk. The e-paper labels are more expensive, but Altierre declines to disclose specific costs. "Retailers can mix and match LCD displays with e-paper for the lowest total cost of ownership, and a fully customizable solution that is right for each store," Altierre's Saxena says. "A retailer could choose to install these [e-paper label] high-end display signs and tags in certain high-visibility/high-impact portions of their stores, while saving money on the lower-impact areas with our low-cost, LCD-based signs and tags."

Altierre hardware can accommodate upgrades to enable passive RFID communication via the Near-Field Communication (NFC) standard, Saxena says. This will allow retailers to increase the benefits they get from shelf labels, beyond improved store operations. For example, customers could hold NFC-enabled phones up to select shelf labels to receive special offers on particular products through shopper loyalty programs.

NFC-enabled smart shelves also can make shopping easier for visually impaired and elderly customers. French supermarket chain Groupe Casino, along with researchers at the Institut de la Vision and Think&Go NFC, a French NFC solutions provider, are developing shelf labels with integrated NFC tags. Shoppers who hold their NFC phones up to the shelf labels will be able to launch an application that renders the product and price information in large print on their phones. The technology could enable other applications to enhance the shopping experience. For instance, customers could download recipes or automatically link product coupons to their orders when they check out. It even opens the door to skipping the checkout line, by allowing for payment via a mobile platform.

SMART REGISTERS

LEANWORKS, A HEALTH-FOOD RESTAURANT in West Roxbury, Mass., was inundated with catering orders from corporations, gyms and hospitals. To keep up, it developed LeanBox, a low-fat packaged food and meal plan business, and partnered with ShelfX, a startup based near Denver, to create a self-service vending system. "It facilitated our ability to supply healthy food anywhere, anytime," says Lean-Works CEO Shea Coakley.

The ShelfX system uses Near-Field Communication (NFC) technology to enable self-checkout at employee cafeterias, health clubs and other nontraditional retail centers. Scales integrated into the shelves holding food are programmed to know the weight of each shelf when it is fully stocked, as well as the type and price of each product on the shelf. NFC readers are mounted nearby and linked to ShelfX's Web-based financial transaction software.

ShelfX recently worked with LeanWorks to install a refrigerated ShelfX case at Solid Body Fitness, a gym in Dedham, Mass. To purchase LeanWorks food or drinks from the case, a gym member holds a membership card, which contains an NFC tag linked to his or her



account, to a reader mounted outside the case. The individual then removes the desired items from the case, and the ShelfX software scans each shelf's weight to determine how many of each item were removed. It deducts the total price from a prepaid account linked to the member account. (Gym workers periodically inspect the cases to ensure the products are on the proper shelves.)

"Our main focus is fitness centers," Coakley says, "but we've also signed contracts with a hospital and some corporations that don't have a full café." —*M.C.O.C.*



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Uniting IoT Networks

Integrating EPC and IPv6 wireless standards will enable the Internet of Things.

By Daeyoung Kim, Seong Hoon Kim and Minkeun Ha



Daeyoung Kim, Seong Hoon Kim and Minkeun Ha

RESEARCHERS worldwide are working to address the many technical challenges that must be overcome to realize the Internet of Things (IoT), a network of networks that promises to connect everything and everyone everywhere to everything and everyone else. At the Auto-ID Lab at KAIST, in Korea, we are developing wireless sensor network (WSN) technologies, based on a verified standard protocol.

We launched a network platform project called Sensor Networks for an All-IP worLd (SNAIL) based on an open-standard Internet Protocol (IP). The IP-WSN enables smart things to seamlessly communicate with other smart things and with the IoT infrastructure. We plan to turn our SNAIL platform into an opensource project, probably by next year.

The Internet Engineering Task Force (IETF), an international standards organization, is developing new IP-WSN protocol standards in three working groups, so we designed the SNAIL platform to be fully compatible with these standards. The IETF standards are: IPv6 Over Low Power Wireless Personal Area Networks, to enable small devices with limited processing capabilities to connect to the IoT; IPv6 Routing Protocol for Low Power and Lossy Networks, to support routing of traffic flows between devices; and Constrained Application Protocol, to allow simple electronics devices to communicate interactively over the IoT.

Another project we are working on is the development of Electronic Product Code sensor networks (EPCSN). By embedding an EPC identifier in each sensor node, we can integrate SNAIL and ZigBee networks with the current EPC network standards. This way, sensor networks can take advantage of the global infrastructure provided by EPC networks. That is, sensor data published locally in a certain area can be discovered, shared and accessed across the Internet by leveraging EPC Information Services (EPCIS), Object Name Service (ONS) and Discovery Services defined in EPC networks. Also, EPCSN can benefit from the low-cost, low-power features of WSNs.



This year, we demonstrated SNAIL and EPCSN at EU IoT-week in Italy and the IoT conference in China, and both have been adopted and integrated with the IoT6, a European research project about the future of the Internet of Things. We believe SNAIL and EPCSN will pave the way for the longstanding vision of the IoT to rendezvous with real-world adoption in the foreseeable future.

Daeyoung Kim is research director of the Auto-ID Lab at Korea Advanced Institute of Science and Technology (KAIST). Seong Hoon Kim and Minkeun Ha are associate directors at the lab.



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Managing Growth

As you expand your use of RFID, you need visibility software to handle all the data you collect. *By Ken Traub*



THERE'S A TYPE of RFID software you may need in the near future, if you're not using it now. It goes by a variety of names—let's call it "visibility" software. You may not be familiar with it if your RFID system was deployed to solve a

single problem and you manage RFID data with middleware, a turnkey software package designed for a specific application, or software embedded in handheld readers.

Visibility software comes into play when you add more RFID applications to your RFID infrastructure. You may, for example, want to use the same RFID readers in a factory to track your own tools and raw materials arriving from a supply-chain partner. Or, perhaps you want to expand an asset-tracking application to facilities in other parts of the country or the world.

Visibility software can act as a layer between middleware (or the readers themselves, if you're not using middleware) and your back-end applications. Or, it can sit adjacent to your back-end systems. Your back-end software typically handles transaction-oriented business processes, such as enterprise resource planning (ERP) and order management. These applications are all about the flow of money or legal obligation. Visibility software, on the other hand, is about the flow of physical things or people—whatever it is you're tagging and tracking. It provides a central place to store this information, so it can be used for many business purposes.

Visibility software can produce reports about the flow and locations of tagged assets, as well as issue alerts when it detects deviations from the norm. It can provide a detailed history of where things have been. Visibility software also can interoperate with business applications when the flow of money and the flow of physical goods intersect. For example, an ERP system can tell a visibility software application what goods are expected in a shipment, and the visibility software can confirm their receipt to the ERP system when the tags on the goods are read.

There are many varieties of visibility software, including custom and packaged products. The big enterprise software players— Axway, Oracle, SAP—each offer one. Many smaller software companies, typically with "track" or "trace" in their name, offer visibility software tailored to specific business use cases. Open-source software, such as Fosstrak, is another option, and some end users build their own visibility software.

When you're ready to evaluate visibility



software, be sure its data model includes the "what," "when," "where" and "why" of each tag read, so business applications know what happened without knowing how the RFID readers collected the data. A product that complies with the Electronic Product Code Information Services (EPCIS) standard will provide this. The EPCIS standard also will ensure interoperability between different vendors' components and futureproof your deployment as technology changes over time.

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.

Omnichannel Retailing

You can't do it without RFID.

By Bill Hardgrave



"ANYWHERE, ANYTIME, any product" is the mantra of omnichannel retailing, and retailers of all types are clamoring to make it happen. The idea is simple: Customers should have a consistent and seamless experience whether they're

shopping in a store, on a mobile device, on a home computer or via a catalog. Many view omnichannel retail solely from the customer's standpoint and believe it starts with the customer's interface. An iPhone application, for example, lets you buy an item on your way to the store and have it waiting when you arrive.

But omnichannel retailing starts with operations—in particular, those that deliver real-time, accurate inventory data efficiently and cost-effectively. If you don't know what you have, where you have it and when you have it, the great mobile or online app you created for your customers is worthless. And, you only get one chance. If your customer uses the app to buy a product only to find out the store doesn't have the item in stock although the app told her it was available she will take her business to another retailer that can execute omnichannel shopping successfully.

To create an "anywhere, anytime, any product" experience—and be able to offer sameday delivery of certain items within specific geographic regions, as some retailers are starting to do—retailers must know what they have in the store, the distribution center and the supply chain. But as I stated in my previous column, "Tracking Your Competitors," the industry average for in-store inventory accuracy among U.S. retailers is roughly 60 percent. I also explained why RFID technology is the only efficient way to achieve in-store inventory accuracy. The case for managing inventory with RFID is even stronger when you extend it beyond the store, to the need for visibility in DCs and the supply chain.

To do omnichannel retailing without RFID, retailers must spend lots of money to achieve near-perfect inventory accuracy, which typically involves increasing labor resources. Or, they must have plenty of product on hand, which means incurring substantial inventory carrying costs. Either way, margins erode as the

cost of operations goes up and, eventually, the retailers must increase prices, accept lower margins or abandon the omnichannel option.

RFID is essential for any successful omnichannel retailing effort, so a retailer knows what it has and where, at any given point in time. But don't take my word for it. Macy's, an icon of U.S. retailing, is aggressively adopting RFID. Speaking to reporters

about the company's RFID adoption plans, Tom Cole, chief administrative officer for Macy's, offered this: "RFID is a tool to better serve customers and drive sales by ensuring we have the right product in the right place at the right time for our in-store and omnichannel shoppers." Need I say more?

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 RFID adoption and business case issues in this column. Send your questions to hardgrave@auburn.edu.



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Better Late Than Never

The Internet of Things is arriving, just 10 years after it was anticipated.

By Kevin Ashton



IN THE LATE 1990S, I had an idea I called the "Internet of Things." It was marvelous: I predicted RFID tags and sensors would connect physical stuff to the Internet without the need for human intervention. We would be able to

automatically gather masses of standardized data about our richly detailed world in real time for the first time ever. The data would transform the way we lived and worked—both in ways we could imagine and ways we could not. It would be an express train bigger, faster and more important than the Internet itself, and it would be arriving by 2005, if not sooner.

I was not the only one who believed in the Internet of Things, but I often felt I was, especially when other people laughed at the concept. I was probably the loudest, youngest, least experienced and, therefore, most certain of all prognosticators. More seasoned, fulltime visionaries hedged. I did not. I went on public record—a new, always available, easily searchable and very permanent record called the World Wide Web—with my conviction that the Internet of Things would be everywhere by 2005.

I was wrong. Progress was made in the RFID arena, including the development of important applications and adopters in many industries, but the Internet of Things did not become ubiquitous or even close to it. In the following years, other things, quite unforeseen—such as Facebook, Twitter and the iPhone—took the world by storm instead. It looked as if the dream of a networked physical world was never going to come true.

But in the past 12 months, everything has changed. I've been receiving a constant stream of messages from strangers who want to talk about the Internet of Things. Twitter developed the hash tag "iot," for Internet of Things, that gets daily tweets from all over the world. My great friend and MIT Auto-ID Center cofounder Sanjay Sarma noticed the same thing. We asked one another whether we were retro or just ahead of our time, and we have yet to reach a conclusion.

The ribbon on the wrapping came last month, when Zebra Technologies, always a believer in the dream, published its 2012



"Internet of Things Adoption Outlook" study. The entire report, available online, is worth reading, but some highlights are that the majority of business decision-makers now know what the Internet of Things is, feel positively about it and see RFID as an important technology. Even better, while only a few enterprises have begun to use the Internet of Things, most plan to do so by the end of 2014.

As so many people told me in the 1990s, I was wrong. But, it turns out, only about the timing. Ten years is a big miss, but more important is that the Internet of Things is finally happening.

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

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