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RFID JOURNAL

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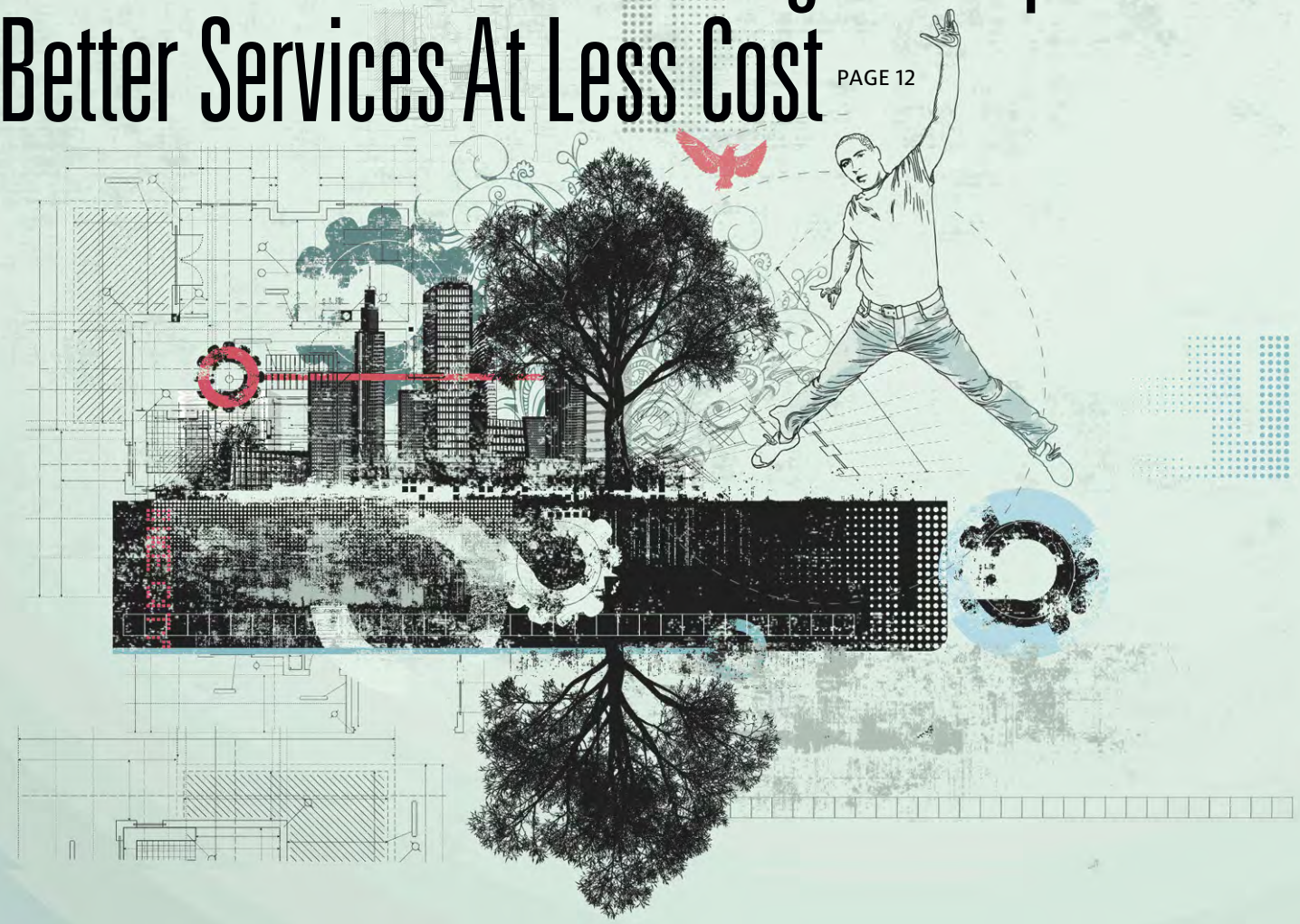
EUROPE'S Smart Cities

RFID And Related Technologies Help Deliver Better Services At Less Cost

PAGE 12



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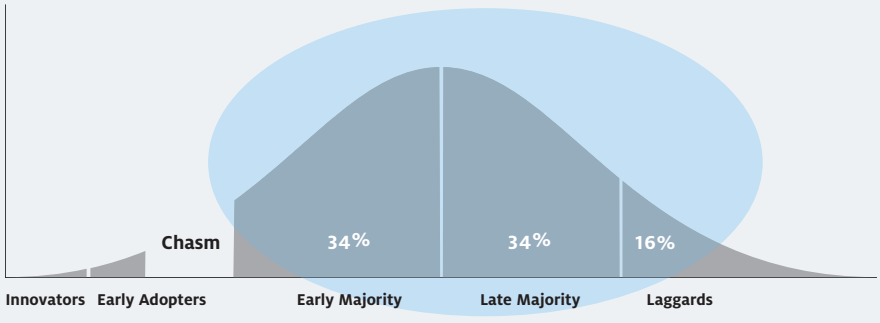

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- Intel's Gen 4 vPro Computer Processors Feature AeroScout Wi-Fi RTLS Technology
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Top 10 Search Terms On RFIDJournal.com

1. NFC
2. Saks
3. Asset management
4. Security
5. Health care
6. American Apparel
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8. Cold chain
9. Sensors
10. Cost

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Beyond RFID's Core Benefits

I've always believed that radio frequency identification would deliver more than just efficient supply chains. From the day we began publishing RFID Journal in 2002, it was clear to me that consumers, nonprofits, government municipalities and other organizations would benefit from the technology's tremendous power. But I have to admit, I didn't imagine that RFID would facilitate garbage collection, enable bicycle rental programs or help the homeless (see "*Meet PAT, Siri for the Homeless*" on page 6).

PHOTO: TOM HURST | RFID JOURNAL

Near-Field Communication technology hadn't been developed back then, and "social media" didn't exist. So using RFID to brand products and services wasn't on my radar. Yet, consumer marketing is the topic of this issue's Vertical Focus (page 20). Hellmann's Mayonnaise, Lexus and Vail Resorts are among the companies using RFID (and NFC in particular) to engage customers and create buzz.

And we weren't that "smart" in 2002. I didn't foresee the "smart city" movement that is gaining a foothold in Europe. As John Edwards reports in our cover story (page 12), government municipalities across the continent are using RFID and other cutting-edge technologies to deliver new and enhanced services to the people they serve. Generally speaking, the goal is to make city living easier and cities greener.

Santander, Spain, for example, has deployed a wide array of sensors (not all of them RFID) under roadbeds, mounted on street lamps and affixed to municipal buses to continuously monitor the city's vital signs. These devices track air quality, traffic and beach conditions, tell people when the next bus will arrive at a specific stop and manage streetlights and parks irrigation.

The European Commission is promoting smart-metering projects, to provide a more efficient way of supplying energy, keeping both utilities and customers informed about energy usage and allowing residents to save money. One application, being deployed in Helsinki, Finland's new Kalasatama area, will create a smart electricity grid that enables residents and businesses to coordinate energy use with the availability of local wind- and solar-generated power.

I've always been an art lover and tend to hit the Tate when in London or the Rijksmuseum when in Amsterdam. So I particularly like the NFC application recently introduced by Nice, France, to help visitors to its modern art museum learn more about the objects they're viewing. Nice, considered a smart-city pioneer, also deployed NFC tags on monuments around the city, to help tourists discover its treasures. In 2009, the city introduced an RFID-enabled self-service bike rental program. Now, Nice is working with Cisco on a technology-driven project to enhance services for residents called Connected Boulevard.

Clearly, it takes vision to plan and identify funding for smart-city initiatives. (There are opportunities for RFID providers to partner on smart-city projects.) But governments don't have to imagine the benefits—just visit a smart city and talk to the residents and local business owners. Meanwhile, I look forward to seeing all the RFID innovations still to come.

Mark Roberti, Founder and Editor

CONSUMER

Meet PAT, Siri for the Homeless

Researchers design an RFID system to remind homeless people about appointments with doctors, housing agencies and others.

MOST HOMELESS PEOPLE don't have iPhones and can't ask Siri to remind them about upcoming appointments with doctors, social workers or housing agencies. They don't carry laptops with Outlook, so they often miss critical meetings that could help improve the quality of their lives. Now, a group of researchers that have come together under the name Patchworks has developed a radio frequency identification-based system to remind the indigent when they have appointments.

Researcher Will Simm, pictured with an RFID wristband and PAT prototype, says the project is being continued by a consortium of agencies.

The Patchworks project is the brainchild of Rod Dillon, a medical biologist at Lancaster University, in the United Kingdom. It includes Signpost, a charity focused on helping the homeless, and MadLab, a group of innovators who share and experiment with inexpensive open-source technology. The idea was to bring together researchers with those working in local communities to find ways to use cheap technology to make people's lives better.

The Patchworks team, with funding from the Engineering and Physical Sciences Research Council via the U.K. Catalyst Hub research project, developed a prototype for "PAT," or Personal Appointment Ticketing service. It's intended to enable homeless people living transient lives to track their appointments with the swipe of an RFID-enabled wristband or card. The PAT device then prints out a personalized reminder list of appointment dates, times and places.

The team developed a shoebox-size device that contains a Raspberry Pi low-cost computer, an RFID reader and a small printer, similar to that in an electronic cash register. The reader and printer are connected to the computer via a USB hub, and the entire device can be battery-powered.

The concept is that each homeless person would receive a wristband or card with an RFID transponder storing a unique ID. The ID would be linked to the individual only in a Signpost caseworker's database. No personally identifiable information would be stored on the chip, for security and privacy reasons.

The idea is to position a number of PAT devices in a city or town that are accessible 24/7. When a user brings his or her RFID-enabled wristband or card close to the PAT device, the reader would interrogate the tag, and then the computer would connect via a Wi-Fi, cellular or wired network to a Signpost server and retrieve appointments for that user. PAT would then print a ticket detailing the person's appointments.

"We looked into biometric ways of identifying people, but RFID was a quick and low-cost way of creating the prototype," says Will Simm, a senior research associate at Lancaster University. "Plus, we had the aim of minimizing the cost of deployment of PAT boxes, and RFID matched this requirement." If the low-cost chip is lost, another can be issued easily.

Now that Patchworks has developed a prototype, the project is being continued by a consortium of agencies that has attracted funding for a broader public-information project. "Those agencies plan to integrate PAT into their larger project," Simm says. "And other agencies in the United Kingdom have shown keen interest in the PAT device as a public-information service, allowing those not connected to the Internet or not carrying a smartphone to access personalized information in a form they can carry and update easily." —*Mark Roberti*

PHOTO: OURUS

ENVIRONMENT

Tracking Hummingbirds

Researchers are using RFID to learn how deforestation affects pollination.

The antennas are placed like "halos" over flowers so they are perpendicular to the transponders when the birds visit.

PHOTO: EVAN JACKSON
HUMMINGBIRD PHOTO: ISTOCKPHOTO

ECOLOGISTS ARE INCREASINGLY concerned that deforestation and development are disrupting the habitats and movements of the birds and insects we depend on to pollinate plants for our food supply. But studying pollination isn't easy. It's hard to track insects, which are small and often don't live long.

It's also hard to track hummingbirds, which play an important role in pollinating a variety of tropical and temperate plant species. But Adam Hadley, a postdoctoral researcher in the Department of Forest Ecosystems and Society at Oregon State University, and his team are doing just that, thanks to radio frequency identification. "Habitat loss affects many pollinators, including birds," Hadley says. "With hummingbirds, we get a better idea of how deforestation affects their movements."

Hadley and his team initially employed small radio transmitters, similar to those used to track migrating deer, elk and other large animals. They shaved a few feathers off the tiny birds and glued a transmitter to each bird's back. But this required the team to follow the birds with radio receivers. Moreover, the transmitters often fell off the birds' backs, and the batteries died after roughly two weeks.

A member of the team had heard about RFID transponders that could be implanted in animals. The team purchased glass-encapsulated 134 kHz transponders just 8 millimeters long and weighing only 0.033 grams, from West Fork Environmental, an Olympia, Wash., company that offers research products and services.

The transponders have a read range of just 10 centimeters, which makes it impossible to track the birds in real time. Hummingbirds vary in length from 8 centimeters to 15 centimetes, depending on the species, so the researchers had to observe them at an aviary to determine the best placement of antennas to capture data consistently without affecting how the birds hover around flowers. They learned they had to place the antennas like "halos" over flowers so the antennas would be perpendicular to the transponders when the birds visited. Small birds must be able to hover within the antennas while feeding; otherwise, transponders on long-billed species will be too far away to be read.

One big advantage of RFID over radio telemetry systems is that readers can be placed permanently in flower patches frequented by hummingbirds, so the birds can be tracked as they return to the same feeding spots year after year. In addition, with RFID, the birds only need to be captured once to implant the tags, rather than repeatedly to affix new devices to their backs.

So far, roughly 300 birds have been implanted with the tiny RFID transponders, which has enabled the researchers to collect a wealth of data in Costa Rica, where the study is taking place. "We are still analyzing all the data," Hadley says. But it's clear that it will provide some meaningful insights into the feeding habits of the hummingbirds and the impact that deforestation has on those habits." —*M.R.*

TOP PHOTO: ISTOCKPHOTO

Going, Going, Gone!

Square miles of mature forest covering the planet in 1947:

5.9 million

Square miles of mature forest covering the planet in 2012:

3 million

Hectares of forest lost annually in Brazil:

3.5 million

Hectares of forest lost annually in Indonesia:

1.5 million

Hectares of forest lost annually in the Russian Federation:

532,000

Hectares of forest lost annually in the United States:

215,200

—Rich Handley

Two Potential Gorillas Emerge

Consolidation has left Honeywell and Motorola Solutions the two dominant players in the automatic-identification market.

LAST MONTH, the U.S. Federal Trade Commission (FTC) approved—after more than nine months of deliberation—Honeywell International's $600 million acquisition of Intermec Technologies, a provider of bar-code scanners and radio frequency identification readers. The FTC's one stipulation was that Honeywell would have to license its patents related to scanning two-dimensional bar codes to Datalogic, an Italian bar-code technology provider, for 12 years. The FTC said licensing the patents would enable Datalogic to enter the U.S. market and "restore the competition lost due to the merger."

The acquisition of Intermec sets Honeywell up as the only serious rival to Motorola Solutions in the automatic-identification market. For the past seven years, Honeywell and Motorola have been gobbling up smaller auto-ID companies, which have made some acquisitions of their own.

Honeywell is a $37 billion conglomerate, based in Morristown, N.J. The company got its start in 1885 with the invention of the damper flapper, a thermostat for coal furnaces. Today, Honeywell is best known for its home thermostats, but it also has aerospace and defense, automotive, construction and maintenance, energy, health care, indus-

ILLUSTRATION: ISTOCKPHOTO

trial process control, and safety and security divisions. Intermec will become part of the Honeywell Scanning & Mobility division, and it will likely take six months to a year to complete the integration.

Honeywell jumped into the market for bar-code scanners in 2007, when it acquired Hand Held Products. A year later, it acquired Metrologic Instruments, a supplier of data-capture hardware, for $720 million. At the time, Metrologic had $240 million in sales, but the two acquisitions set Honeywell up as a legitimate rival to Motorola. In 2011, Honeywell purchased EMS Technologies for $491 million. EMS offered wireless solutions for mobile networking, rugged mobile computers and satellite communications. It also had an RFID business and owned LXE, which made vehicle-mounted terminals and passive ultrahigh-frequency RFID readers.

Intermec made a few of its own acquisitions. In 1997, it purchased Norand and United Barcode Industries. That year, it also acquired passive UHF RFID patents from IBM. And a year later, Intermec acquired Amtech Corporation's high-frequency RFID business, Amtech Transportation Systems.

In 2007, Motorola acquired Symbol Technologies, one of the largest providers of bar-code scanners and RFID hardware. Symbol had purchased several bar-code and RFID companies over the years. In 2000, it acquired rival Telxon, strengthening its position in the market for handheld smart terminals that could scan bar codes. In 2004, with Walmart pushing suppliers to tag pallets and cases, Symbol purchased Matrics, a small maker of RFID tags and readers, for $230 million, giving it a foothold in the nascent RFID market.

Last year, Motorola increased its influence in the mobile RFID reader market by purchasing Psion for $200 million. In 2000, Psion, a London-based maker of smart terminals, bought Teklogix, a Canadian company that made rugged bar-code handheld devices.

All this consolidation leaves Honeywell and Motorola as the two biggest players in the auto-ID space. Motorola currently has the largest market share for passive UHF RFID readers. Intermec has not been as aggressive in the market during the past three years as it was in the early days of the Walmart initiative.

For both companies, bar codes still represent the largest portion of their auto-ID business. With companies still replacing linear bar-code scanners and introducing some 2-D bar-code scanners, that is unlikely to change. But as the RFID market picks up, it is likely these two giants will ramp up their efforts and go head to head for many of the largest deals.

The competition between two dominant players could be good for end users and for RFID adoption in general. Competition leads to competitive pricing, and both companies have the resources to invest in new, more advanced RFID products. But it remains to be seen whether Honeywell or Motorola will invest in the RFID market, where sales are a tiny fraction of the overall auto-ID business. If both do, there could be quite a battle for supremacy, and one could emerge the "gorilla"—author Geoffrey Moore's term for the dominant technology supplier in a market—in the RFID sector. Moore says a gorilla is necessary for the technology to achieve mass adoption.

If only one company invests in RFID, that company will likely be richly rewarded. A gorilla typically gets more than 50 percent of the market for technologies that reach mass adoption. If neither Honeywell nor Motorola focus on their RFID divisions, that could open the door for a smaller reader manufacturer, such as Impinj in the United States or CAEN RFID in Europe, to achieve gorilla status. Stay tuned. —*Mark Roberti*

The competition between two dominant players could be good for end users and for RFID adoption in general. Competition leads to competitive pricing, and both companies have the resources to invest in new, more advanced RFID products.

TERMINOLOGY

RFID, Sensors and the Internet of Things

The use of a wide variety of terms to describe RFID technologies—and the lack of precision among those terms—confuses companies seeking solutions to their business problems.

PITY THE POOR BUSINESSPERSON. He or she is interested in taking advantage of new technologies that enable a company to monitor the location or condition of assets in real time. But technology providers, users and the media throw about so many terms to describe these technologies—including radio frequency identification, sensors, mesh networks, Internet of Things devices and the industrial Internet—how does anyone begin researching possible solutions?

Articles in the mainstream press often conflate all these concepts. Writers sometimes refer to RFID transponders as "sensors" or "wireless sensors," either to avoid the use of radio frequency identification, which seems like jargon to editors, or perhaps because they aren't sure what the different terms actually mean.

Last November, for example, *The New York Times* published an article about General Electric's efforts to gather data from the many items it manufactures. "Today, GE is putting sensors on everything, be it a gas turbine or a hospital bed," the article said. It included no explanation of the different types of sensors. The "sensor" on the hospital bed is most likely an active RFID tag that broadcasts the identity of the object and its location. It's not clear what GE monitors within its gas turbines or which technology it uses, but the company's Web site refers to the use of passive RFID tags for asset management.

The term "Internet of Things" was coined in 1999 by Kevin Ashton, then executive director of the MIT Auto-ID Center. It helped explain the concept of putting a low-cost RFID transponder on, say, a case of shampoo to enable tracking of the product from manufacture through sale. But some now use the term interchangeably with sensor networks and mesh networks. To confuse matters more, the term has broadened over time to include sensors inside medical equipment or photocopiers that can report on a machine's condition through an Ethernet connection to the Internet, and almost any other technology that connects a machine to the Internet.

Whether RFID tags are sensors is open to debate. The *Oxford English Dictionary* defines a sensor as "a device which detects or measures a physical property and records, indicates, or otherwise responds to it."

A basic RFID tag detects the presence of an object and can tell you its identity. It could be argued that this makes an RFID tag a sensor. Ashton addresses the issue in his column "Making More Sense" on page 41. "RFID tags enable computers to sense identity, and knowing what something is almost always is a prerequisite to being able to use other sensory information, such as temperature," he says. "I consider an RFID tag a 'sensor' because it can detect something about the physical world remotely and by proxy."

But passive RFID can also be used simply as a tool for counting objects, such as clothing items on store shelves. When used like a bar code, RFID does not seem like a sensor.

There are active RFID tags with on-board sensors that can detect humidity, moisture, motion, pressure and temperature. There are also battery-assisted and a few passive tags with sensors. RFID is certainly part of a broader ecosystem of data-capture technologies, and the many forms of RFID will exist alongside and in conjunction with sensors that monitor environmental and other conditions.

The debate about whether RFID tags are sensors is not simply academic. The bandying about of these terms results in confusion among businesspeople seeking to pur-

ILLUSTRATION: ISTOCKPHOTO

chase solutions to solve their companies' problems. They don't understand the various types of RFID or the difference between RFID and other technologies for monitoring machines.

To help keep our readers informed and clear about what different technologies do, RFID Journal has adopted the following approach to these terms:

Basic RFID transponders, whether active or passive, are not sensors—they are RFID tags or transponders. Their purpose is to identify an object and determine its location. Tags are often used to count objects in known locations.

Wireless sensors, whether they communicate via mesh networks or conventional RFID readers, are RFID sensors—provided they include an ID that allows you to differentiate one sensor from another. Some argue that mesh-networking nodes, sometimes called motes, are not RFID because they have a central processing unit and run an operating system. That's like saying a laptop isn't a computer because it isn't a mainframe.

Most of our articles discuss a specific type of technology used to identify and track something. The Internet of Things is a term we use to refer to the broad set of wired and wireless systems that enable objects and machines to connect to the Internet and share information. RFID Journal covers smart appliances that rely on RFID to collect and transmit data (see *NFC-Enabled Refrigerator Shares Data With Mobile Phones*), but does not focus on sensors built into machines to monitor their condition and report on it via a wired connection to the Internet.

We believe that clarity in the use of these terms, even if some might consider our definitions arbitrary, will help companies seeking to use these technologies determine precisely what they need. —*M.R.*

THE FUTURE IS NOW FOR Smart Cities

Municipalities across Europe are tapping into RFID and related technologies to deliver new and enhanced services.

BY JOHN EDWARDS

ILLUSTRATIONS: ISTOCKPHOTO

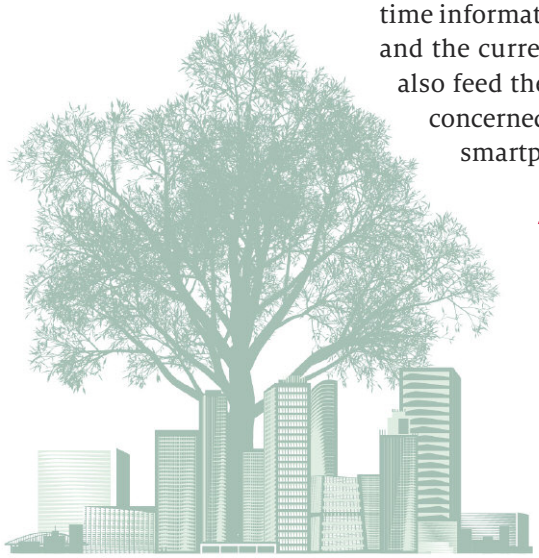
THE CITY 2.0 HAS ARRIVED. European planners, architects and utopians, from Leonardo da Vinci to Le Corbusier, have long proposed strategies for the development of more efficient and livable cities. Now, thanks to radio frequency identification and other cutting-edge technologies, municipalities across the continent are becoming smart cities, paving the way for sophisticated citizen-oriented services that improve the quality of life, address age-old public utility issues and enable ancient infrastructures to accommodate 21st century lifestyles.

Santander, Spain, for example, is a hotbed of smart city experimentation. An ancient port city on the nation's Atlantic coast, Santander is aiming for the future by reshaping itself as a prototype for smart cities worldwide. Blanketed with approximately 12,000 sensors, Santander is changing the lives of its residents by making an array of city services interactive and convenient.

To continuously monitor the city's vital signs, Santander has deployed roughly 3,000 IEEE 802.15.4 devices, 200 GPRS modules and 2,000 joint RFID tag/QR code labels at street lamps, facades, bus stops and other locations, as well as onboard buses and taxis. Relying on video, temperature, moisture, pressure, magnetic strength and a variety of other sensing capabilities, the devices silently monitor parking availability, determine air quality, observe traffic conditions, calculate when the next bus will arrive at a specific stop, and tell residents and visitors whether the surf's up at local beaches. Santander's sensors can alert garbage collectors to full dumpsters, automatically dim streetlights on deserted thoroughfares and manage when parks need irrigating.

Project supervisor Luis Muñoz, a professor at the University of Cantabria in Santander, is particularly proud of the city's ability to monitor parking availability electronically. Display panels, positioned at strategic downtown locations, show the number of available parking spots on every street. "Whenever a car parks on top of one of the magnetic sensors, the field changes," Muñoz says. "The event is detected by the sensor and relayed to the data repository; the information is then displayed on the panels."

All of the city's sensors are linked to a central command and control center. Relevant data is also sent to applications running on residents' smartphones. The apps present real-time information on bus delays, road closures and the current pollen count. Residents can also feed their own data into the system. A concerned citizen can, for example, snap a smartphone photo of a pothole or broken streetlight to notify the local government that there's a problem that needs to be fixed.



> "A smart city is not an end state. It's more of an ambition to use technology to make your city sustainable, more livable, more successful, and to reduce its climate footprint by innovating."
>
> —PAUL BEVAN, EUROCITIES

DEFINING THE NEW METROPOLIS

As the smart cities concept gains adherents, city leaders, system suppliers and technology analysts are struggling to reach a definition of the term. "Smart cities are quite broad, covering a wide variety of applications and services, and different people see things a little differently in their smart-city applications," says Hannu Penttilä, deputy mayor in charge of real estate and city planning for Helsinki, Finland, a municipality that's well on the way to becoming a smart-city leader. "I would say that smart-city applications make living easier in cities, and they are greener than older applications or the old way of doing things."

The goal of the city's Forum Virium Helskinki, for example, is to develop digital services in cooperation with companies, other public-sector organizations and residents. One project enables passengers to access Helsinki Region Transport with a Near-Field Communication-enabled travel card or mobile phone, as well as post their experiences on a virtual messaging wall. Another project in which the travel card doubled as a library card was so popular that plans are now under way to make the travel card a customer card that residents could use to access various city services, such as museums and swimming halls.

"A smart city is not an end state," declares Paul Bevan, secretary general of EuroCities, an organization representing more than 130 European cities. "It's more of an ambition to use technology to make your city sustainable, more livable, more successful, and to reduce its climate footprint by innovating." One of the organization's 2013 priorities is smart cities, as it works toward a "common vision of a sustainable future in which all citizens can enjoy a good quality of life."

It's difficult to create a one-size-fits-all definition for a smart city, because there are so many different aspects to building, creating and running municipal services, says John Devlin, security and ID practice director for ABI Research. Still, he gives it a try: "The basic definition is the employment of new technology and more intelligent processes to enable a cleaner, quicker, smarter way of life." Yet, Devlin adds a footnote. "It has to be available,

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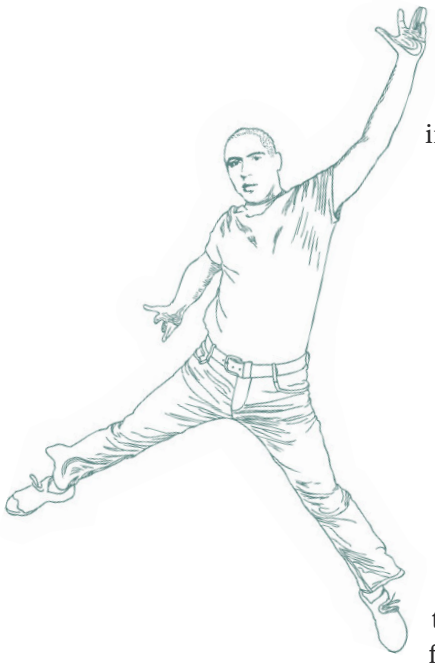
RFID in EUROPE

it has to have scale, and it has to be largely standardized so it can be applied to other... cities as well."

The widespread availability of sophisticated wireless communication, identification and location technologies is inspiring more cities to plunge into smart-city development. RFID, real-time location systems and NFC technologies can all be considered basic smart-city tools, says Michael Liard, VP of AutoID at VDC Research. Cities are drawn to smart-city technologies for the same reasons as private businesses—to identify, track and manage assets (including human resources), as well as to streamline processes and improve productivity, he says. "There's also a desire by localities to enhance and provide new services, plus there's an ongoing requirement to improve safety and security."



Thanks to widespread Internet adoption, European civic leaders are now facing a better connected and informed populace that's demanding improved services from their local governments and isn't reflexively fearful of new technologies. "Citizens aren't out on the streets holding posters or picketing saying, 'We want a smart city,'" Liard says. "They do know, however, that they want more or better services."

Increasing smartphone adoption throughout Europe is creating a more tech-savvy user base. "The continued rise of the smartphone is going to be important," Liard says. "Most of the new smartphones that are being manufactured outside of Apple have NFC embedded," he says, "but it's going to take time for the population to understand how to use NFC, to have available applications and so on."

Most cities that opt to become a smart city do so because they view the concept as the best approach to solving problems that may have existed for years, decades or centuries, Liard says. This is why most initial smart-city applications focus on services residents use routinely, such as public and private transportation, power and water delivery and refuse collection. "I think it makes most sense to identify where your biggest pain points are and begin there," he says. "Build on that as the foundation and continue to grow from there, keeping that vision of a smart city in mind."

"Maybe the city wants to save on auto emissions, reduce street traffic and help its citizenry to get into better shape," Devlin says. "So they introduce a bike rental program, and to make it easy for people to use the bikes, they automate it using RFID technology."

> "You have to get some type of support and buy-in from the citizenry and also from the retailers, the enterprises and the government entities that provide services to citizens to embrace this concept... and to allocate funds toward it."
>
> —MICHAEL LIARD, VDC RESEARCH

The European Commission is promoting smart-metering projects, to provide a more efficient way to supply energy, keeping both utilities and customers informed on energy usage and allowing residents to save money. "Domestic smart meters help people know when they're using electricity and when they can perhaps adjust their energy usage accordingly," Bevan says. "These meters feed back information through mobile phone technology, so they never have to be read."

Some smart applications are designed to help boost local economies. Nice, on the French Riviera, is considered a pioneer in smart cities. The city recently deployed an NFC service to help tourists and other visitors to its modern art museum and other cultural sites

learn more about the objects they're looking at. "The app allows access to an audio guide that gives information about the painter and his work," says Florence Barale, the Nice municipal councilor in charge of innovation. "Moreover, lots of historical monuments are equipped with NFC technology to help the tourists to discover the treasures of Nice."

PLANNING AND FUNDING

Identifying potential applications is the easy, no-pain part of the smart-city development process. The headaches begin when it comes time to plan and fund real-world projects. An important first step is winning the support of the local citizens and businesses that will be using—and, in many cases, funding—the smart-city projects.

"You have to get some type of support and buy-in from the citizenry and also from the retailers, the enterprises and the government entities that provide services to citizens to embrace this concept… and to allocate funds toward it," Liard says.

The SmartSantander project was paid for by a €9 million ($11.8 million) European Union grant that Muñoz supervises. Muñoz notes that winning local support was relatively easy, since a smart city stimulates a productive model based on knowledge and innovation. Furthermore, it creates new services that are customized to residents' needs, an attribute that tends to build community enthusiasm and approval. Local businesses also like the technology because parking automation makes it easier for people to shop at stores, and traffic-management services help delivery trucks, taxis and other types of commercial vehicles move around the city faster and more efficiently. "Before, the services were quite flat, with no special directions for specific groups of citizens," Muñoz says. "Now, we can bind the technology to citizens and serve users according to their profiles."

Potential smart-city adopters need to promote services, not technologies, Bevan says. "It's not just about instrumenting your city and somehow grinding all the data that comes from millions of sensors throughout the domain in order to change behavior or develop infrastructure that will bring solutions," he observes. "It's more about using technology as tools that citizens can access, as well as governments and organizations."

Smart-city technologies also appeal to people who are concerned about the environment. Most Europeans tend to be open to projects that promise to improve their quality of life, particularly if such ventures also lead to a cleaner and healthier community, Bevan says. "In Europe, they have a very strong mindset, at a corporate, citizen and government level, around the concept of being green," he says.

Despite persistent economic weakness, European national governments continue pouring euros into smart-city initiatives, often in the hope that the technology will lower the cost of providing essential services, support EU technology providers and maintain or enhance services despite rapidly aging populations.

"It's national governments that are funding projects within specific cities," Liard says. "Local government is more constrained than ever when it comes to budgets, so continued national government involvement with, and funding of, these types of projects is what's going to continue to drive smart cities onward."

Yet, government support for smart-city initiatives varies widely across the continent. Not surprisingly, project funding is generally weakest among the EU's most economically troubled nations, such as Greece and Ireland. Spain, despite facing significant economic challenges, continues funding smart-city projects, Muñoz notes. "France is certainly the beacon within Europe in terms of allocating euros toward the Internet of Things and creating smarter cities," Liard says.

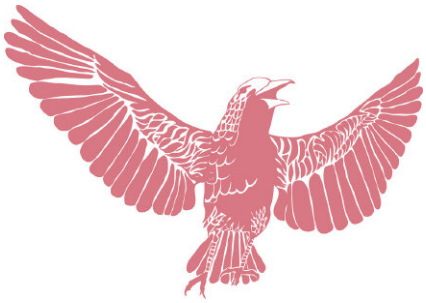
To speed development and reduce costs, many emerging smart cities are seeking business partnerships to share costs, as well as to tap into the latest technology innovations. Meanwhile, transportation, entertainment, retail, energy and tourism-oriented organizations are all beginning to see revenue potential in smart-city applications and are looking for municipal partners to collaborate with. "There's

a good deal of private or enterprise investment," Devlin says. "They see an opportunity."

"Often, a city doesn't need some sort of state investment," Bevan says. "It's a question of partnership and working in such a way that you are creating a market."

"Some very big IT infrastructure and software companies see this as an opportunity for themselves from PR and social perspectives," Devlin says. "There's also business opportunity as well, since they're able to provide the ICT [information and communications technology] infrastructure."

Nice, for example, has partnered with Cisco to create "Connected Boulevard," a system that continuously gathers data from residents via a hybrid network to generate real-time context-aware information on traffic, parking, street lighting, waste disposal and environmental quality. "Having access to this data is essential to enhance many services for residents," Barale says.



People will eventually come to expect the availability of smart-city applications in the same way they currently look for a city to provide parks, street lighting and other essential infrastructure elements.

—HANNU PENTTILÄ, CITY OF HELSINKI

As more municipalities begin exploring the possibility of transforming themselves into smart cities, many quickly realize that some places are better positioned to make a swift and painless transition than others. Europe's biggest and most well-known cities, such as London, Paris and Berlin, may actually have more trouble becoming smart cities than most far smaller communities, Bevan says.

"Bigger cities are generally strong on ideas and innovation and have the capacity and investment for change," Bevan says. "Even so, comprehensive implementation is often easier in smaller urban settings. These offer great pilot scenarios, living-lab style, for smart initiatives and solutions that can be scaled up subsequently."

Smart-city applications are often a logical choice whenever a municipality launches an urban-renewal project or modernization strategy, with the goal of building or remaking an entire neighborhood. Helsinki, for instance, is planning multiple smart-city applications for its new Kalasatama neighborhood. "It is a new part of Helsinki, a totally ground-filled area," Penttilä says. "It was an old fish harbor and now it is being made ready for new development."

Penttilä envisions Kalasatama as a "smart neighborhood" served by applications automating multiple municipal and private services, ranging from mass transit to street repairs. "We will showcase different kinds of smart-city applications," he says.

One application, being developed in partnership with Nokia Siemens Networks and Helsingin Energia, one of Finland's largest energy companies, will create a smart grid that enables Kalasatama residents and businesses to coordinate energy use with the availability of local wind- and solar-generated power.

"There is a strong tendency in Helsinki, as well as in other cities in Europe and in the States as well, for people to want to be better citizens," Penttilä says. "They want more life in their cities, a better life." Penttilä thinks that people will eventually come to expect the availability of smart-city applications in the same way they currently look for a city to provide parks, street lighting and other essential infrastructure elements. "At the end of the day," he says, "it's people who will move the smart-city idea forward."

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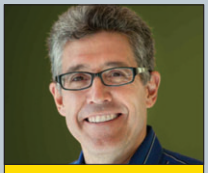

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THE NEW 'IT' TOOL FOR BRANDING PRODUCTS AND SERVICES

By Jennifer Zaino

Companies are turning to RFID to **engage consumers** via social media and interactive ads and promotions.

SINCE MARKETING came of age as a business discipline in the early 1900s, generations of consumers have found themselves the passive recipients of pitches designed to communicate the value of products and services, to encourage immediate purchases and engender long-term loyalty. Companies have built their brands and boosted their revenues with print and broadcast media, and, more recently, e-mail and the Web.

Now, companies are taking marketing to the next level by using radio frequency identification—in particular, Near-Field Communication technology—to make their campaigns more personal and create experiences, at events and in stores, that entice consumers into being active participants. RFID marketing efforts focus on improving brand awareness, loyalty and sales through social media and interactive advertisements and promotions.

Some RFID firms that provide access-control solutions now offer applications that enable event attendees to share their experiences with friends via social-networking sites (see Intellitix Links RFID and Facebook at Coachella Festival and Nike Korea, Nestlé Philippines Like U-Like). The Connect & Go system, developed by RFID Academia, was used at the 2013 Osheaga Music and Arts Festival, in Montreal. Attendees were issued RFID bracelets to access the event, post photos on Facebook at RFID-enabled kiosks and enter contests to win prizes.

There also are startup marketing firms worldwide that specialize in using RFID technologies. Blue Bite, Gauge Mobile and Proxama, for example, offer NFC systems that deliver digital media content—including ads, coupons and video promotions—to mobile phone users within targeted geographic locations. Blondefish, dwinQ, Liquid Lemon, Mediamatic Lab and Publicis E-dologic use RFID at events to connect attendees to their social networks. Cubocc and Pittsfield ID Technologies are among the companies that rely on RFID for in-store marketing and branding solutions.

Consumers seem to like participating in RFID-enabled marketing campaigns—whether it's posting photos from an activity or event on Facebook in real time, joining a loyalty program to receive on-the-spot discounts, or holding an NFC-enabled mobile phone up to a smart billboard to download exclusive video content about a movie being advertised.

That's one reason Lexus, Vail Resorts and other forward-thinking companies that have employed RFID marketing campaigns believe they are getting a return on their investment. "When people choose to reach out and touch, your engagement factor is going to be higher because they have decided that they want something," says Debbie Arnold, NFC Forum director. "And because it's easy, they will want to do it again."

Many of these programs also provide analytic software that lets companies capture key performance indicators, to evaluate the success of the campaign. Often, consumers provide contact or other personal information in exchange for RFID-enabled event passes or to enroll in loyalty programs. "Think of all the things you can do from an advertiser or store or

PHOTO: ISTOCKPHOTO

PHOTO: JACK AFFLECK

RFID is an important part of Vail Resorts' EpicMix social-media tools, because it doesn't make the skier work for the benefits. Guests can track on-mountain stats and share professional photos taken on trails in near-real time.

brand perspective once the user agrees to be tracked," says R "Ray" Wang, principal analyst and CEO at Constellation Research. The data from those transactions can be used to help "figure out how to get them to buy and respond. You can market against, making it easier to serve them what they want."

But Gauge Mobile's CEO Tony Vassiliev admits there's still a bit of a guessing game going on regarding the best use cases for NFC marketing. In 2011 and 2012, Gauge Mobile partnered with two Canadian advertising firms to deploy NFC smart posters on university campuses and at transit shelters. Consumers could use their NFC-enabled phones to tap the smart posters to receive discount coupons, enter contests, win movie passes or purchase products.

The campaigns met with mixed results. They were more successful with a younger, hipper audience, Vassiliev says, but many people were not ready for NFC. Campaigns that rely on NFC mobile phones are limited by the fact that many consumers don't know the technology is in their phones. ABI Research reports that 125 million NFC phones were shipped worldwide in 2012, though Apple has not embedded the technology in its iPhone. Still, while RFID marketing is relatively new, companies are gaining a better understanding of what does or doesn't work, and they are developing best practices (see "Consumer Marketing Tips From the Pros" on opposite page).

Branding via Social Media

One of the first companies to embrace RFID marketing is Vail Resorts, the leading U.S. mountain resort operator. RFID has been a part of vacationers' experience there since the 2008-09 ski season, when the company introduced RFID-enabled ski passes (see Benefits Up and Down the Ski Slope). Building on the RFID infrastructure, for the 2010-11 season, Vail debuted EpicMix, social-media tools that allow guests to track on-mountain stats, such as days skied, lifts ridden and vertical feet accumulated, and share them with family and friends on their Facebook or Twitter accounts.

EpicMix also offers the ability to share pro-

fessional photos of skiers taken on Vail's trails in near-real time. According to a Facebook case study, 300,000 skiers were actively using EpicMix as of February 2012, and one-third were actively using Facebook to share their experiences, creating more than two million posts to Facebook, roughly half of which were photos. "We drive a much larger social engagement and greater brand advocacy through photos getting posted to Facebook," says John Lilley, senior director of digital applications for Vail Resorts.

Today, guests "expect to participate with EpicMix," Lilley says. "There's a real loyalty component to it," he adds, in that it brings people back to vacation with Vail. "The future of EpicMix is to continue providing a rich guest experience through on-mountain gamification and social-media integration," he says.

RFID is such an important part of EpicMix, Lilley says, because it doesn't make the skier work for the benefits, aside from proactively registering for the service. "We have gantries around each entrance to our lifts, and as the individual passes through, we read the UHF tag in their ski pass and register the activity," he says. "All the data is there if the guest wants to engage with it. We've debated about using GPS, but with RFID you don't have to activate your

"What we do [with RFID] is just so measurable, and that's what makes it very exciting to the brand."

LAURA MOODY, BLONDEFISH

Consumer Marketing Tips From the Pros

Make it easy. You've probably built your Web site in HTML5 Responsive Web, which renders well on mobile devices and gets consumers to your Web site. But then they still have to navigate the site to look for the application to download. Create a microsite or minisite, so consumers can simply tap an NFC tag to get an experience, such as entering a contest. —ROBERT P. SABELLA, NFC BOOTCAMP AND ACCELERATENFC

Keep the content fresh. People enjoy the "magic" of using NFC to get information or access experiences, but you must continually refresh the content. If you don't, the user is much less likely to re-engage with the promotion. To keep people's attention, add some dynamic content through the cloud. —MATTHEW BRIGHT, KOVIO

Understand Facebook algorithms. When you add a social-networking component to an RFID-enabled event, you want posts to appear in users' news feeds or timelines, not just on your brand page. Facebook's proprietary algorithms connect users with content relevant specifically to them. Usually, there's not enough affinity, as Facebook rates it, or not enough engagement between a brand page and user to rate brand-page content highly. —PATRICK SWEENEY, DWINQ

Create a keepsake. Design the RFID-enabled access cards you'll use at events for registration and activities with the sponsor's company logo and an image of the featured organization, such as Lexus did for the U.S. Open Golf Championship. That way, the branded card becomes a souvenir. —ADRIAN SI, LEXUS

Invest in resources. Whenever you implement a technology like RFID that is tied to an infrastructure, you are getting into bed with that technology for a long time. Don't underestimate the number of people and amount of time and expense needed to maintain the system. At Vail Resorts, for example, there is a guest experience consideration to take into account if we have to replace ski passes with worn-out RFID chips. —JOHN LILLEY, VAIL RESORTS

During the 2012 Summer Olympics in London, some 20,000 visitors at the Cadbury House used RFID badges to check in, activate games and share photos. Cadbury achieved a tangible return on its investment, according to dwinQ, which implemented the solution.

phone, worry about battery life or manage a phone in harsh conditions, in the cold and with gloves on."

Increasingly, companies that sponsor events—from the Olympics to car shows and golf tournaments—are turning to RFID and social media to better engage visitors and promote their products. Event marketers have always struggled with the fact that events have been one of the least measurable forms of marketing, says Laura Moody, managing director of Blondefish, which has handled projects for Adidas, Converse and Smirnoff that leveraged RFID to let guests share activities, videos and photos with friends on social media. "Literally, it's a simple tap and people are a part of something," she says. "It's a little more personal, and they love it."

Now, the struggle is getting easier, Moody says, thanks to RFID's ability to track people around the experience, and to use tools such as Facebook analytics to understand how users' online engagements as advocates trended in terms of advocacy for the brand. On average, she reports, "for every person you connect with at an event, you reach 580 more friends online" via Facebook or 400 via Twitter. Brand-related comments and click-throughs to a Facebook page, Web site or promotional offer also can be assessed. "What we do is just so measurable," she says, "and that's what makes it very exciting to the brand."

During the 2012 and 2013 U.S. Open Men's, Women's and Senior golf tournaments, luxury carmaker Lexus worked with dwinQ to implement an RFID social-media solution. Visitors to the Lexus Performance Drive Pavilion provided their e-mail and some other personal data to receive an RFID card they could swipe at kiosks to play interactive games and have their photo snapped with the U.S. Open Championship Trophy. RFID readers at each station collected information about the activity and photos, which were transmitted to Facebook, Twitter or YouTube. This allowed users' friends and family to engage with the Lexus brand as well, says Adrian Si, events and partnerships manager for Lexus. "We saw with RFID that we could tie in to certain bits of social media," he adds. "So that gave us a built-in amplification process, which was good for us from a

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.

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branding and engagement perspective."

DwinQ worked with Cadbury on a similar project during the 2012 Summer Olympics in London. Some 20,000 visitors at the Cadbury House used RFID badges to check in, activate games and share photos. This real-time sharing led to 7 million earned impressions on Facebook, says Patrick Sweeney, president and CEO of dwinQ (also founder of ODIN Technologies, now part of Quake Global, which deployed the RFID technology for Vail Resort's implementation). "To get that exposure during the Olympics on the BBC would have cost more than $2 million," Sweeney says. "Cadbury paid about a tenth of that for RFID activation. So, $200,000 for $2 million worth of value is very tangible ROI."

Access to behind-the-scenes content connects fans with their team and feeds their loyalty, and more loyal fans attend more games and buy more team-related items.

MATTHEW BRIGHT, KOVIO

Interactive Ads and Promotions

Companies and organizations are trying a variety of RFID marketing tactics to engage consumers and turn them into customers. At a recent concert in Miami, Post Foods passed out cereal samples and NFC-enabled cards that people could tap with their phones to visit a URL containing videos, music and concert updates (see At Miami Concert, NFC RFID Helps Post Foods Market Its Products). In *Wired* magazine's April 2012 issue, an NFC tag was embedded in a Lexus car ad. Consumers could use NFC-enabled phones to retrieve video and other content regarding the automotive company's latest offerings (see RFID-enabled Lexus Ad Debuts in Pages of Wired Magazine).

This year, California's Sacramento Kings basketball team provided season ticket holders with NFC loyalty cards, which could be used at designated terminals within the arena to accrue reward points. "One NFC tag did multiple things to create multiple revenue channels," says Matthew Bright, director of technical marketing at Kovio, which develops and manufactures printed silicon products for NFC markets. "It was a trading card, and that by itself was a cool item. But it also could be a discount card at the point of sale, and when a user tapped it with an NFC phone, he or she got exclusive content." That access to behind-the-scenes content connects fans with their team and feeds their loyalty, Bright says, and more loyal fans attend more games and buy more team-related items.

In May, Blue Bite and Creative Mobile Technologies (CMT) announced they are working together to enhance the content delivered via CMT media screens in taxicabs. Blue Bite's mTag platform will be installed in 5,000 cabs in Anaheim, Boston, Chicago, New York, Philadelphia and San Francisco. Riders will be able to tap their NFC-enabled smartphones (or use the QR code) to download music, videos, promotional information, coupons and maps.

A recent NFC promotion for Hellmann's Mayonnaise at a supermarket in São Paulo, Brazil, increased sales by 68 percent, according to Brisa Vicente, an account director at the Brazilian advertising and marketing agency Cubocc, which developed the campaign. RFID readers and antennas were installed on store shelves, and shopping carts were equipped with RFID tags and tablet computers. As shoppers walked by, say, the vegetable section, a video of a salad with a mayonnaise dressing would play on the screen. A consumer could use the touch screen to be directed to the other ingredients in the recipe and to share the recipe with friends on social networks (see In Brazil, RFID Is an Important Ingredient to the Marketing of Hellmann's Mayonnaise).

Marketing RFID Marketing Solutions

While RFID marketing faces some challenges, industry insiders believe it will become commonplace as consumers become more familiar with their NFC phones and retailers learn how to exploit these innovative marketing possibilities. In the past year, Samsung has has increased consumer understanding of NFC as a fun technology, with its Galaxy S III Android smartphone commercials that highlight users sharing videos and downloading goodies like music through smart posters, says Robert P. Sabella, founder of NFC Bootcamp and AccelerateNFC. "Really," he says, "the

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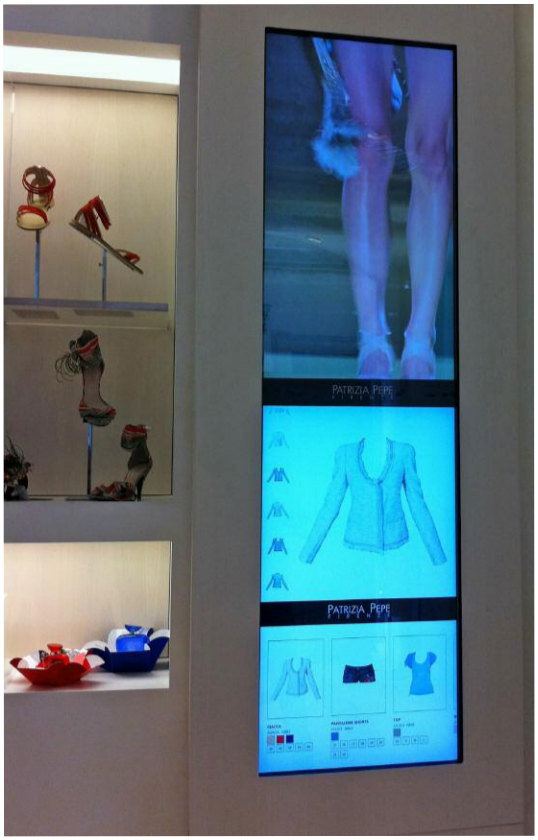
The adoption of item-level tagging in stores opens the door to creative marketing. Patrizia Pepe, for example, installed video "totems" to enhance the shopping experience.



Galaxy S III changed the discussion, being the first real viable alternative [to the iPhone] for people to use with NFC in it. Now people are starting to understand that they can tap and something will happen."

The adoption of item-level tagging in stores is also opening the door to creative marketing. Retailers that adopt item-level RFID to improve inventory management can enhance the shopping experience for their customers, says Jill West, senior manager of marketing communications at RFID vendor Impinj. Consider Patrizia Pepe, an Italian fashion designer that has tagged all its product items—some two million of them—to improve warehouse operations and logistics. The company installed video "totems" at retail locations in Florence and Rome. As a shopper passes by with a tagged item, the totem displays product information, such as details about a garment's construction, videos of models wearing the clothes and advice on coordinating items (see Patrizia Pepe Brings Efficiency to Its Supply Chain).

If supermarket retailers don't want to pay for RFID technology, consumer packaged goods companies likely will, says Michael Liard, VP of AutoID at VDC Research. He points to an active RFID solution, developed by Zebra Technology in partnership with VisibleBrands, that offers targeted promotions to shoppers who enroll in loyalty programs. "They know Suzy Shopper is there, what she likes because she is a loyal customer, and now it's possible to push a real-time dynamic market message to her" as well as maybe a coupon to her smartphone for the advertised product, Liard says.

The catch, Liard says, is that the solution uses ultrawide-band technology, the most expensive real-time location system option. But, he adds, "CPG companies can learn what resonates with Suzy and what would be more likely to get her to spend in the store, especially as the system gets smarter over time. Promotions management and their success measurement are often referred to as the 'black hole' of retail, but with something like this you'll know in real time that an offer or promotion is not resonating with any, most or individual customers."

Meanwhile, companies from Nissan Europe to Sunglass Hut in South Africa are embracing RFID-enabled social media. The connection between social media and events isn't a fad that will fade, dwinQ's Sweeney says. "Connecting events to social media is a new functionality that's going to be required of every event going forward," he says.

"You can find out where users went and what they did, which amplification or activation sites were the most engaging, so there's immediate data back on engagement both on-site and on Facebook to know where to spend money, where investments worked," Sweeney says. Data mining, especially with a good social media operating system, lets marketers go deep into Facebook and Twitter to pull back information about user age, geography, education level and relationship status, and that, he says, is "all-important information marketers love and CMOs [chief marketing officers] are demanding."

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These solutions are designed to monitor hard-to-track and high-value metal assets, such as handheld tools, industrial parts and surgical equipment.

BY BOB VIOLINO

IT'S A WELL-KNOWN FACT that metal causes two major problems for radio frequency identification transponders: It can reflect energy away from a tag, and it can detune a tag antenna, preventing it from receiving energy from a reader.

Several years ago, RFID providers met the physics challenge: They developed "on-metal" tags, now available in a wide variety of sizes and frequencies, that enable companies in myriad industries to track metal assets and to use RFID in warehouses and other environments that contain metal fixtures. Many on-metal tags are designed to withstand harsh environments, so companies in the construction, energy and manufacturing sectors can use RFID to track parts, pipes, tools and other equipment (see Rough Riders: RFID Tags Get Rugged).

Still, there are some applications for which on-metal tags don't work optimally, because the asset is too small, conditions are too harsh or the tag interferes with use of the asset. So RFID providers developed tags that can be embedded in metal items. These solutions are designed to track a variety of assets, including surgical equipment, handheld tools, weapons, metal utility poles, heavy machinery exposed to extreme heat and vibration, iron beams, oil and gas pipes, and valves, agricultural equipment and industrial bolts for automotive assembly.

"On-surface solutions are generally considered first," says

Patrick King, founder of tag provider Technologies ROI (TROI). But, he adds, on-metal tags can be vulnerable to certain environmental conditions. "Some companies may want to ensure mechanical, chemical or heat integrity, which adds life to the solution," he says. Embedding the tag prevents it from being hit or exposed to unusual chemical procedures, as in the case of paint lines and metal foundries.

In addition, the use of on-metal tags can affect the design of finished products. "When you design any product and assuming you take pride in your work, you will always make an efficient design with no waste and meeting all specifications," King says. "If someone then comes to you and suggests either adding to the design or removing something to replace it with a tag, then likely the proposal violates your design intent and may even put the design at risk for quality or cosmetics."

The solution, King says, is to make the tag an integral part of the product, and have the design engineer "envision a total solution and not one modified after fabrication. This is the

TROI's UHF FX-1 tag is embedded in a 4-inch pipe end cap. The solution enables a company to keep track of the assets it rents to oil and gas firms.

Omni-ID's UHF Fit 210 tag can be embedded in small hand tools

real goal and the likely outcome needed in order to have the embedded tag market take off and grow significantly."

Embedded tags are ideal for tracking IT equipment and other high-value assets, says Tracy Gay, VP of marketing at Omni-ID. In addition, Gay says, the company's tags are commonly embedded in tools used in industrial manufacturing or aerospace industries. They are "especially critical" in aerospace, where they enable technicians to "easily scan planes after maintenance to ensure that no tools are left behind," she notes.

Another benefit is that embedded tags can provide security for high-value assets, says Richard Aufreiter, director of product management for identification technologies at HID Global. "The RFID component is fully protected from the environment," he says. "The tag is not visible and cannot be removed—as long as it is embedded into the asset itself, instead of simply being a tag with metallic housing."

Embedding tags in assets is more expensive than attaching on-metal options. But, King says, manufacturers need to consider the long-term benefits. "If a tag is incorporated into the raw material, that allows for automated tracking of the entire work-in-process, so the cost of embedding plummets."

Here's what else you need to know to determine whether an embedded tag solution might be right for your company. For more details, see the vendor table on opposite page.

EMBEDDING THE TAG

Metal assets can be retrofitted with embedded RFID tags or the tags can be embedded during manufacturing. Retrofitting involves drilling a cavity into the asset, placing the tag inside, then covering it with a metal plate that is typically screwed or snapped in, or backfilling the depression with resin. TROI's FX-1 tag is a small round plug with a magnetic base that can be pressed into a fitted hole or secured by

the magnet to the metal in a larger recess. (TROI tags are available from William Frick and other RFID providers.)

Generally, it costs more to add an embedded tag aftermarket. "The lowest cost is when the part to be tagged had the recess [for the tag] prepared in production," TROI's King says. "In this scenario, the tag can even be added during fabrication, including by automation, at a reduced cost."

"Several OEMs [original equipment manufacturers] currently include RFID in the manufacturing of their products," says Sanders Roth, director of Holland 1916's RFID division. "But most OEMs retrofit the tag into the asset based upon customer requests."

Xerafy provides a user guide for its family of "iN" tags. "We have had customers who retrofit their existing assets [such as gas valves and meat hooks], and there are already tools on the market from manufacturers like Stanley Black & Decker that are manufactured with RFID tags already in place," says Xerafy CEO Dennis Khoo.

CHOOSING AN EMBEDDED TAG

Embedded tags come in a variety of shapes and sizes, and frequencies and read ranges, which determine how the tags can be embedded into

Some Leading Providers of **Embeddable RFID Metal Tags**

COMPANY	PRODUCTS	TAG SIZE (mm)	FREQUENCIES/ READ RANGE	INDUSTRIES	APPLICATIONS
HID Global hidglobal.com	Glass tags, e-Module, Piccolino, InLine Tag Ultra, IronTag	• 1.4 x 8 • 4 x 22 • 12.4 x 2 • 20 x 2.5	LF, HF, UHF; read ranges from 1 inch to 26 feet	Health care, manufacturing, utilities	Factory automation; tracking gas bottles, medical equipment, parts, tools and utility lines
Holland 1916 RFID Division holland1916.com	Mtag 13, Data Wedge	• 6 to 25 • 6 x 4 • 13 x 4	HF; 1 foot	Aerospace, automotive, construction, mining, oil and gas	Tracking parts and tools, inspection and compliance, maintenance and field service
Omni-ID omni-id.com	Fit 200, Fit 210, Fit 400	• 8.6 x 6.1 x 2.6 • 56.5 x 5.0 x 1.3 • 13.1 x 7.1 x 3.1	UHF; read ranges from 4 feet to 13 feet	Aerospace, health care; industrial manufacturing	Tracking hand and power tools, IT assets and medical devices
Technologies ROI troirfid.com	CC-71, FT-1002, FX-1, OK-106, PC-106, STI-1, STI-2, WoW-1F	• 12 x 7 • 36 x 10 • 140 x 4 x 2 • 56 x 25 x13	UHF; read ranges from 12 inches to 10 feet	Aerospace, automotive, construction, health care, oil and gas	Factory automation; tracking returnable containers, leased or returnable assets (pipes, tools) and surgical instruments
Xerafy xerafy.com	Dash-iN XS, Dot-iN XS, Micro-iN, Nano-iN, Pico-iN, Pico-iN Plus	• 12.3 x 3 x 2.2 • 06 x .5 • 30 x 30 x 3 • 25 x 9 x 3 • 12 x 7 x 3	UHF; read ranges from 3 feet to 20 feet	Aerospace, automotive manufacturing, constuction, health care	Tracking IT assets, tools for maintenance, repair and overhaul, surgical instruments, weapons

HID Global's LF Glass tags can be embedded in metallic assets, such as tools and engine parts.

To embed Holland RFID's HF Data Wedge tag, a company can drill a hole in a metal asset and push the tag into it.

metal and what functions they provide.

"Low-frequency technology is suitable for embedding a tag into a full metallic housing with no opening," HID Global's Aufreiter says. "High-frequency technology requires that there be a small opening in the metal to power the antenna, which makes it suitable for use with NFC [Near-Field Communication] handsets, adding value to the overall solution. Ultrahigh-frequency is not suitable for embedding into metal without a large opening [the full antenna must be exposed]."

HID Global offers products in each of these categories. Its LF solutions include a Glass tag that can be embedded in metal for use in inventory tracking, warranty validation and other automation and manufacturing applications. The e-Module and Piccolino HF tags can be used for tool maintenance and utility line applications. Its UHF tags include the InLine Tag Ultra, for tracking vehicles, pallets, shipping containers, gas cylinders, and commercial and industrial bins, and the IronTag, designed for tracking machinery, metal tools and industrial components in harsh environments.

Holland developed its own HF chip, and works with Xerafy, Tagsys and other partners to provide UHF components. "We are a metal fabrication shop so we have the ability to make any shape the customer needs," Roth says.

Omni-ID offers the Fit 200, a very small, passive UHF tag suited for tracking hand tools

Xerafy's UHF Dash-iN XS and Dot-iN XS tags are designed to comply with medical standards and survive repeated sterilizations.

and medical devices. It has a read range of roughly 8 feet with a fixed reader and 4 feet with a handheld. The Fit 210 is a bar-shaped tag the company says works well for tracking hand and power tools.

The Omni-ID tags are all embeddable, but require varying levels of custom tuning depending on the application, says Tony Kington, managing director and executive VP of sales, Europe and EMEA. "There is not an off-the-shelf solution, because there are a number of variables when you embed a tag that can affect performance," such as the size of the recess into which the tag is being embedded, he says.

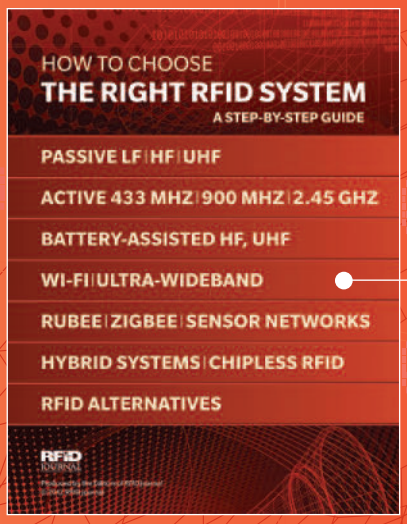
Xerafy offers "the smallest UHF RFID tags on the market," Khoo says. Its Dash-iN XS and Dot-iN XS are designed to track small tools and surgical instruments. "The tags are also designed to comply with medical standards and put to the test to ensure they survive repeated autoclave cycles," he says. For applications that require a long read range, such as tracking metal assets at construction sites and during automobile manufacturing, Xerafy offers the Micro-iN tag, which has a 20-foot read range.

RFID providers admit that the market for embedded tags is small. But they believe there will be a growing demand for such tags as more effective ways of embedding become available and more companies begin tracking metal items through the supply chain.

TROI, for example, has developed a proprietary embedding method in which the metal part being tagged actually becomes the tag. This enables significant cost savings and improved mechanical and chemical performance, King says. The company also has a patent-pending design for a tag that can be screwed into a threaded hole. This tag can withstand extreme temperatures and pressure, he says.

"As the size of embedded tags continues to shrink… and more manufacturers begin to tag at the source," Xerafy's Khoo says, "this market will continue to grow."

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



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EPCIS for Internal Projects

The standard for sharing information can maximize the value of your RFID hardware investment.

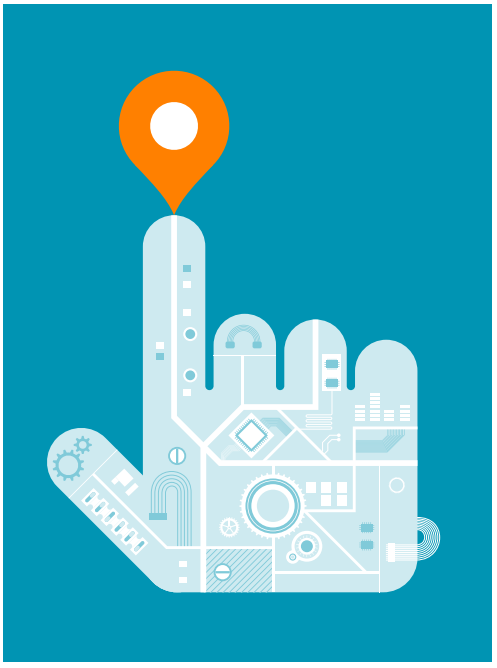
By Ken Traub

GS1's ELECTRONIC Product Code Information Services (EPCIS) standard is known primarily for its ability to enable trading partners to securely exchange information regarding the location of products in the supply chain. Less known is that EPCIS was also designed to let different business units within a company share information. Few companies take advantage of this aspect of the standard, but they should. It helps structure RFID data so the data can be used for many business purposes.

To illustrate how this works, imagine a motorcycle manufacturer that uses special racks to move unfinished motorcycles through the steps of assembly, painting, customization, testing and inventory prior to final shipment. The company decides to RFID-tag the racks to track them through the manufacturing process.

The plant manager uses the RFID data to monitor work-in-process, meet throughput targets and identify trouble spots. The property manager, who works in a different department, views the racks as a valuable asset and uses the RFID data to ensure the company has an adequate supply at initial assembly, as well as to track the repair of damaged racks and determine when to order replacements. In yet another department, the customer-relationship manager uses the RFID data to associate specific racks with custom orders, to keep clients informed about when their motorcycles will be ready for delivery.

The same RFID data can enable at least three business applications—but only if the raw tag reads are captured in a way that anticipates multiple uses. A typical deployment would tailor the RFID infrastructure to the first business application, which would make it difficult to support a second application without reworking the capture software, disrupting the first application in the process. It gets worse with each new application. The problem is that raw tag reads lack the context of *where* and *why* the tag was read, so each application must make assumptions regarding how the data relates to the business process.



EPCIS solves this problem by providing a standard data model that all current—and future—applications can use. The data-capture hardware and software in the plant converts tag reads into EPCIS events, based on the EPCIS standard data model of "what," "when," "where" and "why." The "where" and "why" are what differentiate EPCIS events from raw RFID tag reads. The "where" dimension includes detailed location information, which the plant and asset managers need for their applications. The "why" dimension indicates what process step is being carried out, which the plant and customer managers need, but is less important to the asset manager. The "why" dimension also contains links to client orders, critical information for the customer manager.

In my next column, I'll explain the nuts and bolts of implementing EPCIS software.

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

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Retail 3.0

RFID enables the trend toward consumer-driven showroom shopping.

By Bill Hardgrave

According to several retail industry experts, we are well on our way to "Retail 3.0"—a trend characterized as a power shift from the retailer to the individual consumer. Instead of retailers deciding what brands and items to carry in which stores and at what cost, consumers are using the Internet and mobile devices to find the cheapest place to buy what they want, when they want it. Omnichannel retail is the industry's attempt to capitalize on—and maintain a grasp on—consumer power. As I discussed in my Omnichannel Retailing column, RFID, which delivers real-time accurate inventory data efficiently and cost-effectively, is essential to successfully executing "anywhere, anytime, any product" retailing.

But there's another aspect to Retail 3.0: "showrooming," which puts the consumer in total control. As I see it, there are three types of showrooming: in-store, local and global. Each requires high inventory accuracy that can be achieved only with RFID.

In-store showrooming occurs when the retailer uses a physical location to display its products, typically keeping only one of each item on display, with the remainder of the inventory in the back. American Apparel uses a form of in-store showrooming. Hointer, a new store concept, is the ultimate in-store showroom. The West Coast clothing retailer relies on technology to provide an innovative shopping experience. For in-store showrooming to work, a retailer must know what it has in the store.

Local showrooming occurs when a consumer sees a product he or she likes at a store, then uses a mobile phone to search for that product at nearby locations. The search is typically prompted by one of two scenarios: The item is out of stock at the first store, or the consumer is looking for a better deal.

Global showrooming is what most people think of when they hear the term "showrooming": A consumer walks into a store to see, touch, try on or examine a product, only to go online and order it elsewhere, most likely for a cost savings. The consumer is no longer restricted to a physical store or geographic location; the product can be purchased anywhere.

Showrooming presents a challenge for all retailers, whether they have a physical store, an online store or both. Retailers must be able to satisfy a consumer's demand immediately. If you don't have it, or can't ship it in a timely manner, the consumer will go elsewhere. The shopper has already showroomed the product. Where he or she purchases it is now secondary.

What, then, will separate the winners from the losers? An efficient supply chain and the knowledge of what items you have and where you have them. And you accomplish both with RFID.

Bill Hardgrave is the dean of Auburn University's Harbert 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.

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Making More Sense

We must present all the data we collect in a meaningful way.

By Kevin Ashton

ACCORDING TO CONVENTIONAL wisdom, we have five senses—sight, sound, touch, taste and smell. We also experience sensations, such as hot and cold, pain and the passage of time. It's generally agreed that it is not only useful to sense more than one thing at a time, but it is better—even essential.

As we build the Internet of Things, we are creating a digital nervous system, with a lot of sensors providing cross-referencing, complementary information and confirmation. The sensor that gets the most attention is RFID, and for good reason. RFID tags enable computers to sense identity, and knowing what something is almost always is a prerequisite to being able to use other sensory information, such as temperature. I consider an RFID tag a "sensor" because it can detect something about the physical world remotely and by proxy.

Having a lot of information is good. Showing a lot of information is bad. The first instinct of the typical sensor systems designer is to create a monstrosity of an interface called a "dashboard"—a hard-to-read display with a dedicated chart or dial for every single piece of information.

But our brains do not contain series of dials showing us the amplitude of sound waves coming into our left and right ears, the spectral range of light entering each of our eyes, and values about what we are smelling, touching and tasting. We get one, seemingly complete and comprehensible representation of the world around us. Similarly, information collected from many sensors must converge into a single meaningful number, report, action or some combination of these three.

An example of how to display complex, multisensor data was presented in September, at the annual Ubiquitous Computing (UbiComp) conference, in Zurich. Matthew Kay, a Microsoft researcher, took the show by storm with his insightful paper on a mundane topic: how to improve household bathroom scales. These scales consist of a sensor and an interface. Step on and get a single number that indicates your weight. But weight fluctuates throughout the day.

If a scale could sense who was weighing in (not hard to do, unless several users are the same weight) and days and times, it could show trending, like stock market charts do, making daily fluctuations less of a focus by giving the user the information he or she really needs: Am I getting closer to my target weight?

Kay concludes that adding more sensors to scales but providing clearer information can impact a user's weight and health. This approach, he notes, can be extended to other basic health sensors, such as blood pressure cuffs, glucose monitors and thermometers.

As we move deeper into the age of the Internet of Things, we need to learn how to make more sense. The rule is simple, if counterintuitive: more inputs, fewer outputs.

Kevin Ashton was cofounder and executive director of the Auto-ID Center. He is currently a general manager at electronics maker Belkin.

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