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July/August 2015

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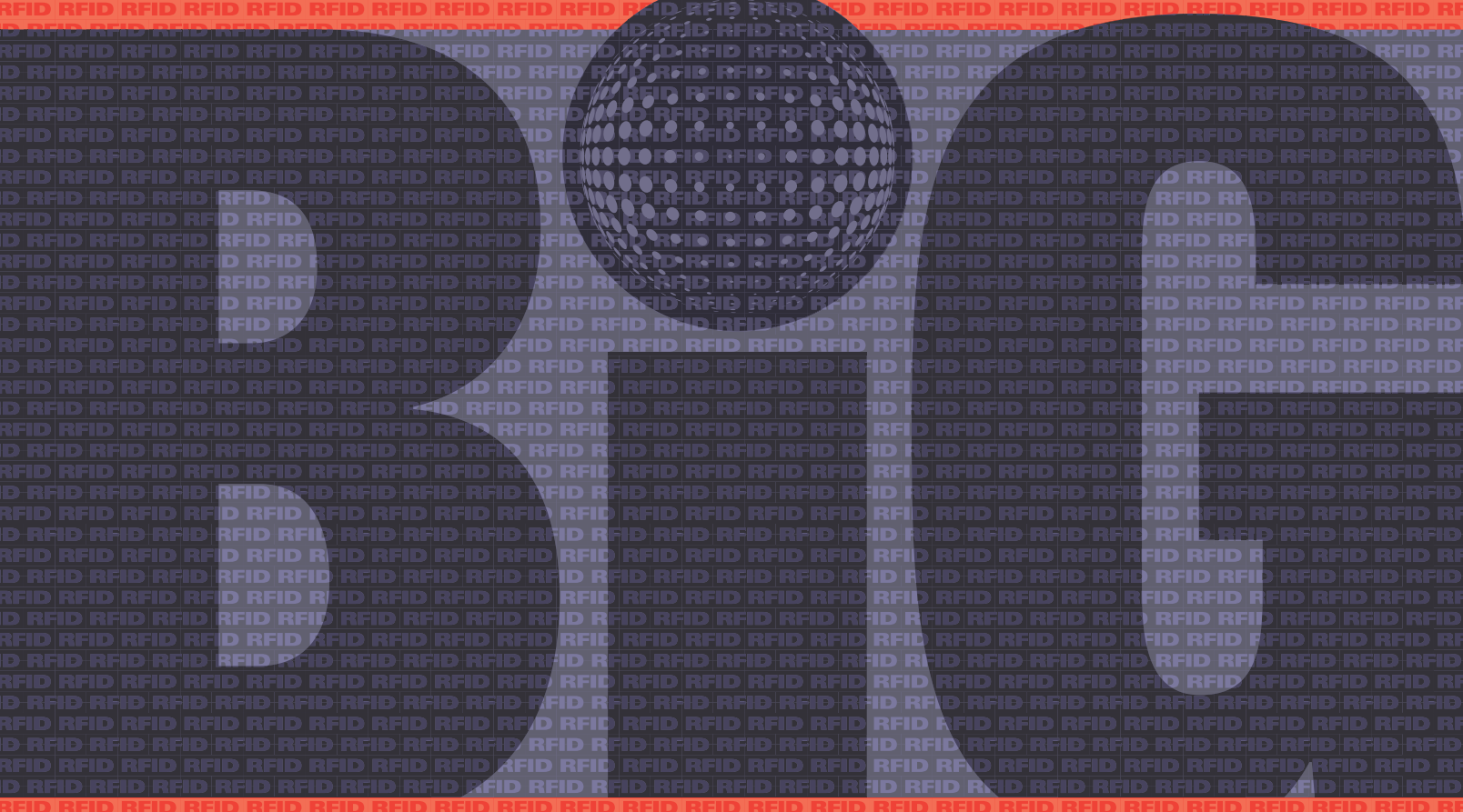

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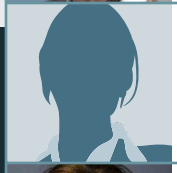	Hudson Bay Lord & Taylor SAKS	**Sarah Polworth** Divisional Vice President
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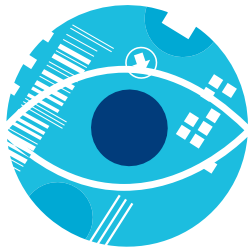
features



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- What Are the Leading RFID Companies?
- NSA Offers Block Ciphers to Help Secure RFID Transmissions
- Thinfilm, G World Introduce Smart Wine Bottle Solution
- One Small Retailer Abandons RFID
- U.K. Hospital Pilots RFID for Bed and Hoist Tracking

Top 10 Search Terms On RFIDJournal.com

1. Sensors
2. Library
3. Read distance
4. Tenders
5. Beacon
6. NFC
7. Standards
8. Construction
9. Disney
10. Drone

The Inside Scoop

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

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- Can passive RFID transponders encrypt data?
- Can I use RFID in the presence of metal?
- How does an RFID reader differentiate from among a large group of tags?
- Are any UHF RFID tags especially designed for tracking logs in the forest industry?
- How can we track tractors?
- Where can I find a forklift RFID reader?

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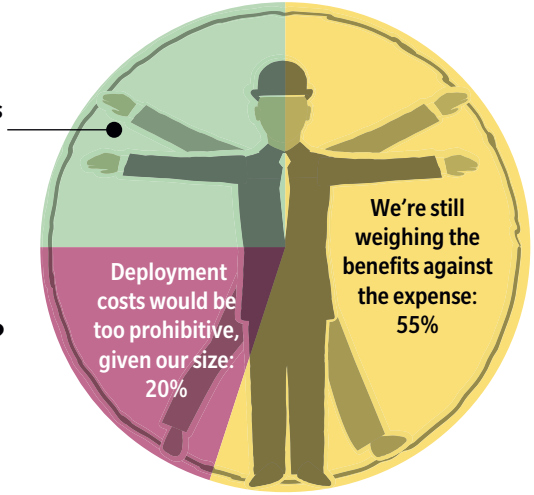

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Making Big Data a Big Deal

BIG DATA has been a popular buzzword for several years now. Most companies collect a lot of information from point-of-sale terminals, manufacturing or other existing systems, and some have applied data analytics to glean new insights into their business. But for the most part, big data has been more of a goal than something companies can point to as a contributor to the bottom line.

PHOTO: SASA STAJIC

That is beginning to change as more companies in myriad industries embrace RFID. The technology is typically deployed as a tool to track and manage inventory or assets, but companies quickly realize RFID provides visibility into the *what*, *when*, *where* and *why* of critical business processes. This insight enables organizations to boost operational efficiencies and productivity, while reducing costs and improving customer service.

Mercy health system, for example, has been using an active RFID-based real-time location system to monitor mobile medical equipment. As our cover story in this issue reveals, Mercy is now exploring how to overlay RFID data with other data sources—patient treatment information, electronic health record data, mortality rate statistics and more—to improve service delivery, medical treatment capabilities and overall performance.

"It's one thing to display a map of the floor and know where all your equipment is," says Scott Richert, Mercy's VP of infrastructure. "It's another thing to understand how to buy equipment, when to maintain and replace it, and where it needs to be located to produce the best treatment and results."

The professional sports industry has always focused a great deal on data. Baseball, for instance, has long relied on the traditional stats of batting average, home runs and runs batted in, and many general managers now review players' wins above replacement, on-base plus slugging percentages and defense-independent earned run averages. In football, hockey, soccer and other sports, it's not as easy to collect data on player performance, so it's no surprise that these franchises have picked up on RFID's ability to precisely track an athlete's movements and provide feedback on a player's performance.

The Montreal Canadiens hockey team is using an RFID solution to track its players as they train, to determine what aspects of their game need improvement. The system captures a wealth of data in real time. Coaches can view the information on a laptop during a practice or game, or save it for post-session analysis. The quantified data provides them with insights into risk (understanding when an athlete is being overworked and at a greater chance of sustaining a soft-tissue injury); readiness for competition (objectively knowing how physically prepared an athlete is for a game or training); and return to play (when an injured athlete can return to competition).

There's no doubt big data is a big deal and will continue to be in most industries—information drives businesses. But until companies embrace RFID, they will not have visibility into what's happening within their own organizations, which will hamper their ability to respond to any insight big data supplies.

Mark Roberti, Founder and Editor

CONSUMER

RFID for Reading People's Reactions

Disney Research has developed a way to use passive UHF tags to determine how people interact with objects.

RADIO FREQUENCY IDENTIFICATION is often seen as a way to take people out of the loop and allow objects to communicate directly with IT systems. Disney Research, a part of The Walt Disney Company focused on scientific and technical innovation, has developed a low-cost, unobtrusive way to employ RFID to determine how people use and interact with daily objects. The system, IDSense, could enable new types of interactive play, smart homes and work environments, and methods for studying consumer shopping habits.

Alanson Sample, who worked at Intel Labs, where he explored RFID's role in monitoring human-computer interactions, led the project. "When I joined Disney Research, I wanted to revisit RFID sensing and human-object interaction in a more scalable manner using off-the-shelf, passive ultrahigh-frequency RFID tags," Sample says. "The latest generation of UHF RFID readers report tag channel parameters, such as received signal strength indicator [RSSI], radio frequency phase and Doppler shift. I realized these offer a unique snapshot of the RF environment of each individual tag. By monitoring changes in these tag parameters as a function of time, and using machine learning techniques, we are able to identify basic human-object interactions."

RSSI is a measurement of signal power received by the reader antenna and is affected predominantly by the distance between the tag and the reader. RF phase—the angle between the carrier signal emitted by the RFID reader and the return signal from the tag—is sensitive to small changes in distance. The Doppler shift is a radio frequency shift caused by the speed of a moving object.

Using these parameters, Sample, his colleague Can Ye, and Hanchuan Li, a doctoral student in computer science and engineering at the University of Washington, were able to simultaneously track 20 objects in a room and infer four classes of movements with 93 percent accuracy. They could tell, for example, whether an object was still or being rotated or moved, or whether the tag on the object was covered, indicating the object was being held, or swiped with a finger.

The Disney team demonstrated how IDSense could enable an interactive storytelling game—rocking or petting RFID-tagged stuffed toys triggered actions by digital characters. In other demonstrations, the researchers used IDSense to monitor 10 commonly used household items—including a drinking glass, a milk container and a cereal box—to show how the system could be used to gather information about daily living activities, and how it could aid in studying the browsing behavior of consumers in a retail store.

Sample believes employing radio channel parameter information to infer how people use technology and interact with their environments has a wide range of potential applications. "There's more than just object-interaction detection," he says. "Understanding the state of an object or infrastructure in a battery-free, low-cost way is really interesting."

Other possible applications include determining seat occupancy and improving security by monitoring the opening and closing of windows and doors. In a video on the Disney Research website, a man sitting on a couch turns on the lights by swiping the tag on a book. Sample says Disney is exploring ways to commercialize the IDSense system. —*Mark Roberti*

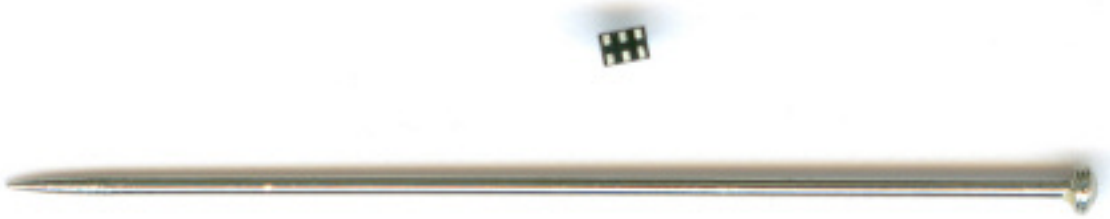
PHOTO: ISTOCKPHOTO

TEXTILES

The Internet of Clothing

U.K. researchers have developed a low-cost antenna that performs about as well as metal ones used in today's RFID tags.

RESEARCHERS AT THE U.K.'S Nottingham Trent University have invented a method of embedding radio frequency identification tags into yarn, which can then be woven or knitted to make fabric for clothing. "The technology will lead to the integration of electronic textiles into the Internet of Things and, ultimately, clothing-based wearable computing," says Tilak Dias, a professor at the university's Advanced Textiles Research Group of the School of Art & Design, who heads the team. "Clothing and other textile products will be able to sense, monitor and record changes in their surroundings and respond appropriately."



The chips (shown here at size relative to a pin) are small enough to be integrated into the yarn fibers of a garment.

PHOTO: NOTTINGHAM TRENT UNIVERSITY

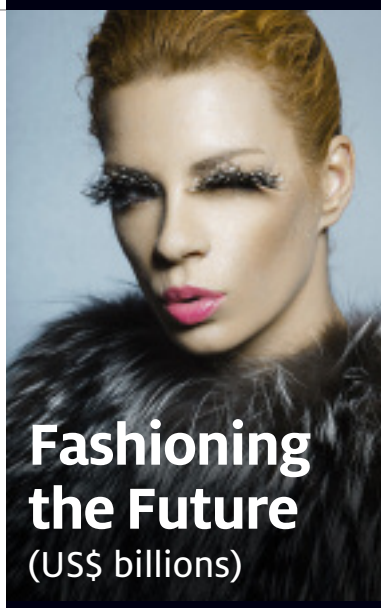
The team used NXP Ucode G2XM RFID chips (other chips could be used as well) and integrated short, thin copper strands attached to either side of each chip into the yarn fibers to act as an antenna. The chip and antenna are invisible to the naked eye. The chips are sealed in resin micropods within yarns, so the smart fabrics can be run through washing machines and tumble driers without being damaged. The technology would add only a few cents to the cost of an apparel item. More than one transponder can be added to increase a garment's identifiability.

Dias sees potential applications in the retail industry, which could use transponders in clothing for supply-chain tracking and instore theft reduction. Unlike electronic article surveillance (EAS) tags and conventional RFID transponders, which thieves can remove, embedded tags would be impossible to find.

This technology also might have applications in sports and health care. Tiny sensors attached to RFID transponders could provide constant data on a person's heartbeat, temperature, perspiration and so on. "In addition to clothing, sensors in textile-based composites could provide lifetime monitoring of structures in the automotive and aerospace industries," Dias says.

Privacy, Dias adds, will not be an issue, because the tags contain only a serial number and users can set them to be read at relatively short range. The research was supported by Sustainable Society Network+. Dias declined to say if any clothing manufacturers have been involved in the research, citing confidentiality agreements.

The team has secured a patent on electronically active yarns. The researchers are now developing a prototype production machine to make smart fabrics, and they are seeking potential partners to help commercialize the technology. Dias believes smart fabrics will be used in myriad ways, just as RFID and the Internet of Things has spawned widespread innovation. —*M.R.*



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Fashioning the Future

(US$ billions)

Global women's clothing market in 2013:

$638.1

Predicted global women's clothing market by 2018:

$773

Global men's clothing market in 2013:

$423.2

Predicted global men's clothing market by 2018:

$571.8

Global children's clothing market in 2013:

$216.2

Predicted global children's clothing market by 2018:

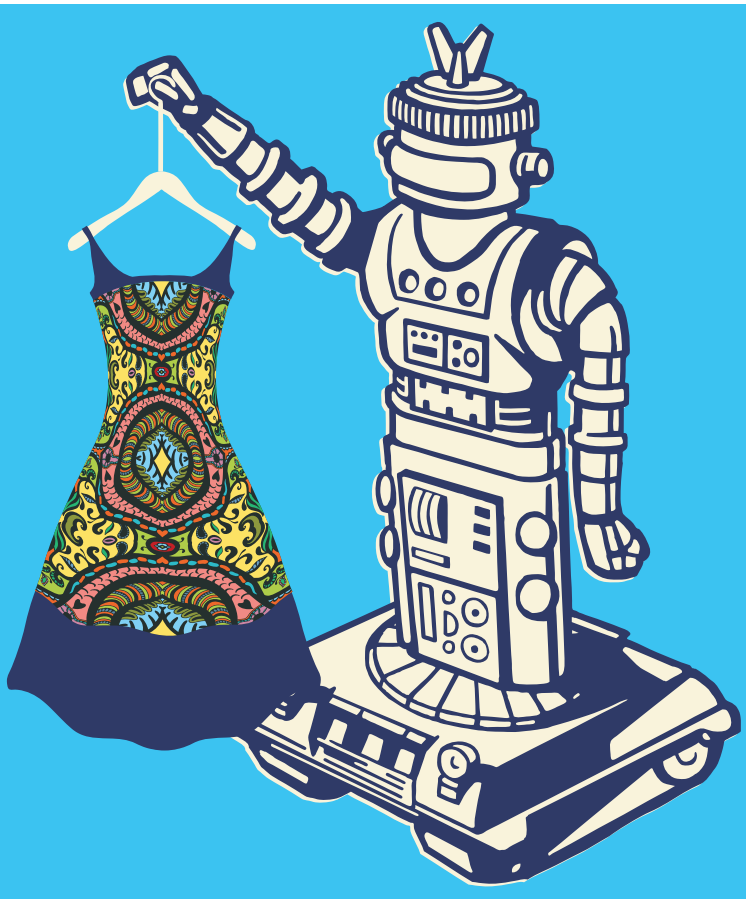
$291.5

—Rich Handley

Source: Global Industry Almanac

RETAIL

Handheld, Fixed or Robotic Readers?



The retail industry ponders the most efficient way to collect RFID inventory data.

IN THE EARLY DAYS of radio frequency identification, most people believed the technology would be used to take humans out of the loop—that is, fixed readers would capture information on tagged products or assets without any worker involvement. But retailers found that handheld readers offered a relatively easy and inexpensive way to collect inventory data. Now, overhead readers and new robotic systems are offering other ways to collect data.

Here are the pros and cons of the three RFID reader options for retailers.

Handheld readers

Handhelds are relatively inexpensive compared with fixed readers, which require an Ethernet connection and electric power if power is not supplied via the Ethernet cable. That means wiring and potentially interrupting store operations. Depending on reader type and store size, dozens of fixed readers could be required. Store associates could cover the same ground with one or two handhelds.

The downside of handheld readers is they require labor—companies must pay people to walk around and take inventory. Another problem is workers don't always follow procedures. When a store gets busy, workers may not have time to conduct cycle counts, so items may not be replenished in a timely manner and inventory may not be consistently accurate. In very large stores, it is particularly difficult to manage workers taking inventory with handhelds.

Fixed overhead and portal readers

The first RFID deployments in retail stores depended on

ILLUSTRATION: ISTOCKPHOTO

fixed readers—mainly, portals were installed at receiving bays, and between the back of the store, where inventory was kept, and the sales floor. In the past few years, Mojix, Impinj and other RFID hardware companies have introduced overhead readers, which can monitor inventory in real time and provide location information, usually to within a few feet. With real-time inventory, retailers can always know what merchandise is on the sales floor and where. In addition, they can use kiosks to let customers search for products and locate those items on a store map.

But, as mentioned above, fixed readers can be expensive to buy and install, because they require cables for Ethernet connections and power. In addition, they need cabling to run to antennas. Fixed readers also can detract from a store's décor, though some overhead readers can be installed in ceilings and vendors have introduced slim-line antennas that are less obtrusive.

Robotic RFID systems

Robots are the newest option for retailers seeking to capture inventory data. Tesco announced in June it is trialing an indoor robotics mapping and analytics system in the fashion departments of five of its U.K. stores. The solution is from Silicon Valley company RFspot, which reports that six other retailers globally are carrying out similar pilots.

The RFspot robots roam through each store's clothing department. Onboard RFID readers perform inventory counts by reading each garment's passive ultrahigh-frequency EPC Gen 2 tag, much the way an employee would with a handheld. The RFspot robot is fitted with multiple antenna arrays to enable tags to be read from six inches to 12 feet above the floor. RFspot says the robot is seven times faster than a human using a handheld.

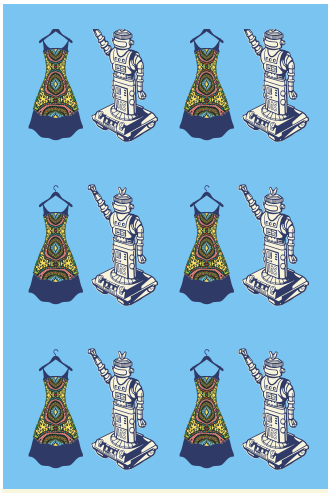
While robots have some clear advantages over store associates when it comes to conducting inventory, they also have some disadvantages. One is cost. Another is having a clunky machine roaming the aisles while people are shopping. Some retailers might prefer to use robots at night, when stores are closed. This would mean updating inventory only after hours or having employees take inventory during working hours. Also, the inventory accuracy of robotic data collection is not yet clear. Tesco and others are aiming to determine more about these factors from the robotics trial.

Retailers deploying RFID systems have been debating which approach will win out. Long-term, RFID Journal believes a fixed RFID infrastructure will likely become an integral part of store systems, hidden from view but constantly monitoring inventory in real time. Lower infrastructure costs, the ability to add readers during renovations or new construction, and improvements in the technology will all contribute to this trend.

But during the next five years, and perhaps much longer, retailers will use handhelds and robotic solutions. Handhelds are a good option for smaller stores, where a single associate can update inventory once or twice a day in less than an hour. The cost of paying a store associate for an hour will likely remain lower than the cost of setting up a fixed infrastructure.

In larger stores, with tens of thousands of tagged items, handhelds will consume too much time and labor to be practical. Retailers will opt for robots or fixed infrastructure, or perhaps a combination of the two. They might use overhead fixed readers to continuously monitor areas of the store that generate the most profit, while using robots to inventory other areas each evening.

The bottom line is that today there is no one right choice for all retailers. Each company should explore all three options and determine which will be most cost-effective, while considering the best long-term data-capture strategy to meet its needs. —*Mark Roberti*



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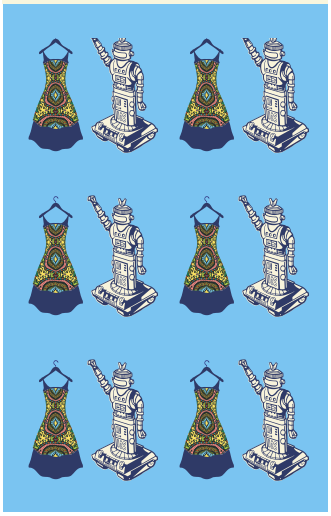
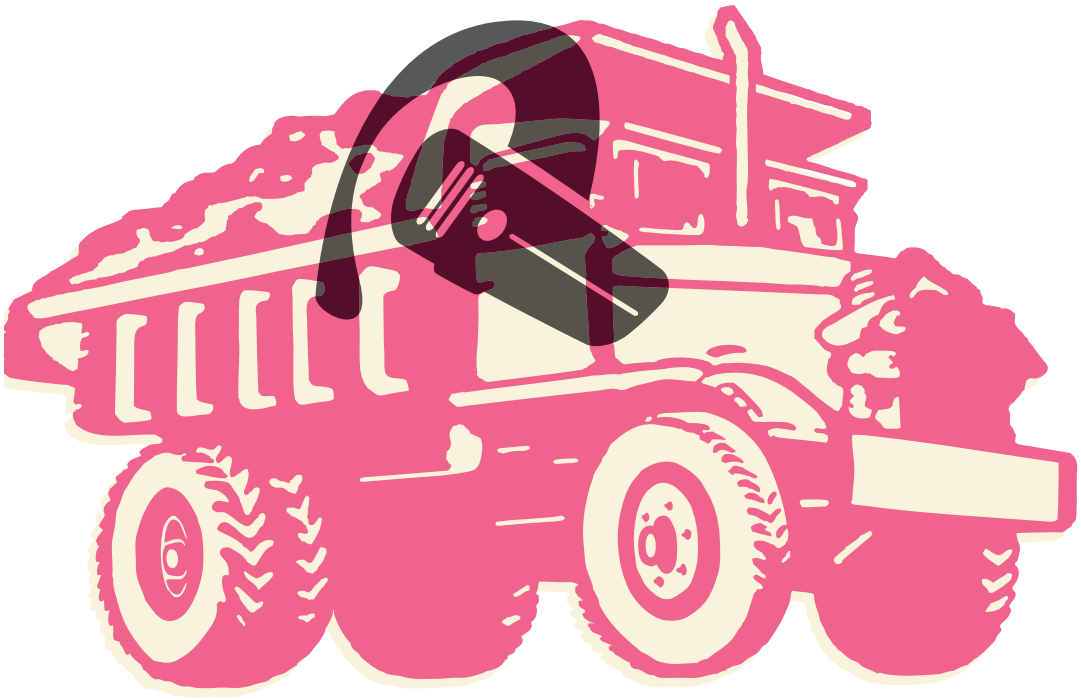




ADOPTION

BLE Beacons for Business

Once used solely for consumer applications, Bluetooth Low-Energy beacons are finding uses in purely business settings.

APPLE INTRODUCED the iBeacon protocol in 2013 as a way for Bluetooth Low-Energy (BLE) devices to transmit location information to a Bluetooth-enabled device, such as a smartphone or tablet. While Bluetooth usually requires pairing, iBeacons could communicate with any device and trigger an action, such as sending a message or launching a browser.

BLE beacons, which function as active RFID tags that transmit a unique ID at regular intervals at 2.4 GHz, were quickly picked up by retailers to send location-based messages to consumers. A beacon in the men's section of a department store, for example, could trigger a message about a sale on men's suits or sports coats (see Macy's Tests Shopkick's ShopBeacon at New York, San Francisco Stores). Museums use them to trigger contextual information in smartphone applications as people view exhibits (see Welsh Museums Deliver Extra Content Via Bluetooth Beacons). Sports franchises and arenas have adopted the technology to trigger video content, promotional offers and other information at sporting venues (see Cleveland Cavaliers Use Beacons to Provide Interactive Team Experience).

Now, BLE is making inroads into purely business applications. Palm Beach Aggregates, a Florida mining company, processes roughly 2 million tons of crushed limestone, sand and other materials for use in asphalt, cement and concrete products, and as base materials for building foundations and roads. On any given day, 100 to 150 trucks arrive at its facility to pick up one of approximately 20 different products, loaded in quantities specific to each vehicle's weight limits, and destined for a variety of customers.

Until recently, the company used manual processes, which were error-prone. Trucks queued up at the loading area for the appropriate material and waited to receive it. Loaders used the weight limit printed on the side of each truck as a guide to indicate how much to load. The trucks were weighed as they exited the facility. Sometimes the wrong product, or too much or too little material, was

ILLUSTRATION: ISTOCKPHOTO

loaded onto a truck. If the amount of material was excessive, the driver had to go to a dumping area to discharge the surplus. Since government regulations, in many cases, restrict the use of the excess material, a single error often cost the company hundreds of dollars.

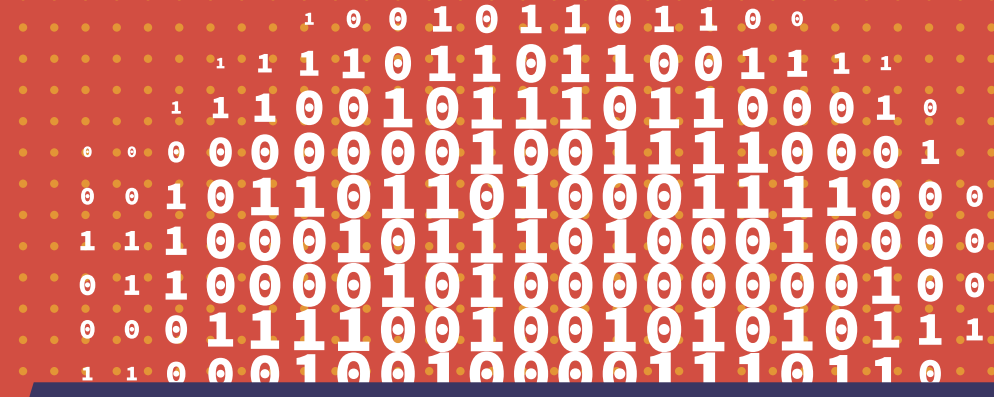
Now, a Bluetooth beacon is mounted on each truck's windshield. Upon arrival at the quarry, a driver reports to the scale house, where the truck is weighed. At that location, a dispatcher with an Android-based tablet receives the ID transmitted by the vehicle's beacon and sends that ID to a cloud-based software application. The dispatcher enters the empty truck's weight into the software, which schedules the truck for loading. Loaders also have BLE-enabled tablets and get information on what materials—and how much—should be loaded onto a specific truck.

The Port of Aalborg, in North Jutland, Denmark, is using BLE technology to improve traffic management, enabling it to know where vehicles are located in real time and how fast they are moving. The port uses BLE to capture data in real time, and then disseminates that information to drivers, prompting them, when necessary, to select alternate routes to reduce congestion (see Sensors Track Traffic Congestion at Port of Aalborg).

TimeForge, a provider of online labor-management software, has introduced a solution that leverages BLE beacons to help companies view where their personnel and key assets are and have been (see TimeForge Intros Beacon-based Solution for Managing Staff, Assets). And Emanate Wireless has built Bluetooth into its active RFID tags, so they can communicate with tablets and smartphones.

The big benefit for BLE in business applications is similar to the benefit in consumer applications—beacons can communicate with almost all tablets and smartphones. This reduces infrastructure cost. An active RFID system would have cost Palm Beach Aggregate far more, for example, because the company would have had to install active RFID readers around its facilities. And it would have had to purchase seat licenses for the software to locate tagged vehicles on its premises.

BLE is not a replacement for all active RFID solutions, but it is an option companies should consider for purely business—as well as consumer—applications. —*M.R.*



BIG DATA

It's time to devise a plan to store all the RFID data you're collecting and a strategy to use it—in combination with other information—to gain insights that could transform your business and provide a competitive advantage.

By Samuel Greengard

Big data. It's a popular term characterized by the three Vs: the volume, variety and velocity at which companies collect data that flows from traditional databases, financial transactions, weather patterns, point-of-sale (POS) terminals, beacons, sensors, clickstreams, social media, log files and myriad other sources. Now it's time to add radio frequency identification data to the mix, as organizations track and manage assets, inventory, tools and other things and people in real or near-real time—across supply chains and within factories, stores, hospitals, construction sites, stadiums and other venues.

Already, companies that have deployed RFID solutions are collecting accurate data automatically. They are dramatically reducing—if not eliminating—errors that result from manual tracking, including the use of bar codes. These organizations have gained visibility into the *what, when, where* and *why* of business processes, so they can turn a basic tracking tool into a business-intelligence tool and even a predictive analytics solution that can help them understand events and boost operational efficiencies and productivity while reducing costs and improving customer service.

Yet, beyond the return on investment that accrues from individual RFID deployments lies far greater business value. The ability to plug in and connect RFID data to other data sources for analysis can determine whether a company winds up on the leading edge and achieves a competitive advantage or lags behind. "Big data creates opportunities that can redefine and reinvent an organization," says Scott Schlesinger, data and information management leader for the Americas at EY IT Advisory.

Consider, for example, a food manufacturer or pharmaceutical firm that is RFID-tagging perishable goods and tracking them through the supply chain. If the product is monitored with a temperature sensor, the company can also receive alerts if the item is exposed to conditions that fall outside acceptable parameters. If that RFID data is also combined with historical sales data, weather data, POS data and social-media data, both the manufacturer and logistics provider can get a broader and deeper understanding of demand and consumption patterns and use this information to optimize production and shipments, Schlesinger says.

Similarly, big data can revolutionize interactions with customers. A department store retailer, for example, could use RFID to track shipments and products at an item level, POS data to monitor demand and social media sentiment data to understand consumer preferences. By combining this data, it's possible to gain a holistic view of the marketplace. It's also possible to use beacons for real-time, highly customized promotions, says Bill Hardgrave, dean of the Harbert College of Business at Auburn University and founder of the RFID Lab. "A business is able to adopt an omnichannel and highly personalized approach that takes customer interactions to an entirely different level," he says.

Industry experts agree that in the near future RFID and other big data will play an essential role in business, by making new insights possible across a wide swath of industries. "Big data is now at the center of everything," says Antonella Mei Pochtler, a senior partner and managing director at Boston Consulting Group (BCG).

Big data "slides the dial" from a reactive mode based on reports and data after the fact to a proactive mode that uses software algorithms and predictive analytics to make better

ILLUSTRATION: ISTOCKPHOTO

decisions, says Mark Beyer, research VP at consulting firm Gartner. In this environment, there's a need for new thinking and new skills. Organizations must identify critical data and how elements intersect, tie together data sets, and break down silos that prevent them from achieving maximum returns.

"It's one thing to display a map of the floor and know where all your equipment is. It's another thing to understand how to buy equipment, when to maintain and replace it, and where it needs to be located to produce the best treatment and results."

—SCOTT RICHERT, MERCY

GAINING GREATER VISIBILITY

RFID, which takes the errors out of manual processes, generates high-quality data that provides better visibility into processes and enables companies to make smart business decisions. Airbus Group, for example, increasingly uses RFID to capture data that managers then use to maximize efficiencies at the jet maker's manufacturing facilities.

"RFID tells us what is going on in the physical world beyond what humans can track and measure on their own—it bridges the gap between the physical and IT worlds," says Carlo K. Nizam, head of digitalization within the Information Communication and Technology team at Airbus Group. "The ability to connect objects and systems provides visibility into complex processes. This extra 'real-world' connectivity leads to an explosion of data that can have enormous value, especially when combined with big-data analytics."

Recently, the airplane manufacturer began combining all that RFID data with other data sources to enhance visibility and gain new insights. When the company connected RFID data from different types of tools used in manufacturing plants with data from enterprise resource planning (ERP) and maintenance systems, it began to assemble a much clearer picture of which tools were used where, when and how within the facilities. Then, using analytics capabilities, Airbus identified optimal locations for tool stores that would reduce waste and more accurately predict when specific tools need calibration or replacement based on actual use cycles (rather than time-based predictions), and which tools were being used more and less frequently. This type of insight was unattainable with paper-based and/or manual "connectivity," Nizam says.

Mercy health system, which operates 46 acute-care and specialty heart, children's, orthopedic and rehabilitation hospitals, as well as nearly 700 other clinics and facilities, in Arkansas, Kansas, Missouri and Oklahoma, is focused on building a next-generation architecture that supports big data. Mercy is using an active RFID real-time location system to monitor equipment, supplies, staff and patients. Mercy is now exploring how to overlay RTLS data with other data sources—patient treatment information, electronic health record data, mortality rate statistics and more—to improve service delivery, medical treatment capabilities and overall performance, says Scott Richert, VP of infrastructure. "It's one thing to display a map of the floor and know where all your equipment is," he says. "It's another thing to understand how to buy equipment, when to maintain and replace it, and where it needs to be located to produce the best treatment and results."

Gartner's Beyer says a logistics and distribution company he worked with RFID-tags cargo

but uses the technology for more than tracking the locations of pallets and other items. "They are using it to cube their trucks—they can determine how to best arrange items for the maximum load, as well as delivery efficiency prior to putting all the cargo on the truck," Beyer explains. The firm achieves this by plugging in routing data and waypoint information, contract information that addresses penalties for delays, and traffic and weather data that could impact delivery times. Because the distributor knows exactly how the truck is cubed, it is possible to reorder and reload at waypoints, he explains. "They are able to generate a modeled representation using RFID," he says. "The system takes into account a number of key variables, including fuel consumption, driver behavior, contract performance issues, penalties and taxation."

Construction companies can also benefit from big RFID data, Beyer says. The operation of cranes, for example, might require maintenance every 25 days. But if you RFID-tag each crane for identification and input that data with weather conditions—humidity, for example—you can increase the safe operation of the crane. "We can say we have a potential situation here," he says, "and we're going to make sure we maintain it a little bit sooner than we normally do."

"The system takes into account a number of key variables, including fuel consumption, driver behavior, contract performance issues, penalties and taxation."

—MARK BEYER, GARTNER

DEVELOPING A BIG RFID DATA STRATEGY

At the heart of a big-data initiative is the ability to collect and assemble the right data and make sense of it. And like any RFID project, any big-data project must begin on the business side, says Ken Traub, president of Ken Traub Consulting. A company first needs to identify the business case. Then, IT can enable the new processes and capabilities.

Companies should begin to think about how they will develop a big-data strategy, Traub says, adding that you can't just go out and hire a big RFID data specialist. Someone in-house—an individual or a team—needs to understand the RFID data you're generating and how it relates to your business, he says. These people need to think creatively about the benefits of knowing where things were (historically) and are (in real time). Before you can begin to use analytics software, you need to know what questions you want answered.

Airbus' big-data initiative focused on two primary goals: to make better use of existing data by tapping into separate systems, and to expose more granular operational data, Nizam says. "We asked, 'What do we want to happen? What do we want to find out? What useful information can we generate and how can we put that to use?'" he explains. "A team then mapped out different attributes and information sources, including where the required data resided. The final step was connecting all the data sources to make the desired information accessible, actionable and meaningful at the touch of a button. At the center of all this was the enabler for real-world data: RFID."

Although Nizam won't disclose details about specific big-data projects across the company, he isn't shy about affirming Airbus' commitment to the technology. "Big data is a highly strategic topic—not only for the digital transformation initiative inside Airbus Group but also for each of the divisions in the group itself," he states.

In retail, most stores deploy RFID to improve inventory management. The big-data compo-

nent begins when retail executives ask, What do we want to know about our customers to improve sales? Companies can then develop systems that allow them to detect changes in consumer behavior and sentiment and make changes to stock more quickly, says Adebayo Onigbanjo, senior product manager at Zebra Technologies. It also might mean knowing a customer's preferences and aligning e-mails and promotions to move stock more efficiently while better matching consumer preferences, he adds. The inventory piece remains important. "You still need to know your inventory counts," he points out, "but you are able to use data and information in a multidimensional way and across channels and systems."

It's essential to hire and train employees who can bring the right set of analytics skills and data science to the enterprise, Onigbanjo says. Transforming data elements into meaningful results is no simple task. In many cases, it's necessary to view the business and various processes from an "outside-in" perspective, and think beyond the narrower domain of a department or division, he says. Data experts can create transparency and determine what type of data to capture. They also recognize which devices, sensors and systems are required and how to connect them to the right algorithms and business logic. "As the situation becomes exponentially more complex, you need the right combination of tools and technologies," he notes.

"You still need to know your inventory counts, but you are able to use data and information in a multidimensional way and across channels and systems."

—ADEBAYO ONIGBANJO, ZEBRA TECHNOLOGIES

It's also important for business leaders to look beyond the four walls of their organizations when assembling a big-data initiative. This often means establishing new partnerships and business arrangements that revolve around shared or pooled data. This can lead to more sophisticated marketing campaigns, improved training and hiring decisions, enhanced research and development, and better operational decisions, real estate purchases and other investments.

PUTTING THE PIECES TOGETHER

RFID generates a lot of data, and many companies don't keep it all—once they've tracked, say, shipments or inventory on a sales floor, they may assume it's no longer useful. Don't dump your data, Traub advises. Even if your company is not ready to plan a big-data strategy, develop a software strategy for storing all your data. "There are many products on the market for managing large quantities of data," he says. "They have different approaches, so you have to research them and decide which works best for you."

Companies also should begin to investigate new tools that do calculations and outputs on an ongoing basis, to process data in real time, Traub says. These new "large-scale real-time event-processing tools" are still immature, he notes, but they will be a major component of a big-data strategy.

In addition, companies will need to build an IT framework that facilitates the exchange of data, says Su Doyle, senior marketing manager at Checkpoint Systems. This typically involves clouds and APIs that connect databases and systems.

EY's Schlesinger says the goal isn't to make different data sets available to different groups but, rather, to make the right data available from the same central data repository. "Data, including RFID data, can be used in entirely different ways to achieve completely different insights that help run the business better," he explains.

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	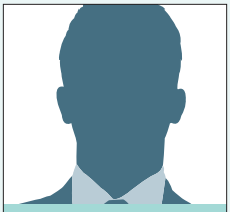			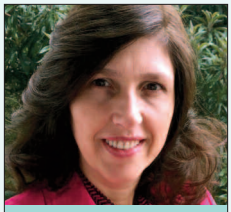
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To facilitate this type of environment, many organizations are turning to next-generation computing platforms such as Apache Hadoop, which offers a robust framework for storing data and running applications on computing clusters that rely on commodity hardware. The highly scalable open-source environment delivers massive processing power and vast storage. SAP HANA, which relies on an in-memory, column-oriented relational database management to process large volumes of data faster and more efficiently than traditional databases, is also gaining favor. Tying together these two technology solutions creates what Schlesinger calls an integrated platform that paves the way for enterprise analytics. What's more, these systems also make it easier to use clouds and APIs to streamline data flow. "Without the right framework in place, the amount of data becomes untenable and it becomes impossible to get any value from all the data," he explains.

Regardless of the specific technology, it's critical to break down data silos and link data from legacy environments, including ERP and supply-chain management systems. Hadoop, for example, allows a business to process vast amounts of sensor data and contextualize it before it is slotted into a database. Yet, organizations must also look beyond technology to break down data silos. Too often, Zebra's Onigbanjo says, RFID projects exist as islands. Because there's no oversight at the senior executive level and no task force or team overseeing initiatives, groups within the enterprise don't share existing knowledge, and organizations wind up duplicating efforts and losing data. "There must be executive support and a structure in place," he points out.

"The business world is undergoing a paradigm shift. There is a growing awareness that data is important, and it unlocks answers to complex questions."

—CARLO K. NIZAM, AIRBUS

CONNECTING TO RESULTS

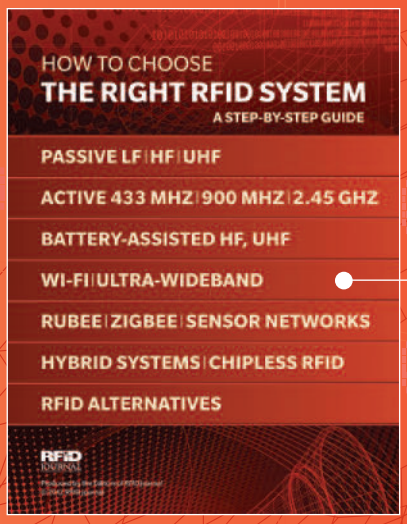
For many businesses, a sophisticated big-data initiative may still be a few years away. But experts say now is the time to begin developing a strategy, building a big-data and analytics framework—and piloting projects. Digital technologies are advancing rapidly, and without a basic foundation and structure the task will be even more difficult in the months and years ahead.

As the business world transitions to an era where data is abundant, it's vital to adopt a clear strategy, BCG's Pochtler says. "A big-data initiative cannot be catch-as-catch-can in terms of simply collecting data and then trying to figure out what you can do with it. You have to focus on the core questions you want to answer and what type of data and analytics are necessary to produce the results that really matter."

When organizations build a big-data framework, it's possible to create a more agile and flexible business that's better prepared for the challenges of the digital age, Hardgrave at Auburn University says. "By marrying a variety of data sources, a company can move from running the business based on past events to running the business on current and, with predictive analytics, future events."

"The business world is undergoing a paradigm shift," Airbus' Nizam says. "There is a growing awareness that data is important, and it unlocks answers to complex questions. The next stage in the paradigm shift will be to ask, Where does data come from and how is it collected? This is where technologies like RFID will play an important role in building greater connectivity and insight into the industrial 'Internet of Things.' Together with big data-analytics, this has the potential to truly transform business and industry."

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



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vertical focus: sports

RFID's Sporting Life

Capturing performance data in real time helps athletes improve their game—and coaches and federations determine which players to back. BY JENNIFER ZAINO

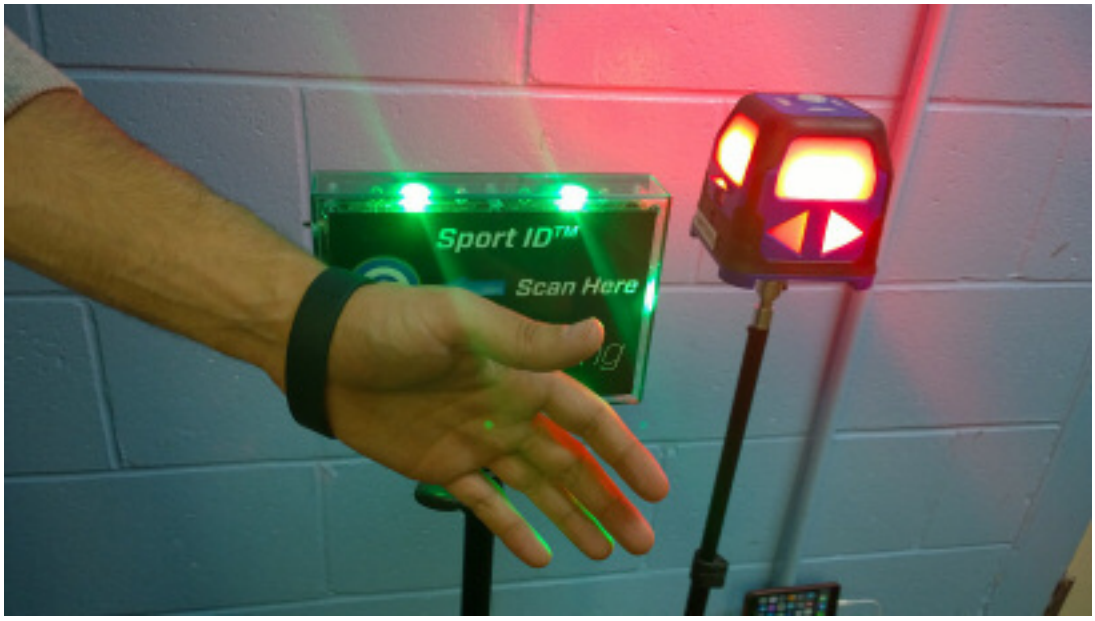
PHOTO: CANADIENS.COM

Montreal Canadiens

THE MONTREAL CANADIENS lost to the Tampa Bay Lightning in the second round of the National Hockey League Stanley Cup playoffs this year, but the players headed off the ice with their heads held high. The team posted 110 points in regular season play, finishing second overall in the Eastern Conference, just behind the New York Rangers.

The Canadiens attribute much of their 2014-15 season success to their enhanced training efforts, which includes the use of Sport Testing's athlete assessment solution, particularly during summer development and training camp sessions. The solution consists of Sport ID passive ultrahigh-frequency RFID bands to identify athletes via an RFID handheld reader before they perform a particular drill; wireless Sport Gate photoelectric timing gates that use Sport ID data and the company's Core Capture algorithms to match athletes with the measurement results from specific drills in real time; Sport Hub software for collecting results that can be displayed on any screen or even a leaderboard to motivate players; and Athlete Manager database software, which provides reports on which to base analyses of player performance.

The Canadiens use the solution to test a number of variables relevant to the sport of hockey, says Pierre Allard, the team's strength and conditioning coach. During a circuit, for example, it will benchmark how quickly a player reacts to lights and colors that indicate whether he should move right or left. "That's a good test, because you want to see if the players controlling a puck can make good decisions," he says. "Another test is to measure the capacity to repeat sprints, which is also an important value for hockey players." The results, he adds, help him determine



Sport Testing's RFID bands, readers and timing gates match athletes with measurement results from specific drills in real time.

what aspects of play a team member needs to work on, and develop ways to improve them.

The RFID bands make the whole process convenient, Allard says, because they accurately and quickly match players to results. "Once you set up the system and get used to it, you save a lot of time, because you can start to collect data," he says. "And with RFID, you are able to go fast."

Over time, Allard can use the collected data from players running different drill combinations to create standards, such as minimum and maximum values of speed, strength and power. Understanding what constitutes good values for NHL players, for example, can help monitor the progression of young draft players, he says, "to see if they are going in the right direction over time from a physical condition standpoint."

In addition to the Canadiens and a few other professional hockey and football teams, company founder Jamie Hollins says Sport Testing has relationships with sports organizations including: the Canadian Hockey League, which represents major junior ice-hockey leagues for players 16 to 20 years of age; National Lacrosse League, North America's professional indoor lacrosse league; Amateur Athletic Union, a U.S.-based organization promoting the development of amateur sports; American Youth Football, an international organization; and Canadian Sports Institute for Olympic and Paralympic training.

Sport Testing also maintains a global database of up-and-comers' test results that organizations can access to monitor individuals' performance in sport-specific drills. The information helps them "make proper decisions about who should progress or be dropped for the draft or scholarship," Hollins says. "Everything is moving into the data world and into more analytics, and RFID lets us gather that data efficiently."

IT'S A NEW GAME

Using RFID to capture real-time performance statistics on male and female athletes is a growing trend, and solution providers are stepping into the sports arena. "New digital technologies and new applications of old digital technologies are being used to quantify everything related to sports, providing a different insight and the option for a lot of analysis," says Henry Hanson, sports equipment specialist and co-creator of the Sports Technology Podcast. "For training, any extra information gathered—if gathered and interpreted correctly—can only benefit the athlete by providing a more complete picture of what is going on."

PHOTO: SPORT TESTING

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Football players on Australia's Greater Western Sydney Giants team wear Catapult's tracking devices, to monitor their movements.

PHOTO: CATAPULT

SportRFID, for example, offers a solution that uses passive UHF RFID sticker tags that can be affixed to a snowboarder's helmet during training or competition. RFID readers placed strategically along a course—such as at points where snowboarders do a 180-degree spin—recognize the RFID stickers and activate multi-angle video cameras. The videos are uploaded to the cloud for review by the athletes, their coaches and others, such as the Canada Snowboard federation.

"Federations want to know who is progressing, at what rate and so on, so they can maneuver their resources to get behind those with the best chance of medaling at various competitions," says SportRFID CEO George Easton. "We dovetailed nicely with what Canada Snowboard wanted to do." The solution, Easton adds, can also be used for downhill skiing, bike racing and other sports with a progressive course that provides an opportunity to set up defined video-capture points.

The New York Knicks, Dallas Cowboys and San Antonio Spurs are among the professional organizations using Catapult's technology to gain scientific insights into their athletes' performance, says Boden Westover, the company's marketing director. Catapult's ClearSky is an RFID-based active real-time location system (RTLS) that can be deployed in indoor or outdoor sports environments. OptimEye, the company's original satellite-based system, requires an outdoor or open-roof venue.

"ClearSky uses RFID because of its accuracy and ability to be used in a range of environments, which is important with our clients training in different venues on a regular basis," Westover says. An athlete's location is calculated via triangulation using small wireless nodes that are easy to install around the perimeter of a playing area, he explains. Athletes wear a small tracking device under their uniforms that measures and records their physical movements every few seconds, including distance covered, accelerations, velocity and direction changes, as well as heart rate.

The data is accumulated in real time so coaches can view it on a laptop during a practice or game, and saved for post-session analysis in Catapult's OpenField software. Coaches can gain insights into risk (understanding when an athlete is being overworked and at a greater chance of sustaining a soft-tissue injury); readiness for competition (objectively knowing how physically prepared an athlete is for a game or training); and return to play (when an injured athlete can return to competition), Westover says. The tracking devices will continue to become smaller and more sophisticated, he says, but the real developments

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Vert uses Bluetooth Low Energy technology to track and analyze jump height, an important factor in basketball and volleyball.

ahead "will be in the data and the sport-specific and position-specific algorithms we build into the system, to ensure the information is as relevant and valuable as possible to the teams using it."

At the University of North Carolina, women's varsity soccer and several other teams have been using the OptimEye solution. "If you look at where we were before we had this, you were just kind of guessing about whether an athlete was stressed out or had a chance of getting hurt," says Greg Gatz, UNC's director of strength and conditioning for Olympic Sports. "It's not an exact science but at least now we have a reference point."

Vert uses Bluetooth Low Energy technology to track and analyze jump height, an important factor in basketball and volleyball. Jump height also comes into play in some facets of other sports; in football, for example, a wide receiver may need to jump to catch a pass. A Vert device is worn on an athlete's waist or integrated into an article of clothing, such as the company's active waistband. A proprietary algorithm measures the jump, and Vert transmits the data to any smartphone or device that supports BLE.

Every player on the U.S. Women's National Volleyball Team wears a Vert during training, says Jamie Morrison, assistant coach. The system helps coaches with talent preservation. It records information such as how many jumps a player makes and how many times a player hits her maximum jump height. The data could reveal that a player is risking injury by taking too many jumps, or getting tired and consistently declining in jump height. Twelve players from this group will be picked for the U.S. Women's Olympics team.

"There are a lot of overuse injuries in our sport—there is a lot of pounding," Morrison says. "We're more interested in longevity, and up until now there has been no tool to manage the workload and make sure we are working athletes the right amount."

Active RFID technology using Wi-Fi networks may be part of the future for Vert, says founder Martin Matak, especially given the interest in the solution by national and professional sports teams. The company has conducted lab experiments with the technology, and Matak thinks it could bring extra value because it is "simpler to triangulate where people are in a field of space, so you can create different elements" to accompany the vertical data. "In a football scenario," he says, "you would want to measure verticals, speed and location, and technologies like RFID could come into play to be part of that platform solution."

BROADCASTING PERFORMANCE DATA

Players' stats have long been part of the sporting game, so it's no surprise that the media and fans are interested in RFID-generated performance stats. Last year, during a National Collegiate Athletic Association (NCAA) live event, members of the University of Florida women's volleyball team wore Vert devices, and their jump height data was displayed in real time on a Jumbotron. An ESPN broadcast of a women's volleyball game between the University of Florida and the University of South Carolina also featured Vert jump stats.

"Being the first wearable technology in an NCAA event, we are going down that road to create new experiences in sports analytics and entertainment," Matak says. Vert is building an application to engage socially with fans at stadiums and at home on smartphones. "Everyone wants instant information that is important to them," he says. "We are building a platform that has the consumer in charge of their own experience."

SportRFID has explored broadcast options

PHOTOS: ISTOCK (LEFT), VERT (RIGHT)

Radio Alerts Could Reduce Brain Injuries

Concussions are an unfortunate fact of life for many athletes, both professional and amateur. Adults and kids suffer head traumas playing football, soccer, hockey and other sports. Wrestlers, boxers and cheerleaders are also susceptible to head injuries. Often, a player who sustains a concussion stays in the game, although repeated concussions can lead to permanent brain damage.

Wireless sensor technologies can't prevent or diagnose concussions, but they can measure head accelerations (the force and rotation with which the brain hits the skull). This real-time information can alert coaches that a player should be examined by a doctor and, perhaps, pulled from the game.

Jolt's wearable sensor and smartphone application, for example, lets parents and coaches track and evaluate the impact to a child's head. The Jolt Sensor, which can be attached to headbands, helmets and other headgear, measures and records head accelerations, and streams the data and corresponding alerts to smartphones using Bluetooth Low Energy (BLE) technology. Following a successful Kickstarter campaign and certification from the U.S. Federal Communications Commission, Jolt began shipping products in July, says founder and CEO Ben Harvatine.

Riddell, which manufactures professional football helmets and other protective equipment, offers Riddell IQ, a smart football platform that includes the Sideline Response System and InSite Impact Response System. InSite features a sensor pad that is positioned in helmet liners to measure impact severity and BLE technology to send alerts to handheld devices, by player name and number, when an impact or sequence of impacts exceeds a predetermined threshold. Riddell says members of the National Collegiate Athletic Association are using the SRS solution largely for research, while close to 500 high-school and youth programs have adopted InSite.

"Concussions are more complicated than accelerations," says Henry Hanson, co-creator of the Sports Technology Podcast. "But any extra information about what the head experienced could help doctors better understand the severity of the incident." —*J.Z.*

PHOTO: JOLT

"The MotionWorks system's reliability was nearly 100 percent in the past year—no tag failures. It smoothly passed the information to broadcast partners."

ERIC PETROSINELLI, ZEBRA TECHNOLOGIES

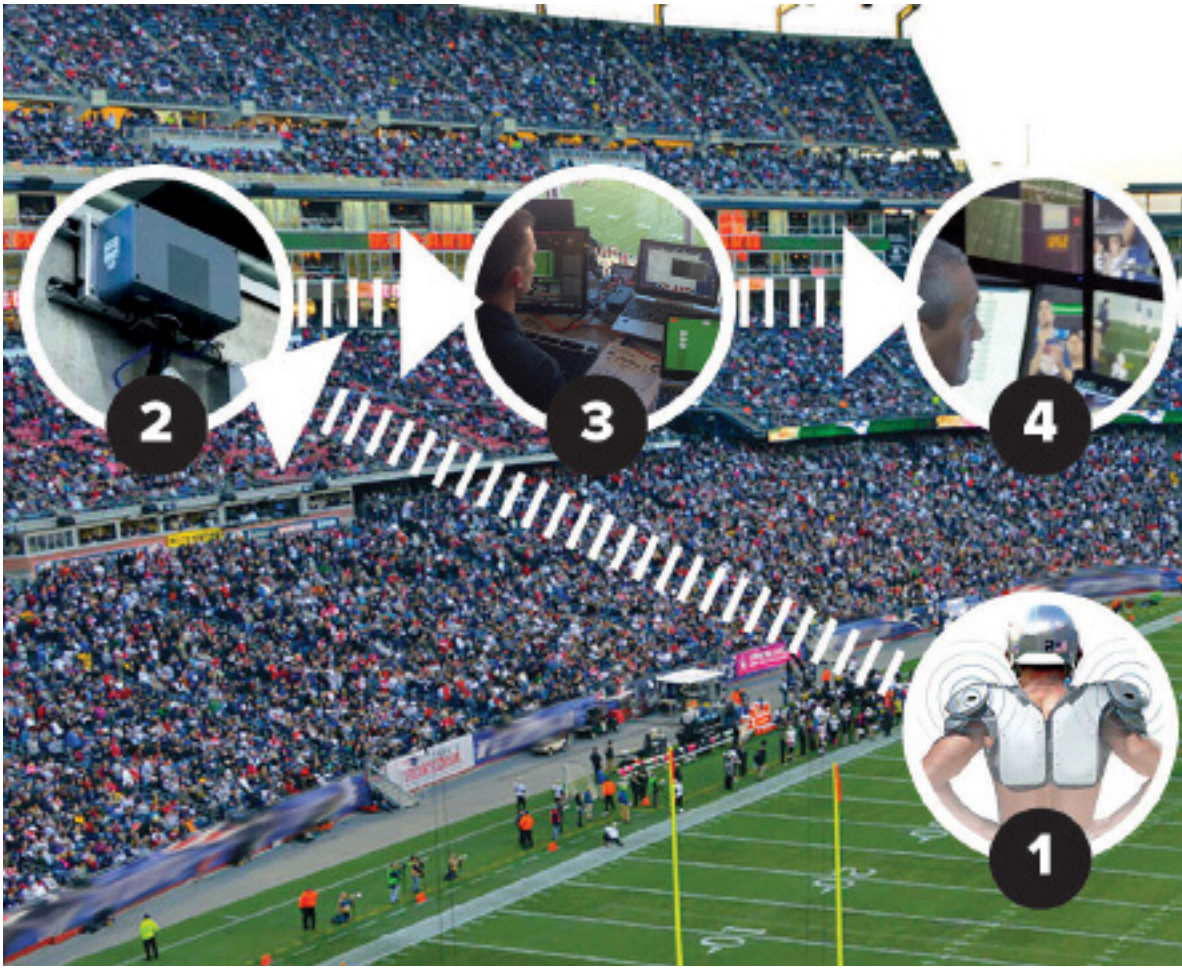


PHOTO ILLUSTRATION: MOTIONWORKS SPORTS SOLUTIONS

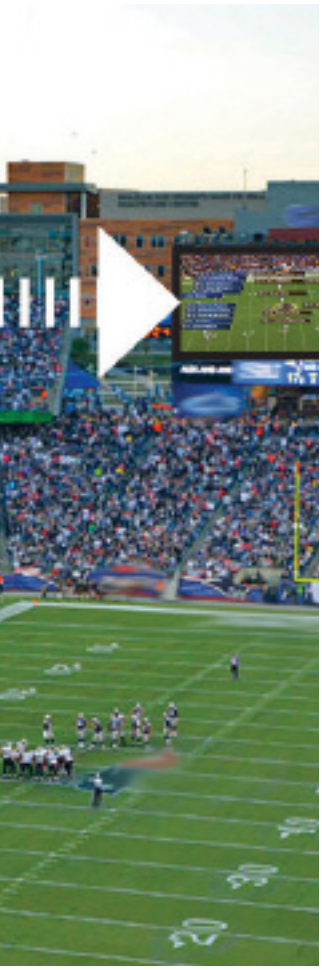
to enhance the fan experience, but Easton notes it's not the company's current focus. "All I can tell you is that the interest is quite high, but the path to execution is riddled with many hoops to jump through," he says, citing contractual obligations and licensing agreements.

Catapult's Westover says there are a few offshoots from its core business "that largely center around the media and working with broadcast partners, but because of the proprietary nature of the data, it is not as straightforward as a lot of people believe. We've had some successful examples in Australian football, and it's something we're keeping an eye on going forward."

Meanwhile, the National Football League, which adopted Zebra Technologies' MotionWorks Sports Solution to monitor players, installed the ultrawide-band RTLS at 17 stadiums during the 2014-15 season and plans to RFID-enable the remaining 14 stadiums for the 2015-16 season (see Zebra's Next-Gen Technology Powers Next-Gen Stats). More than 100 million fans, including viewers of CBS Sports' Thursday Night Football TV, saw what the NFL and Zebra call "next-generation statistics."

The NFL is gearing up to build what Eric Petrosinelli, Zebra's general manager of sports, calls an ecosystem for digital fan offerings. In April, the NFL signed a multiyear agreement with Sportradar US to be its exclusive distributor of official real-time scores, player statistics and play-by-play data, as well as the NFL's proprietary next-gen stats.

"The MotionWorks system's reliability was nearly 100 percent in the past year—no tag failures," Petrosinelli says. "It smoothly passed the information to broadcast partners. On the commercial side, they are just at the start of rolling out next-gen stats, and we'll start



Each player wears two quarter-size battery-powered RFID tags, one under each shoulder pad, which emit their IDs to RFID readers more than a dozen times a second.

At each participating stadium, an average of 20 readers are mounted between the upper and lower decks. They read the tags from all 22 players on the field, pinpointing each player's position, and tracking their speed, acceleration and distance traveled in real time.

Algorithms aggregate players' stats from the data and display it on MotionWorks analytics software, which allows Zebra staff members to add context to the data.

Media producers use the MotionWorks data to create graphics for viewers that can be displayed on a variety of digital devices in real time.

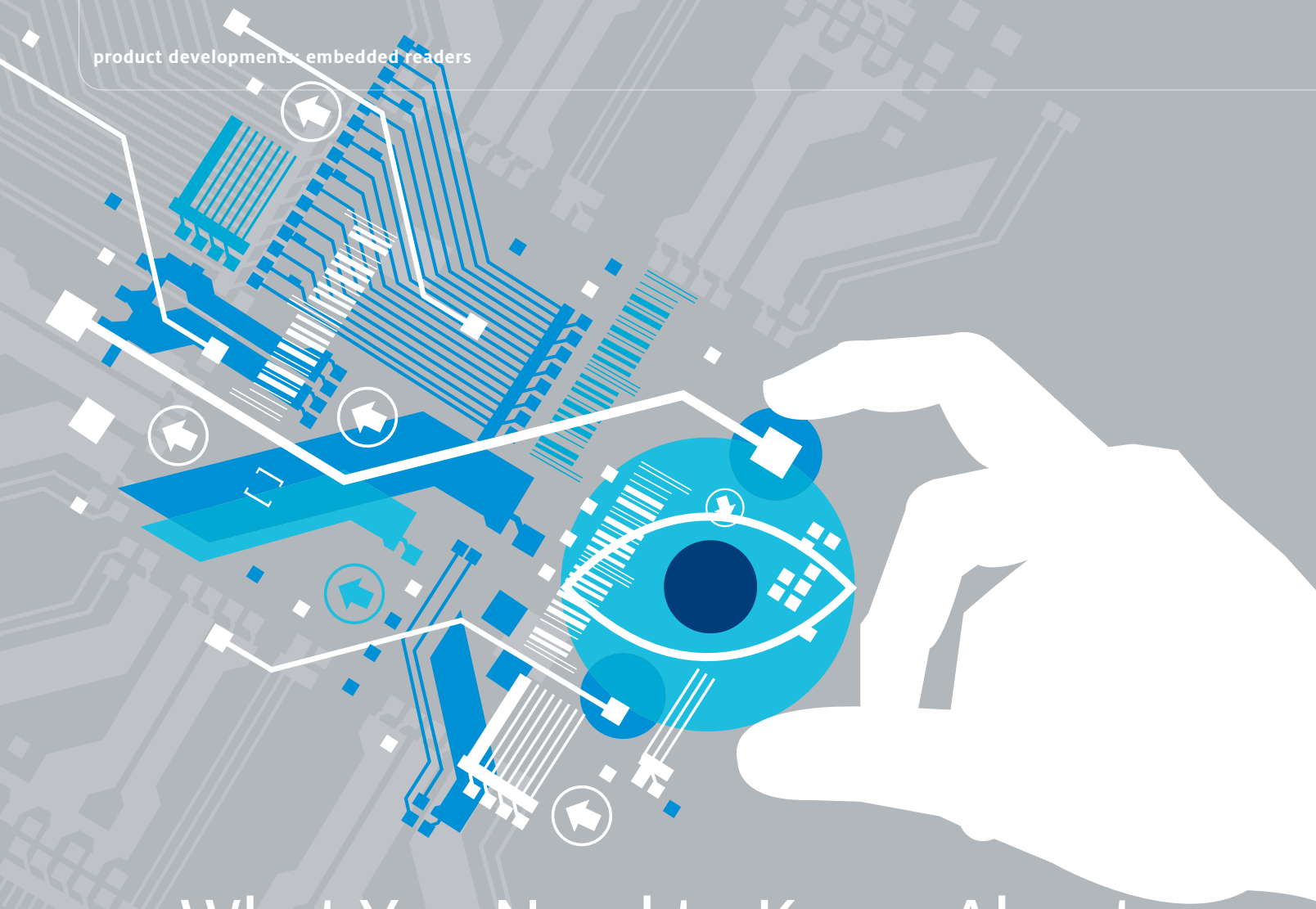
Sports Solutions generates player metrics on proprietary software dashboards for professional and consumer applications.

seeing where they are setting up different channels through which the data is monetized." There remain protocols to work out regarding data distribution for the clubs that own the NFL as an entity, he says. Some, for example, might not want to share all their players' data with external parties or other clubs.

Zebra Sports is rolling out a complementary product with similar functionality to MotionWorks to track football players and their performance during practice. So far, the Detroit Lions, New Orleans Saints and San Francisco 49ers have adopted it. The solution enables coaches to optimize training schedules for top game-day output; if, for example, a player worked really hard at drills, they could scale back his practice the next day. Coaches can also use player positioning and timing stats to better understand how plays were run, so they can address incomplete passes and other errors during practice. "Just as Zebra does for its enterprise asset-intelligence solutions, we'll provide operational visibility to managers and coaches to make better, faster and smarter decisions," Petrosinelli says.

Those coaching and managing sports today think real-time performance solutions are becoming an increasingly important asset, though they caution against losing the human connection when it comes to assessing and preparing athletes. These are "tools to use within the system, not something to base a whole program on," says UNC's Gatz.

"The human factor is still the best for us right now to evaluate and determine the progression of the players' conditioning," concurs the Canadiens' Allard. But, he adds, "We are in a data era" and RFID-enhanced sports solutions that help gather that data are useful in supporting those decisions."



What You Need to Know About

Embedded RFID Readers

BY BOB VIOLINO

ILLUSTRATION: ISTOCKPHOTO

These small modules provide the performance of full-size readers and can be used to create next-generation solutions.

Disney is using self-serve checkout kiosks to track and manage its large inventory of costumes, worth roughly $100 million, worn by characters at its theme parks and on cruise ships. The RFID solution, developed in-house, has saved the company more than $1 million, increasing inventory accuracy and reducing labor.

Interstate Batteries deployed smart storage and display racks to track and manage batteries at 2,000 dealerships in five U.S. markets. Interstate, which partnered with RFID provider Seeonic to develop the smart devices, says the solution eliminates the need to send personnel to dealerships to count battery stock, a process that was time-consuming and error-prone.

The University of California San Francisco Medical Center installed a refrigerated vending machine, Pantry, to dispense fresh food automatically. San-Francisco-based startup PantryLabs developed the RFID solution, which gives hospital personnel and visitors better dining options when the café closes at night.

What these three very different businesses have in common is that each RFID solution for tracking and managing tagged items, whether costumes, batteries or food, depends on a small RFID reader embedded in the kiosks, racks or vending machines. The companies are using ultrahigh-frequency embedded readers from ThingMagic, a division of Trimble.

Elatec RFID Systems and IDtronic are two other leading providers of embedded readers, also referred to as modules. Elatec offers low-frequency, high-frequency and Near-Field Communication embedded readers. IDtronic makes UHF embedded RFID readers, as well LF and HF versions.

In addition to the solutions mentioned above, embedded RFID readers are enabling a variety of new applications, including: forklifts that can locate shipments in warehouses; "magic mirrors" in retail dressing rooms, which can improve customer service and boost sales; smart medical cabinets in hospitals, for managing inventory and replenishing items on demand; and photo booths at events, to engage attendees and market products. But developing a solution that incorporates these devices is not as straightforward as purchasing a fixed or handheld reader. Here's what you need to

The Nano, part of ThingMagic's Mercury6e family of embedded readers, is the size of a postage stamp.

"Adding a finished UHF RFID reader introduces redundant components in a large form factor, whereas a UHF RFID module can often be embedded into an existing device with no change in form factor."

Debbie Power, ThingMagic

know to create a next-generation solution for your business.

ANATOMY OF AN EMBEDDED RFID READER

RFID reader modules are small. The Nano, for example, part of ThingMagic's Mercury6e family of embedded readers, is the size of a postage stamp. But the modules are designed to provide the performance of full-size readers. They transmit and receive radio signals that carry information, such as the identification number of a product equipped with an RFID tag. They use low power consumption, which makes them suitable for mobile applications. Many feature read-write capabilities for label printing and applications with handheld and mobile devices. Zebra Technologies, for example, is using embedded readers from ThingMagic for its R170Xi RFID bar-code printer-encoder. The modules also have one or more connectors to support external antennas.

RFID providers that supply these products note the modules must be combined with other components in order to be of practical use. "The module is the heart of the RFID reader system," says Debbie Power, sales manager at ThingMagic. "For a complete working system, you need to include a small processor to tell the module what to do, what settings to use for operation and how to handle the data. You also need to provide a power supply, an antenna, and some type of enclosure" to house all the components.

"Some of our customers already produce electronic devices that have power, CPU and an enclosure," Power says. "They want to add RFID reading or writing capability to that device. Adding a finished UHF RFID reader introduces redundant components in a large form factor, whereas a UHF RFID module can often be embedded into an existing device with no change in form factor."

For the most part, embedded readers are designed for original equipment manufacturers (OEMs) that integrate the modules in products, such as industrial machines, point-of-sale terminals, and library-management, rental and ticketing systems. Some end users work with systems integrators to develop specific applications that use embedded readers.

Zebra is making ThingMagic's embedded RFID readers part of Zebra's Zatar cloud-based platform, designed for connecting printers,

PHOTO: THINGMAGIC

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beacons and other devices to the Internet so they can be managed remotely. Integrating RFID into the Zatar platform enables the connected devices to share data with any application, according to Zebra. An automobile company, for example, could equip its manufacturing tools with embedded readers and use the Zatar platform to receive real-time information from its production floors to ensure the tools are operating within compliance parameters.

ThingMagic also supplies its embedded readers to companies that make smart cabinets and display systems. Keonn Technologies, for example, uses ThingMagic embedded readers in its AdvanLook interactive displays, which can be used in retail stores to help customers get information about a variety of in-store products. Munich Sports, a Spanish footwear company that installed the system at a children's shoe store in 2014, reports that it's popular with customers, makes employees more productive and boosts the store's image for innovation.

IDtronic integrates its embedded readers in the company's handheld computers and terminals, and in its stationary Bluebox Industrial RFID readers, designed for industrial automation or logistics applications, says Patrick Kochendörfer, a project manager at the firm. "We also have partners and customers using the embedded RFID modules to build their own RFID readers or [integrate] those modules into industrial production machines," he says.

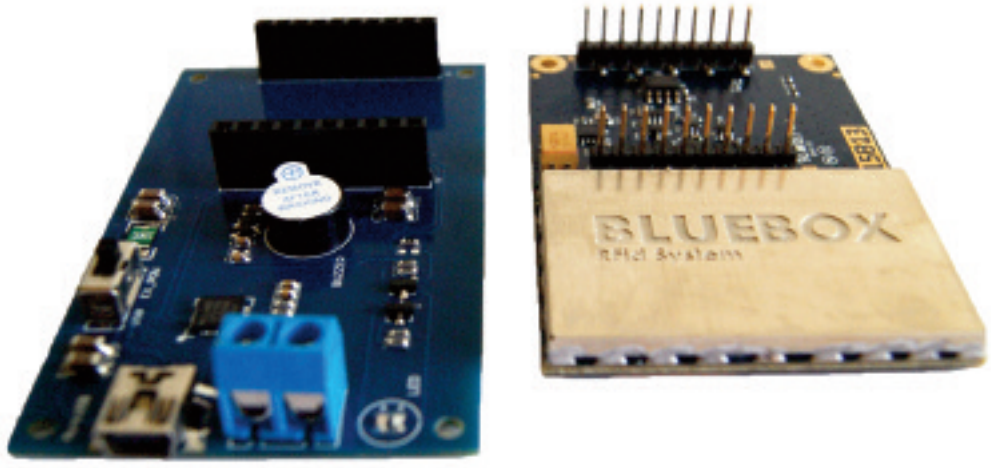
IDtronic customers also use embedded readers for vehicle-based applications, logistics and access control. Due to nondisclosure agreements, Kochendörfer says, IDtronic can't identify customers or partners using its embedded RFID readers. But, he says, one is a company that produces forklifts and other industrial vehicles. "They took our embedded RFID reader modules and integrated them into their latest industrial terminals," he explains. "Those terminals are mounted on the vehicles to manage all vehicle settings or run their industry-specific application on it. For this company, RFID is not the key business, it is just an-

"We also have partners and customers using the embedded RFID modules to build their own RFID readers or [integrate] those modules into industrial production machines."

Patrick Kochendörfer, IDtronic

Some Leading Providers of Embedded RFID Readers

COMPANY	PRODUCTS	FREQUENCIES	CUSTOMERS	DEVELOPMENT KITS
Elatec RFID Systems www.elatec-rfid.com	Two product families: TWN3 (single-frequency) and TWN4 (multifrequency) readers-writers	LF, HF and NFC	OEMs and system integrators technical support	✓
IDtronic www.idtronic-rfid.com	The UHF Modules line (M800, M900 and M950) is the company's latest and most sophisticated offering	LF, HF and UHF; read/write modules for Legic systems	OEMs, technology partners and end-user companies	✓
ThingMagic A DIVISION OF TRIMBLE www.thingmagic.com	Mercury6e family, including M6e, Micro, Micro-LTE and Nano	UHF	OEMs, technology partners and end-user companies	✓



Due to its small size, IDtronic's embedded module M950 fits into almost all devices and housings.

It's important that companies attempting to build their own solutions hire people who understand the technology and are experienced in building a complete system.

Debbie Power, ThingMagic

other option to stay ahead of the competition."

Elatec RFID Systems provides embedded readers designed for integration with point-of-sale systems, to support applications such as physical access control and mobile payments, and managed print solutions for secure printing. The company does not market embedded readers to end-user companies.

DEVELOPING YOUR OWN SOLUTION

While embedded reader providers typically market to OEMs, end-user companies such as Disney and Interstate can develop their own solutions. Large companies with internal resources are more likely to do this on their own, while smaller firms tend to turn to systems integrators for help. The companies that are successful with these projects have a vision of what they want to achieve with RFID and bring in the resources they need, says ThingMagic's Power.

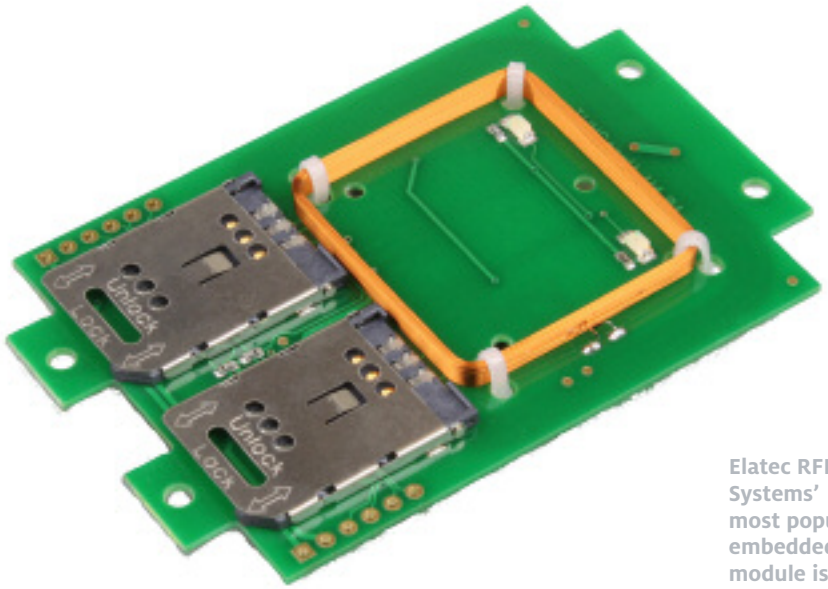
Companies "need the experience and resources to develop their own products and projects," says IDtronic's Kochendörfer. "Most of the end users we know are big enterprise companies. They have their own system integration departments for providing the resources to accomplish a project."

IDtronic offers development kits for customers. "Both our partners and end users can use them," Kochendörfer says. The starter kit comes with all necessary hardware, software and documentation, providing a way to more quickly develop solutions, he says.

ThingMagic also offers a development kit to help companies build RFID solutions based around its modules. In nearly all cases, the kits are used by OEMs, but the company is open to selling these kits to end-user companies as well, Power says. It's important that companies attempting to build their own solutions hire people who understand the technology and are experienced in building a complete system, she adds. If a company has an idea for using embedded readers to create a solution, the best way to proceed is to find a systems integrator that can help with the development process or build the in-house capabilities needed, Power says.

When evaluating modules, companies should consider features such as performance, output power, power consumption, form factor and the number of antennas that can be attached, Power notes. The types of features and capabilities required depend on the appli-

PHOTO: IDTRONIC



Elatec RFID Systems' most popular embedded module is the TWN4 reader-writer.

cation. If, for example, a retailer wants to build a small device that can be carried around in a store or fit on an employee's belt, the Nano would offer the most flexibility. It also offers lower power consumption, which allows for a combination of a smaller, lighter battery and/or longer battery life, she adds. Performance features such as autonomous operation can decrease power consumption, because the "read on power up" mode allows the reader to consume power only when it is on.

In another scenario, a health-care company might require a cabinet that reads a large number of tagged supplies in many drawers and shelves. "Here, form factor is less important and a more powerful, high-performance module such as our ThingMagic M6e" is more appropriate, Power says. It offers four ports that can be multiplexed up to 64 antennas for a large number of read points throughout the cabinet, which typically has metal separating compartments. It also can accommodate RF loss across connectors and cabling, so each antenna gets sufficient power. Performance features can be optimized to accommodate a dense tag population.

Due to its small size, the embedded module M950 from IDtronic fits into almost all devices and housings. "End customers have successfully integrated our UHF modules into handheld computers and PDAs from third-party suppliers, or used them as a basis for OEM desktop and stationary systems," Kochendörfer says. "The wide-range M950, with an output power of 30 decibels per milliwatt, offers read ranges up to 10 meters, four antenna ports and an integrated multiplexer. This allows, for example, portal applications for logistics, vehicle access control or the identification of moving goods."

The IDtronic UHF Stick Reader R830 is ideal for a desktop reader in custom housing, or the integration into terminals and wall scanners, Kochendörfer says.

ThingMagic and IDtronic are both seeing increased interest in their modules from end-user companies. "We tend to match them with a systems integrator in their area and industry," Power says.

"We see that the interest from end users is picking up," Kochendörfer concurs. "Bigger companies that can provide the resources for integration projects are interested in our products."

"We see that the interest from end users is picking up. Bigger companies that can provide the resources for integration projects are interested in our products."

Patrick Kochendörfer, IDtronic

PHOTO: ELATEC

Try It—You'll Like It!

The RFID Lab's annual state-of-adoption report of U.S. retailers shows companies that trial and pilot RFID solutions for inventory management are deploying them.

By Bill Hardgrave

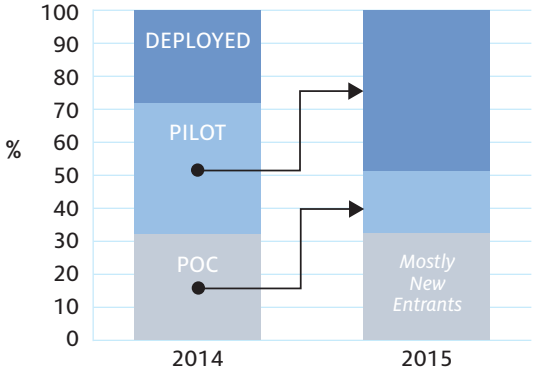
EVERY JUNE for the past five years, the RFID Lab has analyzed RFID adoption by U.S. retailers. While it's not a scientific study—the analysis is based on publicly available information and the lab's work with various retailers—it has provided a reliable snapshot of both new and existing adopters. Following three years of slow adoption, the past two years have witnessed tremendous growth in both the number of retailers testing RFID and those deploying solutions. And we're seeing this among all types of retailers—from large department store chains to smaller specialty shops, though mostly in the apparel sector.

For the study, we consider whether a retailer is conducting a proof of concept (POC), pilot or deployment. A POC, which typically involves one or two stores and a limited number of merchandise categories, is designed to demonstrate RFID's effectiveness in the retailer's environment. The next step is a pilot, which generally involves more stores and categories, to determine if the RFID application, and the resulting benefits, can scale. If the pilot is successful, retailers then move to deployment. Large department stores typically roll out RFID to the entire chain in one or more categories; over time, they add other categories. Specialty retailers tend to RFID-tag all items in one store at a time, until all stores are RFID-enabled.

The 2015 study reveals a pattern of movement expected in a healthy adoption environment. The graphic shows the stage of adoption of U.S. retailers currently investigating RFID solutions. More retailers are deploying RFID, so even though some of the percentages are similar, the total number of retailers in each category is higher this year than it was last year. In fact, new retailers adopting RFID increased a whopping 23 percent from 2014 to 2015; most are new entrants conducting POCs. Many of the retailers that conducted POCs in 2014 moved to pilots in 2015 (some are still conducting POCs). Most retailers that conducted pilots in 2014 moved to deployment in 2015 (the others are still doing pilots).

I suspect the healthy adoption rate is due in large part to the growing awareness among retailers that RFID is necessary for omnichannel retailing, a service retailers must provide to remain competitive. For the upcoming year, we expect both the number of new adopters and those deploying solutions to exceed this year's growth.

The stage of adoption of U.S. retailers currently investigating RFID solutions



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

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Total Cost of RTLS Ownership

Several active and passive real-time location systems may meet your needs, so it's best to evaluate your options solution by solution.

By Ygal Bendavid and Harold Boeck

IN OUR PREVIOUS COLUMN, An RTLS Self-Exam, we suggested a set of questions hospital managers should ask when selecting an RFID-based real-time location system. Once you've defined your business and technology requirements and issued a call for tender, you'll likely receive proposals from providers of both active and passive RTLS solutions.

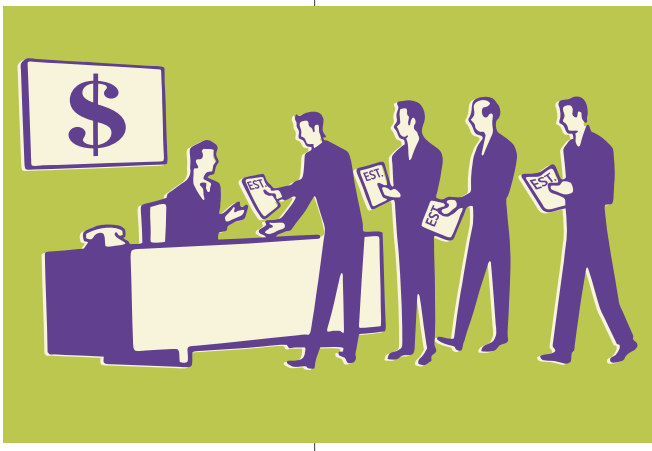
We acknowledged that total cost of ownership can vary greatly between these kinds of systems. Moreover, TCO can vary among the different passive systems—not only those that use traditional reader portals in doorways, hallways and other choke points, but also newer systems that feature phased-array antennas for zone monitoring. So rather than compare active versus passive systems, we recommend you assess the options on a solution-by-solution basis, taking into account the stages of an RTLS project life cycle.

Procurement. Vendor proposals typically include detailed costs of individual components and consultants, but the project costs are based on similar deployments. Ask what and how many resources—equipment and people—your deployment will require.

Active tags are more expensive than passive tags, but some passive systems may demand more readers and antennas. Ask how many readers and antennas and, perhaps, beacons or exciters you'll need to provide the location accuracy and tag-detection immediacy required for your business case.

In addition, look into software license fees; some providers charge based on how many tags you'll need and others on the number of users per year. One solution could be more expensive to acquire but cheaper to maintain.

Implementation. What is the cost of deploying the system? In addition to considering cable placement and other installation issues, ask about the implementation plan. Active systems typically require a great amount of time to calibrate and test for location accuracy. The plan should also include the cost of configuring and integrating the software platform.



Maintenance. The batteries in active tags must be changed periodically. Do the tags have a sleep mode or other feature to reduce battery consumption? What's involved in monitoring all the readers in a passive system?

Future plans. As suggested in our column To RTLS or Not to RTLS, you've prioritized your use cases and determined which to address first. But you need to know what will be involved—and what it will cost—to address the other use cases on your list. When you know the specific costs of the active and passive RTLS solutions that meet your needs, you'll be able to make a smart business decision.

Ygal Bendavid and Harold Boeck are professors in the school of management at the Université du Québec à Montréal, and members of RFID Academia's research board.

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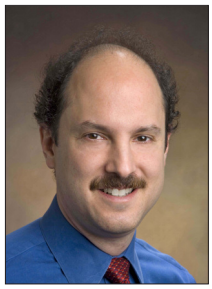
An Online Community for RFID Software Developers

The EPC UHF industry must take steps to welcome innovators.



LAST MONTH, the RAIN Alliance—an industry consortium dedicated to promoting adoption of ultrahigh-frequency RFID technology based on the ISO 18000-63/EPC Gen 2 air interface—met in Portland, Ore. A RAIN subcommittee made three observations about how to improve life for software developers.

First, there needs to be an online community where developers can learn what others are doing and get answers to questions. A typical developer community includes discussion groups and links to educational material and open-source software. Online communities can thrive only if there is critical mass. This means there has to be some commonality in the software interfaces provided by the various reader manufacturers. RFID isn't big enough to support different developer communities for, say, Alien Technology, Impinj and Zebra Technologies, but it is big enough to support one community for all of them.

Second, software engineers must be able to work in familiar ways. Most RFID reader development kits are based on a decade-old style of programming, when the World Wide Web was in its infancy and only weather forecasters talked about clouds. Today's software engineers are accustomed to working in high-level scripting languages oriented toward Web computing and cloud computing. Reader interfaces have to support that paradigm.

Third, the industry needs standardized reader interfaces that operate at a higher level than what's available today. Many readers support the GS1 Low-Level Reader Protocol (LLRP). But as the name says, it is a low-level interface that was never intended as a starting point for building applications. Using LLRP requires too much hardware-specific knowledge, and the data that comes out is raw binary data, not a decoded application-level identifier such as a Serialized Global Trade Item Number.

Consequently, application developers must resort to middleware to get a high-level interface, but that adds complexity and expense that can be justified only when networks of many readers are employed. Reader companies usually provide free software development kits akin to a lightweight middleware layer, but most of these are low-level, too. Nearly all of them, for example, deliver only raw binary data to an application.

RAIN is in the process of establishing a developer community. That could help address the other two issues. As I wrote in my May/June column, The State of Reader Interfaces, the GS1 Application-Level Events (ALE) standard can deliver RFID data in a format most application programming languages are designed to understand. But most reader vendors don't support it. A robust developer community could lobby reader vendors to support ALE or a similar protocol. Or developers could create open-source software that supports ALE and works with proprietary readers. ALE also supports high-level scripting languages, so that issue would be addressed, too.

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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