SELFSERVICEWORLD

Demystifying RFID

WHAT EVERY BUSINESS-PERSON NEEDS TO KNOW ABOUT RADIO FREQUENCY ID TECHNOLOGY

By Frank Richmond,
Self-Service World
contributor

Radio Frequency Identification (RFID) technology promises to reshape our daily lives in many spheres, from shopping to shipping to medicine, so it makes sense to be informed about its rudiments. Although the much-talked-about future applications sound almost magical, RFID is really a combination of technologies that are familiar already.

RFID HISTORY: A MARRIAGE OF RADIO AND RADAR

Commercial applications of RFID began in the 1960s when one of its early uses was in electronic article surveillance anti-theft equipment. But the technology's origins date back to the beginning of the century.

RFID joins radio broadcast and radar technology, so its origins begin in 1906 when Ernst F. W. Alexanderson became the first person to demonstrate continuous wave radio generation and radio signal transmission. In the 1920s, radar technology was born. Harry Stockman explored the idea of combining radio and radar in his 1948 paper, "Communication by Means of Reflected Power," but RFID still needed the development of crucial components like the transistor, the integrated circuit and the microprocessor. In the 1950s RFID got a boost from development of long-range transponder systems applied to the problem of identifying friend-or-foe aircraft, pioneered by the British in World War II.

The 1970s were the great decade for intensive developmental work in RFID. Important work was done at Los Alamos Scientific Laboratory, Northwestern University and the Microwave Institute Foundation in Sweden where companies like RCA, Fairchild and Raytheon conducted research. In the 1980s the marriage of radio and radar began to bear fruit. RFID units were installed in toll roads throughout Europe. There, the tracking of animals was important, but in the United States emphasis was on transportation and personnel access.

Copyright 2006 SelfServiceWorld

RFID strode forward into the 1990s with the widespread use of electronic toll collection in the U.S. A major development was the new capability to use a single tag for multiple applications, such as access to parking lots, gated communities and campuses. Item management and check-out alongside barcode grew.

HOW IT WORKS: FOUR ELEMENTS OF RFID

The four components of a basic RFID system are the host computer, the reader, the antenna and the transponder, or tag. The host computer initiates the chain of events, causing the reader to "interrogate" its field via the antenna, which broadcasts electromagnetic waves over a given range. A tag passing within that range detects the reader's activation signal. The reader reads the data encoded in the tag's integrated circuit, or silicon chip, and sends it to the host computer for processing.

RFID tags, like barcodes, will become familiar in more forms as usage grows, but many of them are already familiar sights. Hard plastic anti-theft tags are attached to merchandise in stores. Screw-shaped tags can be screwed into wooden items or trees, credit-card-shaped tags facilitate access applications, and tags embedded in tiny glass capsules are inserted under the skin of animals for identification. Heavy-duty tags as large as 4 by 6 inches are useful for tracking large shipment containers or trucks, railroad cars and heavy machinery.

Four Key Benefits for RFID at Retail

In its new "Consumer Packaging Report 2005/6," consumer-packaging firm Rexam gives four key benefits to the adoption of RFID in retail enterprises.

1. Product safety. RFID tags can ensure that products are not counterfeits, have not been tampered with, and are not out-of-date. Key areas affected are pharmaceuticals and food and drink.

2. Improved shopping experience. RFID is already at work in "smart carts," which identify products as they are placed in the cart, offer suggestive selling tips and maintain a running total of merchandise cost.

3.Merchandising and marketing. RFID tags can carry a wealth of information, and that information can be integrated with other devices throughout the store. For instance, a kiosk could read the tag of a wine bottle held in front of it and offer a description plus food matching tips.

4. Product functionality. RFID tags can give information to other devices for other purposes. In Chicago, pharmacists place a tag under the label of prescription drugs. When visually impaired customers pass the bottle under a reader device, the dosage instructions are read out loud.

Tags themselves are of two types: passive and active. Passive tags are powered by the reader, and have no internal

Copyright 2006 SelfServiceWorld

battery. They are, therefore, lighter and smaller than active tags, cost less and have almost unlimited life. For those reasons, they are more suitable than active tags for attaching to individual items of merchandise for check-out and to prevent theft.

Active tags are powered by an on-board battery power source, and because of their greater bulk and higher cost, are more suitable for use with pallets of merchandise rather than individual retail items. Their range is greater than that of passive tags, they require less power from the reader, but their life is finite.

Antennae are as varied in form as tags, again according to application. Antennae can be mounted on a freeway tollbooth to monitor passing traffic, or they can be incorporated into a doorframe to check access of persons or to collect data, whether from purchases or other items. They can be activated for ongoing interrogation if a relatively constant flow of information is needed, or a sensor device can activate them if the need is intermittent.

DIFFERENT FREQUENCIES FOR DIFFERENT PURPOSES

To understand how frequencies work in RFID technology, imagine an ordinary radio with channels playing different types of music. To listen to the music of your choice, you have to tune in to the right channel.

Likewise, a tag has to be tuned to the same "channel" (frequency) as its reader in order to communicate. Frequencies fall into four categories: low-frequency (LF), high-frequency (HF), ultra-high-frequency (UHF) and microwave. Different applications require a careful choice of frequency,

Retailers lagging behind manufacturers

According to the survey, "RFID: How Far, How Fast?" sponsored by NCR Corp. and conducted by Retail Systems Alert Group, the adoption rate of RFID is moving at a modest pace. Many challenges, both technical and cultural, continue to impede the growth of RFID. However, there is reason to believe growth may be on the way.

Highlights of the survey include:

- Retailers are lagging far behind manufacturers in adopting RFID. Only 9 percent of retailers who responded to the survey have an RFID-implementation timeline, and the majority of retailers who responded positively estimated their organization's overall revenue to increase to $5 billion or more.
- 44 percent of manufacturers have developed a timeline. Although fewer retailers reported a timeline for implementation, those retailers that have a timeline reported they are spending more than in 2005.
- Manufacturers are focusing attention on one to 50 product lines, rather than across a broader range of product lines as was reported in the 2005 survey results.
- Among those companies that have a timeline for RFID adoption, most respondents (both retailers and manufacturers) report they have pilot distribution centers up and running.

According to the survey, although there still may be several challenges that are on the horizon in the adoption of RFID, the outlook is cautiously positive. The awareness level of RFID among C-level executives, directors and managers has significantly improved. In addition, many respondents are aware of the benefits their companies can expect within the first five years of RFID implementation.

(Source: NCR Retail Solutions Division, Retail Systems Alert Group)

Copyright 2006 SelfServiceWorld

which determines the behavior of the radio waves.

Scanning fruit, for example, would require low-frequency tags, which work well for objects with high-water content and can penetrate non-metallic substances. High-frequency tags also work well for objects with high-water content, but they can penetrate metal too, so they might be a good choice for canned goods. Ultra-high-frequency tags transfer data faster than tags of lower frequency, but they have lower penetrability and have to be directed with a clear path between the reader and the tag. Boxes of goods passing through the door of a dock into a warehouse might be suited to UHF tags.

Another consideration with regard to frequencies is range. In general, higher frequencies can read from greater distances, but require more power. Low-frequency tags have read ranges of less than a foot. High-frequency tags can work at about three feet and the UHF tags have even larger ranges.

RFID IN TODAY'S WORLD

One of the largest uses for RFID is tracking consumer goods. Wal-Mart requires suppliers to include RFID tags at the pallet level. "Eventually that will filter down to the product level," said Dr. John Naber, an associate professor of electrical engineering at University of Louisville who is working to develop new applications of RFID.

Access control and payment systems also benefit increasingly from RFID. Payment systems include pervasive toll collections, as well as the growing field of contactless payments, increasingly embraced by convenience stores, restaurants and financial institutions.

RFID has such varied potential that many exotic applications already are springing up. At the Lynn, a Las Vegas casino, casino chips contain RFID circuits to foil counterfeiters and to create a flow of data on the betting habits of patrons. Cheese manufacturers have embedded RFID chips in the crusts of cheeses to track the manufacturing process; the chips replace the old method of branding the cheeses.

In 2005, McCarran International Airport in Las Vegas began to use RFID in bag identification tags. Its goal is to reduce baggage-handling time, increase accuracy

The human interface

In the future, RFID might track the movements of humans, not just products

RFID will one day be a part of us — literally. Dr. Kevin Walsh, a professor of electrical engineering at University of Louisville, spoke of medical applications that will place RFID inside living human bodies. There will be "implantable smart chips that would be placed inside the eye to measure intraocular pressure for the prevention of glaucoma," he said. "We have another project involving orthopedics aiding spinal fusion implant surgeries. The RFID device is mounted on the hardware and monitors strain on the implanted rod."

RFID inside the body would surely increase the level of comfort with the technology. Then the sky is the limit as far as self-service applications is concerned. And what requires the most trust of all? Anything involving our children.

Walsh and Naber describe applications in amusement parks helping parents keep track of kids, although Naber points out that with passive tags, many readers would be necessary. Perhaps, as Walsh suggests, active tags will become popular pieces of personal equipment, with ranges equivalent to cell phones.

Copyright 2006 SelfServiceWorld

and reduce lost bags. Whereas the barcodes ceased to work if the paper tags were torn or scuffed, RFID chips still work even if the tags they're attached to are damaged. And where the barcode tags had an accuracy read rate of 85 percent, RFID's accuracy rate is 98 percent.

RFID TOMORROW

Eventually RFID will transform the self-service industry, virtually replacing barcodes at checkout in retail and streamlining shopping. The main benefit to shoppers will be time saved, but retailers and manufacturers will also see benefits. Tags will make the supply chain more efficient, helping retailers keep track of their assets and reduce loss. Tags will give feedback not only about location but also condition; providing data about temperature, vibration and humidity. Retailers will have much faster data flow about purchases, aiding timely restocking and cutting losses on unnecessary purchases. That data will be forwarded to manufacturers who will have near-instantaneous information about how many of a particular item to make, thus reducing waste.

Changes will not happen overnight, though. The retailer will notice changes first, partly because certain problems at the consumer end have yet to be solved, and partly because of the need to build consumer trust.

"Retailers will first deploy RFID in the warehouse and supply chain side of the business," said John Parsons, U-Scan Self-Checkout marketing programs manager at Fujitsu. "It will be cost effective to mark and track pallets of merchandise to make sure that the pallet gets on the right truck and then is delivered to the correct store, etc. When some of that bulk merchandise is perishable, RFID sensors can monitor whether or not the case of product has made it to the freezer or cooler in time. After retailers have deployed RFID into the supply chain and have perfected it, they will begin to think about single unit identification and the subsequent recording of the sale of that item."

Dr. Kevin Walsh, a professor of electrical engineering at University of Louisville who directs research in nanotechnology, said tags will get smarter over time, making them more useful.

"The trend is toward making these things smart, so that they can monitor the environment that they're placed into," he said. "They would register environmental conditions like temperature, vibration, humidity, air pressure, maybe oxygen content. And the future really lies in the marriage between microsensor technology and RFID technology to create these smart transponders."

GETTING FROM 'TODAY' TO 'TOMORROW'

So what refinements will be necessary to move RFID from the supply side to the consumer side of business?

Fujitsu's Parsons identifies cost and privacy as central issues. Brad Geiger, manager of University of Wisconsin's RFID Lab, agrees, saying that "tag costs must come down further and there must be some very visible examples of companies realizing a significant return on investment across multiple use cases."

Copyright 2006 SelfServiceWorld

Cost is less of an issue with pallets, since a single tag can be used for many items. But for very cheap consumer items, even a relatively inexpensive tag can be a significant percentage of the total cost.

Companies are pouring money into research to bring that cost down; Naber pointed to companies like Proctor & Gamble, which is working to develop conductive inks that would allow tags to be printed rather than manufactured.

Naber also said privacy concerns have a potential technical solution. Customers may fear that if tags remain active after their purchase, personal property can be tracked into their homes. When products are checked out at the cash register, RFID tags can be deactivated, just as current anti-theft devices are. But according to Parsons, such "tag-killing" still needs to be perfected, because deactivating a tag at check-out can deactivate other tags nearby.

Copyright 2006 SelfServiceWorld