Deployment Experience Creates Progress – Sort of

By Mark Willoughby

The experience from mandated EPC RFID deployments has already created significant advancements in both the technology and understanding of its use. A major example of that progress is the new EPC Global Generation 2 Air Interface Protocol (EPC Gen 2) which creates global frequency standards and solves several problems of earlier protocols. However, experience is also revealing that the technology of EPC RFID has some distance left to travel before the industry can move beyond being mired in tags and readers and address the identity infrastructure necessary for secure, compliant, large scale global, interoperable deployments.

In December 2004 EPC Global approved the Generation 2 Air Interface Protocol (called Gen 2.) In addition to creating a global UHF frequency standard, this protocol includes major improvements for managing dense networks of RFID read-

ers in busy warehouses, and dramatic increases in read and write speeds, according to EPC Global who oversaw the standards effort (see table 1.)

Gen 2 EPC chips for supply chain applications are expected to fuel rapid growth in the RFID marketplace. According to analysts at In-Stat, Scottsdale, Arizona, annual RFID tag usage will balloon from 2004's $300 million to almost $3 billion in 2009. They expect that supply chain applications will propel RFID to the number two spot for most widely used wireless technology after cell phones.

More Speed, Less Interference

"The RFID readers, given that UHF has relatively long read ranges, can interfere with each other. Now [with Gen 2] we can spectrally spread the readers so they don't interfere with each other," said Sue Hutchinson, the director of product management for EPC Global, a joint venture between EAN International and the Uniform Code Council. Boosting read rates for larger pallet-sized lots of goods in busy warehouses means "many small antennas" densely packed to cover the desired space, similar in concept to 802.11 wireless local area networks.

Gen 2 speeds RFID read rates by a factor of five or better, reading the boxes and pallets of goods moving through supply and distribution chains at rates approaching 1500 RFID tags per second, Hutchinson said. But realizing the faster read rates requires some extra work when packaging, or the goods themselves, interfere with the physics of RF energy.

Liquids, Metal, and RFID

Any high school physics student or reader of a Tom Clancy book knows about the propensity of liquids to absorb RF energy – which is why sound waves are used to find submarines underwater. In a perfect world RFID chips can be reliably read on a pallet to a maximum range of 10-15 feet. In the real world, however, containers of liquid absorb the chip's RF energy and degrade the range and read rates.

Joining liquids in the pantheon of RFID miscreants are any packaging materials containing metals. Metals, including foil seals, labels, and most of all cans, are highly reflective of RFID radiation. This imbues radar with the endearing quality of telling us where the Russian Backfire bombers are lurking. For RFID, however, it can create significant difficulty.

So how can a big distribution chain behemoth use RFID to gain a strategic advantage for all those liquids – worse yet, liquids packaged in metal? Borrowing a page from the lessons learned in boosting the effectiveness of biometrics, you work closely with the technology vendors to optimize performance in specific situations, while simultaneously tuning business processes to mitigate those conditions that degrade performance.

Learning in Phases

Christi Gallagher of Wal-Mart says the Bentonville, Arkansas distribution giant "does not expect to read 100% of the cases on pallets, but we do expect to read 100% of the cases circulated on a conveyor." Distributors quickly learn what products must be reduced from pallets – which can be read on a forklift – to cases that can be read as they snake down a conveyor.

The cost of handling pallets, being less than the cost of handling cases, brings the economics of risk management into play. The high probability of not being able to

Table 1: What's in the EPC Global Gen 2 Air Interface Standard for RFID Chips

Open Standards - Tags are available from many sources and prices should drop towards the magic 5-cents per tag threshold for mass supply chain adoption

Memory and Password - 96 bit memory plus 32-bit password on the chip gives more storage and security against the chip being hacked in a retail store

Size - Chips will be 2X-3X smaller than current versions

Cross - Vendor Compatibility – Interoperability between all equipment from multiple vendors

High Reliability - Tags have extremely high read rates (close to 100% in case lot tests)

Better Tag Identification - Eliminates duplicate reads during multiple tag scans

Kills - Tags can be permanently killed by a reader to prevent re-use

Security - Tag data is secured with a password, readers do not broadcast tag data being read

Timing - Tags can enter a reader field late and still be read

Global Frequency - Spread spectrum, frequency-hopping UHF with frequency-modulation capabilities to minimize interference with other wireless devices

Table 2: Wal-Mart's RFID Deployment

	Trial	Live
Timing	April 30, 2004	1Q06
Number of Vendors	137	More than 300
Number of Stores	140	600
Number of Distribution Centers	3	12
Number of States	Texas	Nationally
Estimated Number of Products	1,000 SKUs	100,000 SKUs
Tagging Level	Cases & Pallets	Cases & Pallets, maybe Item-level
Claimed Pallet Read Rates	More than 90%	98% goal
Claimed Case Read Rates	100%	100%
ERP Status Updates Posted	30 Minutes	30 Minutes Average Supplier
Estimated Cost per Tag (Class 1)	20-50 cents	5-20 cents
Avg. Supplier Investment	$500K-$3M	Unknown but much more
Est. Time to Supplier Payback	2 years	More than 2 years

adequately read RFID chips on pallets containing cases of liquids, or cans and foil packaging, carries a high impact. Who pays for mitigation? Who bears the increased handling costs of case-lot deliveries, replacing metal packaging, or for beverages like beer and pop, both? These are issues that are still being worked out.

The Case of Beer

Beer is doubly bedeviled as a liquid product frequently packaged in a metal can. Those two problems – a new rendition of the Coors twins – are compounded by the nature of the beer industry, according to George Neserke, group manager of long-range planning at Molson-Coors. Nerserke said the intense competition in the beer industry keeps profit margins low while Federal law prohibits brewers from selling directly to retailers, mandating large networks of distribution intermediaries.

Thus beer is sold to retailers by intermediaries with Coors having 530 nationally. According to Nerserke, distributors do the bulk-breaking chore, reducing pallets of identical products while assembling new pallets to fill retail orders for a mix of product. Each beer delivery to a retailer may take up to 90 minutes. If the physics of RF energy, metal and liquids can be overcome with chip placement and business processes, the time spent at each beer retailer could be cut dramatically. This would reduce the distributor's costs.

Coors plans to discuss the RFID issue with their distributors to work out the cost sharing in a hyper-competitive marketplace. "In many situations the profit margin on a case a beer would be equivalent to the cost of the tag," said Neserke. "If the distributor is required to put a tag on each case, that could wipe out entire lines of business."

Coors is among the next 200 suppliers Wal-Mart wants to be using RFID by the first quarter of 2006 (see Table 2.) Neserke said he's not worried yet. "Anheuser-Busch is in the top 100" (who need to be using RFID now.) I'm watching what they do, so I'm not too concerned."

Wal-Mart Makes Suppliers Find a Way

For Wal-Mart, refining the distribution process is a partnership and they have not yet encountered a situation with pallets or cases for which no suitable RFID solution could be found. Packaging is the responsibility of suppliers, who are free to pass along increased packaging and handling costs, if they can. So far, industry analysts at Dallas based Incucomm estimate, Wal-Mart suppliers have spent an average $500,000 each on RFID compliance. Boston based AMR puts the number between $1 and $3 million per Wal-Mart supplier.

"One of the biggest lessons for our suppliers has been that a single type of tag, or antenna design, does not necessarily fit all of their products. If we discovered a tag that wouldn't read during the pilot, we worked hard to understand why," Wal-Mart's Gallagher said. "It might have to do with placement, or with the materials that are tagged, or even the size of the antenna selected. All of this information is shared back with technology companies and suppliers."

Retailers are mixed on the value of RFID in the supply chain. A few others in the very large category – Tesco, Metro, and Marks and Spenser – are also conducting well-publicized trials. The majority of retailers, however, are unwilling to shoulder the risk of being an early RFID adopter, not having Wal-Mart's economies of scale as an incentive.

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Security is a Consideration

More efficient warehouse operations are not the only improvement in the Gen 2 standard. Also designed into the "air interface standard" is a pair of new security capabilities to help secure supply chains.

The first new Gen 2 security feature is the ability to "kill" an RFID chip, to disable the chip permanently. Killing a chip is desired by supply chain users to dispose of chips typically making just one trip through the supply chain and costing in the neighborhood of 10-25 cents. The chips, once read, can be killed and safely disposed, with no chance of being re-used for malicious purposes.

Also included is a locking and password mechanism to secure the contents of the tag. The data on an EPC RFID chip consists of quantities, inventory numbers and product descriptions. Backend supply chain management systems typically are needed to make any sense of the product code numbers contained on an RFID chip. EPC chips are not used in applications such as bankcards that include personally identifiable information.

With the new security standard, "passwords are numbers assigned by vendors," Hutchinson said, according to security policies of the users. "Nobody can access or change the contents of the RFID chip without the password," which, at 32-bits, is deemed sufficient to protect the contents of fast-moving supply chain data. Even the U.S. Dept. of Defense, the second largest user of EPC RFID chips after Wal-Mart, has gone on record as not seeing much of a threat to supply chain data. The DoD does not require the information on EPC RFID chip to be secured, including the 97% of tagged cargo pallets being shipped to Iraq.

Beyond the Supply Chain

Supply chain applications are only one, albeit the largest one, of many planned for EPC RFID chips. The EPC Global Gen 2 chips are labeled Class 1, part of the International Standards Organization's (ISO) 18000-6 standard for UHF RFID. The ISO, which issues industry standards for all types of RFID chips, accepted EPC's Gen 2 specification as a proposed standard in January.

Meanwhile, a consortium of Japanese companies proposed in January a subset of the Gen 2 standard to the ISO as a competing standards proposal. Leading sponsors of the so-called Hibiki proposal are Japan's Ministry of Economy, Trade and Industry (METI), Hitachi, Dai Nippon Printing, Toppan Printing and NEC.

The Hibiki proposal is a subset of the Gen 2 specification. Backers claim a 40% smaller chip by discarding one of two data encoding options that may not be useful in countries that have a smaller licensed RF spectrum for RFID chip operations. The ISO expects to have a ruling on the final international UHF RFID standard by year-end.

The Future of RFID Application

RFID use also will grow rapidly in livestock, domestic pets, humans, pharmaceuticals, large freight containers, package tracking, consumer products, security and access control, banking and purchasing. Many of these applications will involve RFID chips defined by other ISO standards, which cover active versus passive reading, the RF signal range versus reading on contact only, and the chip's level of security.

The more complex RFID chips carry a steeper price, some as high as $25 per chip for a Class 3 or 4 chip that includes a battery to power an active signal that can be read over hundreds of feet. The more sophisticated RFID chips are designed to carry personally identifiable data that has raised privacy concerns about unauthorized uses of the information, such as consumer tracking. Personally identifiable data on RFID chips also is protected by encryption, which was the target of a recent well-publicized "proof of concept" hack unlikely to ever be repeated in the wild by a real hacker.

The European Union has started issuing specific privacy regulations governing how the personal information on RFID chips can be used. In the U.S. personally identifiable information on RFID chips is subject to the protections of Gramm-Leach-Bliley, the Health Information Portability and Accountability Act and Sarbanes-Oxley, which does not protect a company acquiring information in a transaction from engaging in consumer tracking.

As the technology matures, it seems likely that privacy will replace physics and cost as the top RFID concern. RFID chips based on plastics and electronic ink are looming. They have the potential to drive the cost of an EPC RFID chip to the 1-cent threshold and take the identification of things to a level unforeseen today. RFID has a bright future, but it is still in its early days. ■

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