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RFID: When Should I Start to Pay Attention? Is RFID technology ready for the market, and what will I do with all that data?

For some years, the IT trade press has been full of the impending adoption of RFID in every vertical market. Strategic planners in manufacturing, retail, health care, and every other field have been warned to anticipate radical changes in work flow and value chains. But most of us have not yet seen a “tag” in operation in a business process. So it has become fair to ask if this is real.

This article is an attempt to survey the state of the art of RFID. It will explore four issues:

- The strategies of the players in RFID
- The size and shape of the RFID market, both at present and as predicted
- The risks and concerns
- The scenarios by which RFID systems might become integrated into existing systems

STRATEGIC DIRECTIONS

The logic of RFID is to provide increased information about transactions and logistics, of much higher reliability, at much lower cost. The technological trends are towards smaller, more durable chips, with better ability to communicate with “interrogators” (tag readers), and over longer distances. This has led to variety in the design of tags, and the chips that are in them, as well as in use of different portions of the radio spectrum. The variety of approaches has meant slow growth of standards and consequent reluctance on the part of end users to commit to adoption.

In general, using lower frequencies (13.56MHz is the most common) means lower cost and more resistance to radio frequency interference (RFI), but limits the tag to lower data rates over a shorter range. Using higher frequencies (in the UHF – 868-956MHz – range) allows higher data rates and longer range, but at higher cost and with more susceptibility to RFI. So the optimal design for automated highway toll-gathering at speeds of 70 mph and distances of 15 feet is very different than the optimal design for taking inventory on retail shelves with a hand-held reader at one foot. Moreover a system that will work reliably to identify pallets in one warehouse, with minimal RFI, may not be reliable in another, where RFI from fork lifts, cordless PBX systems, microwave ovens, or bug zappers drowns out the ID. And, obviously, applications that foresee an RFID tag on every consumer packaged good (CPG) are only feasible if the cost of the tags is driven way down.

Chip manufacturers have indicated that producing chips that cost less than one cent each, so that tags could be produced for less than five cents, is possible only when orders of ten billion tags are received. That is the price level that is assumed to be necessary before “item level” CPG tags could be placed on most retail products. Chipless tags, costing one cent each or less, will soon be able to be printed onto products and packaging with all-polymer transistor circuits and electronic inks. This will allow the item level CPG tag market to mature. These technologies will need another five years to be ready for

mass deployment. This means that there will be a transition period in which the market for tags, as a separate product market, will grow and then decline as the integrated chipless tag becomes possible. At that point the growth will be in polymers and inks used for chipless tags, as well as in more sensitive interrogators to work with these new tags.

MARKET FORECASTS

According to the RFID trade association, IDTechEx, 1.8 billion RFID tags have been sold up to now, 77% of those were "active" tags (with batteries). Thus far, the most successful applications have been in access control, automated toll collection and parking lot access, and public transportation sectors. The total 2005 market for tags, systems, and services should be about US\$1.94 billion, and should grow to about US\$24.50 billion in 2015.

Remembering that the five cent tag barrier is predicted to be broken with orders of ten billion tags, it is noteworthy that IDTechEx estimates the 2006 market for pallet/case tags at 3.1 billion and the 2008 market at 15.3 billion. This ignores other growing applications such as item level tagging of pharmaceuticals, meat and livestock tagging for food safety, books, tickets, hospital IDs, and a variety of others. Nonetheless, even considering these "niche" markets (if you can call them niches when they have potential sales over one billion) the real breakthrough in adoption rates will occur after 2010, when chipless tags make item level tagging of tens of trillions of CPGs and hundreds of billions of tags for other applications economical. By then the market will have bifurcated into "niche" applications where five cent tags with chips are appropriate and mass market item level applications where one cent or less chipless tags are called for.

Before that breakthrough, the revenue from RFID applications will already have gone through a transformation. ABI Research predicts that global revenues from RFID integration services will surpass revenues from tag and interrogator products by 2007, when they will both be at \$2.7 billion. Thereafter, systems integrator revenues will grow in excess of 35% per year, while product revenues will grow at a slower pace.

RISKS AND CONCERNS

Although there are some troubling technical issues, the primary areas of concern for RFID are economic. The technical issues have to do with RFI and reach. The recently approved Gen2 (second generation) standard from EPCglobal Inc. uses UHF frequencies to enable greater reach, while the interference issue is being addressed from both sides. Vendors like IBM, HP, and Samsung are working on better antennas and signal propagation while CPG vendors like P&G are working on packaging that will facilitate signal propagation and limit RFI.

The economic issues may prove more formidable. A.T. Kearny estimates that a typical retailer will pay \$400K per distribution center and \$100K per store, along with \$35-\$40 million for systems integration, to move to RFID inventory control. This will reap a 5% inventory reduction and 7.5% labor savings, plus a .07% increase in revenue from avoiding "out of stock" lost sales. Meanwhile a manufacturer will have to pay \$400K per factory and \$35-\$40 million for systems integration, plus the recurring cost of tags. The manufacturer's rewards will be increased inventory control, improved order fulfillment, and the nebulous but clearly valuable increased visibility into inventories in sales channels. This picture shows that there are very high fixed costs and a relatively slow ROI from RFID adoption. Couple this with continued uncertainty about standards, which might mean that the fixed costs could become

stranded if the standards migrate away from current systems, and adoption poses tremendous risks. This concern is also preventing chip makers from investing in production capacity, which poses the downstream risk that tag production bottlenecks may be inevitable once adoption takes off.

Another area of concern is the social concern about security and privacy. Consumers are being made aware of potentially intrusive RFID applications, in mass media messages such as the targeted advertisements in the movie *Minority Report* as well as in news reports such as the FDA approval of human implantations of RFID devices. Benetton was the victim of a false rumor that they were planning to track some of their garments with RFID, and were smart enough to publicly apologize for and withdraw plans they had never made, rather than to face public disapproval for disregarding customer privacy. At the very least, tags will need to be easily and permanently disabled by customers, although unintentional disabling will need to be almost impossible. If consumers are to accept full RFID implementation, complete protection of personally identifiable data is a critical success factor.

INTEGRATION OF RFID DATA INTO EXISTING SYSTEMS

The data generated by RFID systems will only be of real use if it can be seamlessly integrated into existing ERP, CRM, and other business application systems. This is what will produce the greatest rewards from adoption, and it also creates the most critical risk. The early strategies for integration will involve attempts to cope with a “tidal wave” of new data. Applications will filter the data being used and limit the applications affected. The most common strategy will be to ignore normal business patterns reflected in the RFID data and use business rules to focus on its capacity to report exceptions.

As businesses become more comfortable with RFID data flows, they will begin to use middleware to interface between the RFID systems and existing applications. Early adopters will be looking for packages of features to implement the most obvious improvements in inventory control, reduced labor costs, and strategic planning. The longer term benefits will come from integration of RFID data into B2B information sharing, both up the supply chain to vendors and down the supply chain to retail customers. This will require a more extensive solution than middleware.

There are five basic principles of systems integration that will need to be attended to as the massive amounts of RFID data begin to become available.

1. There must be a communications infrastructure connecting all component systems
2. There must be process management infrastructure to control interactions
3. There must be a shared data model for every business concept
4. There must be a shared directory infrastructure
5. Business process models must be able to be modified without affecting component systems

There are three approaches to integration that will adhere to these principles while accommodating the RFID data flood. The first is that RFID data will comprise a separate database, accessible by all applications using middleware. The second is that RFID data will comprise a separate database, but sharing a data model with other data bases used by the applications, so that the business logic of the RFID database is accessible by them. The third is that the RFID data will be an integral part of a fully integrated, and therefore very large, enterprise database.

The first approach is the least elegant and most likely to suffer repeated serious “fallouts” that will negatively affect inventory control, order fulfillment, and the overall cost effectiveness of the RFID

implementation. But it is also the most affordable approach, and therefore is likely to be the approach most often taken. As between the other two approaches, the second approach is truly the middle ground. It is more elegant and more likely to achieve a good result than middleware, and, although it is not as fully integrated and elegant as the single enterprise database, it does not require a complete integration, which would probably be accomplished by a very expensive extension of an existing ERP system.

How will RFID systems and data be integrated into existing business applications? The most likely scenario is that it will be fully integrated into one or more large applications, probably ERP or CRM, and interfaced with other applications using middleware. One or more software firms, however, are likely to see this as an opportunity for expanded market share. An historical metaphor will illustrate this point. From 1972 until the early 1990s, SAP was a relatively small firm selling manufacturing management software. When the cost of Y2K compliance became apparent in the IT world, SAP ramped up to offer fully integrated ERP systems at a price point modestly above the cost of Y2K compliance. Many businesses decided that this provided a unique chance to achieve a level of data and systems integration that would normally be cost prohibitive. Only SAP was in a position to capitalize on the demand for integration created by Y2K. SAP is now one of the two largest enterprise software firms in the world.

This history can be seen as a metaphor for what is likely to happen when RFID implementation hits the steep slope of the adoption curve. The database, including internal as well as upstream and downstream external data, will grow very rapidly. Most firms will throttle it down, giving up most of the potential benefits. Some firms will want to fully integrate that data into their enterprise applications. The cost of doing that will be imposing. Will any enterprise software firm be prepared to offer full database integration as a combined solution to the RFID problem as well as the overall systems integration problem? If so, who might that be?

This report was prepared by the Systems Consulting Consortium, Inc. (SCC) as a service to our past, present, and future clients. The author, Terry Curtis, has over 20 years of experience in evaluating, auditing, and benchmarking networking strategies and technologies. In addition to his work with SCC, Terry is a tenured Professor of Telecommunication Policy and Technology at California State University, Chico, and is a member of the State Bar of California. He is recognized internationally as an expert in the strategic use of new telecommunication systems and services, is widely published on these issues, and is regularly called upon to speak about them at industry events.

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