

Item-Level RFID in the Retail Storefront

Insights Garnered from Experience with Several of the
World's Leading Retailers

March 2005

A white paper from:



ITEM-LEVEL RFID IN THE RETAIL STOREFRONT:

Insights Garnered from our Work with Several of the World's Leading Retailers

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EXECUTIVE OVERVIEW

A variety of well-publicized studies place retailer out-of-stocks at 8% and as much as 15% on heavily promoted items – inefficiency that costs both retailers and their suppliers billions of dollars annually. The problem is well known – solving the problem has proven more elusive. Retailers have been focused on the out-of-stock problem for years, but despite significant investments in enterprise inventory management and supply chain systems, the problem persists.

Use of passive RFID technology at the item level could prove a “game changing” technology in solving the out-of-stock problem, as well as potentially improving customer interaction, decreasing shrinkage (theft), decreasing POS costs and supply chain labor costs. To this end, global retailers Tesco and Wal*Mart have both announced out-of-stocks as their primary target in deploying passive RFID technology.

R4 Global Solutions and Intelligent Systems, a division of MeadWestvaco Corporation have been working with several of the world's leading retailers to develop strategies, architectures and pilots of item-level RFID technology within the storefront environment. This white paper leverages data gathered from these pilots, as well as best practices and insights garnered from lab studies and our work with many of the world's largest consumer goods, retail, and pharmaceutical companies.

The purpose of this paper is to:

- Provide insight into **demand for item-level RFID** in the retail storefront
- Discuss the financial impact of RFID at the item level in the retail storefront, including **quantified metrics developed in operational pilots**
- Provide a reference **roadmap for success in evaluating RFID in the retail storefront**, from the perspective of both a retailer and consumer goods manufacturer



Figure 1: Item-level RFID “smart shelf” system being piloted with Tesco and other leading retailers

INTRODUCTION

“It is alarming to me the amount of time we are out of stock” declared Target CIO Paul Singer at the May 2004 Retail Systems Conference in Chicago, IL. For executives, managers and staff in the retail industry, perhaps no issue is more frustrating and costly than out of stocks.

On average, roughly 8% of the average retailer’s inventory is out of stock – unavailable on the retail store shelf. Worse, according to the GMA (Grocery Manufacturers Association), approximately 75% of the time the out of stock is a “can’t find” – the product is actually sitting in back room inventory. The out of stock problem costs U.S. retailers and consumer goods companies over \$50 billion per year, persisting despite years of effort and hundreds of millions of dollars spent on inventory management and supply chain systems.

Out of stocks cost U.S. retailers and consumer goods companies more than \$50 billion annually.

Another area of great frustration related to retailer inventory management is shrinkage (theft), which costs retailers an estimated 2% of sales on an annual basis – over \$30 billion annually in the U.S. alone.¹ Further aggravation is driven by the fact that roughly 50% of this number is due to internal/employee theft. Again, millions of dollars spent on security cameras and related systems, but the problem persists.

So what has changed?

Over the past few years, many industry analysts and technology vendors have been pointing to passive RFID technology as a potential solution to the out of stock problem. RFID tags on individual items in the stock room and on store shelves could be monitored on a regular basis by RFID readers, thereby providing “real time” visibility into current inventory levels and making employees aware when inventory of a particular item runs low. In theory, this is right on target. Two primary challenges have existed, however, in making this a reality:

In December of 2004, members of EPCglobal, the global standards body for RFID technology, approved a new standard known as “Class 1, Generation 2.”

This new standard sets the stage for a dramatic increase in production capacity of RFID chips and tags from industry leaders such as Texas Instruments, Philips, Alien, Symbol, Intermec and others.

- 1) The cost of placing RFID tags on individual items has been too high for most goods (individual tags cost approximately \$0.20 today, with labels at \$0.40).
- 2) The cost and capability to deploy RFID reader technology within a stock room and/or storefront has been prohibitive (requiring hundreds of readers to canvas shelves, etc.).

¹ Source: University of Florida National Retail Security Survey

Both of these challenges are being met by the market, however. RFID tag prices are steadily declining, and are projected by many analysts to reach \$0.10 by the end of 2006 or 2007. This declining price point is due primarily to accelerated adoption and purchasing of tags. In fact, our current work with many of Wal*Mart's largest suppliers suggests we have passed the "if" stage of RFID adoption in the supply chain and moved into the "when" stage, with most participants viewing the initial pallet and case-level RFID tagging efforts as the first phase in a 5-10 year adoption cycle. As we move through this first phase of adoption, the quantities of tags being deployed are rising rapidly, and validate analyst projections utilized to calculate projected tag costs.

Shrinkage cost U.S. retailers more than \$30 billion last year, according to the University of Florida.

The second challenge, reader technology cost and functional capability, is being met by solutions developed and deployed by Intelligent Systems and R4. Both companies began item-level work with global retailers as far back as 2003, and in 2004 several major retailers began piloting these solutions in stores on a global basis. The most visible and public of these pilots have been run by leading European retailer Tesco (the 6th largest retailer in the world with more than \$50 billion in sales), with Tesco IT Director Colin Cobain publicly commenting on the value Tesco expects to derive from RFID:

An estimated 48% of this shrinkage is internal employee theft.

"The future has arrived. We will track high-value, high-shrink items through our supply chain. That will give us improved on-shelf availability of products. It will make our processes simpler and our data more accurate."

*Tesco IT Director Colin Cobain
RFID Journal, January 31st, 2005*

Thus, while the bulk of the attention surrounding passive RFID technology is on its use at the pallet and case level by leading retailers such as Wal*Mart, Best Buy and Albertsons, **a number of leading retailers and consumer goods companies are evaluating, and beginning to implement, item-level technology for use in the retail storefront.**

DEMAND FOR RFID AT THE ITEM LEVEL

Demand for RFID at the item level in the retail and consumer goods industry is being driven by several business challenges, including:

- Out of stocks
- Shrinkage
- Counterfeiting
- Weak visibility into in-store inventory
- Marginal supply chain visibility

These problems are not new, and retailers and consumer goods manufacturers alike have been trying to solve them for decades. Inventory, warehousing and other supply chain systems now incorporate sophisticated analytics which drive planning, forecasting and replenishment cycles. These systems, however, are only as sophisticated as the data they are able to leverage, and in many cases there isn't a lot of data to be had. As a supply chain executive for one of the ten largest retailers in the U.S. put it to us recently, "We have a decent, albeit somewhat fragmented, view of what is sitting our DC's. We do not, however, have *any clue* exactly what is sitting on our store shelves at a given time."

This lack of store inventory visibility results in significant financial costs to both the retailer and consumer goods suppliers. As noted above, shrinkage and out of stocks cost retailers billions of dollars annually. In a November, 2004 report, the GMA estimated that improvements in shelf inventory management could increase retailer sales by 3% by reducing out of stocks - a healthy number for even smaller retailers and certainly worth pursuing for those with \$1 billion or more in annual sales. Perhaps more difficult to measure, but no less damaging to the income statement, are the lost employee hours and missed add-on sales with customers.

With these economic drivers in mind, retailers and consumer goods companies are increasingly evaluating, and in some cases beginning to adopt, in-store RFID systems for use at the item level. This adoption has been underway for several years, with members of the Auto-ID center, Wal*Mart, Gillette and others validating the potential benefits of such technology several years ago. The pace of play has accelerated recently, however, as public item-level RFID pilots by retail industry leaders such

Initial retail pilots suggest employee productivity can be improved by as much as 8X for inventory-related functions.

Wal*Mart began utilizing item-level RFID tags to track and manage Schedule II (prescription narcotics) pharmaceuticals in 2004.

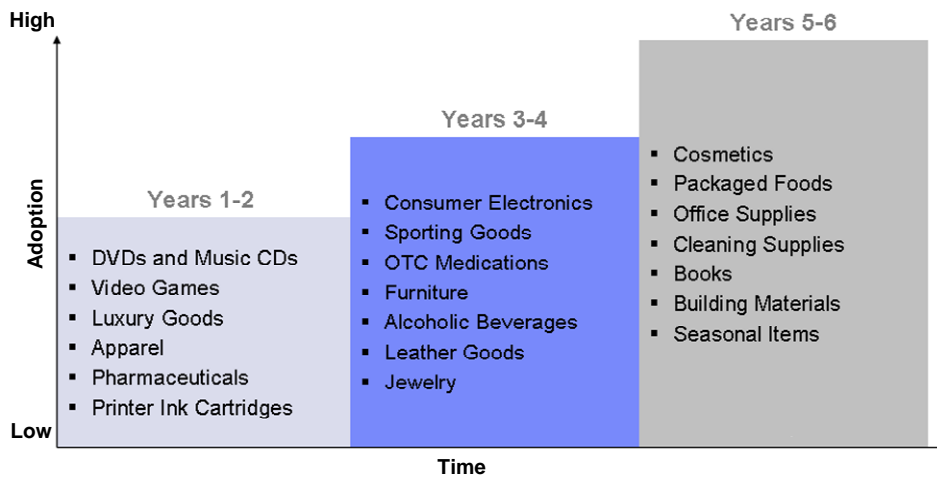
as Tesco and Marks & Spencer point to significant (and real) economic benefits.

Staged Adoption

As noted above, the cost to apply and utilize passive RFID tags at the item level present limitations in utilizing the technology for many product categories. Put simply, placing a \$0.20 RFID tag on a \$1.00 can of tuna fish will likely present a challenging economic model, no matter how high the out of stocks, shrinkage, etc. However, for higher-value and high-shrink items, the economics do work, and work quite well.

Thus, we are beginning to see a “staged” adoption of RFID in the storefront, beginning with products that match the criteria above, including apparel, pharmaceuticals, DVD’s, CD’s and video games. After initial trials at two stores, Tesco announced in February, 2005, it would expand its item-level pilot (utilizing Intelligent Systems’ technology) from 2 to 10 stores and include all Media and Entertainment categories (DVD’s, CD’s, video games). Marks & Spencer announced in early 2005 it would expand its pilot to include 53 stores and 6 clothing departments. A number of other retailers are piloting RFID in the storefront as well, with most focused on similar product categories. The staged adoption cycle is portrayed in Figure 2 below.

Figure 2: Potential Adoption of RFID at the Item Level Across Product Categories



Increased Sales, Increased Customer Satisfaction

The potential benefits of item-level RFID technology in the retail storefront do not stop with reduced out of stocks and reduced shrinkage, however. Several of the world's leading merchandisers are also looking at how RFID could increase the customer experience while also driving additional sales through cross-selling and promotion. Major names who have conducted, or are conducting item-level evaluations (and publicly discussed them) include Prada, The Gap, Best Buy and others.

The potential benefits are enormous: think of a customer evaluating the purchase of a pair of pants and either receiving a recommendation on complimentary shirts, socks and shoes via an interactive kiosk or a knowledgeable store sales clerk. Further, imagine this sales clerk being able to check inventory, back stock or even sales trends on a real-time basis utilizing a hip-mounted mobile device. "That combination is one of our top sellers. We also have several new colors coming in that shirt next Monday. It's washable but we recommend dry cleaning, by the way." The same scenario will play out in other retail environments around the country, starting with stores where consumers rely heavily on in-store information to determine purchasing habits; examples include consumer electronics, building materials and wine (depicted in Figure 3, with a consumer utilizing an RFID-enabled in-store kiosk to gather information).



Figure 3: In-Store RFID-Enabled Kiosk
Graphic Source: Kiosk Business

Just as important, the same RFID-enabled systems providing inventory data to the sales clerk can provide replenishment and throughput data to store managers, buyers and supply chain specialists. Tighter visibility into store inventory should result in fewer inventory write-offs (outdated, seasonal or discontinued merchandise) and enable store managers to potentially shift inventory to stores where products are selling more quickly. In the apparel industry, where buyers make decisions as much as 6 months prior to the selling season, adjustments to inventory and stocking can make the difference between a profit and loss on a product category.

BENEFITS: MOVING FROM CONCEPT TO REALITY

Industry analysts and technology vendors began projecting the benefits of item-level RFID in the retail storefront in the late 1990's. Today, we have real validation using real technology, and the benefits are proving to be significant.

“Inventory checking is a rather boring task that can total eight hours a week (for each department) in a big store. Using RFID cuts that to one hour, and we can be more confident that we have the stock our customers want.”

*James Stafford, Marks & Spencer
RFID Journal, February 10th, 2005*

The chart below outlines the benefit metrics we are utilizing in our work with several of the world's largest retailers and consumer goods brands. The statistics in the chart depict results achieved in a February, 2004 study completed by R4, Intelligent Systems and an independent analyst. While we cannot publicize actual results being achieved in retailer pilots with R4 and Intelligent Systems, we note that the study results are not materially different from those being achieved in the pilots.

Automated inventory management in the retail store environment enables the use of more granular metrics to measure employee and store performance.

Impact of RFID at the Item Level – Retail Store	
<u>Area</u>	<u>Impact</u>
<input checked="" type="checkbox"/> Out of Stocks.....	60% Reduction
<input checked="" type="checkbox"/> Shrinkage.....	20-50% Reduction
<input checked="" type="checkbox"/> Employee Productivity.....	8X Increase

Source: February, 2005 R4 / Intelligent Systems Lab Study, various retailer pilots

As noted above in this paper, out of stocks cost U.S. retailers more than \$50 billion annually. Calling this a “supply chain problem” is a bit of a misnomer, however. More than 75% of the time, the product wanted by the consumer is sitting on a stock room shelf. Thus, the bulk of the problem lies squarely with in-store inventory management and the corresponding systems and processes. Today, basic systems track inventory received and point of sale data, but the steps in between represent a virtual black hole for most retailers. We achieved a 60% reduction in out of stocks in our study, a figure representative of what major retailer pilots are finding. While utilization of the Intelligent Systems item-level tracking system enables the user to monitor inventory in real-time, as well as set alerts when inventory levels reach a

certain point, human interaction is required to actually replace shelf stock – thus a 60% improvement and not 100%. We expect process enhancements, as well as systems to monitor and direct employees, to further improve this statistic over time.

With respect to shrinkage, two primary contributors: first, the belief that “no one knows,” and second, the transitory nature of the retail store employee. In retailer pilots we have been a part of, both a significant *and* rapid reduction in shrinkage has occurred on items which are monitored with RFID tags. This is primarily due to the fact that, in using the shelf-reader system in both the back room and on the store floor, as well as monitoring the back-and-forth between doorways, it is easy to see when and where product is moving, and to track discrepancies. Employees quickly become aware of the tracking mechanism and cease past patterns of theft.



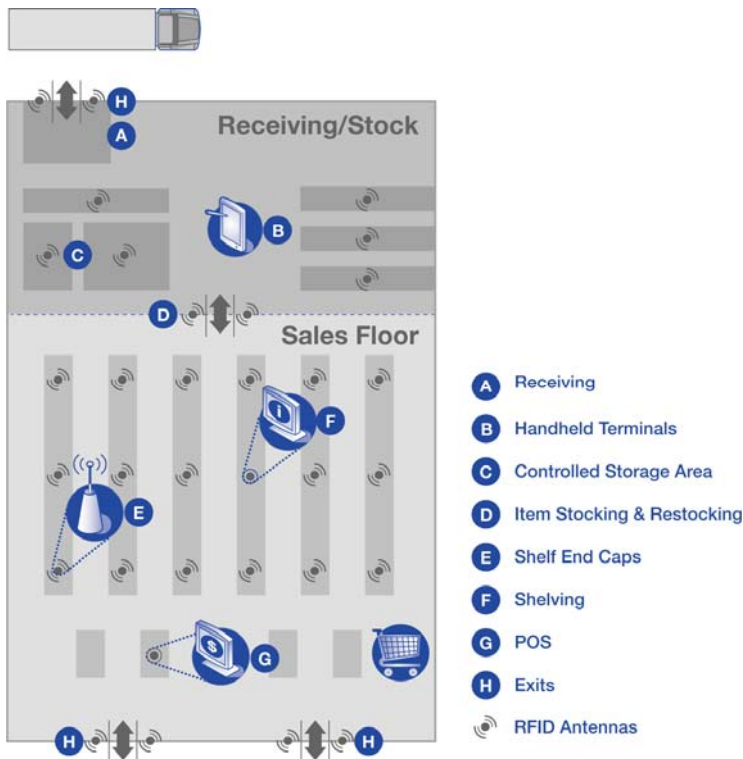
While many retailers and consumer goods companies are focused on solving the out of stock and shrinkage problem, employee productivity is one of the most significant areas of improvement we have seen in retailer pilot environments. Additionally, labor is one of the top areas of cost (if not #1) for any retailer, so the potential benefits are significant. Further, an 8X improvement (as noted above at Marks & Spencer) in productivity not only results in significant financial impact, it also means higher employee satisfaction.

Major EAS (Electronic Article Surveillance) vendors are working on technology which combines the functionality of EAS and RFID.

ACHIEVING THE BENEFITS

The diagram below depicts a retail store with an RFID-enabled inventory management system utilized to track and manage the movement of items from receiving (area A) to point of sale (area G). In this configuration, the Intelligent Systems solution is utilized to track merchandise both in the back of the store (areas B and C) and on the retail store shelves (areas E and F).

Figure 4: RFID-Enabled Store Schematic and Placement of RFID Antennas



Utilizing this configuration, the retailer has complete visibility of items as they are moved from receiving to stock room to store floor and eventually through point of sale. The high-level technical specifications of the configuration are as follows:

- A. Receiving:** Dock door and conveyor reader and antenna configurations (as being deployed currently by Wal*Mart and its suppliers); typically one or two EPC-class readers and multiple antennas per dock door.

- B. Handhelds (receiving):** Mobile devices used to scan product and manage pick and put away processes (beta versions of EPC C1G2 technology handhelds will be available Spring 2005).
- C. Controlled Storage:** Intelligent Systems intelligent shelving (supports both HF/13.56 MHz and UHF 850 to 950 MHz technology).
- D. Item Stocking and Re-Stocking:** Typical “portal” reader and antenna configuration in doorways; typically one or two EPC-class readers and multiple antennas per door.
- E. Shelf End Caps:** Intelligent Systems RFID-enabled intelligent shelving, typically configured with more rapid read rates for monitoring promotions and other fast moving merchandise
- F. Store Shelving:** Intelligent Systems RFID-enabled intelligent shelving
- G. POS:** RFID-enabled POS systems. Note that RFID-enabled POS is not required to achieve inventory benefits (reduced out of stocks and shrinkage).
- H. Exits:** RFID-enabled portal configuration similar to stock room door, though we expect to see combined EAS/RFID capability in the future (again, not required to achieve inventory benefits).



Figure 5: Intelligent Systems RFID-Enabled Shelf Readers

We note that while the RFID-enabled mobile/handheld and POS systems are still in “beta” production form at this point, the Intelligent Systems shelf systems and portal configurations are tested, operational systems. We also note that these pilots have leveraged the Intelligent Systems software suite, which accompanies the Intelligent Systems shelf reader solution and provides complete visibility as well as monitoring and alert capability (i.e. “10 units of SKU 12300 were removed from shelf 16, quadrant 4”). Many retailers will elect to integrate this inventory data into existing/legacy inventory systems as the system of record.

Critical Functionality Required

As mentioned at the outset of this document, one of the inhibitors to adoption of RFID at the item level has been the prohibitive cost of deploying hundreds, if not thousands, of RFID readers within a store environment. The MWVIS shelf reader system solves this challenge

through a proprietary multiplexing algorithm which enables multiple shelf antennas (hundreds) to run off of a single reader.

The system also incorporates an RFID “middleware” function, enabling data filtering and a wide breadth of business process functionality – including key processes such as variable monitoring (a store may choose to monitor fast-moving product more frequently than slow-moving goods, for example), redundancy/failover (enabling re-routing in the event of a hardware failure) and power management (antennas are turned on only when scheduled to read).

Experience tells us the bulk of retailers employ a wide variety of custom systems and processes within stores. As a result, a fair amount of planning, architecture, integration and customization is required to enable an in-store shelf inventory system. At a most basic level, specific product sets have varying types of shelving employed, and the corresponding antenna design must meet the shelf specifications. Software must also be configured with knowledge of the product and shelving design.

Most of the major POS vendors are actively involved in the overall development of RFID technology and the market’s evolution. Thus, the adoption of RFID for use in item-level inventory management will likely coincide with, or be shortly followed by the adoption of RFID-enabled POS systems. Today, available systems with this functionality are in their infancy, but one need look no further than a Home Depot to see a self-checkout system (using barcodes) in action. The transition to RFID is not far behind, and frankly the “holdup” is not so much POS system functionality as it is demand and the feasibility of high volumes of items reaching the POS with RFID tags.

RFID will eventually be incorporated into packaging – just as barcodes are today. A number of the major corrugated and packaging vendors have been actively involved in the development of RFID over the past few years.

APPROACH

As mentioned previously in this document, we will not see RFID at the item level across all product categories for quite some time (some analysts argue “never”). Most initial pilots and interest have been focused around apparel, consumer electronics, and fast-moving but valuable goods like DVD’s, CD’s and video games. While the focus of this paper is on inventory management benefits in the retail store, there are also significant benefits to be gained by retailers if and when RFID-enabled self checkout/POS systems are viable (primarily in labor cost savings). While this functionality is not on the immediate horizon, it is a factor that could drive segments other than those outlined above to explore use of RFID at the item level sooner.

One retailer estimates a reduction in checkout times of more than 50% from RFID-enabled self-checkout (but does not see it on the near horizon).

An estimated 50% of large retailers are expected to begin item-level pilots by 2007, according to research firm Gartner (Gartner G2, September, 2004). Before doing so, however, it is important for retailers and their supplier partners to understand the costs, benefits, relative impact points and best practices involved. At a high level, a sample approach we are utilizing with several leading retailers is as follows:

Opportunity Assessment



- Opportunity identification
- Impact: systems, processes, facilities, people
- Cost/benefit, ROI
- Rank prioritization
- Business case

Approach / Plan Development



- Project plan development
- Validation, refinement of pilot approach(es)
- Define success metrics
- Define external impact points (suppliers, logistics partners, etc.)
- Sequencing, risk mitigation
- Technology vendor coordination

Pilot Program



- Pilot deployment
- Validate cost, timing assumptions
- Evaluate against key metrics
- Establish, compare best practices
- Refine and measure impact points
- Opportunity re-assessment

There are of course many sub-steps to each phase of this approach. Whether this or any other approach, a retailer should incorporate knowledge of existing item-level pilots and research, best practices from industry leaders (not just with respect to store shelf management – most retailers garner significant insight into other “broken” processes such as planogram management) and deep insight into the both the technical

and process components required to make item-level RFID work in the retail storefront.

We note that this document specifically does not incorporate discussion on the topic of privacy or go into depth on the integration of the shelf reader systems into an overall retail systems environment, but both are important components of the approach outlined above.

We have spent the last several years helping several of the world's largest retailers evaluate the privacy issue with respect to RFID, and believe it is an important component of any initiative. So much so that it warrants its own discussion, and cannot be treated with a simple paragraph within this document. Suffice it so say that at this point retailers do not need to "recreate the wheel," as Wal*Mart and others have spent a great deal of time and energy on the subject.

Likewise, integration and architecture of the new retail environment incorporating item-level RFID is a subject unto itself, and cannot be covered in short form. Thus, we have placed only nominal discussion of integration within this document.

One current item-level RFID pilot we are a part of has been initiated by a consumer goods supplier - seeking increased visibility with two of its key retailers.

CONCLUSION

In this document we have discussed the demand for item-level RFID technology in the retail storefront, discussed the financial impact of such technology using real data points from live operational installations, and provided a roadmap for success in evaluating and implementing the technology.

Within this background, two major conclusions can be drawn:

- 1) The benefits to be gained from item-level RFID technology are significant, and industry leaders are moving forward.
- 2) The technology, strategy, and process solutions required to make item-level RFID technology work in the retail storefront exist and are actively being deployed (sooner than many analysts thought possible).

We take careful note of the fact that significant change is required in business process, systems, facilities and even employee behavior to make RFID at the item level feasible. We also note the direct correlation between the value of goods being sold (and the corresponding profit margins) and the evolutionary path towards adoption of RFID in the retail supply chain. For some industries, this adoption is taking place at the item level now. For others, adoption will take 3, 5 or even 10 years.

Additionally, though not covered in this document, every one of our retail clients is sparking deep collaborative discussions with their respective suppliers to determine the impact on current processes and the feasibility of utilizing RFID from the supplier perspective.

With these points in mind, we emphasize that we have only begun to scratch the surface on this topic, and encourage industry leaders to contact R4 or Intelligent Systems to find out more.

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ABOUT R4 GLOBAL SOLUTIONS

R4 Global Solutions is a leading provider of EPC-class RFID and related technology solutions to Global 2000 leaders in the Retail, Consumer Packaged Goods, Manufacturing, and Pharmaceutical industries. R4 is headquartered in San Francisco, CA with additional locations in Michigan, Virginia, Boston, Atlanta and New Jersey. R4 maintains two RFID Laboratory facilities, one in San Francisco and the other in Dallas, TX. R4 is a sponsor of EPC Global. For more information visit R4 Global Solutions on the Web at www.r4gs.com or send an email to info@r4gs.com.

ABOUT INTELLIGENT SYSTEMS, A DIVISION OF MEADWESTVACO CORP.

Intelligent Systems, a division of MeadWestvaco Corporation (NYSE: MWV), provides EPCglobal-compliant item-level inventory management solutions for manufacturers and retailers. Our unique approach greatly reduces the cost and complexity of item-level data collection applications. Intelligent Systems' technology has been developed to take advantage of the open-architecture features of the EPC Network, and supports the vision of low-cost ubiquitous RFID pursued by EPCglobal and its other subscribers. For more information, please visit www.is-mwv.com or email info@is-mwv.com.



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