

# **RFID: The UPC of the 21st Century**

Small Technology,  
Enormous Impact

---

# Table of Contents

- Executive Summary ..... 1
- Old Technology Takes on New Role ..... 1
  - What is RFID? ..... 1
  - Electronic Product Code ..... 2
  - Tagging Options ..... 2
  - How RFID Works ..... 3
- Smart Technology; Smart Move ..... 4
  - Market Drivers and Needs ..... 4
  - Understanding the Challenges ..... 4
- Making the Vision a Reality ..... 5
  - RFID Implementation Strategy ..... 6
    - Receiving ..... 7
    - Putaway/Staging/Picking Replenishment ..... 7
    - Shipping ..... 8
    - Supply Chain Inventory Visibility ..... 8
- Bottom Line: RFID Makes Cents ..... 9
- Manhattan Associates' RFID Leadership Role ..... 9

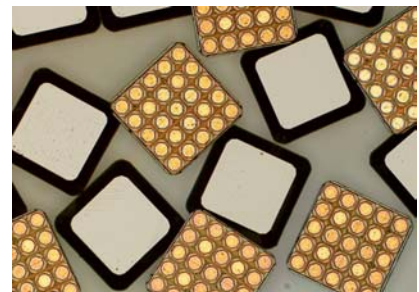
## Executive Summary

Over the course of the last fifteen years, universal product codes (UPCs) have become the dominant product-tracking standard across all industries. Created by U.S. manufacturers to negate the lure of much cheaper offshore manufacturing labor and championed by industry retailing giants, UPC coding has improved product tracking across multiple trading partners, reduced labor costs, and sped up product replenishment. But like all technologies before it, the next great leap in the evolution of product tracking has emerged—automatic identification technologies. These technologies allow machines to identify objects and capture information, providing organizations with much greater degrees of control and flexibility in managing goods as they move through the supply chain.

One such automatic identification technology is radio frequency identification (RFID). Accurately seen by many in the industry as the next transformational technology, RFID promises higher quality information and real-time tracking. This paper will first identify what RFID technology is and how it works. It will then detail the market drivers and needs, before outlining the benefits and the challenges. Finally, an implementation strategy will be laid out, beginning with implementation within the four walls of the distribution center (DC) and extending to collaboration with trading partners.

## Old Technology Takes on New Role

First introduced during the Second World War, RFID technology was used to help identify ally and enemy aircraft through radio frequency (RF) waves. Since that time, this technology has continued to evolve, being used by the railroad industry to track cars, the automotive industry to automate production processes and track parts, and the agricultural industry to track livestock. More recent technological



advances, such as declining chip and reader prices and the increased ability to inexpensively and efficiently send data, have allowed companies to begin using RFID for tracking goods as they travel through the supply chain.

### What is RFID?

RFID tags themselves are un-powered microchips with antennas that wirelessly transmit information encoded on the tag. This is done over RF waves that are activated when placed in the transmission field of a reader. One variation of RFID tags, called Auto-ID tags, are encoded with electronic product codes, a standard which has been designed to track products in the supply chain. Each Auto-ID tag can hold up to 96 bits of information. To put that in perspective, 23 bits could tag every car in the world, 33 bits could tag every person, and 54 bits could tag every grain of rice.

## Electronic Product Code

The 96 bits contained on the tag are known as the electronic product code (EPC), a unique naming scheme for objects containing the following parts:

<b>Electronic Product Code:</b>			
01	0004Y7	0002B9	000622CA
<b>Header</b>	<b>PC Manager</b>	<b>Object Class</b>	<b>Serial Number</b>

- **Header (8-bits)**- defines the number, type and length of all subsequent data
- **EPC Manager (28-bits)** - identifies the entity (most often the manufacturer) responsible for tracking and maintaining the object class and serial number codes
- **Object Class (24-bits)**- acts as the tracking mechanism for specific groups- e.g., SKU, lot number, etc.
- **Object Identification Number (36-bits)**- serves as the unique identification number for the item.

## Tagging Options

While every tag contains an EPC, they differ in functionality as well as price. RFID tags can be either active or passive, read-only or read-write. The table below demonstrates the differences that companies must consider when deciding which type of tag to implement.

Type	Price Range	How They Work	Pros	Cons
Active Tags	High	Battery-run tags that constantly emit radio frequency signals	Good for tracking large objects-- read range is 100+ feet; not as impacted by metals/liquids	Significantly more expensive than passive tags; require maintenance
Passive Tags	Low	Activated by electromagnetic waves of RFID reader	Cost-effective for implementation today; require no maintenance	Read range is less than 10-25 feet; difficulty working through metal/liquid
Read-Only Tags	Low	Information written on the tag during manufacturing is permanent	Cost-effective	Information can never be changed
Read-Write Tags	High	Users can add new or write over existing information when tag is near a reader	Gives users the flexibility to add information at any time	Costly, not practical for everyday tracking of inexpensive items

On the cheaper end of the price spectrum are passive tags, which are activated by the electromagnetic waves of a reader. These waves effectively “turn the tag on,” allowing it to transmit radio frequency waves with specific EPC information. While passive tags are most likely to be the first to see widespread adoption because of their low cost, users must beware of one drawback—these tags must be within 10-25 feet of the reader in order to be activated. Active tags, on the other hand, contain a battery that allows them to constantly emit radio frequency signals that can be picked up from 100 feet or more away. These are useful for larger objects because they don’t require as many readers. While having a power source provides various benefits, including reducing the impact of metals and liquids, active tags are significantly more costly than passive tags.

Another determination for companies to make is whether to invest in read-write tags or read-only tags. As demonstrated in the chart, read-write tags are significantly more expensive, but allow users to add or write over existing information. Read-only tags are much less expensive, but are good for one time recording of information only.

With a variety of tag options to choose from, companies need to examine the specific business needs before making a selection. For example, if a company needs to more closely monitor its yard, attaching a higher priced active tag to a trailer or container of product would allow for instant location in a large area. However, if a company just needs to automate its picking processes within the DC, it would likely choose to invest in passive technology.

### **How RFID Works**

Regardless of which type of tags are chosen, the operation of RFID transmission remains basically the same. Once in the area of transmitted signals from the antennae of the reader, both passive and active RFID tags can transmit hundreds of radio frequency signals every second. An application serves as a liaison between the reader and the host system, discerning duplicate information and passing along only the useful information to the host system. For example, if a reader receives 500,000 EPC transmissions, but only 200 EPCs are unique, this application can send the correct information to the host system. The host then knows that 200 cases, pallets or items, depending on the level of tagging, are received into inventory. As these items pass through other areas of the warehouse where readers are strategically placed, this information is continuously captured, allowing for a variety of applications.



# Smart Technology; Smart Move

## Market Drivers and Needs

Understanding how RFID works is only half the battle. In order for mass adoption to take place, it is critical to understand why companies, across industries, need to implement this technology to remain competitive and successful.

In tough economic times, all businesses are looking for ways to cut costs. With labor comprising approximately 30 percent of overall supply chain costs<sup>1</sup>, it is an area that is frequently targeted for reductions. By automating business processes through technologies such as RFID, companies can reduce labor costs while simultaneously improving productivity and efficiency.



A second RFID adoption driver is the expansion of consumer and regulatory demands that require companies to more accurately track product-handling information. As threats to security continue to loom, regulatory bodies are becoming increasingly stringent in the requirements they place on companies, especially in industries such as food and healthcare. In order to ensure the tightest security and highest standards, companies must know where

products are at all times and where they have been in the supply chain. This not only allows for date and lot tracking, but it also simplifies the process in the event of recalls.

Key to a company's success in today's marketplace is its ability to communicate in real-time with its trading partners. In order to improve margins, companies must increase supply chain visibility by improving communication mechanisms and deploying the latest technology for real-time tracking and monitoring of goods. By achieving this seamless integration with partners, every aspect of the supply chain process will improve.

Advances in RFID technology itself are also helping to pave the way for adoption. Declining chip and reader prices, along with the growing ability to simply and inexpensively connect devices and distribute information, are making RFID implementation economically feasible for companies of all sizes. These advances, in conjunction with emerging EPC standards, are the key drivers in making RFID the UPC of the 21<sup>st</sup> century.

## Understanding the Challenges

Every new technology has its challenges and RFID is no exception. In order to enjoy the benefits that this emerging technology offers, there are some obstacles that

need to be overcome within individual organizations and across the market as a whole.

Individual companies face justifying the initial investment in RFID tags and readers as well as the business challenge of applying the tags to goods, although these challenges are beginning to diminish. As RFID adoption continues to grow, hardware costs are continuing to decline and tag application solutions such as remote RFID tag generation™ are already emerging from leading solutions providers to combat the application dilemma. But implementing the tags and installing the readers are only the first steps towards realizing the benefits of RFID. Having the supporting technology and infrastructure in place to aid such an initiative is vital, because without the ability to utilize and analyze the data generated, the full benefits of RFID cannot be realized.

Beyond the individualized process of getting RFID into the DC, is the more complicated job of developing a common set of standards that are accepted and adopted by the masses. As mentioned above, EPC is the method used to uniquely identify each object in the supply chain. An effort to develop and institutionalize these standards is currently being led by an organization called the Auto-ID Center in conjunction with various industry leaders. This team is striving to achieve widespread acceptance of EPC standards.

A final, more technical, challenge facing RFID adoption, is the inability of RF waves to be read through certain materials. For example, some liquids absorb radio frequency waves, while other liquids are permeable. Certain metals, such as steel, can also cause complications and inaccuracies because of their reflective nature. The upside to these challenges is that people have a good understanding of which materials are not conducive and they are working diligently to find ways to avoid these problems. For example, a leading detergent company has experimented with putting the RFID tags in the lid instead of on the body of the container, averting the potential dilemma.



other liquids are permeable. steel, can also cause inaccurate readings because of their reflective nature. The upside to these challenges is that people have a good understanding of which materials are not conducive and they are working diligently to find ways to avoid these problems. For example, a leading detergent company has experimented with putting the RFID tags in the lid instead of on the body of the container, averting the potential dilemma.

As with all new technologies, challenges will always exist. It is the companies that are committed to being leaders that will work to overcome these obstacles and spearhead RFID adoption.

## **Making the Vision a Reality**

Despite the lingering challenges, as costs associated with RFID continue to decline, the viability of utilizing RFID at the pallet, case or item level throughout the supply chain is becoming a reality. By attaching RFID tags to products, RFID creates an enormous opportunity for real-time product tracking, decreased labor costs,

security against counterfeiting, and improved accuracy in distribution—all of which can lead to increased shareholder value.

In order to further improve shareholder value, companies must lower costs, increase revenue, decrease working capital or reduce fixed capital. RFID can help accomplish this.

- **Lower Costs-** As evidenced by the fact that labor comprises approximately 30 percent of supply chain expenditures<sup>1</sup>, one of the easiest ways to drive down costs is to increase operational and labor efficiencies. According to the National Retail Security Survey put out by the University of Florida, approximately \$5.8 billion worth of inventory was lost in 2001 due to administrative errors alone<sup>2</sup>. RFID not only ensures accuracy of information, but it also limits the amount of error-prone human interaction that is needed. With information that is updated in real-time, RFID can further reduce costs by allowing companies to decrease shrink.
- **Increase Revenue-** With U.S. retailers losing approximately 3.8 percent of sales per year as a result of out-of-stock inventory<sup>3</sup> greater inventory control and increased product availability can have a major impact on increasing revenues. RFID tags allow companies to capture and track a variety of data on goods. This information aids in the development of accurate inventory forecasts.
- **Decrease Working Capital-** Because of the speed and accuracy of RFID, orders can be filled in a shorter amount of time, allowing for quicker product availability. Reducing this order cycle time decreases the need for an abundance of safety stock.
- **Reduce Fixed Capital-** With RFID, companies can better manage fixed capital by tracking assets such as totes, pallets, etc. This reduces the need for replacement due to lost items and cuts back on the amount of redundant equipment that spends significant time unutilized. Additionally, by increasing the speed at which a forklift can perform a certain task, the same amount of work can be completed with fewer vehicles, further reducing the costs of these fixed assets.

The overarching business benefits of RFID are obvious, but it takes many operational successes to reach these goals. In order to understand exactly how RFID can impact the bottom line, it is critical to discuss the tactical implementation of the technology, and learn what results each step of the supply chain process can yield.

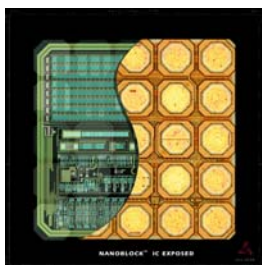
### **RFID Implementation Strategy**

With a wide-range of possible RFID applications, one basic implementation approach is for businesses to first focus on the benefits of RFID within the DC. The

best way to execute this is to first determine the distribution processes where RFID would have the biggest impact, and then implement the technology area by area.

## Receiving

Since receiving is the initial touch point for accepting inventory into the DC, it is a logical place for many companies to begin RFID implementation. RFID in the receiving area provides many advantages. Unlike with barcodes, employees are not required to handle products or physically scan RFID tags. This drastically lowers labor requirements—a major market need. In addition, tags do not have to be within the optical line of sight of a reader, allowing for multiple reads with one pass by the reader. As goods enter the DC, readers automatically capture EPC codes and link them to product and shipment information in the warehouse management system (WMS). Not only does this provide quicker entry of goods into inventory and reduce the amount of labor needed, but it also increases accuracy and tracking.



Before taking advantage of these and many other benefits of RFID, companies first need to work with suppliers to resolve a few logistical issues. In order to enable RFID in receiving, companies need to purchase and apply RFID tags to their products at the pallet, case or unit level (depending upon the type of product). The most effective way to do this is to utilize remote RFID printing technology, which enables suppliers to generate RFID tags and apply them to goods before they are shipped. These tags, in conjunction with data transmission techniques such as advance ship notifications (ASNs) allow for scan-free receipt of goods and automatic tracking. Not only does this method help businesses improve receiving processes, but it also exposes suppliers to the benefits of RFID without significant investment. Positive supplier experience will ultimately help further the adoption of RFID.

## Putaway/Staging/Picking Replenishment

Once RFID has been brought into the DC's receiving process, it can be more easily integrated into other areas such as picking and putaway. Using RFID to help synchronize and streamline the flow of inventory throughout the DC achieves quantifiable gains such as shipment visibility, inventory accuracy and labor productivity.

By eliminating manual steps to count and record putaway moves and picks and reducing the amount of time spent correcting errors, RFID helps move increased volumes of goods through the DC in less time, with fewer people. It also provides real-time data on the movement of goods. This improved information results in better inventory control and product availability because product sales readily tie back to successful shelf replenishment and

inventory management. Greater inventory control and increased product availability have the potential to have a major impact on a company's bottom line.

Another key benefit of RFID in the picking/putaway area is that it can capture an entire DC's inventory in a fraction of the time required by cycle or physical counts. Shelf-mounted readers, placed strategically throughout the facility, eliminate the need for annual physical inventory, saving thousands of dollars in labor as well as the downtime associated with closing the DC. Reader-mounted vehicles have the same capabilities, picking up inventory levels as they traverse the aisles.

## **Shipping**

Benefits of RFID throughout DC process carry over to the last step within the four walls—shipping. Because of the ability of readers to capture information on goods as they move through the DC, automated load scans, invoice matching and generation of all shipping documentation is possible. Companies can know exactly what they are shipping, how it compares to what they were supposed to ship, and generate the necessary information to accompany the order—all in real-time with little or no human interaction required. By eliminating the once manual process of preparing to ship orders, faster and more accurate loading and shipping are possible. Accuracy in shipping contributes to lower return rates, which in turn provides significant cost savings.

## **Supply Chain Inventory Visibility**

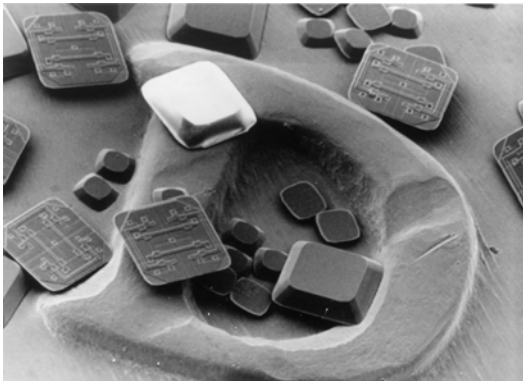
Global visibility and real-time collaboration and communication with trading partners are paramount to further developing overall supply chain efficiencies. After seeing the value of RFID in a targeted fashion within the DC, companies can expand implementation of the technology to improve other areas of the supply chain. By utilizing RFID from the manufacturer's factory to the retailer's shelf, totally automated logistics tracking through the entire supply chain is not only possible, but it streamlines replenishment, increases control and reduces overall costs.

It is this tracking that provides trading partners with real-time information about the location of their goods at all times in the supply chain—telling them when an order arrives or is shipped. Should a recall be necessary, due to a contaminated or damaged product, a company can easily track the history of the problem back to its origin and recall all effected products. Today, this often requires a blanket recall that wipes out more inventory than is necessary. RFID allows for a targeted recall that is more efficient, more cost-effective and safer.

Eventually, RFID will be able to provide critical information on customer demand in real time, without the delay and error potential associated with human intervention. For example, if a customer cancels or changes an order, RFID will allow companies to locate the order, make adjustments and divert it immediately. The increased accuracy, visibility and real-time decision making that RFID enables translates into increased responsiveness and better forecasting and planning in the supply chain. Using real-time data instead of relying on historical trends for forecasting and planning will allow companies to be less conservative in their planning approach. Consequently, they will not have as many exceptions or as much safety stock.

As RFID permeates the supply chain, the benefits will extend to point of sale (POS) information. With 35 percent of people walking out of apparel stores without product when product is there, but the customer or sales representative could not find it<sup>4</sup>, visibility into in-store inventory is critical. RFID will track this information and make it easily accessible, reducing the number of lost sales.

## Bottom Line: RFID Makes Cents



The benefits of radio frequency identification technology in the supply chain are clear. With the ability to one day track goods from raw materials to landfills and simultaneously address issues like counterfeiting, theft and perishability, RFID opens a world of possibilities. As with any new technology, many companies are taking a wait-and-see stance towards implementation. A cautious approach is understandable, but problematic. To further the adoption of RFID and speed the benefits

and ROI for all users, businesses need to take an active role in shaping standards, investigating opportunities and demonstrating the value of RFID implementations.

## Manhattan Associates' RFID Leadership Role

As the leader in providing supply chain execution solutions, Manhattan Associates has become a key player in the emergence of RFID technology in the supply chain. The company is the only supply chain execution provider to join the Auto-ID Center, where it is taking an active role. As part of the Auto-ID Center's Software Action Group, Manhattan Associates is working to determine the specifications by which readers will communicate with software.

Partnering with top companies such as Accenture, Alien Technology and Zebra Technologies has also allowed Manhattan Associates to aggressively move forward with the development of its RFID solution, which is scheduled to be released in the

company's 2004 base product. Manhattan Associates' Remote RFID Tag Generation™ capability makes it the only supply chain execution provider with this functionality—a key driver in initial adoption. As RFID continues to evolve, Manhattan Associates is committed to being a leader in both technology development and education.

---

## Footnotes

1. Logistics Benchmarks for U.S. Retailers  
Accenture study, 2001
2. National Retail Security Survey  
University of Florida, 2001
3. Retail Out-of-Stocks: A Worldwide Examination of Extent, Causes and Consumer Responses  
University-led research for GMA/FMI, 2002
4. RFID Changes Everything  
Line56, Jim Ericson, Sept. 2002