



## **Aanza AutoID Group**

# **Evolving from Bar Code to RFID in the Supply Chain**

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**Aanza AutoID Group White Paper**

# Evolving from Bar Code to RFID in the Supply Chain

*RFID promises performance and cost benefits from higher throughput and efficiency when compared to bar code identification in the supply chain.*

## **Automatic Identification Requirements and Bar Codes in the Supply Chain**

Bar codes in the supply chain are used to identify packages and pallets for purposes of accounting, inventory control, shipping verification, billing, and material handling decisions within manufacturing and distribution facilities. Industry standards and specifications for bar code physical characteristics, placement on cases and pallets, and data content have been developed and optimized specifically for these applications. Bar codes can be purchased separately for application to cases, pre-printed on to cases at the time of case manufacture, printed real-time directly on to cases, or printed on separately applied labels for cases and pallets.

Bar codes are typically read within facilities at points of accounting or ownership transition such as department or shipping doors, or where decisions are required in material flow. They are read by fixed position scanners or readers if the associated material handling systems are automated. They are read by hand-held readers if human operators are required to control package or pallet movement, or if the codes cannot be read by automated means. Decoded data from the readers is communicated to local control and business computer systems as appropriate.

## **RFID for today's applications**

Radio Frequency Identification (RFID) is a technology using radio frequency energy to communicate information from RF Tags on items to be identified to RF Readers. Two of the most visible commercial applications are EZ Pass™ for automatic vehicle toll collection and SpeedPass™ used for Exxon Mobil gasoline and Stop & Shop supermarket purchases instead of credit cards.

Active RF Tags used for automobile toll collection include built-in batteries to power the tags for the long reading ranges needed. These long-range tags are larger and more expensive than the passive or un-powered tags with adequate performance for the short reading distances needed for gasoline and supermarket purchases. Passive tags can be smaller and less expensive because they receive sufficient power to operate from the reading device's transmitted RF energy.

In other less-visible automated manufacturing applications, active RFID tags are used in automobile production to identify automobiles and control option installation on the assembly line. Passive RFID tags are used in the semiconductor manufacturing industry for wafer carrier ID and AGV (automated guided vehicle) ID and location.

Bar code and credit card magnetic stripe technology have been used for these Automatic Identification applications in the past, but newer installations are using RFID technology for better readability, improved durability, increased data content, and re-writeable data capability.

### **RFID for the product supply chain**

Like most evolving technology, RFID performance and cost have improved over time to become attractive for use in the product supply chain. With industry standards now being finalized for these applications, this new technology provides reading and data content advantages over existing bar code implementation in many applications, promising significant benefits to users. These benefits have been sufficiently demonstrated that a growing number of dominant and progressive retailers and users like Wal-Mart, Target, and the DOD have mandated RF Tag labeling on items to be received from their top suppliers starting in year 2005.

### **RFID's major benefits**

- Increased material handling throughput and efficiency with lower costs from enhanced tag readability over greater tag placement variation.
- Increased accounting accuracy and lower costs from tracking individual cases and pallets. RF Tags provide increased data content, including the additional capacity for unique identification of every case and pallet in the supply chain, in addition to the manufacturer and product data now available from standard bar codes.

Enhanced readability and unique package identification also enables:

- Faster and less labor-intensive tag reading
- Automation of material handling processes
- Fewer lost cases and less shrinkage
- Reduced "out of date" losses by finding and using the oldest cases first, or first in, first out (FIFO)
- Reduced costs and potential liabilities when searching for "recalled" cases
- Reduced shipping and receiving errors and vendor fraud
- Faster cycle time
- Reduced "out-of-stock" business losses

RFID has some unique characteristics compared to Bar Code ID that benefit supply chain applications.

- RFID offers more generous reading areas and tag positioning tolerance than optical scanning of bar codes. As an everyday example, compare the positioning flexibility of a portable phone communicating with its base station with the positioning constraints of a person reading a newspaper.

RFID Tags for the supply chain can be read over a larger variation of placement and orientation than bar codes used for these applications. RFID reading distances can be greater than 10 feet with the tag in any orientation, compared to optically reading bar codes within a few feet with orientation restrictions. Although RFID Tags can

even be read through many, but not all materials, highest reading rates result from approximating line-of-sight between tag and the reader's antenna.

Bar codes require direct line-of-sight between code and reader, typically with the readers scanned beam approximately perpendicular to the code face and oriented to pass through all or most of the coded lines at the same time. In automated reading applications like reading codes on boxes or pallets passing on conveyors, multiple readers may be needed to cover larger variations of placement and orientation of bar codes on cases or pallets, or their position on conveyors. If needed, larger RFID reading areas can be inexpensively achieved by adding only additional antennas connected to the same reader.

This more generous RFID reading performance improvement allows greater code and case positioning variation with respect to the reader's antenna. This flexibility can provide for higher throughput and lower costs from less precise automated positioning requirements, or in manual reading applications, less time for an operator to locate the code and position a hand-held reader to read it. RFID tag reading can frequently be automated where reading bar codes automatically would be nearly impossible or would require complex and expensive scanning arrays for applications such as reading pallets passing on fork lift trucks.

- RFID's large reading area and characteristics allow for novel new applications not possible with line-of-sight reading of bar codes. RFID enables searching areas for taking inventory or searching for specific tags or items within reading range of antennas. Some new RFID applications allow construction of reading areas on storage shelves with built-in antennas that effectively inventory the shelves' contents by continuously reading the tagged items on the shelves, allowing the associated inventory system to maintain real-time accuracy.

In certain situations there may be some potential drawbacks of RFID technology.

- Larger reading areas can include reading tags on adjacent cases or pallets rather than, or in addition to, the intended tag. If this characteristic becomes a problem, numerous low-cost solutions, such as optional, more directional antennas or simple RF power reduction can be implemented.
- RF energy between the reader's antenna and the RF Tag can be reflected, blocked, or reduced by metal or liquids, so care must be taken when implementing RFID near these materials. If metals and liquids can come between the tags and the readers' antennas, antennas should be repositioned or additional antennas employed to avoid reading through the obstacles. Reading rates may also be reduced when RF Tags are directly applied to metal objects or to containers holding liquids unless the tags are spaced slightly away from these objects or containers.
- Local sources of RF energy like arc welders, large motors, or nearby communication devices operating at the same frequencies as the RFID system can interfere with reading RF tags just as intense light sources, like direct sunlight, can interfere with optically reading bar codes.

Like bar code reading applications, surveying intended application areas for reading requirements and potential sources of interference allows solutions to be optimized for best performance.

### **Cost and size comparisons**

- Bar codes usually cost less to print or purchase than RF Tags cost to purchase. Bar codes cost only pennies to purchase or print. The goal for basic RF Tags is \$0.05 but it's uncertain when that price goal will be reached. RF Tags are rapidly decreasing in cost as volume increases, but today cost ~ \$0.20 to \$0.75 for the base tag, depending on quantity.
- RFID Tags for the supply chain are typically smaller than bar codes currently used. Smaller tags allow application to smaller cases, and can increase available space for marketing messages, improved esthetics, larger logos, or additional human-readable information.

### **RF Tag or label application to cases or pallets**

Bar codes can be preprinted on cartons or cases, or printed onto a separate label and applied either by automatic label applicators or manually by a human operator.

In a similar manner, RF Tags can be inserted or embedded into the carton, attached separately, or integrated into a separately attached label and applied like bar coded labels, automatically or manually. Label printers like those used for bar codes are available that include an RF Tag within the printed label.

### **Benefits of extra data content**

The extra data content of RFID Tags provides for unique identification by serialization of every case and pallet in addition to the normal bar coded content of manufacturer and product. This unique identification provides for tracking and accounting of each individual case and pallet throughout the distribution chain, rather than just tracking a certain quantity of identically coded products. With specific manufacturing information associated with each case of products in the manufacturer's database, and appropriate information from that database accessible to distributors and retailers, information like expiration dates, product information appropriate for recalls, etc., can be made accessible to optimize product sales and reduce potential liability.

### **Programmable RF Tags**

Once printed, bar codes cannot be printed again to add information.

The basic RF Tag for the distribution chain is preprogrammed for data content at the time of manufacture, like preprinted bar codes, requiring the product manufacturer to plan ahead for purchasing tags coded appropriately. Optional tag classes are available for tag programming at the time of application (one time only), and also for multiple programming events, so tag data can be added or updated as appropriate.

## **RFID Implementation overview**

Most efficient manufacturers and distributors have already taken advantage of bar codes to identify cases and pallets shipped. Implementation of RFID Tags and systems will have many similarities to the bar code procurement, case or pallet labeling, reading, and IT communication and business infrastructure already in use. Because of these similarities, basic RFID implementation should be evolutionary to experienced bar code Auto ID users. Efficient implementation should allow product suppliers and distributors to also take advantage of the many RFID benefits expected by their customers.

### **Implementation costs**

Like most investment initiatives in efficiency and productivity, initial implementation costs are those for investigation, planning, readers, upgrades to communication and software systems, as well as slightly higher per-unit costs for RF Tags.

Implementing the RFID reading infrastructure will add costs comparable to implementing or upgrading existing bar code reading systems. If the existing bar code systems have been in place for some time, plans for updating or replacement may already be budgeted so those funds may be available for initial RFID implementation.

For lowest initial costs for business software enhancements, initial implementation could be limited to use only the data now available from bar codes, discarding the extra data available for unique case and pallet identification. Costs for upgrading the “middleware” and business software to take advantage of the additional RFID data may be phased in over time when justified by the benefits offered.

Although tag costs are rapidly decreasing with increasing volume from rapidly increasing implementation, they are currently higher than mature bar codes. Increased adoption will increase manufacturing volume, thus decreasing tag costs to approach those of today’s bar codes.

### **Deciding whether, when, and where to implement RFID**

For manufacturers, the first steps are review of your customers’ receiving requirements, industry standards, appropriate RFID technology, products, and vendors, an audit of your company’s existing processes and systems to see where RFID can be implemented, comparison of requirements with vendor products, and then a benefit/cost evaluation to analyze and prioritize possible applications to identify the best place to begin.

Even if the benefits appear to be attractive but don’t initially appear to justify the costs, it must be remembered that implementation costs are decreasing rapidly as more users implement RFID and manufacturing volume increases. Since it will take time to plan, budget, gain approval, and implement the first application, costs will certainly be lower by the time implementation expenditures begin. To become familiar with RFID technology and initially evaluate its performance in your application and environment, most RFID vendors offer training courses and relatively inexpensive evaluation kits of sample tags and reading systems.

## **How to get started if in-house resources are already overcommitted**

Like most efficient-but-lean organizations today, a company's resources and staff may be too limited or busy to undertake additional evaluation and planning for RFID implementation. Many companies in this position utilize outsourcing for new initiatives, while relying on internal resources for critical input and management overview. Experienced consultants can provide the outsourced resources cost-effectively, while providing a beneficial independent perspective.

## **About Aanza AutoID Group**

For many years, consumer packaged goods manufacturers, logistics services providers, and retailers have used bar codes to effectively control and track their inventory of goods. Recently, due to the improved performance and cost effectiveness of radio frequency ID technology and the initiatives from companies like Wal-Mart and the Department of Defense, there has been increased interest to implement this new technology.

Aanza AutoID Group enables companies to select the best applications for moving from bar code to RFID environments, effectively transition to the new environment, and maximize their ROI. Its consulting services include

- Feasibility studies for RFID relative to existing business processes
- Management briefings on standards status
- Potential costs/benefits
- Recommended approaches
- Vendor selection
- Application specific process optimization
- Training sessions addressing real-life implementation challenges and Recommended best-practices
- Implementation project management

Aanza AutoID Group personnel have extensive business and technology experience with AutoID applications in a diverse set of industries including automated manufacturing, automotive, electronics, package distribution, pharmaceutical, retail, and transportation with companies such as Bic, Kimberly Clark, Nabisco, Ford, GM, Maytag, UPS, FedEx, Warner-Lambert, Stop & Shop, and Marshalls.

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