

White paper

## **RFID Basics for Retailers**

RFID has become one of the most talked about technologies in the market today. Leading retailers and their consumer goods supplier trading partners are beginning limited use of RFID systems in their operations and are announcing plans for expansion. Despite the promise that the technology holds, limitations with the initial RFID implementations have made the experiences to-date mixed.

The recently ratified EPCglobal UHF Generation 2 standard and the RFID standards work being done by ISO are key to improving this experience and progressing RFID into the mainstream. With global RFID standards coming into place, the key technology providers are now spending the millions and millions of dollars necessary to gain the system performance increases, reliability and cost reductions that the market needs. This will result in more affordable solutions and a better variety of choices for retailers.

Going forward, most retailers implementing RFID systems won't get the same attention as the early adopters, but they can get the same or better results. The ultimate winners will be those retailers that can use RFID as an enabler to improve their business processes and operations.

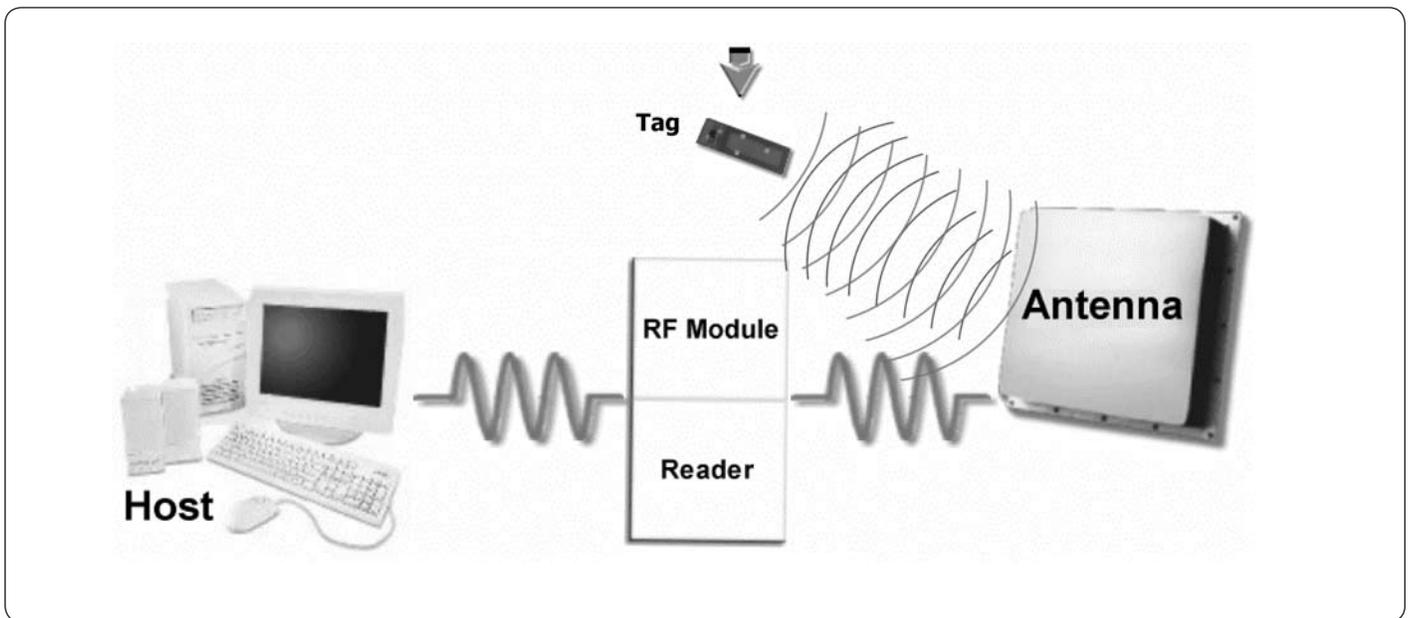
Dependable technology, emerging standards plus increasing business pressures are driving the rapid adoption of RFID. That is why it is important to have up-to-date information about RFID performance, integration capabilities and standards. This white paper will help you better understand RFID by:

1. Providing an overview of RFID technology
2. Describing the current status of relevant RFID standards initiatives
3. Illustrating how RFID can be integrated to enhance existing wireless LAN, bar code and mobile computing systems
4. Providing guidance for selecting and planning RFID pilots and implementations
5. Answering frequently asked questions

#### **A Briefing on the Basics**

RFID wirelessly exchanges information between a tagged object and a reader/writer. An RFID system is comprised of the following components (Figure 1):

- One or more tags (also called transponders), which includes a semiconductor chip and antenna.
- One or more read/write devices (also called interrogators, or simply, readers).
- Two or more antennas, one on the tag and one on each read/write device.
- Application software and a host computer system.



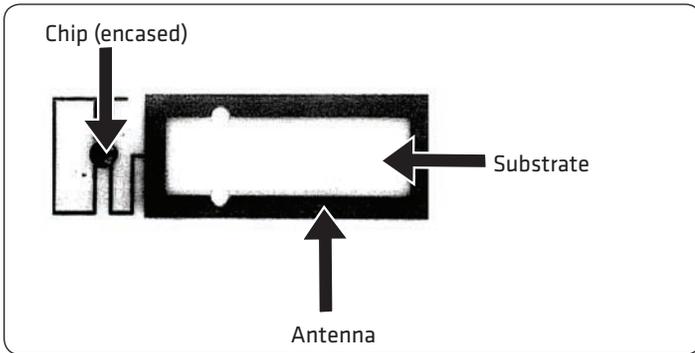
**Figure 1: RFID System Components**

Radio waves are used to transfer data between the RFID tag and the read/write device (interrogator), which are tuned to the same frequency. The interrogator sends out a signal, which is received by all tags tuned to that frequency that are present in the RF field. Tags receive the signal with their antennas, and selected tags respond by transmitting their stored data. The tag can hold many types of data about the item, such as its manufacturer, product number, serial number, configuration instructions, what time the item traveled through a certain zone, even temperature and other data provided by sensors.

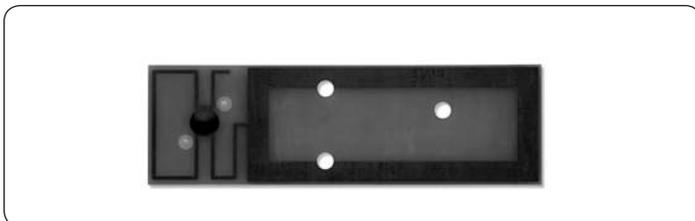
The interrogator receives the tag signal with its antenna, decodes it and transfers the data to the host computer system. RFID tags can be attached to virtually anything – from a semi tractor, to a pallet, to a case, to an item on a store shelf. If multiple tags are present in the field, more efficient RFID implementations have anti-collision algorithms, which determine the order of response so that each tag is read once and only once.

**Tags (Transponders)**

RFID tags must have three basic elements: a chip, an antenna and the substrate. The substrate can be one of a variety of both flexible and rigid materials. This includes FR4 laminate (used in printed circuit boards), polyester and paper, among others. The antenna is a metallic based material and is produced on the substrate through either additive processes such as printing or deposition, or subtractive processes such as etching. The chip is a silicon integrated circuit (IC) that is attached to the antenna via solder or adhesive. Together, these three components form what is commonly called an inlay. The inlay itself can act as an RFID tag or it can be processed further to provide more robust capabilities for specialized applications. Examples of this additional processing include encapsulation in plastics or insertion under a label stock to produce a combination barcode/RFID smart label.



**Figure 2: Inlay - RFID Tag Components**



**Figure 3: Finished Tag – Pallet Tag**

Various types of tags are needed for use in different environmental conditions. For example, tags that perform well when attached to cardboard cases may not be the best choice for wooden pallets, metal containers or glass. Tags may be as small as a grain of rice, as large as a brick, or thin and flexible enough to be embedded within an adhesive label and run through a bar code label printer. Tags also vary greatly by their performance, including read/write ability, memory and power requirements.

Depending upon the application and environment, RFID tags have a range of durability. Paper-thin labels, often referred to as “smart labels” are typically used for disposable applications and, as such, are not as durable (Figure 4). Many tags are used for permanent identification applications and can be encased in materials to withstand extreme environments or caustic materials that make text, bar code or other optical-based identification technologies unusable. RFID tags can be reusable and suitable for lifetime identification, which can provide a total cost of ownership (TCO) advantage over bar code labels or other identification methods that are disposable and need periodic replacement.



**Figure 4: Finished Tag – “Smart Label”**

Tags are either 1) passive, which receive their power from the signal sent by the reader, 2) active, which have a battery to power their own transmissions, or, 3) battery assisted, which have a battery that powers chip electronics but does not transmit RF energy.

Most current and proposed retail and consumer goods logistics RFID applications can be satisfied with passive tags, which are less expensive and smaller than active versions because they do not require a battery. Active tags are the best selection when the most important consideration is to be able to read the tags at the longest possible distance.

Just like compact disks, RFID tags can be read-only or read-write. Read-only tags are programmed with a serial number or other data at the factory and cannot be altered. Read/write tags can come in two forms. One form is often referred to as “Write Once, Read Many”, or WORM. These tags allow for one-time field programming of data into the chip memory. A second form of read/write tags can be programmed multiple times. Data on these read/write tags can be revised or erased thousands of times by the user. Read/write tags are often partitioned with a secure, read-only area encoded with a unique ID number, and a writeable portion of memory that users can program, reprogram or permanently lock themselves. One application for this technology

is to permanently encode a tote ID number in read-only memory and to use the read-write blocks to record items that have been loaded into the tote. When the tote is unloaded, the writeable section can be erased and made available for new information when the tote is reused. Companies or departments throughout the supply chain can also take advantage of the writeable portion of tag memory to add data to support their own business operations (traceability, quality assurance, etc.).

Writeable tags can also be interfaced with sensors to capture and record variable information. For example, a frozen foods producer may apply RFID tags to pallets and interface them with a temperature sensor to monitor temperatures during shipment or storage. The system could be set to sound an alarm if temperatures moved outside of the pre-set acceptable range. Temperature sensors could also be used to automatically

provide documentation that materials were kept at required temperatures. Sensor applications often use battery-assisted tags and power for the sensor.

#### Reader/Writer Options

Because direct line of sight between the reader and tags is not necessary, there are many more placement options for RFID readers than were possible with bar code labels. Readers can be either placed in a fixed-position or be portable, just like bar code scanners. Fixed-position readers can be mounted to read items traveling through dock doors, conveyor belts, loading bays, gates, doorways and other areas. Readers may also be attached to lift trucks and other material handling equipment to automatically identify pallets and other items that are being moved. Interrogator capabilities have also been engineered to now be able to fit into smaller mobile devices.

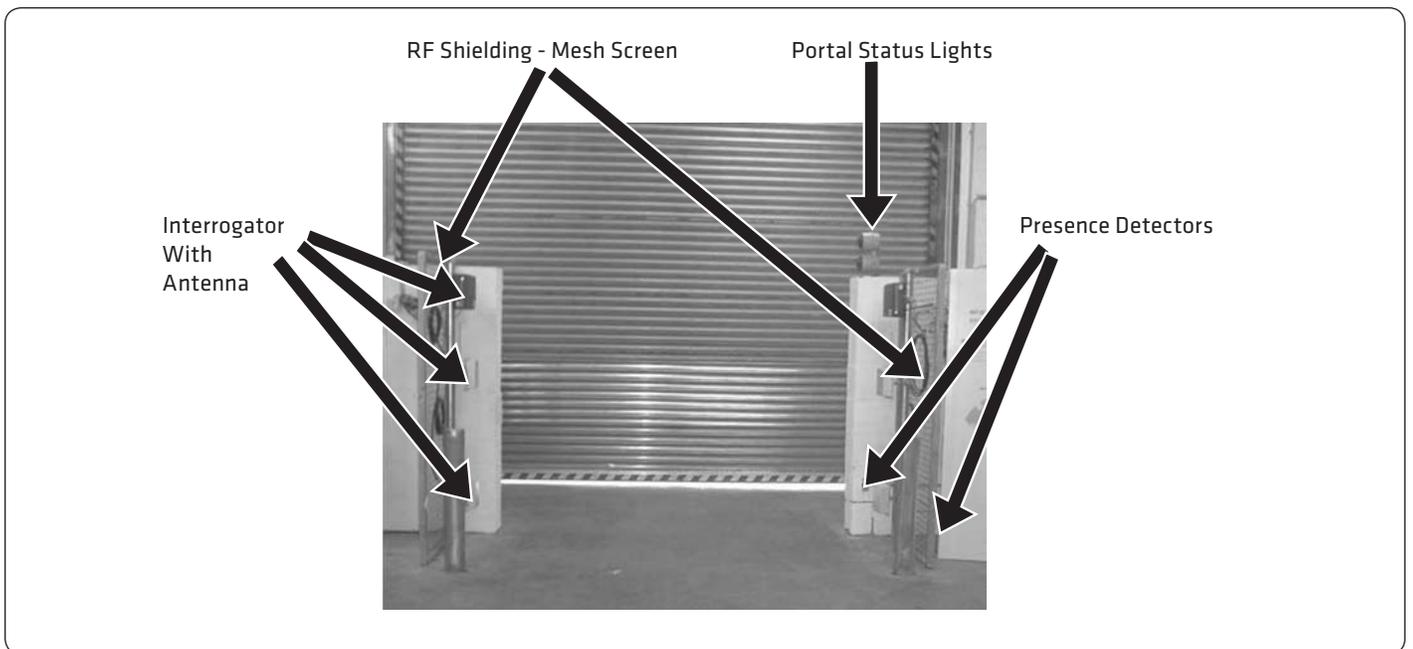


Figure 5: Dock Door Fixed Mount Interrogator

The ease with which RFID can be integrated into current operations depends on the openness and flexibility of the technology infrastructure, especially the mobile computers and wireless LANs that will be used to collect and communicate RFID data. These variables will have a significant effect on the return-on-investment. One way to maintain flexibility is to use mobile computers with card slots, peripheral ports and other expansion options that can be used to add RFID capability without sacrificing other functions.

Smaller footprint interrogator devices, such as those in PC Card format or designed to work with handheld computers, can enable users to add RFID capabilities to their existing applications without having to reinvest in entirely new mobile computing systems (Figure 6). Portable interrogators can also be connected to fixed or mobile computers like a forklift mounted computer, a handheld computer, a desktop computer or a laptop. These portable interrogators can be connected either wirelessly or tethered with a wire cable (Figure 7). Mobile RFID interrogators allow users to read and write to tags that may be in remote locations or where it is not feasible or prudent to install fixed-position readers. The RFID interrogators can also include or be used with bar code scanners to address applications or environments where both technologies are needed.

One of the most desirable implementations for RFID interrogators is mounting them on fork lifts (Figure 7, shown with multiple antennas). The advantages to forklift mounted interrogators is that there are typically fewer forklifts in a facility than dock doors, so less interrogators are needed to cover a facility. Forklift mounted systems are also portable so that they can go to wherever they are needed.

“Smart label” tags are typically initially programmed by printers that have the capability to print bar codes or other visible information on the paper side of the label while also writing to the memory located on the RFID chip inside the label.



Figure 6: PC Card and Handheld Clip-on Interrogators



Figure 7: Forklift Mounted Interrogators



Figure 8: “Smart Label” Printer

## Performance Features

Radio frequency is not an optical technology and does not require line of sight between the tag and reader, which is an important distinguishing feature that gives RFID many performance advantages compared to bar code and other automatic identification technologies. Because RFID is a radio-based technology, performance considerations for its implementation are that 1) RFID can be susceptible to interference from other radio transmissions and metal 2) some materials absorb RF signals more readily than others 3) sensitivity to interference varies by frequency and the usage environment. These factors can impact the tag read/write range and speed. Most scenarios can be handled by using the proper specific tags, readers and applications.

Because no line of sight is required, RFID-tagged objects can be read in different orientations at very high speeds. Orientation sensitivity depends on the antenna design and the amount of interference present. In some environments tags may be read in any orientation. This gives product and package designers tremendous flexibility in tag placement options, and eliminates the need for human intervention to scan labels or to ensure items are placed properly for reading in conveyor belt or retail checkout applications.

RFID is a flexible technology that is convenient, easy to use and well-suited for automatic operation. It combines advantages not available with other identification technologies: RFID can be supplied as read-only or read/write; does not require contact or line-of-sight between the reader and the object to be identified; can function in harsh environments; enables multiple tags to be read simultaneously; and provides a high level of data integrity. RFID can also provide anti-theft security and product authentication because tags can be applied discreetly and are extremely difficult to counterfeit.

Some vendors offer systems that can be programmed to search for specific tags within a field. This functionality, called “group select,” improves processing speed because only the tags of interest are identified and read, other tags in the field can be ignored. Group select is extremely valuable for logistics and retail operations. For example, distribution center workers could use mobile RFID readers to quickly search dozens of cartons from an incoming shipment to locate the specific cases that are needed. Retailers receiving mixed-load shipments could locate hot selling products and promptly place them on the shelves before the rest of the shipment was unloaded.

RFID systems have the potential to produce more data than information systems and software applications are accustomed to receiving. To take advantage of greater data availability, it is important to consider what data is desired and how often it should be collected. Planning a successful implementation requires more than just knowledge of RFID technology. Knowledge and real experience with other data collection technologies, mobile computing, industrial and wireless networking, manufacturing and distribution processes, and enterprise software are also needed.

## Security

It is extremely difficult to counterfeit radio frequency identification chips. A hacker would need specialized knowledge of wireless engineering, encoding algorithms and

encryption techniques. Different levels of security can be applied to data on the tag, so information could be readable at some points of the supply chain but not others.

## Range

An RFID system’s “read range” – the distance a reader antenna must be from the tag in order to read the information stored on its computer chip – varies from a few centimeters to tens of meters, depending on the frequency used, power output, whether a tag is active or passive, and the directional sensitivity of the antenna. The presence of metal and liquids also affects range and read/write performance because these materials may cause interference. For read/write tags, the read range is typically greater than the write range. Active tags are capable of much longer ranges than passive tags. For example, 433MHz active tags can transmit data about 300 feet, but passive tags at the same frequency are typically readable from up to 25 feet.

## Frequency

Frequency is one of the leading factors that affects range. Virtually all RFID systems used today fall into one of four frequency bands, which are described in Figure 10.

Frequency Band	Description	Range
125 – 134 KHz	Low frequency	To 18 inches
13.553 – 13.567 MHz	High frequency	3 -10 feet
400 – 1000 MHz*	Ultra-high frequency (UHF)	10 - 30 feet
2.45 GHz	Microwave	10+ feet

\* Most supply chain RFID systems in the UHF band will operate between 860 and 930 MHz.

**Figure 9: Common RFID Frequencies and Passive Ranges**

No single frequency is ideal for all applications, even within a single industry. Just as separate bar code symbologies are used at different levels of consumer goods packaging, from UPC/EAN symbols at the item level to Code 128 and two-dimensional symbologies on cases and pallets, RFID tags of different frequencies and functionality will be used together within overall supply chain operations. Current logistics and supply chain applications tend to use the UHF band, between 860 and 950 MHz.

## Current Standard Initiatives

There are multiple initiatives to create RFID standards at these frequencies so tags and equipment from multiple sources can be used together in open supply chain systems. Standards and specifications may be set at the international, national, industry or trade association level, and individual organizations may term their own specifications as “standard.” Many industry standards and specifications set by individual organizations are based on international standards to make implementation and support easier and to provide a wider choice of available products.

One of the most important standards organization for retailers is the International Organization for Standardization (ISO), which is based in Geneva and whose standards carry the weight of law in some countries. All ISO standards are required to be available for use around the world, so users of ISO RFID

standards will not have to worry if their systems comply with the different regulations on frequencies and power output for each country where they do business. The ISO is very active in developing RFID standards for supply chain operations.

**EPCglobal** is also an important body. EPCglobal is a non-profit organization formed by GS1 (formerly EAN International) and the Uniform Code Council (UCC), which also jointly manage the system of UPC/EAN bar codes used on consumer goods plus many other identification and commerce standards. EPCglobal has 3 standards that particularly apply to retailers – Class 0, Class 1 and, the latest standard, UHF Generation 2.

The recently ratified EPCglobal UHF Generation 2 standard and the RFID standards work being done by ISO are key for progressing RFID into the mainstream. With global RFID standards coming into place, the key technology providers are now spending the millions and millions of dollars that are necessary to gain the system performance increases and cost reductions that the market needs. This will result in more affordable solutions and a better variety of choices for retailers.

### **Integrating RFID into Operations**

The biggest difference between RFID and other automatic and manual data collection techniques is its ability to recognize multiple items simultaneously, regardless of orientation. That means RFID systems can be largely automated, reducing the need for manual scanning. Therefore RFID is advantageous in operations that require labor-intensive data collection or where it is difficult to guarantee line of sight between the object and the reader. RFID tags can also be updated and can hold much more data than linear bar codes traditionally used for item and shipment identification.

These differences can provide advantages in operations where faster processing or more information is desirable. Cross docking is an excellent example. RFID readers can expedite handling by instantly reading a specific pallet, enabling needed items to be identified, located and pulled for transfer to a waiting shipment. Group select capability is especially valuable for this operation. Networks of RFID readers can also be set up in retail storage locations and warehouses to automatically locate items, without labor. Integrating the RFID system with a wireless LAN enables activities to be directed remotely and information to be communicated and shared in real-time across the enterprise.

RFID can provide more information, and provide it more quickly, than other data collection methods traditionally used in retail supply chain operations. If not implemented correctly, the extra volume of data that can be generated may not be necessary, and could potentially cause problems. Companies won't always need to record every item on a pallet each time the pallet is within range of an RFID reader. The potential data volume should pose no throughput problems for enterprise wireless LANs, but could require software applications to perform unnecessary processing. Successful RFID implementations enhance enterprise data collection and processing applications, rather than replacing them, and require careful planning to produce the desired impact.

For example, RFID tags can also be interfaced with sensors, a feature that can be used to reduce shrink and spoilage. Pallet tags can be programmed to accept readings from temperature sensors and transmit an alert if storage temperatures are close to becoming too high or too low. This could trigger corrective action that would save the pallet from spoiling.

The benefits were gained in the above scenario by tagging the pallet, and continuing to use bar code as the primary method to identify the cartons and cases it holds. This is just one of the many ways bar code and RFID can be used together to enhance operations without requiring major technology infrastructure changes throughout the enterprise.

Bar code is and will remain the easiest and least expensive method to identify individual consumer goods. Mail delivery didn't disappear when cell phones and e-mail became ubiquitous, and bar coding will not disappear as RFID use grows. RFID creates options for capturing and communicating information. A well thought out infrastructure allows you to take advantage of RFID while keeping other data collection and communications options open. In some cases the combination of RFID, bar coding and voice/speech may be the best approach. Flexible equipment, such as RFID readers capable of processing tags with different frequencies, and mobile computers that can be upgraded to support RFID are excellent tools for creating a flexible infrastructure. Committing to standards is an important way to maintain flexibility and a smooth migration path.

### **Determining Where to Implement**

Retailers face the constant demand to have the right goods available at the right places in the right quantities. RFID can reduce the time and labor required to keep needed items in stock while providing more inventory visibility and accuracy. Retail RFID implementations can reduce warehouse and store labor expenses by 7.5 percent and reduce out of stocks resulting in \$700,000 in incremental revenues per \$1 billion of sales, according to a study by management consulting firm A.T. Kearney released in November, 2003. The study complements research by Accenture, AMR Research, Gartner, Forrester Group and others which showed a business case for RFID use to support various supply chain operations. Accenture found retailers could increase sales by 3 percent through fewer out-of-stocks and could reduce receiving labor by 65 percent.

The actual savings and return-on-investment vary according to the scope of the implementation and the type and volume of materials being identified. One of the most challenging questions retailers face regarding RFID is where to get started. Areas where bottlenecks frequently occur, or that require labor-intensive handling, are good potential places to start. Following are some examples of how RFID can benefit operations.

### **Returnable Container Tracking**

By tracking pallets, totes and other containers with RFID, and building a record of what is stored in the container, users can have full visibility into inventory levels and locations. With

visibility and control, retailers can easily locate items within distribution centers necessary to fill orders and fulfill rush orders without incurring undue managerial or labor time.

Reusable Plastic Containers (RPCs) are used to package and transport produce. A grower packs and ships fruits and vegetables in RPCs for travel through distribution to a store's produce department. There, store associates simply lift the container onto the shelf for an instant display. That means no more manual unloading of cartons or disposal of used or soiled packaging. When the produce container is empty, it is returned for cleaning and reuse. The RFID tag is used not only to keep track of the location of the RPC, but also to document its cleaning history, from the date and temperature of the washing to the chemicals used.

Each RPC's RFID tag incorporates a unique identification that can be read from 3 to 5 meters (9.8 – 16.4 feet) away as the RPC moves along high speed conveyors, passes through doorways, rests in fields, is loaded on a truck or is stacked on a pallet, even in groups of 100 or more. By adding tag interrogators, a grower can track loads of produce to a specific retailer to help speed payment, or a retailer can make sure the first produce into the system is the first to go on the shelves.

Returnable container tagging also facilitates the development of tracking systems that can provide accurate, real-time information about item locations and availability. This information can be used to save money by reducing safety stocks and improving asset utilization.

### **Inventory Control**

The main benefits to using RFID in the supply chain come from improved inventory tracking, especially when the technology's capabilities are used to collect information and provide visibility in environments where tracking was not done before. Retailers, wholesalers, distributors, logistics providers and manufacturers can all use RFID for inventory applications, and in carefully planned systems may share the same tags to reduce implementation costs. Because it can be read through packaging, without concern to orientation, without direct line of sight between object and reader and can withstand exposure to dirt, heat, moisture and contaminants that make bar code unusable, RFID can remove blind spots from inventory and supply chain operations.

By using the highly accurate, real-time and unattended monitoring capability of RFID to track stock, retailers can improve visibility and confidence into their inventory to enable overall inventory levels, labor costs and safety stocks to be reduced. Readers covering dock doors, warehouse racks, shelves and other storage locations could automatically record the removal of items and update inventory records. If an item was misplaced or needed urgently to complete an order, RFID readers could automatically search for the item by reading for its specific ID number.

### **Shipping & Receiving**

The same tags used to identify work-in-process or finished goods inventory could also trigger automated shipment tracking applications. Items, cases or pallets with RFID tags could be read as they are assembled into a complete customer order or shipment. The individual readings could be used to automatically produce a shipment manifest, which could be printed in a document, recorded automatically in the shipping system, encoded in an

RFID tag, printed in a 2D bar code on the shipping label, or any combination. For example the SSCC data structure commonly used in bar codes on shipping labels could be encoded into RFID to facilitate automated handling. The new RFID application could be very effectively integrated into existing business processes because it takes advantage of data structures that are already supported in enterprise databases and software applications.

Manifest information encoded in an RFID tag could be read by the receiving organization to simplify the receiving process and to satisfy requirements like those for advance shipping notices (ASN), so there would be no processing delays if the physical shipment arrived before the electronic data interchange (EDI) transmission with the ASN information. Having complete shipment data available in an RFID tag that can be read instantly without manual intervention is very valuable for cross dock and high-volume distribution environments. Incoming shipments can be automatically queried for specific containers. If a sought-after item was present, it could be quickly located and selected.

### **Recall Management**

Retailers could take advantage of automated reading and group selection functionality to quickly identify and locate products affected by a recall. Using RFID to automatically capture serial numbers or lot codes on cartons processed at distribution centers and received at retail stores provides a new level of traceability without requiring time-consuming manual data collection. By accurately and efficiently capturing lot codes, retailers could target their recalls so unaffected products would not have to be pulled from stores.

### **Summary and Conclusions**

There are many excellent opportunities to benefit from RFID right now. Careful planning will yield a system that provides immediate benefits and long-term competitive and total cost of ownership advantages. Here are some points to remember to plan a system that provides the functionality and flexibility to meet current and future needs:

- Consider starting with high return areas where manual handling or item orientation causes bottlenecks, or where improved accuracy would improve operations
- Analyze the changes to your infrastructure that an RFID implementation would require
- Consider how the pilot could impact other operational areas and potential follow-up applications.
- Investigate appropriate standards to support the intended application
- Look for hardware that supports standards and can integrate with existing systems
- Work with vendors and supplier/trading partners that have experience with RFID or with whom you have a good working relationship
- Plan a pilot implementation
- Identify SKUs and locations which have the greatest potential to provide a win for you and your pilot trading partner
- Conduct the pilot, measure results and assess the feasibility of rolling out the system
- Get experience with your systems and within your operations. What will you do with the data? When will you capture data? Where should you place interrogators?

## Frequently Asked Questions

### *Will retailers start to deploy RFID to some degree in 2005?*

According to a 300+ retailer study based on a survey by the National Retail Federation and Bearing Point 35% of retailers indicated that they will deploy RFID to some degree this year. That is up from 15% in the same survey last year. From the same study 50% said they would tag between 6-10% of their merchandise and 11% saw RFID deployment in 2005 as of key strategic importance.

### *Why are retailers interested in RFID?*

Leading retailers are interested in RFID for its technical benefits. RFID helps them to reduce labor and improve their ability to gather desirable data. The availability of this data will be an enabler for these leading retailers to make business process changes, both internally and with their Consumer Goods suppliers, which are advantageous for them. Other retailers are interested in RFID as they do not want to be too far behind the leading retailers as they begin to benefit from RFID. The initial areas that retailers are primarily focused are those related to receiving, replenishment, category management, traceability, counterfeit prevention and inventory.

### *How could RFID impact the consumer's shopping experience?*

RFID should enable a retailer and its consumer goods suppliers to better manage their inventories through better visibility. One of the most notable benefits that a consumer should see is a reduction in out of stocks (i.e. the products they want are on the shelf when they want them).

### *What should retailers consider when purchasing RFID hardware?*

Two of the key issues affecting retailers' purchasing decisions are compatibility and the ability to be upgraded. It is critical that retailers and their CPG suppliers have compatible readers and tags. This is done primarily by using industry standard components like those compliant with the upcoming EPCglobal UHF Generation 2 standard. This is particularly important as the marketplace becomes more and more global. The ability to be upgraded is also very important for protecting retailers' investments in technology as RFID has been fairly fluid and will continue to be so in the near future.

### *Which suppliers should retailers work with on RFID pilots/implementations?*

Retailers should identify the suppliers that are doing a significant amount of business with them, have the necessary business systems in place, are technically capable and are willing to work through start-up problems. Also, make sure the potential supplier has sufficient service offerings to make the implementation as painless as possible and will support you going forward to reduce your total cost of ownership.

### *How can RFID impact CPFR and/or Global Data Synchronization?*

RFID can be an enabler for improved data that will feed into CPFR or Global Data Synchronization systems. Much like bar code technology, RFID can automate the data that is collected in a CPG supplier and retailers' operations, thereby reducing errors. This holds the promise for improved collaboration between retailers and CPG suppliers and better decision making that is based upon good, clean, timely data.

### *Is item level tagging moving forward?*

Item level tagging will move forward on products and product categories where the business case warrants (higher cost, higher theft, regulatory compliance, etc.) or in situations where a single unit is a "case" (ex. TV, refrigerator). There are many additional benefits that can be derived from tagging on an item level over pallet/case tagging. We expect that as Generation 2 products become available a number of items that were not practical to tag with Class 0 or Class 1 will be tagged with Generation 2. The performance, cost and breadth of choices with Generation 2 will provide relief to some of the limitations plaguing Class 0 and Class 1; however the majority of activity will continue to be limited to the pallet/case level for the near term.

### *What do standards like the emerging EPCglobal UHF Generation 2 mean to retailers?*

The recently ratified EPCglobal UHF Generation 2 standard and the RFID standards work being done by ISO are key for progressing RFID into the mainstream. With global RFID standards coming into place, the key technology providers are now spending the millions and millions of dollars that are necessary to gain the system performance increases and cost reductions that the market needs. This will result in more affordable solutions and a better variety of choices for retailers.

### *How long should retailers wait before using RFID?*

We expect that RFID implementations will see an increase this year with the greater availability of the products and services that are global, integrated, cost effective, high performing and reliable. As retailers that are using RFID are able to benefit from improved supply chains and business relationships they will gain competitive advantages. The competitive marketplace will determine when other retailers will need to gain the advantages that RFID has to offer.

### *What should retailers do to prepare? What technologies should they be anticipating?*

It is very important for retailers to understand their systems and business processes so that they fully identify their opportunities for improvement and pain points. It is also important for retailers to understand the specific advantages and nuances of RFID and other alternative technologies such as voice and bar codes. This will increase the retailer's confidence that they are applying the right solutions to the right problems. The learning and consultation that are available from pioneering retailers, consumer goods suppliers and technology providers will also greatly help retailers to increase their benefits and reduce their risks. This can be initially gained by the information that is available, but needs to be validated by actual experimentation and experience with the technologies within the retailer's operations. Finally, it is critical that retailers are in lockstep with their consumer goods supplier partners so that they can both benefit to the fullest.

## Resources

There are many additional resources to help you learn more about RFID technology and applications, standards and project planning. Intermec Technologies suggests the following sources for more information:

Intermec's own Web site, [www.intermec.com](http://www.intermec.com) has an online RFID assessment tool to help analyze the potential impact of RFID on your operations. The site also has more white papers, case studies, product details and information about Intellitag® RFID hardware, software and professional services.

AIM Global is the trade association for the automatic identification and data capture industry that has technology information and links to RFID standards activities on its Web site, [www.aimglobal.org](http://www.aimglobal.org).

ISO (International Organization for Standardization) – [www.iso.org](http://www.iso.org).

EPCglobal, Inc. ([www.epcglobalinc.org](http://www.epcglobalinc.org)), is leading the development of industry-driven standards for the Electronic Product Code™ (EPC) to support the use of RFID. EPCglobal was jointly created by the Uniform Code Council (UCC, [www.uc-council.org](http://www.uc-council.org)) and GS1 (formerly EAN International) who each maintain additional information about the EPCglobal Network on their Web sites. EAN International has been renamed GS1 ([www.gs1.org](http://www.gs1.org)).

The National Retail Federation (NRF, [www.nrf.com](http://www.nrf.com)) has a variety of RFID news and resources on its Web site.

The Food Marketing Institute (FMI, [www.fmi.org](http://www.fmi.org)) also has a variety of RFID news and resources on its Web site.

For more information about standards, including downloadable specifications, visit the ISO Web site, [www.iso.org](http://www.iso.org) or the American National Standards Institute site, [www.ansi.org](http://www.ansi.org).

Intermec Technologies offers a complete range of services and products to help organizations evaluate if they could benefit from RFID and how it could be integrated into business processes. Intermec is a leader in RFID technology and standards development with extensive experience helping retailers, manufacturers, distributors, logistics providers, service companies and other businesses implement complete RFID data collection systems. Products include bar code readers and printers, wireless networking equipment, rugged handheld computers, vehicle-mounted and stationary industrial computers. Intermec systems support RFID and other data input and networking options plus related software and peripherals. Intermec has been helping companies profit by taking advantage of data collection technologies for more than 35 years. Visit us today at [www.intermec.com](http://www.intermec.com) to learn more about how Intermec can help you benefit from RFID.

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