



## **Leveraging RFID for Demand Chain Optimization:**

Real-Time Tracking of Field-Based Inventory and Assets

**January 2009**

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## Executive Summary

This paper describes the use of Radio Frequency Identification (RFID) to provide real-time visibility of finished-goods inventory from the point of manufacture to the point of sale – commonly referred to as the demand chain. Leveraging RFID in this way enables inventory management optimization that increases sales and customer satisfaction and decreases inventory levels, product loss, and legal liability.

As evidenced by RFID deployment at Walmart, Target, and the U.S. Department of Defense, RFID has proven to be an effective technology for allowing companies to track inventory in the supply chain from the point of receipt back to suppliers. RFID is also proving to be an equally, if not more, effective technology for allowing manufacturers and distributors to track inventory through the demand chain, as it moves from the factory and/or distribution center through the field to customer sites. Demand chain RFID provides real-time, highly accurate inventory visibility enabling the following improvements in sales and operations:

- Shorter more accurate cycle-counts
- Reduced out-of-stocks
- Improved merchandising effectiveness
- Improved service level attainment
- Higher inventory turns
- Reduced product loss
- Improved route optimization
- Expired product removal
- Shorter invoice-to-cash cycles

Whereas RFID for the supply chain is only deployed on-premises, RFID for the demand chain is deployed both on- and off- premises. When inventory is on-premises (eg, a factory), the RFID system leverages the local IT infrastructure because it is owned by the enterprise deploying RFID. When inventory moves off-premises (eg, in the field or to a customer site), the RFID system has little or no IT infrastructure to leverage. As a result, there are limitations in computing power, storage capacity, as well as network availability and bandwidth. RFID for the demand chain must be designed from the ground up to be intelligent and lightweight for off-premises use in addition to being fast and scalable for on-premises use. Thus, a RFID application specifically built to leverage both mobile and web services based architectures provides the best solution for demand chain optimization, as it can fulfill use cases which have both on- and off- premises requirements.

Both manufacturers and service providers stand to benefit from the use of RFID in the demand chain. Among the many industries now adopting Demand chain RFID:

- Aerospace manufacturing / services
- Apparel / accessories manufacturing / distribution
- Clinical lab services
- Consumer electronics manufacturing / distribution
- Food manufacturing / distribution
- Hospitality services
- IT services
- Medical device manufacturing / distribution

This paper illustrates the benefits of Demand chain RFID, including in-depth ROI models, through three examples:

- Medical Device Manufacturer that uses a vendor managed inventory model at hospitals.
- Electronics Retailer that uses interactive merchandising in its stores.
- Chemical Manufacturer that utilizes field-based assets for product distribution.

## Sales & Operations Planning Challenges

Many manufacturers are responsible for managing the distribution and merchandising of their finished goods inventory as it moves through the demand chain from the factory and/or distribution center, through the field, ending at the customer site. This responsibility creates significant challenges for both sales and operations planning, particularly when inventory and assets are in remote locations where on-premises, centrally controlled RFID solutions will not work.

Examples of situations where manufacturers and/or distributors own the responsibility of managing and merchandising inventory through to the end of the demand chain at point-of-sale locations include:

- Medical implant manufacturers and distributors loan or consign inventory to hospitals and surgery centers only charging them once a product has been used.
- Electronics and book retailers manage inventory from their distribution center to their own in-store kiosks and promotional displays.
- Manufacturers of industrial goods, such as aerospace parts, retain ownership of inventory as part of vendor managed inventory (VMI) arrangements.
- Manufacturers and distributors of foods and beverages often have agreements with retailers requiring them to deliver, manage, and merchandise their inventory at the store. This type of operation is often called direct-to-store delivery (DSD).
- Manufacturers of shoes, apparel, accessories, and jewelry commonly lease space inside a third party department store, requiring them to deliver, manage, and merchandise their own inventory at those locations.

Manufacturing and services industries also often have an asset management component to their business that requires them to track assets moving between company- and customer-controlled sites.

Examples include:

- Chemical manufacturers ship product to customers in expensive containers and require the return of those containers for reuse in future shipments.
- Clinical laboratories manage specimens as they move between hospitals and labs in order to meet service level agreements (SLAs) and reduce error rates.
- IT service providers, whether an internal department or a third-party provider, must know the location of inventory dispersed to users, as well as keep track of the counts and types of bench stock available to ensure SLAs can be met.
- Orthopedic implant manufacturers loan tool kits to doctors for surgery and require their return for cleaning, sterilization, and future reuse.
- Utility companies must manage meters, equipment, and replacement parts in the field and at customer sites in order to maintain SLAs.

At the highest level, the inability to track and manage inventory and assets leads to lost sales, lower customer satisfaction, higher costs, and increased legal liability. Table 1 provides a more detailed listing of the most common challenges associated with managing the distribution of finished goods through the demand chain.

**Table 1: Challenges of Managing Inventory throughout the Demand Chain**

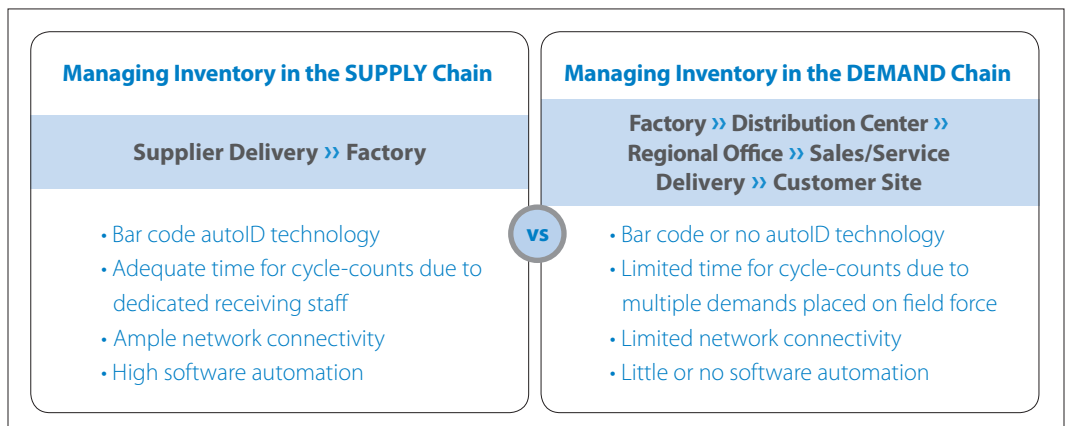
Challenge	Business Impacts
Manual Cycle-Counts	<ul style="list-style-type: none"> <li>- Increased labor expense</li> <li>- Less time spent selling to / servicing accounts</li> <li>- Less accurate counts / invoicing</li> <li>- Less accurate forecasting</li> <li>- Longer invoice-to-cash cycles</li> </ul>
Out-of-Stocks	<ul style="list-style-type: none"> <li>- Lost revenue</li> <li>- Brand dilution</li> <li>- Lower customer satisfaction / service level attainment</li> <li>- High delivery expenses</li> </ul>
Shrinkage	<ul style="list-style-type: none"> <li>- Higher product costs</li> <li>- Billing inaccuracies</li> </ul>
Low Inventory Turns	<ul style="list-style-type: none"> <li>- Higher working capital requirements</li> <li>- Higher carrying costs</li> <li>- More write-downs / -offs</li> <li>- Lower return on assets</li> </ul>
Product Expiration / Recalls	<ul style="list-style-type: none"> <li>- Higher safety risks</li> <li>- Increased legal liability</li> <li>- High warranty costs</li> <li>- Negative customer experience</li> </ul>

**Manual Inventory Problems**

- Time Intensive
- High Staff Costs
- Data Inaccuracies
- Delayed Invoicing
- Billing Errors
- Aged Data
- Weak Accountability

Managing inventory gets increasingly more difficult the further away items get from the point of manufacture or distribution. The closer inventory gets to the customer site, the less visibility and control the manufacturer or service provider has over its products because the inventory moves beyond the capabilities of existing IT and automatic identification (autoID) technologies. RFID solutions designed specifically to address these demand chain realities manage to extend the edge of the enterprise IT network and provide real-time visibility to the status of goods which otherwise become almost impossible to track. Figure 1 explains the differences between these inventory management scenarios.

**Figure 1: Managing Inventory in the Supply Chain vs. Demand Chain**



**The historic lack of inventory management automation in field locations creates challenges for many departments:**

**Sales / Service** – In companies where field representatives are required to deliver product, count inventory, stock shelves, set-up merchandising and reconcile consumption, considerable time is taken away from maintaining and growing customer relationships. In these situations, field representatives often find themselves spending too much time on manual inventory-related tasks and less time on maximizing revenue or service levels. Consequently, they try to minimize the inventory-related time by taking cycle-counts less frequently or spending less time per cycle-count – in either case, inventory accuracy decreases leading to poor inventory visibility and forecasting accuracy for Operations and longer invoice-to-cash cycles for Finance. The lack of forecasting accuracy affects the field representative in the future because it leads to out-of-stock situations and lower customer satisfaction.

**Operations** – The ability of Operations to react to out-of-stocks and accurately forecast production levels is fundamentally limited by the frequency and accuracy of the inventory data coming from field locations and customer sites. For their inventory data, many companies require field representatives to conduct cycle-counts using pen / paper or a bar code scanner, which is only capable of scanning one item at a time. Both methods are time-consuming and error-prone – moreover, they occur infrequently due to the high degree of human interaction required. To mitigate the out-of-stock situations resulting from the inaccurate data, Operations often over produces inventory lowering inventory turns.

**Finance** – The overproduction of inventory leads to higher working capital requirements to fund the business which in turn leads to a lower return on assets for the company as a whole. Inaccurate inventory data, moreover, leads to billing inaccuracies and longer cash-collection cycles.

**Compliance/Legal** – The lack of timely, accurate information regarding the location of certain products, identified by serial/lot number or expiration date, prevents effective regulatory compliance and risk mitigation that are key to preventing misuse, accidents, and injury.

**Marketing** – The latency and inaccuracy of data coming from retail sites prevents Marketing from determining the efficacy of specific promotions or merchandising.

## The RFID-Enabled Demand Chain

As evidenced by RFID deployments at Walmart, Target, and the U.S. Department of Defense, RFID has proven to be an effective technology for allowing customers to track inventory in the supply chain. RFID is also proving to be an equally, if not more, effective technology for allowing manufacturers and distributors to track inventory through the demand chain to/at point-of-sale locations. By making RFID an extension of wireless networks, a whole new generation of inventory management applications is coming of age which extends the edge of the enterprise in order to provide highly accurate, real-time inventory visibility from the factory all the way to the customer site.

RFID is based on a set of industry standard wireless protocols that use radio waves to identify tags placed on items or carried by people. RFID is significantly less labor intensive than laser-based bar code technologies. There is a cost associated with the additional performance, so RFID tends to be used on inventory that is either higher value or faster moving. Table 2 provides a comparison of RFID and bar code.

**Table 2: Comparing Automatic Identification (AutoID) Technologies**

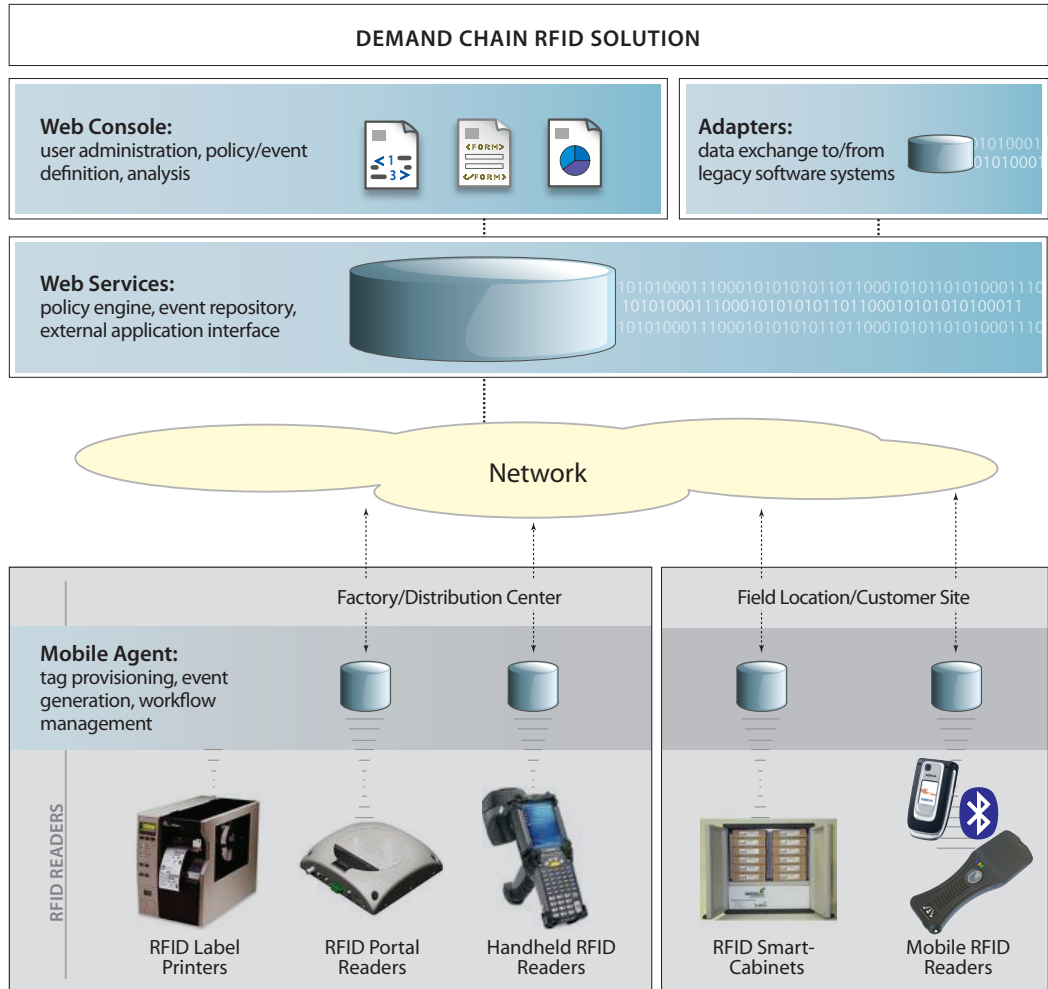
RFID	Bar Code
Typically 50 to 200 tags identified per read operation	1 tag identified per read operation
No "line of sight" required between reader and tag	"Line of sight" required between reader and tag
Read distance typically up to 5 meters	Read distance typically up to 6 inches
Little to no human involvement required to read tags	Significant human involvement to read tags
Read/write capability allows information such as expiration date and history to travel with the item	Read only functionality

Whereas RFID for the supply chain is only deployed on-premises, RFID for the demand chain is deployed both on- and off-premises. When inventory is on-premises (eg, a factory), the RFID system leverages the local IT infrastructure because it is owned by the enterprise deploying RFID. When inventory moves off-premises (eg, in the field or to a customer site), the RFID system has little or no IT infrastructure to leverage. Given this limitation in computing power, storage capacity, and network bandwidth, RFID for the demand chain must be designed from the ground up to be intelligent and lightweight for off-premises use in addition to being fast and scalable for on-premises use.

An RFID solution specifically built to leverage a mobile web-services architecture (see Figure 2) can meet the requirements of both on- and off-premises use cases to provide a complete, robust system to manage goods in the demand chain. The requirements for off-premises use are addressed by a lightweight software agent running on a handheld RFID reader or a mobile device, such as a cell phone, connected to a reader via Bluetooth or some other short range communications medium. The agent controls reader operations, converts raw RFID events into logical business events (eg, two products have been consumed since the last cycle-count), and enforces policies at the edge (eg, generate invoices and order replacements for the two consumed products). The mobile agent communicates with the central web services, which provide centralized policy management, centralized event storage, and legacy application interfaces, over a wireless network such as GPRS or WiFi.

The requirements for on-premises use are addressed by either the mobile software agent, which controls a single reader just like it does in the off-premises use case, or a local application server and can control many readers simultaneously via a local area network. Both the mobile agent or local application server perform the same functions, such as reader control, event generation, and policy enforcement. The choice of which agent to use depends on network speed, event traffic, and the number of readers on-premises.

Figure 2: Mobile Web Services Architecture for RFID



**The following is a typical deployment for this architecture:**

**FACTORY OR DISTRIBUTION CENTER:** RFID tags are provisioned, printed and placed on inventory items. Fixed and handheld RFID readers (carried by employees) are used to scan inventory as it moves around the factory or distribution center, including entry and exit points. In some cases, RFID readers scan the inventory prior to shipment and the data is compared to bills of material generated by the ERP system to ensure that the correct items go to the correct customers. Shipments are then taken by field sales or service personnel for delivery.

**FIELD LOCATIONS:** Inventory in the field typically gets counted by sales or service representatives using handheld RFID readers (eg, paired to their mobile phone via Bluetooth or WiFi). Once read operations are completed, the inventory data is sent to central web services via a wireless network connection, typically provided by a cellular data service. Once the data arrives at the central web service, the ERP system receives the data in real-time or batch via a XML-based adapter.

**CUSTOMER SITE:** Goods at customer sites can be inventoried in three ways: (1) sales or service representatives using handheld RFID readers (eg, paired to their mobile phone via Bluetooth or WiFi for network connectivity), (2) fixed readers in and around portals or choke points, and/or (3) “smart-cabinets” which have been outfitted with RFID reader(s) and antennas that can automatically inventory their own contents. The fixed readers and smart-cabinets can be set via policies defined at the administrator console to gather inventory data at regular intervals (eg, every 30 minutes). The RFID readers in use take inventory to determine the customer’s invoice amount for consumed product and the re-order amount for sufficient replenishment. Once the invoice and replenishment events are confirmed, the data is sent to central web services via a network connection, either wired or wireless (eg, cellular or WiFi). Once the data arrives at the central web service, the ERP system receives the data in real-time or batch via a XML-based adapter.

**HEADQUARTERS:** The ERP system, updated with data from the web services, then processes invoices and orders received from the customer site. The operations staff builds a production plan based on the more accurate, timely data coming from field sales / service representatives.

Deploying RFID in this way optimizes inventory management so that companies increase sales and customer satisfaction, while decreasing excess inventory levels, product loss, and legal liability. The following are the specific operational benefits:

- **Shorter Cycle-Counts** – The use of fixed RFID readers eliminates the need to involve people in cycle-counts. Furthermore, reads occur on a continuous basis (eg, every 5 minutes, every hour) and are sent back in real-time to the central web services. Some use cases do not lend themselves to fixed readers and require field representatives to conduct the cycle-count. In this case, handheld RFID readers reduce the amount of time spent taking counts by up to 95 percent which also serves as an incentive for sales personnel to take inventory more regularly. Once complete, data from the read is sent to central web-services in real-time. In either case, RFID typically achieves greater than 99 percent read reliability leading to significant accuracy improvements over bar code, shown to be as high as 13 percent in tests<sup>1</sup>.
- **Reduced Out-of-Stocks** – Since the use of RFID allows for more frequent and accurate cycle-counts, out-of-stocks decrease due to better visibility which allows for just-in-time replenishment and better forecasting. The worldwide average for out-of-stocks in the retail industry is over 8 percent<sup>2</sup>. This rate shoots up to 17 percent for promotional items<sup>3</sup>. RFID has been shown to reduce out-of-stocks by up to 60 percent for faster moving products and up to 30 percent for slower moving products<sup>4</sup>.
- **Increased Merchandising Effectiveness** – RFID-enabled merchandising can provide continuous real-time visibility of shopper traffic and overall sales performance. This information not only allows retailers and vendors to avert out-of-stocks, but also enables marketers to correlate performance with other factors, such as location on the store floor, type of signage, and version of messaging, in order to quantitatively optimize campaign effectiveness.
- **Improved Service Level Attainment** – Enterprises often have service level agreements with their customers that involve availability of product or service. RFID maximizes product availability much like it minimizes product out-of-stocks. Services based on the availability and serviceability of assets and equipment also benefit through the use of RFID as a mechanism to ensure that service personnel perform the right service, on the right asset, at the right time, at the right place.

<sup>1</sup> Hardgrave, B., Aloysius, J., Goyal, S. and Spencer, J., 2008, “Does RFID Improve Inventory Accuracy? A Preliminary Analysis,” White Paper, ITRI, Sam M. Walton College of Business, University of Arkansas.

<sup>2</sup> Gruen, T. and Corsten, D., 2002 (Revised 2008), “A Comprehensive Guide To Retail Out-of-Stock Reduction In the Fast-Moving Consumer Goods Industry,” Study, Grocery Manufacturers Association (GMA), Food and Marketing Institute (FMI), National Association of Chain Drug Stores (NACDS), The Procter & Gamble Company (P&G), the University of Colorado at Colorado Springs.

<sup>3</sup> Ibid.

<sup>4</sup> Hardgrave, B., Waller, M. and Miller, R., 2006, “RFID’s Impact on Out of Stocks: A Sales Velocity Analysis,” White Paper, ITRI, Sam M. Walton College of Business, University of Arkansas.

- **Higher Inventory Turns** – Companies often overcompensate for out-of-stocks by disproportionately increasing the amount of inventory on hand. This practice leads to lower inventory turns reducing cash efficiency. RFID's ability to reduce out-of-stocks not only reduces the need to over-produce, but also enables forecasting accuracy which further reduces inventory level requirements.
- **Reduced Shrinkage** – The real-time inventory visibility afforded by more frequent and accurate cycle-counts reduces the amount of shrinkage occurring from misplacement. This capability is further enhanced when the software receives real-time input from the point-of-sale system as shrinkage can be identified on a shift-by-shift basis. Employers are then able to ensure that an inventory reconciliation occurs prior to each shift change.
- **Improved Route Optimization** – The better visibility afforded by RFID allows operations planning to better optimize the routes and territories of field personnel. This practice not only reduces driving expenses but also frees field personnel to perform other higher value-add tasks such as new account acquisition.
- **Expired Product Removal** – Companies also need to ensure the quality of the products that are stocked. Expired, out-of-season or inappropriately configured items take up valuable space at point-of-sale locations, and may compromise positive brand identification and customer satisfaction. In some cases, there are also safety concerns raised when inventory is not removed from circulation in a timely way or when a product is used incorrectly.
- **Shorter Invoice-to-Cash Cycles** – Delays and inaccuracies measuring product usage in the field introduces a plethora of delays to invoicing the customer. A delayed bill adds time to a traditional 90-day cash collection cycle. The manufacturer must float the uncollected cash at its opportunity cost of capital. By accelerating this process in the field, a manufacturer can reduce the average time it waits to invoice, and thus its overall float required is lowered as well.

#### Benefits of RFID for Field Inventory Management

- Increase sales productivity
- Reduce stocking time
- Real-time billing
- Reduce stock-outs
- Reduce shrinkage
- Increase customer loyalty

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This type of demand chain RFID solution can aid a range of companies, across diverse industries, to more effectively track and manage field inventory and assets. Some of the business scenarios where demand chain RFID can optimize success for field sales representatives are:

- Vendor Managed Inventory
  - Interactive Promotional Displays
  - Field-Based Asset Tracking
-

## Use Case Examples

The following three use cases illustrate the applicability and benefit of a demand chain RFID solution used to solve real world demand chain problems. They are generalized examples designed to represent common challenges, practical solutions, and realistic benefits based on the experience and knowledge of SkyeTek.

### VENDOR MANAGED INVENTORY

VMI is a process through which suppliers stock products at a customer location, in some cases retaining ownership of those products (ie, consignment) until those products get used or purchased. There are numerous industries that rely on a VMI model including, but not limited to, healthcare, electronics, and industrial goods.

#### Use Case 1: Medical Device Manufacturer

##### Business Challenges

Rather than buying a supply of highly specialized medical devices, many hospitals opt to have a supply on consignment from the manufacturer. In this example, a stent manufacturer employs 400 highly compensated and skilled sales representatives across the United States that work primarily on-site at hospitals where they have accounts.

Sales representatives are responsible for a broad array of activities from managing the consigned inventory to advising doctors about which devices to use. Inventory tracking at hospitals is a time consuming activity and involves counting, reconciling, invoicing, re-ordering and re-stocking. These tasks are encumbered by the bar code system used to count the inventory. This system requires: (1) finding an item, (2) locating the bar code on the item, and (3) lining up the optical scanner to read the bar code. This process is inherently slow; furthermore, it can only be performed on one item at a time.

The significant time required to count inventory takes time away from maintaining current doctor relationships and developing new ones. Consequently, sales representatives either take inventory infrequently, rush the bar code scanning process, or “eye-ball” the count (without scanning the bar codes). In any event, the infrequency and inaccuracy of the field cycle-counts lead to shrinkage, low inventory turns, long invoice-to-cash cycles, and regulatory liability.

##### Solution Overview

Demand chain RFID solution components:

- EPC Class 1 Gen 2 RFID tags
- RFID label printers for tagging inventory at the point-of-manufacture
- Portal RFID readers for tracking inventory as it moves throughout the factory and distribution centers
- Handheld RFID readers, running mobile inventory management software, for cycle-counts conducted by field representatives
- Web-based RFID application for user administration, policy management, and reporting
- Web services-based adapter for communication with ERP system



#### Problem Summary

- Lost sales productivity
- Poor forecasting
- Shrinkage
- High inventory levels
- Long invoice-to-cash cycle

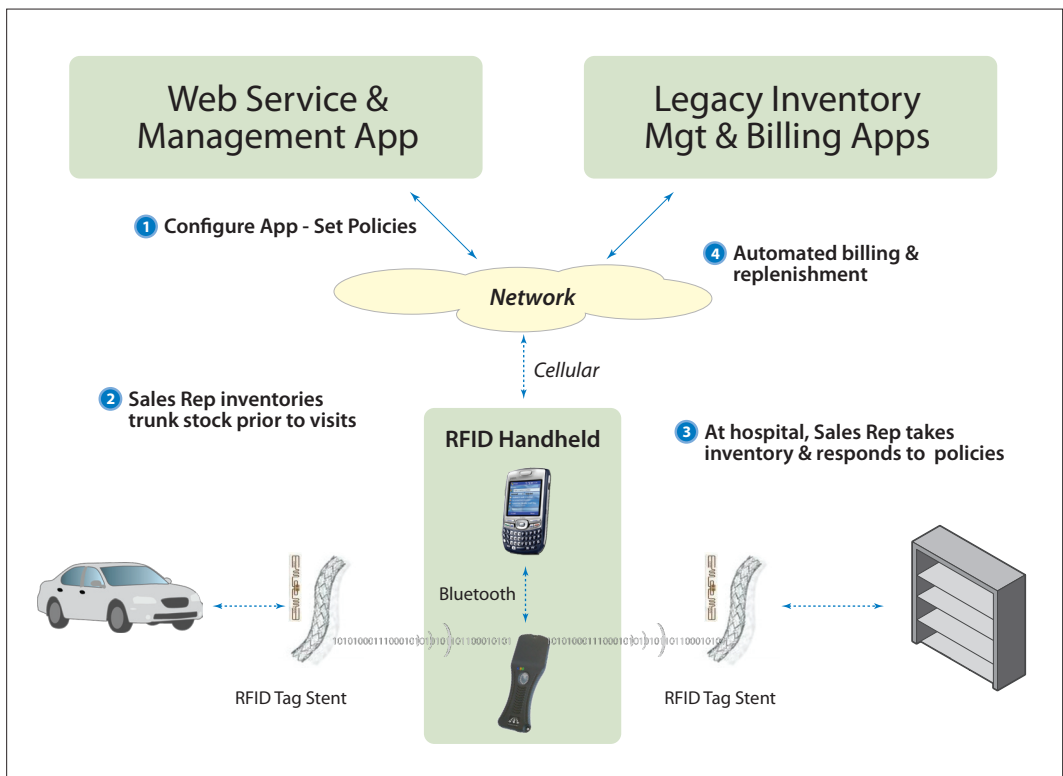
**Headquarters:** The operations planner accesses the web-based RFID application and sets up roles/users, defines events and configures policies. Once complete, the application's web services publish the data through the corporate extranet and/or Internet, via wired and wireless network connections, to RFID printers and readers distributed throughout the enterprise, in the field, and at customer sites. RFID printers and readers only receive data and policies that are relevant to their specific location, use case, and/or users.

**Manufacturing Site:** RFID-enabled thermal printers are used to print/encode RFID labels of the same dimensions as the previously used bar code labels. Bar codes and other information are printed on the outside of the label while the RFID inlay inside the label gets encoded with a tag ID. Employees place these labels on the medical device box the same way they would a standard bar code label.

**Distribution Center:** Warehouse employees use handheld RFID readers to perform inventory cycle-counts and prepare orders for shipment. Portal readers register inventory as it leaves for field locations or hospitals. All readers send inventory events (ie, SKU, lot number, location, employee, time) to the web-based RFID application.

**Field Locations and Hospitals:** Sales representatives use handheld RFID readers to perform inventory cycle-counts and reconciliations in the field and at hospitals. The time required for cycle-counts reduces significantly because the RFID reader allows the representative to count all the items in seconds. Via a Bluetooth connection with the rep's cell phone, the RFID handheld uses the cellular data service to send inventory events to the web-based RFID application. Via a web services adapter, the application then sends the event data in real-time to the ERP system so that it can perform invoicing, forecasting, and production planning.

Figure 3: Medical Device Manufacturer RFID Solution



### Benefits

Replacing bar code with RFID lowers the time required to perform an average cycle-count by approximately 75 percent. RFID also increases count accuracy which significantly improves location visibility and forecasting accuracy. These benefits result in quantifiable savings in sales rep productivity, product shrinkage, and inventory carrying costs. The total annual benefit per rep in this example is approximately \$53,635.

**Table 3: Medical Device Manufacturer Savings per Field Representative**

Value Driver	Bar Code	RFID	Annual Benefit
Inventorying Time	84 hrs	21 hrs	\$13,797
Shrinkage	4.0%	3.2%	\$28,300
Inventory Turns	7.3x	8.8x	\$11,538
<b>Value Per Sales Rep Per Year</b>			<b>\$53,635</b>

At this rate, the demand chain RFID solution is able to pay for itself in approximately five months. There are other quantifiable benefits that do not apply in this use case but could apply in others such as increased sales productivity (ie, less time spent taking cycle-counts equates to more time spent generating sales) and protection against legal liability (eg, due to product recall or date expiration).

**Table 4: Medical Device Manufacturer ROI Model**

Area	Amount
Total Investment	\$8.3M
Total 3-Year Benefit (Net of Investment)	\$64.3M
ROI	671%
<b>Payback Period</b>	<b>5 months</b>

## INTERACTIVE MERCHANDISING

Retailers and consumer goods manufacturers place special emphasis on the merchandising of promotional items because they increase store traffic and sales. Due to the speed at which promotional items move, however, they are difficult to track and keep in stock. As cited earlier in this paper, the average out-of-stock rate for promotional items in the retail industry is 17 percent, greater than two times the standard out-of-stock rate for non-promotional items. Worse yet, customers will often go to a competing store or buy a competitor's product when they encounter an out-of-stock situation<sup>5</sup>.

### Use Case 2: *Electronics Retailer*

#### *Business Challenges*

In this example, an electronics retailer faces the constant challenge of keeping popular video games in stock during promotional periods across its 200 stores. Frequent cycle-counts are conducted; however, they are time-consuming and still do not prevent out-of-stocks because the product moves so fast. The retailer's out-of-stock rate is 17 percent across all locations. Delays and inaccuracies in the inventory data prevent restocking and/or reordering from occurring in time for the promotional period.

#### *Solution Overview*

Demand chain RFID solution components:

- "Smart-displays" outfitted with the following:
  - A fixed RFID reader connected to two antennas
  - A small form factor PC running mobile inventory management software
  - An LCD screen connected to the PC for displaying information to shoppers
- Web-based RFID application for user administration, policy management, and reporting
- Web services-based adapter for communication with ERP system
- (Assumption: Video game inventory is already tagged by the manufacturer using EPC Class 1 Gen 2 RFID tags)

**Headquarters:** The operations planner accesses the web-based RFID application and sets up roles / users, defines events, and configures policies. Once complete, the application's web services publish the data through the corporate extranet and / or internet, via wired and wireless network connections, to smart-displays placed at store locations.

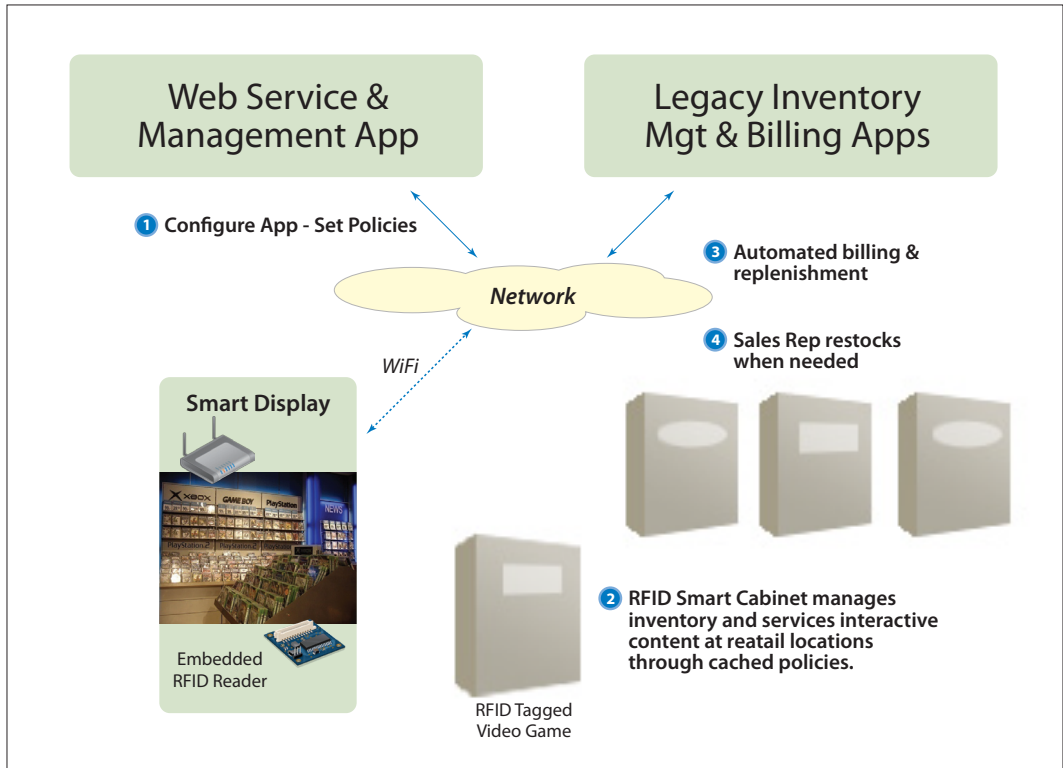
**Store Locations:** Store representatives place RFID-tagged video games into smart-displays which then begin taking inventory at one-second intervals using their onboard RFID readers. When a customer removes an item from a particular display, the RFID reader provides the SKU number of item picked up to the PC. The PC then plays a SKU-specific video to the shopper via the integrated LCD screen so that the shopper can witness product specific merchandising for the item he or she just picked up. Via a WiFi or cellular connection to the Internet, the smart-display sends inventory counts, shopper interaction events, and product movement events (eg, the number of times a product was picked up) to the web-based RFID application. These events can be viewed in real-time through the web-based console so that operations managers and marketers can view performance of their promotions in real-time and avoid an out-of-stock before it happens.

#### Problem Summary

- Significant time required for inventory cycle-counts
- Frequent out-of-stocks on promotional items

<sup>5</sup>Gruen, T. and Corsten, D., 2002 (Revised 2008), "A Comprehensive Guide To Retail Out-of-Stock Reduction In the Fast-Moving Consumer Goods Industry," Study, Grocery Manufacturers Association (GMA), Food and Marketing Institute (FMI), National Association of Chain Drug Stores (NACDS), The Procter & Gamble Company (P&G), the University of Colorado at Colorado Springs.

Figure 4: Electronics Retailer RFID-enabled Interactive Merchandising



### Benefits

Replacing bar code scanning inventory methods with RFID-enabled smart-displays eliminates the need for store representatives to conduct inventory counts and provides more accurate data for maximizing stock-ins. This solution is able to decrease inventorying time by approximately 95 percent and lower out-of-stocks by approximately 35 percent. The investment in RFID pays for itself in a little over a year.

Table 5: Electronics Retailer Benefit per Store

	Prior to RFID	Demand Chain RFID	Value Created
Inventorying Time	19 hrs	1 hrs	\$253
Out-of-stocks (OOS)	17%	11%	\$13,518
<b>Value Per Sales Rep Per Year</b>			<b>\$13,771</b>

Table 6: Electronics Retailer ROI Model

Area	Amount
Total Investment	\$12.5M
Total 3-Year Benefit	\$41.3M
ROI	230%
<b>Payback Period</b>	<b>11 months</b>

## FIELD-BASED ASSET MANAGEMENT

Manufacturers and service providers alike use assets in their daily operations, such as equipment, tools, and containers. High value assets are difficult to track and often become lost or stolen, costing companies significant amounts of money. This tracking problem is exacerbated by assets that move from place to place, especially if those locations are off company-owned premises.

### Use Case 3: Chemical Manufacturer

#### Business Challenges

In this example, a large chemical manufacturer distributes its products using expensive metal containers that must be returned for reuse. Approximately 40 field service representatives working out of 20 regional warehouses deliver these chemical-filled containers to customer locations. Service representatives also track containers while they reside at the customer site and then collect them for return to the warehouse.

The existing tracking system lacks the required accuracy because bar code labels placed on containers often get damaged or scraped off. Moreover, taking inventory with the bar code system takes significant time because the containers are large and only one can be read at a time. The time consuming nature of this process leads service representatives to either take inventory infrequently, rush the bar code scanning process, or “eye-ball” the count (without scanning the bar codes).

The resulting infrequent and inaccurate inventory counts lead to lost containers and the need to maintain a large bench stock to ensure that customer deliveries are not impacted due to a shortage of containers.

#### Solution Overview

Demand chain RFID solution components:

- Hardened EPC Class 1 Gen 2 RFID tags with metal-mount insulation
- Portal RFID readers for tracking inventory as it moves throughout the factory and distribution centers
- Handheld RFID readers, running mobile inventory management software, for cycle-counts conducted by field representatives
- Web-based RFID application for user administration, policy management, and reporting

**Headquarters:** The operations manager accesses the web-based RFID application and sets up roles/users, defines events, and configures policies. Once complete, the application’s web services publish the data through the corporate extranet and/or internet, via wired and wireless network connections, to RFID readers distributed throughout the enterprise, in the field, and at customer sites. RFID readers only receive data and policies that are relevant to their specific location, use case, and/or users.

**Factory:** Hardened RFID tags are placed on containers. A unique identifier is printed on the outside of the tag while the RFID inlay inside the tag gets encoded with the same identifier. Employees place these tags on the container with a strong adhesive capable of surviving harsh conditions.

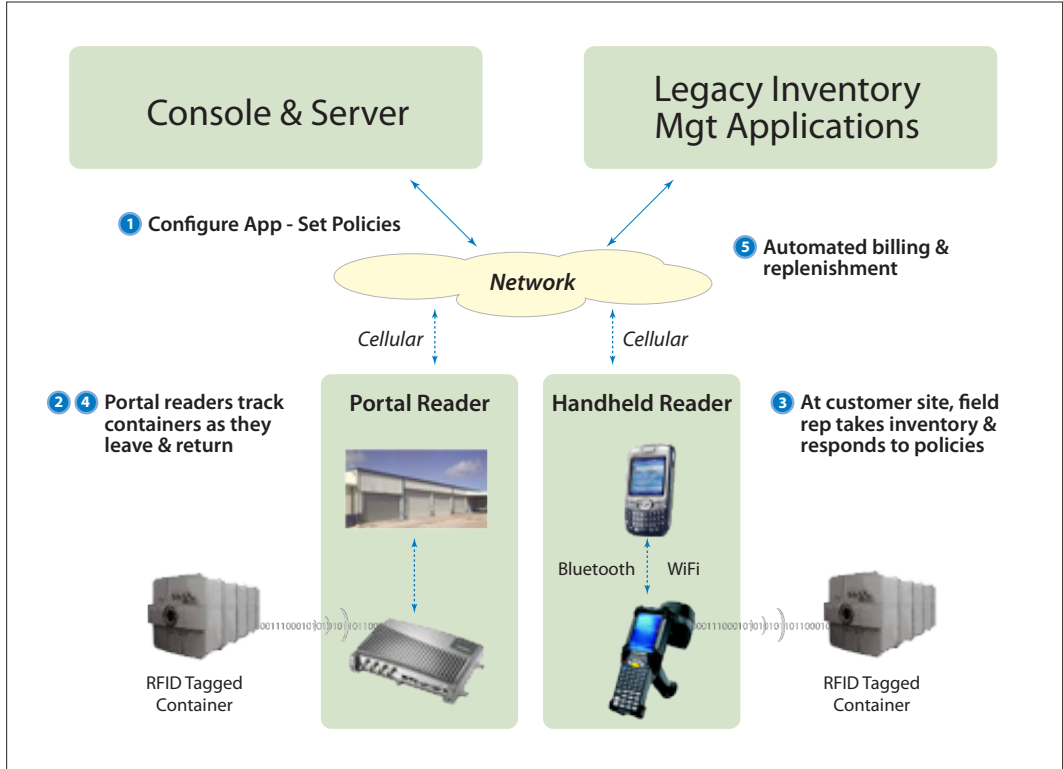
**Distribution Center:** Warehouse employees use handheld RFID readers to perform inventory cycle-counts and prepare orders for shipment. Portal readers read tagged containers as they leave for customer locations. All readers send inventory events (ie, SKU, lot number, location, employee, time) to the web-based RFID application.

**Customer Locations:** Service representatives use handheld RFID readers to perform inventory counts at customer sites. The time required for these counts decreases significantly because the RFID reader allows the representative to count all the items in seconds. Via a Bluetooth connection with the rep’s cell phone, the RFID handheld uses the cellular data service to send inventory events and other business events (eg, invoice, order) to the web-based RFID application where the Operations Manager can view container locations in real-time.

#### Problem Summary

- Service representative productivity
- Lost containers cost company hundreds of thousands of dollars per year
- Large bench stock required to ensure container availability

Figure 5: Chemical Manufacturer RFID Solution



### Benefits

Chemical manufacturers, as well as other companies in the industrial sector, can decrease the time service representatives spend on field inventory counts and increase the accuracy of asset tracking by implementing an RFID solution that includes both fixed and mobile readers. This company is able to realize an additional \$19,317 per rep annually is realized. Over three years, the solution provides a savings of \$2.3 million and pays for itself in 16 months.

Table 7: Chemical Manufacturer Benefit per Field Representative

Value Driver	Bar Code	RFID	Annual Benefit
Inventorying Time	173 hrs	35 hrs	\$6,300
Lost Containers	12%	3%	\$5,625
Container Utilization	3.2 turns	5.0 turns	\$7,392
<b>Value Per Field Rep Per Year</b>			<b>\$19,317</b>

Table 8: Chemical Manufacturer ROI Model

Area	Amount
Total Investment	\$1.0M
Total 3-Year Benefit (Net of Investment)	\$2.3M
ROI	124%
<b>Payback Period</b>	<b>16 months</b>

## Deployment Considerations

Companies interested in leveraging RFID to provide visibility of inventory throughout the demand chain should consider the RFID solution illustrated in the aforementioned use cases. One additional consideration is the method of implementing such a solution. Like many software applications today, companies do not need to purchase a perpetual software license and perform the hosting / maintaining themselves. Rather, next generation RFID software is now available offering turn-key application functionality offered through a Software as a Service (SaaS) model. This subscription model allows enterprises to quickly and inexpensively conduct a pilot and then scale in lock-step with growing production needs, tying price to usage requirements. For companies with large numbers of field-based employees, the SaaS model removes the burden of deploying and maintaining software running on mobile devices from corporate IT departments. Industry analyst firm Gartner provides these predictions:<sup>6</sup>

- Technology adopters will purchase 40 percent of their IT infrastructures as a service by 2011.
- At least one-third of business application software spending will be as a service subscription by 2012.
- Half of traveling workers will leave their lap-tops at home in favor of other devices by 2012.

The following are key things to consider when evaluating RFID-based solutions for managing field-based inventory:

- › The solution provider should have a strong track record in deploying RFID systems that deliver enterprise class read reliability - the ROI is fundamentally limited or enhanced by the resultant inventory cycle-count accuracy.
- › The solution should be based on a mobile architecture with agent software at the edge (ie, running on mobile readers and remotely deployed fixed readers) that communicates with back-end web services.
- › Software as a Service (SaaS) solutions offer turn-key functionality that greatly eases pilot and production deployments and increases overall ROI.
- › Configurable applications (versus customizable middleware) with web-based user interfaces ensure that line of business users in operations, sales, and service can easily adopt and use the solution. Their level of participation will help determine the ROI generated by the solution.
- › Integration with back-end software such as ERP applications allows those systems to increase the value they deliver to the enterprise because they benefit from the increased inventory data coming from the RFID system.

**Ease of Deployment** – With no IT equipment purchases required, new customers can implement a demand chain RFID solution for field inventory management in as little as 30 days. Specially designed demand chain RFID applications can use Bluetooth and cellular networks, in addition to WiFi and other Internet connections. This eliminates the need for a particular type of Internet access to make these solutions function.

**Ease of Adoption** – Data collected via the Web service is in a flexible format making integrating the data into existing legacy systems a very manageable task. At the same time, the Web service provides reliable, enterprise-class availability that can run offline if needed.

**Return on Investment** – In most cases, a demand chain RFID solution can pay for itself in four to twelve months given the returns for lowering field rep time, stock outs and shrinkage. In addition to the tangible returns, there are intangibles such as protecting brand integrity and lowering legal liability that can stem from expired or counterfeit products if they are not managed out of active inventory.

<sup>6</sup>Gartner's Top Predictions for IT Organizations and Users, 2008 and Beyond: January 8, 2008

### RFID for Managing Inventory in the Demand Chain

- › Expedites Cycle-counts
- › Reduces Stock-outs
- › Decreases Shrinkage
- › Reduces Invoice-to-cash Cycle
- › Creates Inventory Traceability
- › Improves Forecasting Accuracy
- › Increases Sales Productivity

**Interoperability** – The networked RFID readers described throughout the paper can be used in a handheld device or fitted to shelves, cabinets or displays. Seamless, cost-effective wired and wireless connectivity to the enterprise and Internet ensures network connectivity to the Web service.

**Security** – Failure to adequately secure field inventory management data can expose a company to legal liability concerns. Demand chain RFID also supports security when implemented as an authentication solution. Another aspect of security relates to privacy protection on the tags so that only the product manufacturer/distributor can read them. The ability to secure generic tags provides additional benefits. There are the immediate cost savings from purchasing generic tags that are less expensive than proprietary tags. There is also a degree of investment protection, since generic tags avoid the “lock-in” effect of proprietary solutions.

**Total Cost of Ownership** – By lowering or eliminating capital investment costs, SaaS solutions can offer a significantly lower total cost of ownership. In addition, a demand chain RFID solution for field inventory management can increase sales rep productivity, thus growing sales.

## Conclusion

In situations where manufacturers own the responsibility of managing inventory as it moves through the field and is stored at customer sites, a demand chain RFID solution can provide the visibility necessary to increase sales and customer satisfaction and decrease inventory levels, product loss, and legal liability. Mobile RFID readers and remotely deployed fixed readers are able to transmit inventory data via wireless networks from field locations and customer sites making transparent what heretofore has been an opaque demand chain. Furthermore, RFID software delivered via a turn-key SaaS model expedites deployment, maximizes user participation, and enhances ROI. This type of RFID solution can deliver game-changing improvements to demand chain operations.

## About SkyeTek

SkyeTek delivers a mobile RFID solution named MetaFi™ that provides real-time visibility of field-based inventory and assets allowing enterprises to improve operational efficiency, field productivity, and regulatory compliance. Fixed and handheld readers operated by MetaFi’s mobile agent software are installed and configured at customer sites and/or carried by mobile workforces and communicate with central MetaFi web services hosted by SkyeTek. These agents capture inventory events occurring in the field and at customer sites and enforce policies in real-time based on those events. The central web services distribute policies to remote readers, aggregate events coming back from those readers, and avail inventory data to legacy applications that rely on accurate inventory data.

For more information, visit <http://www.skyetek.com>

## Appendix: How RFID Works

### Overview

An RFID system is composed of two core components: an RFID reader and an RFID transponder (commonly called a tag) which each have an antenna that broadcasts and receives the radio signals.

### What is a Tag?

The tag is an integrated circuit (IC) with an attached antenna which is fastened in some way to a physical object. The tag IC broadcasts machine-readable information on a radio frequency listened to by RFID readers. RFID readers locate the objects associated with the IC by tuning into the radio broadcast of the tags.

The broadcasts are produced in one of two primary ways:

Passive Tags rely upon reflective power emitted by RFID readers to broadcast information back to the reader. Reflective power is a concept dating back to at least 1948, whereby a radio signal generates power in a remote object. In RFID, reflective power has made it possible for an RFID reader to both locate a tag and supply it with enough power to broadcast a short radio transmission that is received by the reader.

Active Tags broadcast a signal at regular intervals and at longer distances and require an internal power supply. Active tags are an effective solution in environments where the need for a longer and more reliable read range prevails over the factor of higher cost and increased size.

Passive tags are typically much smaller and economical than an average active tag, but with far shorter read ranges.

### What is a Reader?

RFID readers are integrated devices with an internal power supply, radio transceiver, radio antenna, and some level of network integration. They can be as small as a US quarter.

The purpose of the reader is to locate, identify, and track tags. It collects information and writes new/updated information to components that store and process the data.

### What are the other system components?

Additional components depend upon the type of system being installed. RFID can be part of a closed-loop or open-loop system. A closed loop is self-contained, where all the tags and readers are integrated as part of a single RFID system. In an open-loop system the RFID system shares its data with other applications. When RFID data is aggregated and shared with enterprise software systems, the data can provide visibility into customer buying patterns, inventory flows, stock levels, financial information, etc. Such information can be analyzed and interpreted to optimize business decisions that drive product and customer experience differentiation and create competitive advantage.

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