As bar codes give way to RFID tags, accounting for inventory will go high-tech.

Radio Frequency Identification: The Wave of the Future

BY HAROLD E. DAVIS AND MICHAEL S. LUEHLFING

Much has changed since an Ohio grocery store sold the first product with a bar code on it—a pack of Wrigley's gum—in 1974. In the 30 years since then, organizations have been applying these identifiers, more formally known as universal product codes, to everything from aircraft parts to zippers, so they can manage inventory more efficiently. But a new technology—radio frequency identification (RFID)—offers greater precision, flexibility and potential cost savings and has attracted the interest of a wide range of businesses and public entities. This article explains RFID (see "How It Works," page 46) and shows CPAs—auditors, members in industry and consultants serving as de facto CFOs for small businesses—how to help their clients and employers use it in the most cost-effective ways possible.

More and more organizations are deploying RFID for a variety of business purposes. New York and other states use E-ZPass to electronically collect tolls without interrupting traffic...
flow. As motorists swiftly pass through an RFID-enabled toll gate, information from each participating car's tag is transmitted to the highway authority's computer system, which uses it to charge drivers for tolls. ExxonMobil's Speedpass, an RFID application instantly and securely—without a credit card or signature—collects the payment for a gas-station transaction from a tag on a driver's key-chain. And in certain Ford Truck plants, workers temporarily place in each truck a tag containing information about the vehicle. When an order for a specific type of truck arrives, transceivers gather information from the tags in the staging area. This enables Ford employees to easily locate trucks that meet dealers' needs. Significantly, Wal-Mart and the Department of Defense are requiring their top suppliers to apply RFID tags to every carton of goods delivered by 2005; smaller vendors must comply by 2006. And in September Continental Airlines began using RFID tags to track its passengers' baggage.

To keep pace with such developments, CPAs must become sufficiently familiar with RFID to provide advice and to audit supply chains that use the technology. Reflecting this, the AICPA information technology member section identified RFID as one of the top emerging technologies of 2004, and organizations with warehousing and/or distribution systems have made it an important part of their operations.

**EXECUTIVE SUMMARY**

- **RADIO FREQUENCY IDENTIFICATION** has the potential to reduce the cost and increase the efficiency of managing and accounting for inventory.

- **AN RFID SYSTEM** consists of tags, transceivers and a computer system. These components share information on the characteristics, location, arrival/shipment time and other information about inventory items.

- **WAL-MART AND THE DEPARTMENT OF DEFENSE**, two huge participants in the global supply chain, are requiring their top suppliers to begin using RFID by 2005 and the rest of their vendors to do so by 2006.

- **RFID USES RADIO FREQUENCIES** to transmit product-related information and does not require a line of sight, as barcode technology does. This makes it easier to perform a physical inventory.

- **RFID WILL PROVIDE AN EASIER WAY** to value inventory and identify slow-moving and obsolete items. To ensure RFID systems are producing reliable information, CPAs auditing them must understand the appropriate controls and know how to assess their effectiveness.

- **RFID IMPLEMENTATION STILL IS IN ITS INFANCY.** As a result accountants seeking to expand their consulting practices should consider adding RFID-related services to those they offer, as should auditors, whose expertise also will be required.

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CPAs also may have the opportunity to enhance an organization’s strategic planning by calculating the return on investment (ROI) of an RFID system. By estimating the savings or other advantages—such as increased efficiency—RFID would produce, the practitioner can help management compare the costs and benefits of funding such an effort and prepare a suitable budget for it.

The biggest issues for auditors will be the effectiveness of RFID-related controls and the risk of unreliable item counting or tracking. To assess controls practitioners will have to ask questions such as

- Does the system use active tags or passive tags, and what are the limitations on their ability to be read? Exhibit 1, page 48, provides additional information on the two types of tags.
- Is any inventory located beyond the normal readable range of the transceiver?
- Are any tags capable of both “reading” and “writing,” that is, sending as well as storing information?
- What control procedures are in place to ensure that only authorized information is written to a write-capable tag?
- Do some tags transmit at different frequencies? If so,

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How It Works

One of RFID's most important advantages over bar codes is its use of electronic signals that easily can be generated and read without, for example, removing items from shipping cartons. A functional RFID setup consists of integrated transceivers, tags and a computer system. Like an antenna, a transceiver (see photo at right) transmits and receives data over radio waves, and a tag (see photo below) consists of an antenna on a computer chip that contains information about the object to which it is attached. For an individual item, such data might include product codes and the manufacturer's identification. For cartons, a tag could contain a list of the contents. To obtain information from a tag, a transceiver must send it a signal, causing the tag to transmit its information to the transceiver. The transceiver reads the signal, converts it to a digital format and transmits it to, for example, a computer system or a printer.

Tags. There are two types: Active tags, which have an internal battery, and passive tags, which do not. The battery sends a stronger signal for a greater distance, but active tags also are larger and more expensive. Exhibit 1, page 48, provides additional information on the two types of tags.

Wireless frequency range. This is the medium through which tags and transceivers communicate. High-frequency tags transfer information at a faster rate over longer distances but are less likely to pass through nonmetallic materials than low-frequency tags are and generally require an unobstructed path to the transceiver. See exhibit 2, page 48, for more details on how RFID tags of different ranges compare with bar codes.

Transceivers. These components provide the communication link between tags and the computer system. A simple transceiver consists of a device that generates an electromagnetic field (that is, a transmitter); a device that receives the tag's signal (that is, a receiver); and a device that converts the signal received into digital information (that is, a decoder). A business can place numerous transmitting/receiving devices throughout its warehouse and track goods as they come in and go out, or on store shelves to track—and automatically reorder—goods as they are sold.

Various organizations are experimenting with RFID. For example, pharmaceutical companies are testing it as a potential means of detecting counterfeit drugs and the United Nations uses it to track the movements of its personnel. Are there transceivers in place that are capable of reading at each of these frequencies?

Because automated RFID processes will perform basic functions, such as the actual counting of inventory, auditors will spend more time verifying that the RFID technology is providing accurate tallies and confirming that listed inventory items actually are present. Auditors will need to determine whether any tags are missing or not able to properly transmit the necessary information. And since auditors—using their own equipment—will be able to independently calculate inventory, the inventory audit may become more encompassing and may provide a greater degree of reliability than current methods allow.

If inventory items are tagged, auditors will be able to track their flow from initial receipt to ultimate disposition. Such detailed tracking can help auditors calculate inventory value, determine whether sold items are included in inventory, reduce the likelihood that items are counted more than once, and determine each item's age so that slow-moving and obsolete items can be identified when auditors calculate inventory valuation.

OTHER CONSIDERATIONS

Because RFID systems have the potential to create vast amounts of data, CPAs also should consider their impact on clients' or employers' information system infrastructures and processing capabilities. This will be particularly important when companies apply tags to individual inventory items and store millions of unique identifiers. It may become necessary to upgrade both the hardware and the software supporting the RFID system.

Another major concern over the use of RFID is its "Big Brother" implications for tracking what people and companies buy and spend. While RFID may increase efficiency and cut costs, its potential misuse could threaten consumer privacy and purchasing anonymity. One consumer advocacy
group focused on mitigating this risk is Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN) (www.nocards.org). Its concern is that tags are so small they can be embedded in an object without the consumer's knowledge. If the tag is not disabled after the consumer buys an item, it can be read again for purposes to which the consumer has not consented, such as developing a profile of the consumer's brand and product preferences. Another concern is that every item will have a unique number, creating the potential for objects to be associated with individuals. This could make it possible to track and "profile" people. Auditors should ascertain whether companies considering RFID technology have appropriate risk management policies, procedures and strategies regarding such privacy concerns.

**RFID ON THE JOB**

For example, "ABC Corp." is considering requiring its suppliers to place RFID tags on all individual inventory items, cases and pallets that they deliver. (continued on page 48)

**PRACTICAL TIPS TO REMEMBER**

- CPAs should consider the impact of RFID implementation on their clients' or employers' existing information system infrastructure and processing capabilities. RFID will create vast amounts of data to be processed and stored.
- Members in industry should be alert to the potential effects RFID will have on inventory-costing methods. They may have to help their employers convert to the specific identification cost-flow method from, for example, FIFO or LIFO to determine the actual cost of each individual item sold as well as the cost of each item remaining in inventory.
- To assess controls, practitioners could ask whether the system uses active or passive tags, what the limitations are on their ability to be read and whether any inventory is located beyond the normal readable range of the transceiver.
- CPAs still will have to verify that RFID is providing accurate counts and confirm that listed inventory items actually are present.
- To attest to the value of inventory, auditors should explore using RFID technology to track the flow of inventory from initial receipt to ultimate disposition.
RFID transceivers, located at the receiving docks of the distribution centers, will read the information on the pallet tags as shipments arrive. Each pallet tag lists the unique identifiers associated with each case on the pallet. The transceivers read the tags on the cases so that any discrepancies between the cases ordered and those received are noted immediately. The cases then are routed for prompt shipment to retail stores or into storage locations.

As goods are scheduled to be delivered to ABC Corp.'s retail stores, cases of goods are stacked on large pallets. Once a pallet is full, the RFID system reads the tags on the cases and transfers the information to the pallet's tag. When a pallet arrives at the retail store, the same receiving procedure used at the distribution center determines the accuracy of the pallet's inventory. Cases of inventory then are routed to the sales floor or to the stockroom.

Once the items are on the shelf, the RFID system can determine the inventory on the sales floor, calculate the number of items that need to be sent up from the stockroom and automatically order replenishments from the distribution center. As consumers remove items from the shelves, the information from each item's tag can be used for checkout and to generate point-of-sale transaction data.

### Exhibit 1: Active Tags Vs. Passive Tags

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Active Tags</th>
<th>Passive Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Internal battery</td>
<td>Generated by transceiver</td>
</tr>
<tr>
<td>Duration of power</td>
<td>Finite</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Weight</td>
<td>Heavier</td>
<td>Lighter</td>
</tr>
<tr>
<td>Cost</td>
<td>Greater</td>
<td>Lesser</td>
</tr>
<tr>
<td>Size</td>
<td>Larger</td>
<td>Smaller</td>
</tr>
<tr>
<td>Transmission range</td>
<td>Longer</td>
<td>Shorter</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>Faster</td>
<td>Slower</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>Greater</td>
<td>Lesser</td>
</tr>
</tbody>
</table>

### Exhibit 2: RFID Advantages Over Bar Codes

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>RFID</th>
<th>Bar Codes</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Line of sight” or unobstructed path between tag and reader.</td>
<td>Unnecessary in low-frequency tags.</td>
<td>Always necessary.</td>
<td>Labor is reduced when low-frequency RFID tags are applied to goods; they need not be facing readers. Tags can be read at great distances without anyone running a scanner over the tag as is necessary with bar codes. This makes it possible to instantly take the inventory of a carton without unpacking it.</td>
</tr>
<tr>
<td>Effective range.</td>
<td>Varies with type of tag.</td>
<td>Limited.</td>
<td>High-frequency RFID readers can operate at great distances.</td>
</tr>
<tr>
<td>Processing speed.</td>
<td>Signals from multiple tags are received and processed in rapid succession.</td>
<td>Reads one at a time.</td>
<td>RFID readers can process greater quantities of goods much faster.</td>
</tr>
<tr>
<td>Multiple capabilities.</td>
<td>Can “write” information on certain RFID tags, as well as “read” it.</td>
<td>Not applicable.</td>
<td>In contrast to bar codes, certain RFID tags with read/write capabilities allow the information on the tag to be modified. For example, quantities can be updated when items are added or removed from a pallet.</td>
</tr>
<tr>
<td>Resistance to adverse conditions</td>
<td>Can read and transmit data through soot or dust.</td>
<td>Easily obscured.</td>
<td>RFID systems can be used outdoors and in less-than-optimal indoor conditions.</td>
</tr>
</tbody>
</table>

### RFID R&D

The Auto-ID Center, a research and development organization, designed RFID technology, studied manufacturing techniques to reduce tag costs and developed RFID standards. The center was a global partnership among several of the world's leading research universities, such as the Massachusetts Institute of Technology and the University of Cambridge, organizations that provide domestic and global standards for bar codes (that is, the Uniform Code Council and EAN International) and almost 100 sponsoring companies, such as Wal-Mart and Johnson & Johnson. In 2003 the center closed and transferred its work to a similar organization, EPC Global Inc.
TECHNOLOGY

(www.epcglobalinc.org). The university labs now are referred to as Auto-ID Labs (www.autoidlabs.org) and work with EPC Global in the development of RFID. EPC Global develops and administers RFID standards as this technology evolves toward providing supply chain participants with standards that promote more efficient movement of goods and increase the flow of information among trading partners.

According to EPC Global’s president Michael Meranda, “RFID will affect the most important processes in the global supply chain. That’s why designing a return-on-investment plan for their clients and employers is an immediate and critical challenge facing CPAs.”

LOOKING AHEAD

Many companies have become interested in RFID’s advantages over bar codes and are waiting for prices to drop and the technology to mature before trying it out. As this interest evolves into actual adoption, CPAs will need the skills and knowledge to reevaluate accounting methods, procedures and systems in light of this new technology.

For their part, auditors will have to be skilled in assessing RFID system controls and alert for signs of inaccurate or incomplete information, such as partial inventory counts.

Public accountants seeking to expand their consulting practices should consider adding RFID-related services to the array of those they now offer current and potential clients. Though the use of this powerful and innovative technology still is in its early stages, the market potential for RFID is great. CPAs therefore should learn as much as they can about it in preparation for assuming a leadership auditing or consulting position.

Michael Meranda says CPAs should design return-on-investment plans so their clients and employers can participate in the RFID marketplace.

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