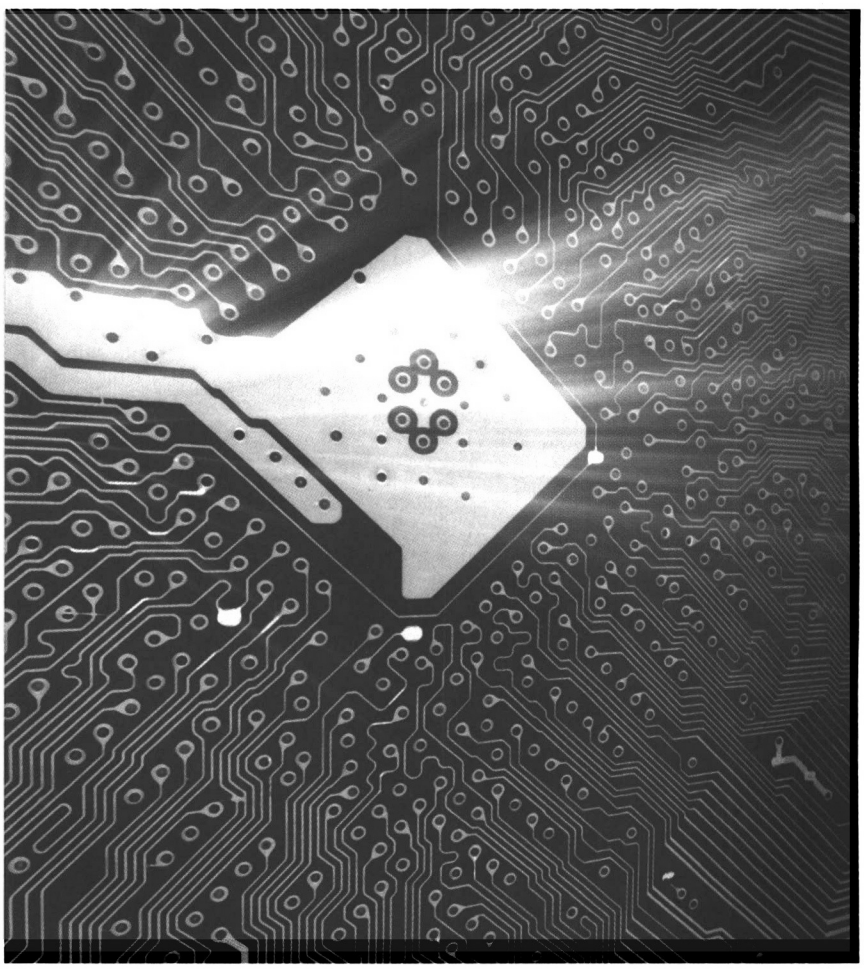
RFID Deployment

Considerations for Accountants

By P. Paul Lin and Kevin F. Brown



Radio frequency identification (RFID) is transforming the way organizations track inventory and plant assets, and will soon allow companies to automate business processes and asset management. Many large retailers are focusing on deploying RFID in their supply chain management, and most are probably only a few years away from item-level RFID deployment in their stores. As RFID is increasingly integrated into enterprise information systems, accounting professionals must be well-acquainted with the technology, specifically deployment issues including technology standards and RFID middleware.

Current Barcode Systems

The majority of today's business information systems are designed to handle barcodes. However, barcode systems are not designed to track individual inventory items, as they are typically assigned to product categories. For example, most merchandise sold in the United States carries a 12-digit universal product code (UPC) approved by the Uniform Code Council (UCC). The UPC contains the product type (the first digit), the manufacturer's code (the next five digits), the product code (the five digits following the manufacturer's code), and a check digit (the last digit). The publishing industry uses the 13-digit European Article Numbering (EAN) system for encoding ISBN numbers on books. While these popular systems can identify product categories, they do not have the capability to uniquely identify individual items

When merchandise is scanned at the checkout counter in a barcode-based retail environment, the barcode data are transmitted to the store's computer, which instantly locates the matching record in the master file. The matching record contains an array of important information, including product description, sales price, preferred vendor, quantity on hand, and reorder point. Upon the sale of merchandise, the barcode system will subtract one unit from the quantity on hand and update the master file. Conceptually, the process is similar to the lookup functions used by accountants in Microsoft Excel.

RFID Standards

In contrast to category-level barcodes, RFID systems can treat every inventory item individually. To use this capability, however, the technology requires industry-wide standards. The EPCglobal consortium, a nonprofit organization, is a collaboration between EAN and UCC to promote the adoption and standardization of electronic product code (EPC) technology. *Exhibit 1* shows EPCglobal's outline of a network of EPC-enabled data services used by companies to enable near-real-time information retrieval for items in their supply chains (Himanshu Bhatt and Bill Glover, *RFID Essentials*, proquest.safaribooksonline.com/0596009445/rfid-CHP-8-SECT-2). Such an RFID system is composed of up to three subsystems [*Guidelines for Securing Radio Frequency Identification (RFID) Systems*, National Institute of Standards and Technology, April 2007]:

- ***The RF subsystem,*** consisting of EPC tags and readers, performs identification

and related transactions using wireless communication.

- ***The enterprise subsystem*** is composed of network infrastructure, middleware, databases, applications systems, and web servers. The enterprise subsystem stores, processes, and analyzes data acquired from RF subsystem transactions to make the data useful to support business processes.
- ***The inter-enterprise subsystem*** is composed of Internet, object naming service (ONS), and discovery service. The inter-enterprise subsystem connects enterprise subsystems when information needs to be shared across enterprise boundaries (e.g., between customers and suppliers).

Every RFID system contains an RF subsystem for reading or writing tags and an enterprise subsystem to assimilate the information into business processes. An inter-enterprise subsystem is needed to support the data exchange required in supply chain management systems.

EPCglobal has more than 1,000 members worldwide and its board of governors includes Walmart, Procter & Gamble, Johnson & Johnson, Cisco, Hewlett Packard, and the U.S. Department of Defense. EPCglobal functions as the standards setter for the RFID industry. *Exhibit 2* shows the standards already ratified by EPCglobal to date. Note that these standards are subject to continual updating by EPCglobal.

The steady decline in the price of tags has accelerated RFID implementation. These tags are categorized into three classes:

- Class 0. Data are encoded when tags are manufactured (i.e., read-only).
- Class 1 Gen 1. Data are encoded in tags once by users.
- Class 1 Gen 2. This latest type of tag can operate globally in the United States, Europe, and Asia in the 860- to 960-MHz UHF band. A Gen 2 tag has a memory size of 96 bits or larger.

With a minimum of 96 bits, the memory of Gen 2 tags can accommodate the item-level tagging needs of any company. The 96 bits are divided into four segments: header (8 bits), EPC manager (28 bits), object class (24 bits), and serial number (36 bits). Given the binary representation for every bit, a total of 28 bits for EPC manager can represent up to 268 million companies, and the object class can represent up to 16 million product groups for any given company. Moreover, the 36 bits reserved for serial numbers can represent up to 68 billion different identities in the same product group. The data representation capability of a Gen 2 tag is sufficient to provide unique identifiers for all items produced worldwide. This enormous data identification capacity, however, requires vast amounts of storage to accommodate the volumes of data caused by RFID deployment.

RFID Middleware

Business applications of RFID have only just emerged in recent years, so most enterprise information systems are not ready to directly process the data collected by RFID readers. Consequently, the deployment of RFID requires middleware, which provides the interface between RFID readers and a company's existing application systems. The three primary reasons for using RFID middleware are: 1) to provide connectivity with readers while encapsulating the applications from the device interface and interconnections; 2) to lower the volume of information that applications need to process by filtering and grouping raw RFID observations coming from readers; and 3) to provide an application-level interface for managing readers and querying RFID observations. RFID middleware can apply filters and logic to tag data collected by readers so that business events can be properly processed by other application systems (Himanshu Bhatt and Bill Glover, *RFID Essentials*, proquest.safaribooksonline.com/0596009445/rfid-CHP-2-SECT-5#X2ludGVybmFsX1RvYz94bWxpZD0wNTk2MDA5NDQ1L3JmaWQtQ0hQLTc=).

Middleware providers can be grouped into three categories: large IT conglomerates (e.g., HP's OpenView and IBM's WebSphere), software vendors (e.g., Microsoft's BizTalk Server, SAP's NetWeaver, and Oracle's Fusion Middleware), and pure RFID vendors (e.g., OATSystems and Intermec). Companies considering RFID deployment must weigh the pros and cons of the various vendors before selecting one to provide RFID solutions. Because the item-level RFID deployment will result in an explosion in the volume of data processed and stored by an information system, IT conglomerates offer middleware with the intent to complement and promote their other products or consulting services. When choosing middleware from an IT conglomerate, a company might simply try to integrate RFID data into its existing application systems. The company, however, risks missing the greater payoff of RFID technology: the opportunity to enhance its business processes. Software vendors often provide proprietary middleware in order to retain or expand their market share. Consequently, when working with a software vendor, a company will likely align its RFID deployment with the vendor's enterprise resource planning (ERP) software product lines. Pure RFID vendors often work closely with other hardware and software providers on various projects; therefore, they may be biased toward a particular vendor. When making a middleware choice for deployment, companies should select vendors that are familiar with their business operations and enterprise information systems.

The rapid evolution of RFID products has resulted in a wide variety of RFID tags and readers of various types and signal frequencies. EPCglobal's standards-setting efforts are having a significant impact on RFID middleware development. Compliance with EPCglobal standards ensures the interoperability between middleware and RFID products. Furthermore, the recently ratified Application Level Events (ALE) standard ensures a standardized interface to access filtered tag data. Several vendors have already introduced their ALE-compliant middleware in the market, without which application developers would have to write additional programs for communicating with devices, filtering data, and assimilating data to application systems. The ALE standard provides simple yet flexible mechanisms to filter and group RFID data. This filtering and grouping capability provides a means to identify and focus on relevant business events (Himanshu Bhatt and Bill Glover, *RFID Essentials*).

According to one RFID deployment expert, many early RFID adopters later regretted their haste in selecting the middleware for their RFID system (Mary Catherine O'Connor, "How to Choose RFID Middleware," *RFID Journal*, August 13, 2007, www.rfidjournal.com/article/articleprint/3511/-1/1). While their initial middleware selection may have suited their earlier needs, these companies are discovering, as they attempt to more fully integrate their RFID system with their business processes, that their systems lack flexibility. As a result, many companies are now ripping out their old RFID platforms

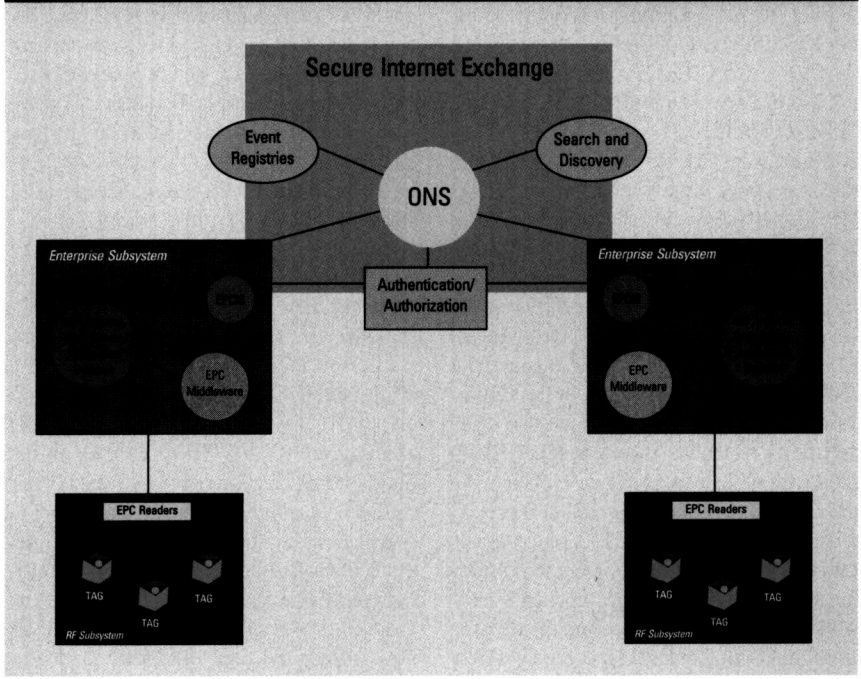
in favor of newer, more expensive platforms. The above expert suggests that companies may be wise to start their RFID deployment on a small scale, but adopt more flexible middleware from the outset, even if it is pricier than less-flexible alternatives. More careful planning, including a better analysis of future RFID integration, may result in substantial savings.

Additional Caveats

Businesses are moving toward a world of item-level identification in an RFID environment, where the EPCglobal standards will drive tagging mechanisms, transmission protocols, and network formation ("Discovery Services—Enabling RFID Traceability in EPCglobal Networks," IBM; www.almaden.ibm.com/cs/projects/iis/hdb/Publications/papers/comad2006.pdf). IDTechEx, an RFID research firm, forecasted that retail eventually will be the biggest market for RFID; it also predicted that the real opportunity lies with item-level tagging, as opposed to the current pallet-level tagging some retailers have already adopted ("Benefits of Case/Pallet Tagging Rapidly Flow to Retailers," *IDTechEx*; www.glscs.com/news/focus.htm). Nonetheless, opportunities will abound in almost all business environments. Decisions regarding when and how to adopt RFID technology will generally be determined by the tradeoffs among several factors, including cost, transmission rate, transmission range, and potential environmental interference. No single RFID technology has proved to be superior in all applications. Incidentally, the diversity of IT infrastructures has become a hurdle to RFID deployment because companies are having trouble deciding which technology offers the best long-term solution.

The volume of event data collected in the RFID environment is enormous. In order to reap the benefits of RFID technology, a huge volume of data needs to be filtered, processed, and stored in a network environment. Companies must evaluate the impact of RFID deployment on data storage, data communication, and information sharing (within the firm and with business partners) on system infrastructure. In a barcode environment, a clerk is always near a scanner to ensure the machine works properly and that barcodes are being read. Human involvement with the data collection process in an RFID environment, however, will be minimal or nonexistent. It is therefore necessary to implement automated means to monitor and manage RFID readers. The mission-critical RFID network must be available at all times and continually assessed for potential system threats. Failure to evaluate an RFID system's vulnerabilities and lack of business continuity planning may result in a serious disruption of operations

EXHIBIT 1
EPCglobal Network Standard



Accounting Applications

The RFID data filtering and grouping capabilities allow businesses to select transactions associated with particular events, such as sales, sales personnel incentives, introductions of new products, and changes in existing products, for analysis. RFID technology enables accountants and auditors to tie events to transactions and evaluate cause-and-effect relationships. While RFID data capabilities are useful to management, external auditors can use the system as well, although the massive amounts of data can be burdensome if they are not effectively filtered.

The item-level identification offered by RFID can help improve numerous business processes. Accountants and managers should review their processes and ask themselves where item-level identification would benefit decision-making processes, manufacturing processes, and overall company profitability.

The use of any IT tool will impact a company's internal control systems, as well as the external audit of those systems. The Committee of Sponsoring Organizations (COSO) defines the objectives of the internal control process as effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations (www.coso.org). Using RFID technology to track inventory and plant assets should raise concerns about safeguarding resources, under the first objective, and financial reporting for inventory and fixed-asset data, under the second.

RFID technology should be implemented with the goal of increasing the efficiency and effectiveness of internal control procedures and audits, in addition to reducing the cost of serving customers while increasing inventory and plant-asset data collection. A complex IT environment increases the risks of inaccurate data processing, unauthorized

access to data, and potential loss of data, as well as the importance of control systems to address those risks. A discussion of IT internal control procedures is beyond the scope of this article, and readers can refer to Public Company Accounting Oversight Board (PCAOB) Auditing Standard 5, as well as the "Preliminary Staff Views" guidance for smaller companies (www.pcaob.com).

Organization Implementation

When deploying RFID technology it is important to assess both the business needs and system requirements, and to evaluate how these needs will evolve over time. Instead of treating RFID as a mere data-collection device, companies should take advantage of RFID's real-time information to improve business processes. One formidable obstacle for RFID deployment is the shortage of RFID expertise. A report by the Aberdeen Group revealed that more than half of the companies surveyed suffered from a critical internal shortage of qualified RFID staff (Evan Schuman, "Major RFID Hurdles Ahead," *eWeek*, July 20, 2006, www.eweek.com/c/a/Retail/Report-Major-RFID-Hurdles-Ahead-[1]/). A more recent survey by the Computing Technology Industry Association found that 84% of technology resellers, solution providers, systems integrators, and consultants will or might offer RFID products and solutions in the next three years ("Implementing RFID Solutions Survey," *TechNews*, June 24, 2007, www.technologynewsdaily.com/node/7233). Companies should hire consultants if they do not have qualified personnel for RFID deployment in-house. The same survey also indicates that, despite the slower-than-expected adoption rate, IT firms remain bullish on the future of the RFID market. ❑

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EXHIBIT 2
EPCglobal Ratified Standards

Standard	Version	Approval/ Ratification	Objectives
EPC Tag Data Standards (TDS)	1.3	March 8, 2006	Defines standardized EPC tag data, including how it is encoded on tags and used in the information systems layers of the EPC Systems Network.
EPC Tag Data Translation (TDT) Standard	1.0	Jan. 21, 2006	Concerns a machine-readable version of the EPC TDS specification. The machine-readable version can be readily used for validating EPC data.
Class 1 Gen 2 UHF Air Interface Protocol Standard	1.0.9	Dec. 16, 2004	Defines the physical and logical requirements for a passive RFID system operating in the 860 MHz–960 MHz frequency range.
Low-Level Reader Protocol (LLRP) Standard	1.0.1	April 13, 2007	An interface standard that specifies the interactions between a device capable of reading/writing tags and application software.
Application-Level Events (ALE) Standard	1.0	Sept. 23, 2005	Specifies an interface through which clients may obtain filtered, consolidated EPC data from a variety of sources. ALE allows application software developers to focus on business operations and leave the technical details surrounding EPC data to a dedicated software component (i.e., the middleware).
Object Naming Service (ONS) Standard	1.0	Oct. 4, 2005	Specifies how the domain name system is used to locate authoritative metadata and services associated with the serialized global trade item Number (SGTIN) portion of a given EPC.
EPCglobal Certificate Profile Standard	1.0	March 8, 2006	Enables broad interoperability and rapid deployment of EPC, while ensuring secure usage.
Reader Management Standard	1.0.1	May 31, 2007	Defines the wire protocol used by management software to monitor the operating status of EPCglobal compliant RFID readers.
EPC Information Services (EPCIS)	1.0	April 12, 2007	Offers a standard set of interfaces for EPC data, enabling a single way to capture and share information, while still allowing the flexibility for industry and organization-specific implementations. EPCIS can simplify data-sharing among enterprises (i.e., enhancing the supply chain management) and provide some interoperability among software applications.
Drug Pedigree Standard	1.0	Jan. 5, 2007	Specifies the architecture for maintenance and exchange of electronic pedigree documents for use by pharmaceutical supply chain participants.

Source: www.epcglobalna.org