RFID

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Radio frequency identification (RFID) has been used in a number of practical applications, such as improving supply chain management, tracking household pets, accessing office buildings, and speeding up toll collection on roadways. RFID is used to automatically identify people, objects, and animals using short range radio technology to communicate digital information between a stationary location (reader) and a movable object (tag).

RFID technology can be used to track products in a manner similar to using bar codes for product identification, but RFID also carries additional benefits. RFID does not require line of sight to read the tag, has a longer read range than bar code reader, and tags can store more data than bar codes. Readers can simultaneously communicate with multiple tags. This feature could allow customers to breeze through grocery store checkout counters while a reader identifies all items in a shopping cart at the same time, instead of scanning each bar code individually.

RFID tags fall into two categories, active tags, which contain an internal power source, and passive tags, which obtain power from the signal of an external reader. Because of their lower price and smaller size, passive tags are more commonly used then active tags for retail purposes. A passive tag consists of a microchip surrounded by a printed antenna and some form of encapsulation, plastic laminates with adhesive that can be attached to a product or a small glass vial for implantation. The tag reader powers and communicates with passive tags. The tag's antenna conducts the process of energy capture and ID transfer. A tag's chip typically holds data to identify an individual product, the product model and manufacturer.

Active tags	Passive tags
Transmit a stronger signal	Transmit a weaker signal
Have a longer "read" range, can exceed 100 meters, depending on antenna size	Read distance ranges of 10 cm. to a few meters
Operate at higher frequencies-commonly 455 MHz, 2.45 GHz, or 5.8 GHz	Typical operating frequencies- 128 KHz, 13.6 MHz, 915 MHz, or 2.45 GHz
Expire after battery power runs out	Operate until damaged or discarded
Cost a few dollars per tag	Cost 7.9 cents per tag when purchased in quantities of 1 million (as of May 2006)
Size is typically slightly larger than a deck of playing cards	Can be as small as a grain of rice

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Although applications of RFID have become more widespread in recent years, radio frequency identification is not a new technology. RFID has been in use for several decades and an early version of the technology was used by British Allied forces in World War II to identify "friend or foe" aircraft. In the 1960s Los Alamos National Laboratory research led to the use of RFID in employee badges for automatic identification, to limit access to secure areas, and to make the badges difficult to forge. [3]

Public awareness of RFID was heightened in recent years when the U.S. Department of Defense (DoD) and retail giant Wal-Mart required their suppliers to use RFID technology. Wal-Mart's mandate required its top 100 suppliers to use RFID tags on cases and pallets of products by January of 2005. The technology enables the company to track products as they move through distribution centers and into stores, allowing for better inventory tracking and improved efficiency in the supply chain. Wal-Mart's CIO recently stated that using RFID has resulted in a 26 percent reduction in out of stocks in the stores with RFID capabilities, and out of stock items that are replenished three times faster than those items not RFID tagged. [4]

RFID tagging at case- and pallet-level has been adopted to improve supply chain management by several food and consumer goods retailers, including Best Buy, Target and Wal-Mart (U.S.), Tesco (U.K.), and Metro (Germany), but product-level tagging has not been widely adopted. Widespread use of RFID at the item or product level has been slowed due to both cost and privacy concerns. In 2006, the cost of passive RFID tags fell to about 7.9 cents each when purchased in quantities of one million. Though prices have fallen, placing RFID tags individual items may still be impractical for many inexpensive consumer products, but could be cost effective for more expensive items like clothing.

RFID technology has several applications that extend beyond the retail sector. RFID tags are embedded in passports for security and personal identification and in ID cards to control access to buildings. Tags are also used for electronic payment for transportation (i.e., E-ZPass and Chicago Transit Authority's Chicago Card) and other payment systems, such as credit cards and smart cards. RFID also has several medical uses including tracking of newborns in hospitals, storing information on surgical patients and procedures, and tracking medical equipment.

Privacy concerns represent one of the largest barriers to widespread adoption of RFID technology. Consumers fear that their movements could be tracked after leaving a store if RFID tags are used on individual products and not removed at the time of purchase. Consumers have also voiced concern over having their buying habits automatically tracked. Certain countermeasures have been developed to address concerns of privacy invasion. EPCglobal has designed a kill switch in their tags that would allow vendors to permanently disable a tag at point of sale. RSA Security has developed a "Blocker Tag" which basically acts as a shield to prevent RFID tags from being read.

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Concerns over invasion of privacy have prompted several states to draft legislation concerning the use of RFID. Pending legislation in California, Senate Bill 1834, limits the amount of information on the tag. Pending Massachusetts legislation, House Bill 1447 and Senate Bill 181, requires labels and logos to inform consumers about he use and purpose of RFID on products and readers. The legislation also requires the ability to remove tags that are not essential to the product and limits the information stored on tags to inventory and similar purposes.

There are several standards related to RFID technology. The standards cover the following topics:

- identification, the coding of unique item identifiers, or other data on the RF tag;
- data and system protocols, effectively the middleware of an RFID system;
- the air interface, that is, the wireless communication between the reader and the tag;
- application support, which provides advice about how to implement the technology;
- testing, compliance, and health and safety, that is, the rules that govern RFID operations; and
- terminology. [1]

The International Organization for Standards (ISO) has drafted several standards related to RFID. ISO 11784, 11785 and 14223/1 deal with code structure, technical concept and advanced transponders for radio frequency identification of animals. ISO10536, 14443, 15693 relate to contactless integrated circuit, vicinity and proximity cards. ISO 18000 specifies the air interface for various radio frequency identification applications.

EPCglobal has developed a framework for worldwide RFID standards. The framework is based on the widely accepted Electronic Product Code (EPC) for product identification, as well as the ID System (EPC tags and readers), Object Name Service (ONS), which acts as a directory service for looking up product numbers on the Internet, Physical Markup Language (PML), and Savant, software that manages information in the EPC network.

IEEE-USA has a position paper regarding the use of RFID. Issues addressed include building RFID systems on the concepts of openness and transparency and using appropriate layered levels of protection and security with regard to RFID systems and the information they collect. Such policy is of particular importance as RFID systems are able to collect data “inconspicuously, remotely, and by unknown, unauthorized, or unintended entities.” [5]

The upcoming IEEE International Conference on RFID will address technical and policy issues related to RFID. The conference will be held March 28-29, 2007 in Grapevine, Texas and will address some of the following topics: antennas and propagation, circuits, devices, and sensors, RFID system architecture and implementation, deployment, security, policy and regulatory issues, and application issues and concerns.

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