Chapter XLI
Radio Frequency Identification (RFID) Technology

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INTRODUCTION

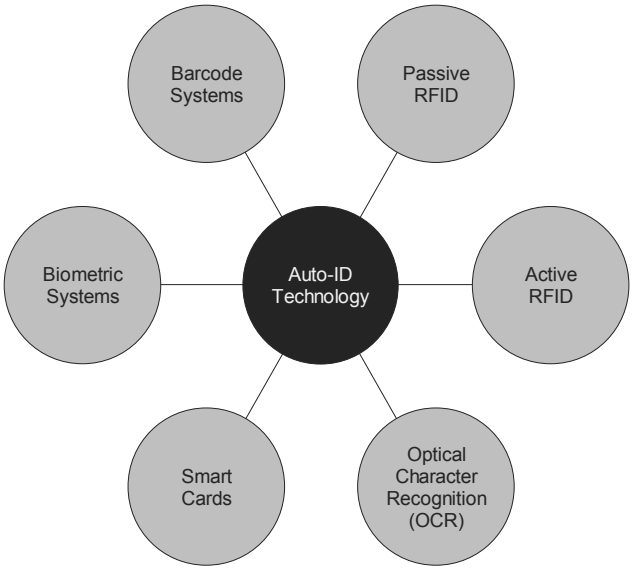
We are in the midst of what may become one of the true technological transformations of our time. RFID (radio frequency identification) is by no means a new technology. RFID is fundamentally based on the study of electromagnetic waves and radio, pioneered in the 19th century work of Faraday, Maxwell, and Marconi. The idea of using radio frequencies to reflect waves from objects dates back as far as 1886 to experiments conducted by Hertz. Radar was invented in 1922, and its practical applications date back to World War II, when the British used the IFF (Identify Friend or Foe) system to identify enemy aircraft (Landt, 2001). Stockman (1948) laid out the basic concepts for RFID. However, it would take decades of development before RFID technology would become a reality. Since 2000, significant improvements in functionality, decreases in both size and costs, and agreements on communication standards have combined to make RFID technology viable for commercial and governmental purposes. Today, RFID is positioned as an alternative way to identify objects with the ubiquitous bar code.

BACKGROUND

Automatic identification, or Auto-ID, represents a broad category of technologies that are used to help machines identify objects, humans, or animals. Auto-ID is a means of identifying items and gathering data on them without human intervention or data entry. As can be seen in Figure 1, RFID a type of Auto-ID technology. Sometimes referred to as dedicated short-range communication (DSRC), RFID is "a wireless link to identify people or objects" (d'Hont, 2003, p. 1). RFID is, in reality, a subset of the larger radio frequency (RF) market, which encompasses an array of RF technologies, including the following:

- Cellular phones
- Digital radio
- The Global Positioning System (GPS)
- High-definition television (HDTV)
- Wireless networks (Malone, 2004)

Figure 1. The family of automatic identification technologies



RFID is a technology that already surrounds us. If you have an Exxon/Mobil SpeedPass™ in your pocket, you are using RFID. If you have a toll tag on your car, you are using RFID. If you have checked out a library book, you have likely encountered RFID. If you have been shopping in a department store or an electronics retailer, you have most certainly encountered RFID in the form of an EAS (electronic article surveillance) tag.

RFID TECHNOLOGY

To best understand the power of radio frequency identification, it is first useful to compare RFID with bar-code technology, which is omnipresent today. The specific differences between bar-code technology and RFID are summarized in Table 1. The principal difference lies in the potential of RFID to provide unique identifiers for objects. While the bar code and the UPC (Universal Product Code) have become all pervading and enabled a host of applications and efficiencies (Brown, 1997), they only identify an object as belonging to a particular class, category, or type. Due to its structure (as shown in Figure 2), a bar code cannot uniquely identify a specific object: It can identify only the product and its manufacturer. Thus, a bar code on any one package of sliced meat in a grocery store is the same as on any other of a particular type or size from a particular firm. Likewise, the bar code on a case or pallet of military supplies cannot tell one shipment from another. The two technologies also differ in the way in which they read objects. With bar coding, the reading device scans a printed label with optical laser or imaging technology. However, with RFID, the reading device scans, or interrogates, a tag using radio frequency signals.

There are three necessary elements for an RFID system to work. These are tags, readers, and the software necessary to link to a larger information processing system. In a nutshell, the technology works as follows. The tag is the unique identifier for the item it is attached to. The reader sends out a radio signal, and the tag responds to identify itself. The reader then converts the radio waves returned from the tag into data that can be passed