Chapter 1.6
Understanding RFID (Radio Frequency Identification)

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INTRODUCTION

RFID, also known as radio frequency identification, is a form of Auto ID (automatic identification). Auto ID is defined as "the identification of an object with minimal human interaction" (Puckett, 1998). Auto ID has been in existence for some time; in fact, the bar code, the most ubiquitous form of Auto ID, celebrated its 30th year in commercial use in 2004 (Albright, 2004). Barcodes identify items through the encoding of data in various sized bars using a variety of symbologies, or coding methodologies. The most familiar type of barcode is the UPC, or universal product code, which provides manufacturer and product identification. While barcodes have proven to be very useful, and indeed, have become an accepted part of product usage and identity, there are limitations with the technology. Barcode scanners must have line of sight in order to read barcode labels. Label information can be easily compromised by dirt,

dust, or rips. Barcodes take up a considerable footprint on product labels. Even the newer barcode symbologies, such as 2D, or two-dimensional, which can store a significant amount of data in a very small space ("Two dimensional…," 2005) remain problematic. RFID proponents argue that limitations of barcodes are overcome through the use of RFID labeling to identify objects.

HISTORY OF RFID

Jeremy Landt (2001) wrote a history of RFID published by AIM, The Association for Automatic Identification and Data Capture Technologies, explaining that in the 20th century, the invention of radar took advantage of the electromagnetic energy that some postulate to have been present at the creation of the universe. By broadcasting and analyzing the reflection of radio waves, radar can identify two important characteristics about an

Figure 1. Barcode examples

Code 39 (Source:
http://www.idautomation.com/fonts
/free/word-example.gif)

UPC-A (Source:
http://www.idautomation.com/upceanfaq.html)

object, its position and its velocity. This application of radio waves was a precursor to the use of radio waves in radio frequency identification.

During the 1950s, transponders were developed and improved, becoming increasingly more sophisticated and allowing for long-range determination of the identification of aircraft (Landt, 2001). Through the decades of the 1960s, 1970s, and 1980s, inventors, academicians, commercial enterprises, and governmental agencies explored a plethora of opportunities related to the use of early RFID devices, using radio transmissions, "short-range radio-telemetry," microwave technology, and radar beams (Landt, 2001). Landt states that RFID was first used commercially in the 1960s by companies that developed security related devices called "electronic article surveillance (EAS) equipment." Although EAS could only present the detection or absence of a tag, the tags were low cost and provided valuable deterrents to theft. EAS is still an important application of RFID today.

Work continued through the 1970s and in the 1980s, as companies began offering a variety of RFID related business solutions, primarily aimed at transportation, controlled access, and animal tracking applications (Landt, 2001). Of primary importance, in 1973 the United States government determined that there was no need for a national standard for electronic vehicle identification. This was serendipitous because it meant that individual firms, researchers, and others could have the freedom to develop new uses of RFID without being constrained by a governing body (Landt, 2001).

RFID TECHNOLOGY

Radio Frequency

Electromagnetic waves are comprised of a continuum of emanations, including visible light waves, and invisible frequencies such as television and radio waves, which are lower frequency than light, and x-rays and gamma rays, which are higher frequency than light. Frequencies are measured in Hertz (Hz), kilohertz (kHz), megahertz (MHz), or gigahertz (GHz), and represent the rate of oscillation of the waves. The portion of the electromagnetic spectrum used by radio frequency identification includes LF (low frequency), HF (high frequency), and UHF (ultra high frequency), which are all portions of the radio wave frequency bands, hence the term "radio frequency identification." An advantage of radio waves over visible light is that radio waves can penetrate many substances that would block visible light. Radio waves range from 300 kHz to 3 GHz (Hodges et al, 2003). Specific frequencies use is controlled by governmental agencies.

Some of the concerns relating to RFID are inherent to the technology upon which it is based. For instance, the range over which devices using

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