Chapter V
Barcode:
The Pioneer Auto-ID Technology

BARCODE TECHNOLOGY

Historical Overview

Of all the auto-ID technologies in the global market today, barcode is the most widely used. In 1994, Cohen (p. 55) wrote “...barcode technology is clearly at the forefront of automatic identification systems and is likely to stay there for a long time.” It is estimated by GS1, that there are over 5 billion barcode reads each day. Despite complementary and supplementary technologies entering the barcode space, Cohen’s statement still holds true. Palmer (p. 9) agreed in 1995, that “barcode ha[d] become the dominant automatic identification technology”. Ames (1990, p. G-1) defines the barcode as: “an automatic identification technology that encodes information into an array of adjacent varying width parallel rectangular bars and spaces.”

The technology’s popularity can be attributed to its application in retail, specifically in the identification and tracking of consumer goods. Before the barcode, only manual identification techniques existed. Handwritten labels or carbon-copied paper were attached or stuck to ‘things’ needing identification. In 1932 the first study on the automation of supermarket checkout counters was conducted by Wallace Flint. Subsequently in 1934 a patent was filed presenting barcode-type concepts (Palmer, 1995, p. 11) by Kermode and his colleagues. The patent described the use of four parallel lines as a means to identify different objects.

In 1959 a group of railroad research and development (R&D) managers (including GTE Applied Research Lab representatives) met in Boston to solve some of the rail industry’s freight problems. By 1962 Sylvania (along with GTE) had designed a system which was implemented in 1967 using color barcode technology (Collins & Whipple, 1994, p. 8). In 1968, concentrated efforts began to develop a standard for supermarket point-of-sale which culminated in the RCA developing a bull’s eye symbol to be operated in the Kroger store in Cincinnati in 1972 (Palmer, 1995, p. 12). Until then, barcodes in retail were only used for order picking at distribution centers (Collins & Whipple, 1994, p. 10). But it was not the bull’s eye barcode that would dominate but the Universal Product Code (UPC) standard. The first UPC barcode to cross the scanner was on a packet of Wrigley’s chewing gum at Marsh’s su-
permarket in Ohio in June 1974 (Brown, 1997, p. 5). Within two years the vast majority of retail items in the United States carried a UPC.

The Barcode System

Barcode technology increased in popularity throughout the 1980s as computing power and memory became more affordable, and consumer acceptance increased. This enabled programs and peripheral devices (complementary innovations) to be built to support barcodes for the identification and capture of data. A barcode can only work within a systems environment. Barcode labels in themselves are useless without peripheral equipment. The components required in a barcode system include: a barcode label (encoded with a symbology), a scanner, a decoder, a computer with a database, and a printer. Additional components include software, monitors, and networks which are used to complement most systems (Jesse & Rosenbaum, 2000). Simply put, a scanner reads the label using a given symbology, a decoder then converts this signal into a digital form so that a computer can perform its functions.

The Importance of Symbologies

When examining the technical features of the barcode it is important to understand symbologies, also known as configurations. There are many different types of symbologies that can be used to implement barcodes, each with its distinct characteristics. New symbologies are still being introduced today. Cohen (1994, p. 55) explains a symbology is a language with its own rules and syntax that can be translated into ASCII code.

Common to all symbologies is that the barcode is made up of a series of dark and light contiguous bars (Collins & Whipple, 1994, pp. 20-24). Each barcode differs based on the width of the bars. Of particular importance is the width of the narrowest bar which is called the ‘X dimension’ (usually measured in millimeters) and the number of bar widths. Essentially, this defines the character width- the amount of bars needed to encode data. When the barcode is read by a device called a scanner, light is illuminated onto the bars. This pattern of black and white spaces is then reflected (like an OFF/ON series) and decoded using an algorithm. This special pattern equates to an identification number but can be implemented using any specification. For instance, the major linear barcode symbologies include: Interleaved 2 of 5, Code 39 (also known as code 3-of-9), EAN 13, U.P.C. 8 and Code 128. Major two-dimensional symbologies, known also as area symbologies, include Data Matrix, MaxiCode, and PDF417.

Interleaved 2 of 5 is based on a numeric character set only. Two characters are paired together using bars. The structure of the barcode is made up of a start quiet zone, start pattern, data, stop pattern and trail quiet zone. According to Palmer (1995, p. 29) it is mainly used in the distribution industry. Code 39 is based on a full alphabet, full numeric and special character set. It consists of a series of symbol characters represented by five bars and four spaces. Each character is separated by an intercharacter gap. This symbology was widely used in non-retail applications. The barcode is made up of light and dark bars representing 1s and 0s. The structure of the barcodes includes three guard bars (start, centre and stop), and left and right data. The barcodes can be read in an omni-directional fashion as well as bi-directional. Allotted article numbers are only unique identification numbers in a standard format and do not classify goods by product type. Like the Interleaved 2 of 5 symbology, EAN identification is exclusively numerical. The structure of the EAN and U.P.C. includes (i) the prefix number that is an organization number that has been preset by EAN, and (ii) the item identification that is a number that