Not Barcodes or RFID, but Both ∎ ∎ ∎

Leveraging Printer Infrastructure to Reap the Benefits of Converging Technologies

Technology has an inexorable momentum, but one that proceeds at a pace determined by utility. Such is the case with barcodes and radio-frequency identification (RFID).

"When technology rolls over you, if you're not part of the steamroller, you're part of the road," said the American writer and editor Stewart Brand. When Wal-Mart issued its famous RFID mandate in 2003, many manufacturers thought they were being steamrolled; pundits saw the mandate as the death knell of barcode technology. Neither the fear nor the forecast has proved accurate.

First, the mandate did not result in a rapid torrent of RFID adoption. Deadlines associated with the mandate have been extended several times because many vendors faced significant difficulties implementing RFID systems, including the relative cost of implementation. The Wall Street Journal published an article stating that the RFID plan set forth by Wal-Mart was "showing signs of fizzling" due to a lack of progress by their executives to introduce the technology to its stores and to the lack of incentives for suppliers.[1] No one was being steamrolled.

Second, barcode technology has remained absolutely vital. It is by far the most dominant track and trace technology in the world. Used globally in nearly all industries, barcode is the de facto standard for companies worldwide, regardless of size, standing, or location. It is clearly not on its deathbed. In fact, RFID has emerged not as its executioner, but rather as an ally in extending value and intelligence across the supply chain.

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right by our customers.

Industry analyst VDC Research Group puts it succinctly: "Although these two technologies could be perceived as direct competitors for the same applications, end users continue to require both solutions—and this is not a short-term condition."[2] While RFID may not have emerged as rapidly as it might have in the wake of the Wal-Mart initiative, its time is now.

"We are heading into this RFID world because of a multitude of issues, ranging from regulatory pressures to security to inventory control," says Cindy Guiles, product manager at Datamax-O'Neil. "Those things relate to everyone, from their own consumer perspectives, but also when they put on their business hats; those that have invested in printer technology like that provided by Datamax-O'Neil should know that they have the ability, with the infrastructure they have in place today, to embrace RFID while continuing to meet their barcode needs."

This paper considers the ramifications of the barcode/RFID convergence, and specifically details how printer technology can be leveraged to provide value by working for both barcode and RFID solutions. The two technologies are reviewed independently—their objectives and utilization—as well as what their convergence means: how it can be used, where it can be used, and when the combination is most effectively employed. It concludes with a look at what this means in terms of printing, and how printer technology has prepared the way for growth by being able to accommodate both barcode and RFID requirements.

Barcode 101: A Quick Refresher ■ ■ ■

As we rapidly approach the 40th anniversary of the barcode's first retail application, the technology has become so ubiquitous that we rarely give it a second thought. A barcode is an optical machine-readable representation of data that shows information about the object to which it attaches. Originally barcodes represented data by varying the widths and spacings of parallel lines, and may be referred to as linear or one dimensional (1D). Later they evolved into rectangles, dots, hexagons, and other geometric patterns in two dimensions (2D). Although 2D systems use a variety of symbols, they are also referred to as barcodes. Special optical scanners called barcode readers originally scanned them, but later scanners and interpretive software became readily available on devices ranging from PCs to desktop printers to smartphones. Barcode readers require a direct line of sight to the printed barcode.

Barcodes were first used to label railroad cars, but were not commercially successful until they helped to automate supermarket checkout systems, a task for which they have become almost universal. Their use has spread to many other tasks that are generically referred to as automatic identification and data capture (AIDC). The very first scanning of the Universal Product Code (UPC) barcode was on a pack of Wrigley's chewing gum in June 1974.[3]

The typical information on a barcode pertains to what a product is, where it came from, and the date it was made or received. As the information needs of enterprises and their trading partners have expanded to address a myriad of uses ranging from product recalls to item-level authentication, new symbologies and standards have been developed to support these requirements.[4] As security concerns have proliferated in all areas of commerce and society, so too has the application of barcode technology for identification and authorization purposes, in addition to its principal track and trace function.

Virtually all industries have adopted barcode technology, with many of them employing specific barcode label requirements. Included are automotive, chemical, distribution, electronics, government, hospitality, law enforcement, life sciences, logistics, manufacturing, publishing, retail, security, transportation, utilities, and wholesale markets.

The Basics of RFID ■ ■ ■

Radio-frequency identification is a technology that uses radio waves to transfer data from an electronic tag, called an RFID tag or label, attached to an object, through a reader to identify and track the object. Some RFID tags can be read from several meters away and beyond the line of sight of the reader. The application of bulk reading enables an almost-parallel reading of tags.

The tag's information is stored electronically. The RFID tag includes a small RF transmitter and receiver. An RFID reader transmits an encoded radio signal to interrogate the tag. The tag receives the message and responds with its identification information.

An RFID tag is an active tag when it is equipped with a battery that can be used as a partial or complete source of power for the tag's circuitry and antenna. Some active tags contain replaceable batteries for years of use; others are sealed units.
An RFID tag is a passive tag when it does not contain a battery; the reader supplies the power to the tag. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory. The RFID system design includes a method of discriminating several tags that might be within the range of the RFID reader.[5]

RFID can be used in a myriad of applications. A tag can be affixed to any object and used to track and manage inventory, assets, people, and more. For example, it can be affixed to cars, computer equipment, books, and mobile phones. The healthcare industry has used RFID to reduce counting, looking for things, and auditing items. Many financial institutions use RFID to track key assets and automate compliance. With recent advances in social media, RFID is now being used to tie the physical world with the virtual world.[6]

RFID provides non line-of-sight wireless communication and increased information storage capacity vis-à-vis barcode. RFID can uniquely identify each item or asset tagged, while most barcodes only identify the type of item (i.e. via the UPC code), but not uniquely.

The Convergence of Barcode and RFID ■ ■ ■

According to VDC Research, the idea of convergence "refers to previously separate technologies and solutions that now share resources and interact with each other synergistically, creating new efficiencies."[7] Convergence itself is not about technology per se, but rather the commonalities technologies share to better leverage resources and expand opportunities.

As barcode meets defined requirements enabling trading partners to share information, it has become a foundation technology integral to enterprises and their value chains. But, as analysts have noted, as a standalone solution barcode cannot meet the complex and fluid demands of end users. Its shortcomings include line-of-sight scanning and storage limitations, and relatively low automation potential. RFID resolves each of these issues. It leverages non line-of-sight wireless communications and enables a higher level of automation (i.e., lower human intervention, greater labor savings, less risk of error) and increased information storage capacity. It also provides additional functionality and data beyond what barcode offers (e.g., environmental monitoring).[8] According to industry analyst Gartner, the RFID business case focus is moving away from cost reductions into business process innovation.[9]

"RFID not only expands the tracking of product throughout the supply chain, it also enables security and encryption at the item level," says Guiles. "It can be used effectively from point-of-manufacture to point-of-sale."

Despite the significant value provided by RFID, its penetration rate remains low compared to barcode, due in part to its high cost when compared to the entrenched technology. According to VDC Research, the strongest use case emerging involves employing both barcode and RFID. The two technologies, working together, are capable of supporting existing requirements while providing the end user with additional benefits:

- The ability to support either technology within the value chain as well as providing an additional layer of redundancy and visibility
- The capacity to enhance and add functionality (i.e., more memory, sensing/monitoring, analytics) to a legacy system with minimal invasiveness and downtime
- A migration path to a more advanced technology in which the end user has more control over the conversion pace and associated investment requirement

Although there is overlap in functionality and capabilities, the combination of the two solutions provides the end user with the best of both worlds: more actionable business intelligence with little disruption to existing solutions and processes from a robust technology platform that extends their ability to support operational requirements that drive required financial results.[10]

As global competition raises the pressure for greater operational efficiency, the combination of barcode and RFID becomes more persuasive. "Increasingly, companies are looking to leverage all streams of business intelligence," says Guiles. "From a track and trace perspective, this means using both technologies. The greater the utilization of AIDC solutions, the greater the benefit to the supply chain: the more information gathered, the better the visibility, decision making, security, and vitality of the enterprise."

From a functional point of view, there are three principal drivers of using both barcode and RFID:
  1) When the environment requires both visual and encoded data
  2) When more memory and/or greater security is needed
  3) When non line-of-sight tracking and visual data tracking are both needed

Dual utilization of barcode and RFID is increasingly common, and will only continue to grow. According to VDC, this is happening within most AIDC solutions in nearly every region, vertical, and facet of the value chain: "a global phenomenon that transcends industries and integrated supply chains (e.g., pharmaceuticals integrated with retail, CPG, healthcare, government and transportation/distribution)."[11]

Printing Consideration ▪ ▪ ▪

One of the reasons people have been resistant to RFID is the investment required in implementing the technology; yet, many have already invested in enabling technology and are unaware of it. For example, Datamax O-Neil M Class printers, H Class printers, and A Class print engines support RFID and comply with the industry's EPC G2 standards.

"The value of these printers within this converged environment is what they bring to the infrastructure moving forward," says Guiles. They can print barcodes, encode RFID tags, or both. This is a good example of how convergence works to a company's benefit. "The investment in our printers gives you both capabilities, so throughout the supply chain you'll be able to capture more data and expand its utilization," she continues.

Today, barcodes provide information about what is in the product, where the product came from, and other similar metrics. RFID is able to expand that track and trace functionality in the supply chain, and enhance the identification of the product by allowing the collection and storage of more information throughout the supply chain. "If you have other components, such as biometrics or sensors to record the temperature of perishables as they move through the supply chain, they can easily be added within the RFID environment," says Guiles.

The intersection between barcode and RFID is such that RFID acts as an extension of barcode to provide more information across the value chain to meet the data requirements of today and tomorrow. Further, barcode and RFID provide data into a common database that allows the two to intersect and work together, providing new opportunities within the existing AIDC framework.

"Consider the non line-of-sight scanning environment," says Guiles. "With barcodes, you have to scan one at a time, and you have to be in front of it. That's very time consuming. With RFID, there is no line of sight. You can scan more items more quickly."

This advantage is famously used in the retail industry. To take inventory, instead of spending a full day doing direct scans of each barcoded item—and closing down the store to do so—multiple inventories are taken over the course of several days or a week via RFID, yielding more accurate data while increasing uptime.

"With RFID, you can scan, know exactly what inventory has been depleted, and be able to reorder quickly," explains Guiles. This is more efficient, profitable, and secure. When there are high volume or high value items, it is easier with RFID to scan and make certain that the label or tag affixed has the right information on it—that people aren't switching things out.

Extending Value ▪ ▪ ▪

Having printers that can support traditional barcodes and RFID encoding is a value to resellers and end users alike. With the aforementioned Datamax-O'Neil printers in particular, it is simple to upgrade to RFID without discarding the investment already made. Whether in a production line or in distribution, the equipment is already there; because it adheres to industry standards, having been validated as EPC compliant, printer output can be read on someone else's scanner—potentially protecting a prior investment.

"Today our printers have a module or an antenna that allows the user to send a label format to the printer," says Guiles. "It can print the date, the lot number, and so on. At the same time we're sending communications data. As the printer is printing the label, it also is encoding the information onto a chip—an inlay that is on the same label. It's doing both things at the same time." Therefore, for companies using barcode exclusively today, it is simple to convert to barcode and RFID with their existing printers.

Regulatory compliance is often a key driver for companies making this change. For example, in pharmaceuticals, if the FDA issues a mandate that RFID has to be included, then production must adhere to that requirement for their product to be sold in pharmacies.

"This is how labels continue to evolve for both the back and front end," says Guiles. The front end is the retail store or pharmacy, where the pharmacist or customer picks up an item and needs visual information. On the back end, for inventory purposes, RFID allows the same item to be scanned and identified quickly, whether in a case, pallet, or locked medical cabinet.

## The R-Series: Convergence as Competitive Advantage ■ ■ ■

By enabling companies to extract value from their printing infrastructure via barcode or RFID technology, Datamax-O'Neil printers can make convergence a competitive advantage. This is the objective of the R-Series printers.

The R-Series encompasses a broad spectrum of RFID printers to meet the many demands of today's constantly advancing RFID implementations. All R-Series printers comply with EPC G2 standards, and feature the benefits and modularity inherent in Datamax-O'Neil printer designs. These RFID printers currently support two frequency modules, HF and UHF, as well a wide range of configurations that meet global frequency requirements. Their integrated auto calibration feature ensures optimum performance and power levels.

"The investment that the customer has in our printers today, in terms of the equipment and knowledge, can grow along with technology," says Guiles. "R-Series printers can help people grow their business, be they reseller, integrator, or an end customer."

That this growth can be accomplished as a direct extension of technology that these customers have today is real value. It leverages technological convergence, but also maximizes utilization of existing assets. It deals with current demands while preparing to meet future ones. In today's competitive and volatile markets, this is not only an advantage—it's a necessity.
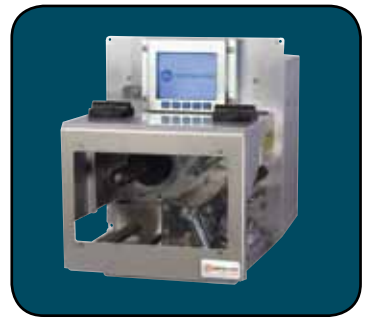
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