Beyond The Supply Chain

Only when RFID becomes integrated with industrial automation, process control and manufacturing systems will the technology become truly ubiquitous.

March 20, 2006—With RFID technology being rediscovered and increasingly deployed over the past several years, it is important to remember that the use of RFID need not be limited merely to asset identification and tracking-type applications. Though this may, in fact, be a most effective use for the technology at present, the potential also exists for its use in process control, discrete manufacturing, utility operations and many other industrial settings.

Nevertheless, like any other technology, RFID cannot exist in a vacuum. To be utilized effectively for any application, an RFID system must integrate—that is, communicate and work effectively with—other hardware devices and software systems.

How RFID is Used Today
RFID systems are most commonly used in applications for asset identification, tracking and management. Data stored within an individual RFID tag identifies an asset and can provide such information as the owner or manufacturer, intended destination, current location, serial number and shipping and handling instructions. These types of applications typically use passive RFID tags, but in increasingly sophisticated applications, more detailed data, such as assembly instructions, can be included in an active (battery-powered) RFID tag. For example, an RFID tag in an automotive plant can specify the color of paint for a car body as it enters a paint spray area on the production line.

RFID is also frequently used for identification purposes in toll payment and access control applications. In these settings, RFID tags identify a vehicle as it approaches a toll plaza or security gate, then sends a signal to a lane controller or automated lock so the vehicle can pass through unimpeded.

In short, by implementing RFID—a complete system of transceivers and tags—one can achieve visibility to any asset within the RF range. This visibility creates all types of monitoring and data acquisition capabilities, and the gathered data can be aggregated and used in innumerable ways.

Perhaps more intriguing is the possibility—if RFID systems are cleverly integrated with an organization's line of business equipment—for that equipment to act (to some degree) almost independently on the information it receives via RFID. In this way, RFID is an important component of the burgeoning M2M (machine-to-machine) communication movement.

Again, though, all of this is contingent upon the RFID system's ability to integrate successfully with the other hardware and software systems found in the environment in which the RFID system is deployed. In industrial automation environments, this includes devices such as programmable logic controllers (PLCs), input/output (I/O) systems and programmable automation controllers (PACs).

Why RFID is So Popular
RFID has been around since the 1940s. So why is it just now being so widely heralded? Why is Wal-Mart

Stores, the largest company in the United States, using RFID technology to improve its inventory management operations? Why is the U.S. Social Security Administration using RFID to supplement (and, in some cases, replace) the handheld bar code scanning system it's been using for data acquisition in its warehouse management operations? Why are the U.S. Secretary of Commerce and other high-ranking government officials paying so much attention to analysts' predictions that the RFID market for consulting, implementation and management will grow to between $2 billion and $4.2 billion by 2008? And why is RFID now being used in industrial and manufacturing settings more than ever before?

There are several reasons. For one, RFID technology is relatively cheap and incredibly versatile. The small size and low cost of RFID tags, in particular, continue to drive the expense of RFID systems sharply downward. Additionally, although the RF environment can be adversely affected by moisture, weather and other interference, it remains relatively reliable and uncomplicated as a communications medium. As we shall see, these two factors—low cost and simplicity—are what make RFID just as viable for identifying a lost pet as it is for classifying parts.

Perhaps the most important reason, however, for the increasingly broad acceptance of RFID technology—particularly in the industrial automation sector—is standardization. This standardization includes the frequencies over which RFID systems operate, as well as the codes and protocols they are able to recognize and utilize. For example, the electronic product code (EPC)—which evolved from the UPC (Universal Product Code)—has now become the de facto standard for retailers.

Moreover, significant progress continues to take place toward integrating EPC and ISO standards. This standardization is what will continue to make RFID a popular and effective technology and much more viable for solutions in industrial application. For example, there are many manufacturing applications where bar code systems help move products down an assembly line. At each successive stage of production, a bar code reader scans a serial label, and that information is sent to a computer that determines what the next step of assembly is.

By comparison, RFID is able to facilitate this type of data collection and delivery much more effectively. In many instances, RFID systems' antenna-to-tag communication method is superior to that of bar codes. The latter utilizes an interrogating beam of light that needs to be physically manipulated to pass over the linear bar code. Not only does RFID eliminate this need for line of sight, but it's also capable of reading multiple tags simultaneously, as well as selected tags based on a query requesting certain criteria.

The Value of RFID

Until recently, the main value of RFID resided in its ability to facilitate the transfer and sharing of the information it helps gather, improving, in turn, a number of business processes. Information has always been the single most important business driver—the more we know about what takes place at every level of the business, the better. The ability to access, aggregate, evaluate and collate the right data can, among other things, tell you which business decisions need to be made in order to optimize manufacturing processes, manage inventory, staff properly and streamline supply chain activities.

It is for these reasons that businesses most often deploy RFID-based solutions. RFID provides the information needed to make properly informed decisions that positively impact a business. The ability and ease with which RFID aggregates and communicates data makes it a most effective means to feed today's supply chain management and other business management systems. This is why Wal-Mart has undertaken its well-known RFID project, requiring suppliers—including Gillette, Hewlett-Packard, Johnson & Johnson, Kraft and other companies—to RFID-tag the cases and pallets they ship.

Beyond the Supply Chain

To move beyond asset management/inventory tracking/supply chain-type applications and fully prove its worth in industrial environments, RFID needs to work with a host of sensors, PLCs, I/O systems and controllers, wired and wireless data networks, protocols and software packages utilized in these settings. Imagine the possibilities of being able to associate the data contained in an RFID tag with that relating to the sensor and actuator interfaces of an I/O system or other industrial device. The key to such an accomplishment is to find a way for these industrial devices to communicate with RFID interrogators (readers).

To that end, many RFID interrogator manufacturers have moved beyond USB and Bluetooth connectivity, incorporating Ethernet ports on the devices they make. Intermec, Alien Technology and Symbol Technologies are just a few that offer hardware of this type. This Ethernet connectivity means a great deal, because it makes communicating RFID data to enterprise applications and databases running on PCs incredibly simple. Similarly, Ethernet-based controllers and I/O systems are able to provide these same PCs with important data relating to manufacturing machinery, utility equipment and the like.

Let's examine this point a bit more closely. Over the last 10 years, Ethernet networking has grown increasingly popular as a communications medium for industrial applications, largely due to the fact that Ethernet has the ability to reach beyond the plant floor. Indeed, Ethernet is already entrenched as the standard in most corporate business settings—that is, most corporations' entire networking infrastructures are Ethernet-based. Significantly, any industrial controllers, I/O systems, data acquisition systems and other devices with Ethernet connectivity can be recognized and function on these networks.

Suddenly, thanks to the Ethernet networking interface, you now have the ability to access the controllers operating the systems and equipment on your plant floor, and to send and receive production data, alarm messages and status information over that network to any database running on any computer or server. This is commonly referred to as PC-based control and data acquisition. So what we potentially have now in industrial settings is an RFID tag communicating to RFID interrogators, which send the data to a computer. We also have industrial equipment (manufacturing systems, utility systems, etc.) controlled and monitored by and communicating with industrial controllers, I/O and data acquisition systems. They, in turn, then communicate the data to computers.

What's missing? The direct link from the RFID system to the industrial device. There are all kinds of value in establishing this connection.

For example, RFID tags can include data and instructions for a controller, I/O system or some other device to execute. In scenarios such as these, a true M2M connection is established, where machines talk to one another and act independently—without a human interface. For instance, if an RFID tag contains information pertaining to a particular manufacturing or operational process, the RFID interrogate can read the tag and an I/O system can poll the reader, get the information and give the manufacturing or operational equipment it's controlling the appropriate commands.

Here's a for instance: Let's say an RFID tag is attached to an individual part coming down an assembly line. The tag identifies the part, distinguishes it from similar parts and provides specific instructions relating to the next stage of assembly—torque specifications, for example. The RFID reader gets this information from the tag, and an I/O system, PLC or other intelligent device polls the reader. This intelligent device then executes the necessary logic and gives the manufacturing equipment its controlling the appropriate instructions. In our scenario, a robotic screwdriver receives the correct torque settings and applies them to the part.

RFID in the Real World

The Sao Paulo, Brazil-based company Flextronics designs, builds and ships consumer electronic, computing, medical, automotive and other products to a worldwide list of OEM customers. These customers include Motorola, Dell, Microsoft, Xerox and Hewlett-Packard, which often just provide the packaging for products

actually built by Flextronics. For example, most assume HP makes and ships its well-known line of printers itself. In reality, all printer components are collected and assembled by Flextronics, then shipped to the warehouses of HP retailers.

This being the case, Flextronics has had to implement RFID in its warehousing and shipping operations. (This, no doubt, is due in part to the mandates of Flextronics OEM customers, who, in turn, have had to respond to the earlier-mentioned RFID requirements of Wal-Mart and other large retailers.) A major difference between Flextronics and many other enterprises, however, is that RFID plays a major role in the company's assembly processes. All printer housings include an RFID tag, manufactured by UPM Raflatac, containing basic information about the printer—product ID, original manufacturing date, and so forth. As the printer moves down Flextronics' assembly lines, the various components (cartridges, paper trays, rollers, etc.) are installed in the printer housing. After each component or procedure is completed, the SAMSys RFID interrogator encodes data to the tag indicating that a component, adjustment or test has taken place.

At four different stages of the assembly process—the last of which is the product's final testing prior to shipping—an RFID reader interrogates the tag and sends the data over Ethernet to an Opto 22 SNAP Ultimate I/O system. The SNAP Ultimate I/O is an intelligent industrial controller that uses sensor interfaces to connect to and communicate with a number of mechanical and electronic controls and systems on Flextronics' printer assembly line. After receiving the tag data indicating a component has been properly installed, or that a line test has been successfully completed, the SNAP system validates the printer by issuing commands to conveyors and other systems that, in turn, send the printer down the assembly line to the next stage. If the tag data received by the SNAP system indicates a part is missing, or a test was failed or never conducted, the SNAP system routes the printer back to start the assembly process over again. If a severe problem exists, SNAP is programmed to reject the printer entirely and send the commands to convey the printer to an area designated for defectives.

Other Uses for RFID

So far, we have described two scenarios where RFID can be extended beyond uses in the supply chain, warehousing and asset tracking, facilitating manufacturing and industrial automation processes more directly. Now let's examine one other way in which RFID can be implemented in the factory: in the areas of validation and regulatory-compliance reporting.

Many industries—oil, gas, pharmaceutical, automotive and others—have strict requirements and guidelines (some self-imposed, others federally mandated) applicable to their manufacturing and processing operations. The U. S. Food and Drug Administration (FDA), for example, requires pharmaceutical manufacturers to maintain unalterable electronic records to prove their drugs and the raw ingredients used to make them have been stored at proper temperatures. This means refrigeration-system temperatures must be constantly monitored and recorded in some sort of database.

An easy way to accomplish this would be to affix a smart RFID to a lot of drugs (or ingredients) and integrate that tag with whatever industrial I/O system or device is being used to monitor the refrigerators. With a relatively simple configuration, the monitoring system can be programmed to acquire the data and communicate it to the RFID system. The latter can then write these temperature readings to the RFID tags affixed to each individual lot as they sit in the very refrigerator, warehouse or storeroom that's being monitored. Once again, the medium enabling this communication is Ethernet. The RFID tag can carry this temperature data with it all the way through the supply chain; in the event of an FDA audit or product recall, lot numbers can be quickly tracked to verify storage temperatures.

These kinds of scenarios—where industrial automation, control and data-acquisition systems seamlessly integrate with RFID systems, reading and writing to tags automatically—offer the brightest hope for RFID to become a truly ubiquitous technology. It's important to note that we already have the supporting infrastructure

to accomplish this. We have the devices (I/O systems, PLCs, PACs and the like) to make the necessary sensor-actuator connections. And we have the communication protocols and industrial networks we need to make these new types of RFID applications a reality.

All we need now are individuals throughout the organization—from C-level executives down to plant managers and operators—with the vision to recognize the value of RFID and the fact that it can function as more than just an asset-tracking technology. It can, in fact, complement all types of control and data acquisition systems, and with its unique features and capabilities, it's ideally suited for integration into new and existing industrial applications.

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