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TECHNOLOGY

Come Together

Successful, high-performance RFID-based serialization deployment relies on coordination with best-of-breed OEMs.

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Impinj Guardwall antennas and Speedway readers integrate with LSI case conveyor, shown here with both subsystems operating under a combination of local and Systech control.

Consider this definition of synergy: “The interaction of elements that when combined produce a total effect that is greater than the sum of the individual contributions.” If this concept applies anywhere, it applies to successful serialization deployment on a pharmaceutical packaging line, where the coming together of numerous and complementary hardware, software, and service elements yields a complete solution.

Maintaining high operating efficiencies on a packaging line is challenging enough without bearing the additional burden of a serialization process. This amplifies the importance of deploying a serialization solution that exhibits high performance, high reliability, and scalability across multiple packaging lines installed in multiple locations. And then there is risk mitigation. The solution, comprising subsystems delivered by multiple solution providers, must work extremely well and must also work right the first time—and on time, especially given looming e-pedigree deadlines.

Here’s the irony: expertly deployed RFID-based product serialization can actually enhance the operational efficiency of production lines while simultaneously helping to secure the products produced on them. We’ll address this aspect in a future installment, but for now, we’ll focus our attention on the alignment of your critical deployment partners. See the basic ecosystem of serialization solution providers in Figure 1.

These four key providers—packaging and serialization execution, labeling, case conveyor, and RFID providers—each bring a high degree of customer-driven expertise to bear on a single point: the pharma manufacturer’s packaging line. But the respective solutions only serve the customer when they also work well together, hence the interactions and dependencies indicated among them. And that takes experience.

A recent New York Times headline declared, “It Used to Take a Village, Now It Takes Synergy.” More than the mere assemblage of point solution providers, a team of A-list original equipment manufacturers (OEMs), usually led by the packaging execution system (PES) provider, leads to a successful outcome. This OEM model differs from that of a conventional integrator in two respects:

OEMs own every aspect of their respective subsystems, meaning they are able to modify, tune, and adapt their products to the specifics of the application on demand.
OEMs are able to bring to a solution their latest technology, as well as the deep insights only they possess.

Together these factors mitigate performance and schedule risk. Transition this discussion to a typical packaging line, and you can identify the areas where UHF Gen 2 RFID-based serialization intersects the line operations in Figure 2.

Labeling and RFID Tag Inlay

Various labeling systems yield a range of price/performance possibilities. Both in-line and rotary systems easily accommodate RFID-converted label application. EPC values may be preencoded by the converter, in which case the labeler simply applies the labels. The RFID encoding may be verified before and/or after label application using read points installed on the labeler, and diverting rejects via retractable peel plate (mechanically retaining rejected labels for reconciliation). Most pharma manufacturers, however, prefer EPC encoding in real time on the line, where the manufacturer maintains complete control over EPC security. In terms of system operation, this is straightforward:

EPC numbers are defined by the ERP system (e.g., SAP, Oracle), which also allocates the number ranges of specific lots, ensuring EPC uniqueness.
EPC numbers then are passed to the line management system (e.g., Systech), which in turn provisions the RFID devices on the labeler and elsewhere on the line.

The EPCs are best encoded while the labels or inlays are still on the labeler web, prior to application on the

product, at a speed that—even at 350 labels per minute—allows sufficient time for the EPC encoding operation. This way, only those inlays verified as good are applied to the product, yielding savings in rework. Bottles entering the labeler feed screw then are pitched to the required spacing for label application.

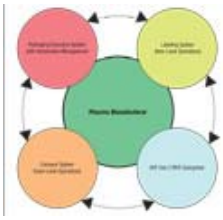

Figure 1. The core network of serialization solution providers is made up of four elements. (click to enlarge)

Integrating RFID components with the labeler calls for precise coordination of the labeling and RFID operations.RFID inlay selection ultimately drives the particulars of the labeling solution.

Creating a performance-optimized system begins with prequalifying the inlay for the product to be tagged, while considering the pharma product's package type, dose form, orientation, case-pack configuration, and other variables. This determines how the tag will be presented to the RFID reader antenna with respect to the labeler.

Some companies, such as Impinj, work with labeler partners to identify the optimal mounting location(s) of RFID hardware, as well as determine the specific antenna aperture that maximizes the performance of the RFID operations while eliminating any possibility of stray reads or interference. Whether the labeler is operating in continuous motion or in an indexed fashion, Impinj's reader-resident algorithms manage the RFID operations with precision. In the case of the continuous mode, two tags can appear in the RF field at the same time, and yet the system will address only the tag of interest, pushing the limits of high-speed performance. Combining Impinj's near-field UHF reader antennas with tag inlays optimized for cost and performance is key to this capability.

This performance aspect calls for a brief digression into UHF Gen 2 RFID. UHF Gen 2 is a worldwide RFID standard supported by many RFID product manufacturers. Impinj developed and edited the specification that became the Gen 2 standard, proving its technological elements in the lab. The understanding gained from this experience enabled Impinj to bring to market the first Gen 2 products, which still hold market-leading positions. Additionally, this drives new and complementary Gen 2 devices, including handheld readers.

Standards address the protocol—how tags and readers communicate with one another—but a standard says nothing about things such as the performance, quality, and reliability of the components built to that standard. Through these parameters, vendors can distinguish themselves and form the basis on which to decide a best of breed. The capability to perform in a high-speed labeler situation where encoding windows are not only small but potentially crowded is one such acid test.

Now that UHF Gen 2 can apply to the item level, pharma can deploy RFID in a practical and scalable manner that addresses the needs of all pharma trading partners. Consequently, all current and planned pharma pilots and production projects deploying RFID are based on UHF Gen 2, having all but abandoned HF technology (seeTracking & Tracing Pharmaceutical Products Summer 2008 for background).

PES Serialization Control

Systech, a leading pharmaceutical PES provider, likewise has distinguished itself with data management solutions in the packaging environment. Its modular software makes it easy to add line management and tracking capabilities to packaging operations. Scalability is important to pharma manufacturers and the products and applications Systech provides. It has developed software to replicate readily, allowing companies to move seamlessly from pilot-level applications to full-scale implementations.

Figure 2 . These components comprise a typical packaging line sequence. (click to enlarge)

Each pharma company will have unique packaging line serialization but similar line components. Consequently, deployments relying on a complementary team of solution providers including PES systems, RFID providers, item operations-oriented labeling systems, and case operations-oriented labeling systems are able to leverage their collective pharma experience and knowledge to develop use cases and integration approaches for common components across packaging lines. The benefits to the pharma company are significantly reduced risk in replicating serialization strategies across multiple packaging locations and greater ability to leverage common practices.

To enable yet further practices that will become common as well, Impinj developed a specialized reader API (application programming interface) for pharma packaging lines, and integrated with Systech's line management modules. By shifting more intelligence and processing responsibility to the very edge of the RFID operations, the system is able to eliminate latencies and better perform. Just as importantly, though, the API exposes process-critical information from the RFID operations on the line in real time. Line operators can use this data for diagnostics, or IT personnel can exploit it for trending and other statistical analyses; procurement and quality control personnel also can use such data to good effect. In short, it provides an unprecedented level of visibility into RFID operations that reveals what's working and how well.

Case-level Operations

Returning to the packaging line (Figure 2), once the label is applied, the product is conveyed to bundling or case pack operations. If RFID is the primary data carrier, generating the case-item parent-child association is straightforward (and automatic). If the chosen serialization scheme involves dual data carriers (RFID and 2-D), however, then the two must be correlated at the item level either in-line or post-casing. Once sealed, case contents encounter verification roadblocks with 2-D Data Matrix codes, as this is a line-of-sight technology.

For items that are also RFID-tagged, the system can automatically verify proper aggregation and association for the items and their cases. Impinj has developed patents-pending methods for automatically correlating and verifying the 2-D and RFID data at the item level (matching the two at the item level and to the case into which they are packed), independent of where (or whether) the RFID is encoded along the line.

The case operations are facilitated by Labeling Systems Inc. (LSI), whose conveyor equipment (see photo) hosts the Impinj hardware and certain Systech components. LSI facilitates communication between the three subsystems via its PLC-based controls architecture. Interfacing among the LSI system, Impinj hardware, and Systech systems allows the three units to work together.

The information required for human-readable characters and RFID information is retrieved through the Systech management system. The data are transmitted to the appropriate media through either the LSI Print & Apply Labeler, Impinj antennas and readers, or an ink-jet or laser printer. Impinj hardware reads and/or encodes the RFID at both item and case levels, and verifies the results. The information is checked against Systech's management system, and LSI receives an accept or reject signal based on the outcome. Cases either continue downstream or are rejected for rework.

Benefiting from numerous pharma deployments, this team of solution providers is standardizing configuration packages to facilitate the smooth delivery of complex systems. Creating reproducible, repeatable packaging line serialization solutions comes from deliberate, experienced collaboration among solution providers. The synergy that results from a team of complementary OEMs helps achieve packaging line performance, quality, and reliability objectives while minimizing deployment risk in the process.