Give RFID Systems an Analytical Edge

The success of an RFID deployment depends on the accuracy of the data reads, and on the analysis of the received data. As RFID technology is maturing, enterprises can adopt the technology in a bigger way and move toward item-level tagging. Analyzing data and deciding its business relevance then become

increasingly critical, because an RFID network at just a single warehouse could potentially generate terabytes of data.

In order to stand the test of time for achieving true business value and cost reduction, an RFID network must provide a higher degree of real-time business activity monitoring (BAM)—the aggregation and analysis of relevant information to get accurate information—near the edge of the enterprise systems. At that level, the need for data analysis and integration is critical.

How do you achieve a high level of BAM in RFID networks and make enterprise resource planning (ERP), supply change management (SCM) and other enterprise information systems (EISs) respond in real time? RFID technology has the potential to provide a higher degree of business automation than what exists today.

This automation can be achieved in two ways. The first is by developing new applications to monitor the RFID networks that work in parallel with an existing EIS. Examples of these new applications include electronic proof of delivery (ePOD), electronic pedigree (e-pedigree) to fight counterfeiting and product-recall management. The other way is to supplement and integrate with the existing EIS systems by providing real-time data and presenting the information in a way they can understand. As the EIS world has matured over the past two decades, it makes more sense to achieve automation by integrating “meaningful” information collected by RFID

interrogators into these existing systems.

Different enterprise information systems currently manage mission-critical data throughout an enterprise. If the enterprise is RFID-enabled, the RFID data analysis (transformation of RFID data to actionable information) becomes important and brings the need for a software layer that gives real-time visibility to the EIS and insulates the RFID data analysis from the EIS. Therefore, an analytics and integration services (AIS) layer is needed to analyze the filtered and consolidated RFID data in real-time and send intelligent notifications to relevant EISs automatically.

The AIS layer can help in reducing the complexities of application development, integration and maintenance, giving significant benefits to developers, technology providers and end users. The AIS layer absorbs the complexities and challenges that come along with RFID technology, while proving real-time visibility to the business processes and allowing companies react to ever-changing demands by aligning business processes accordingly. Using an RFID network to detect a shipment delay from a distribution center to a retail store, raise an alert and inform both the transport management system (TMS) and the supply chain management (SCM) system is a complex operation that can be easily accomplished with AIS.

Current State of RFID Data Analysis in RFID Networks

EPCglobal has defined a standard interface and application-level events (ALE), through which clients (using either traditional applications or some other software) may obtain filtered, consolidated EPC data from a variety of sources leaving the client to interpret and act on the “reports” it produces.

With the increasing need for RFID data analysis, building custom applications at each RFID network is becoming a complex

and time-consuming process. Interpreting RFID data, converting it into high-quality, meaningful business information and integrating it with EIS systems is currently an expensive task with many challenges.

Challenges

Fragmented events need to be correlated. Individual events generated from RFID readers need to be correlated to make business sense out of them, as those individual events have no meaning by themselves. For example, to create an advance shipping notice (ASN) for the trading partners, the requirement is to know which cases are present in a pallet Q. If the tagged pallet Q contains 10 cases, each with its own tag, there will be 11 different RFID reads. A correlation is needed to convert 11 RFID reads to a single pallet/case relationship.

Duplicate events must be purged. For example, RFID interrogators at dock doors may read the same tag twice, 24 hours apart, and treat the reads as two distinct events. From a business perspective, however, it is a duplicate event and the second one should be ignored.

Event patterns that make business sense need to be detected. For example, if a milk pallet enters the warehouse and does not leave within 24 hours, an alert needs to be generated.

Old events must be removed. If an application is storing RFID data to detect patterns, then at some point, this information will expire and need to be purged or archived.

Applications need the ability to store event context. Applications will need to convert RFID events into business actions, and this may require storing the context in which the events were generated. At times, the same event may be needed by two different applications.

RFID data must be integrated with existing enterprise information systems. The integration of RFID data into an existing EIS is a complex process today and needs to be simplified. To achieve elusive ROI, enterprise information systems need to be informed of real-time conditions by converting RFID data into business actions.

But what should an AIS layer look like? And what do the users need?

Extracting the Most Relevant Information

AIS should have the ability to sieve out the most relevant information from filtered and consolidated RFID data sent by RFID middleware in real-time. For tracking inventory in a warehouse, when a tagged forklift carrying a new tagged pallet enters the warehouse that has a sensor at the entry door, what information about the inventory is relevant to the warehouse? Only the tag on the pallet is relevant, not the tag on the forklift.

Consider another scenario (using item-level tagging), in which Store A keeps certain brands of items. When a person carrying a bag containing a tagged item (purchased from a different retailer, Store B) visits Store A, what information is relevant to that store—any tags, or only those tagged items that truly belong to Store A? The tags from Store B need to be ignored in Store A. AIS needs to have efficient filtering mechanisms and an ability to read tags of concern, ignoring all others.

Event Correlation and Analytics

AIS should have the ability to analyze information from different RFID networks, collate it and send it to relevant enterprise information systems. In order to give real-time visibility to tagged objects, RFID data needs to be aggregated

and transformed into meaningful, actionable information. Current RFID systems, after doing filtering based on tag patterns, pass RFID data to existing EISs, and in turn those EISs derive meaningful information that aligns with the business process. This puts too much onus on the enterprise information systems to correlate the event patterns and make sense of the RFID data.

By doing event-pattern matching in the AIS layer, information can be presented the way an enterprise information system needs it to be, and AIS can invoke specific functions of the system. For example, if a truck starts toward a distribution center but does not reach it within a stipulated time due to an unforeseen breakdown, AIS can trigger the enterprise resource planning system's alert-generation function. For normal delivery, AIS can invoke another ERP function to register the receivables. By moving the event-pattern analysis outside the ERP, integration of RFID information becomes simple and the cost of integration is reduced.

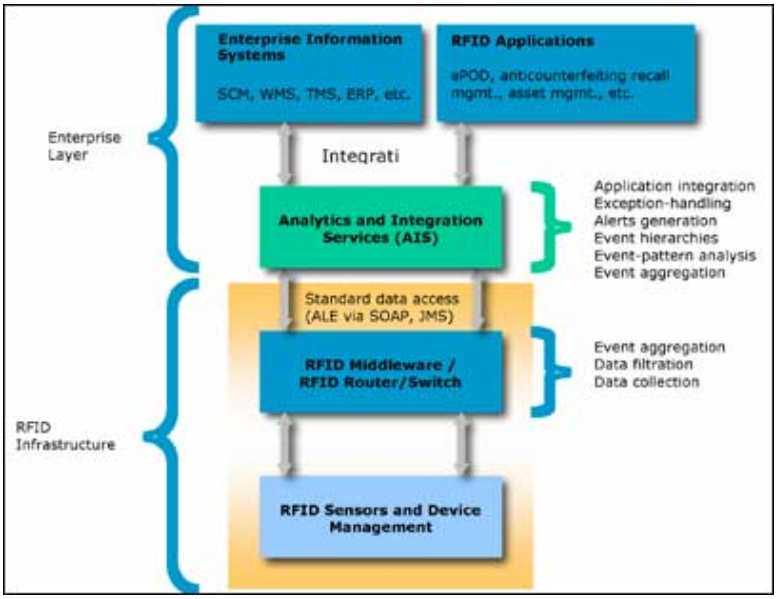

Figure 1: Analytics and integration services (AIS) at the edge of the enterprise.

Event aggregation is needed when a single tag read has no meaning to the application, but multiple tag reads together as one transaction make sense to the application. A warehouse management system (WMS) is interested in confirming that all cases are present on the pallet. Once a pallet enters the warehouse, tags on the pallet and cases will be reported as separate RFID reads. Correlating these individual events in the AIS layer and presenting the case-pallet relationship to the WMS is more effective and brings the cost of development down.

Event-pattern matching is needed when a combination of certain events makes sense to a business process or back-office application. For example, a store's security department does not need to be alerted every time an RFID interrogator detects an expensive camera passing through a store's exit door. But if the data is matched with other related information indicating the camera did not go through the checkout process, then AIS can alert store security that a potential theft is taking place.

AIS can provide event hierarchy (recursive event-pattern matching) when event aggregation and event-pattern matching are not adequate to generate the desired actionable business intelligence. For example, a store manager may need an alert every time a theft is detected, but the regional manager of a chain of stores in a certain area needs to be notified only when more than 10 thefts have taken place in a given month.

The AIS layer can also be used to recognize exceptions, so that under certain conditions deviating from the norm, it can send instantaneous alerts directly to the appropriate devices, systems or persons. For example, if the temperature in the medicine storage area goes above a certain limit, AIS can instantaneously send an alert to a temperature-adjusting device and to the relevant personnel as well.

Extending Real-time Visibility to EISs

The purpose of using RFID technology is to extend real-time visibility to enterprise information systems by giving them intelligent RFID feeds (sending the right information to the right processes or systems at the right time, and in the right format) so they can respond appropriately. EISs need to be alerted or notified only when a meaningful event has occurred, and not for every RFID read that happened. The definition of a meaningful event may vary across enterprises, and so a configurable rules-processing engine that does correlation and pattern-matching must be part of the AIS layer. By keeping the analysis of RFID data in an AIS layer separate from the EIS, minimal modifications to the EIS itself need to be made. For example, the application should just query the AIS layer for the real-time location of a pallet, rather than storing the last known location within itself.

Integration

Integration of RFID data with existing enterprise information systems forms a vital part in RFID deployments. Integration is the ability to communicate the right RFID event or aggregated events or alert to the right process in the right format. It is a complex process today because RFID middleware sends granular RFID events to the existing systems, leaving them to deduce information and route the right event to the right process. When an RFID network expands, changes have to be updated in three places: the middleware, the integration layer and the processes of concern in the resource management systems. This increases the cost and the time of integration and maintenance.

AIS can simplify the integration process to a great extent by using the combination of RFID data analysis and standard integration adapters (a software component) within AIS to connect to multiple business applications (e.g., ERP, WMS, TMS, SCM). In other words, integration becomes a simpler process when the logic for extracting meaningful information

resides within the AIS layer and the communication to the existing system occurs via standard integration adapters. In this way, expanding the functionality or features for the entire RFID-enabled system will become easier and cost-effective.

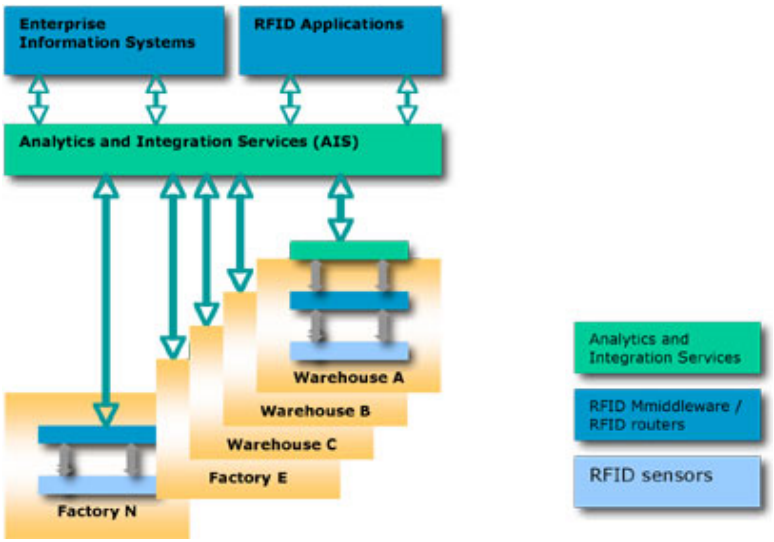

Figure 2: Supply chain example showing integration and scalability of AIS.

For example, an existing ERP system has a mechanism to place orders automatically when the inventory of high-value items goes below a certain level. RFID can be used to track inventory levels and trigger the order-placement process when the inventory goes below safety-stock level. In order to achieve this, the RFID middleware will notify AIS each time a reduction in inventory occurs, and AIS will keep track of the inventory count. When the inventory level goes below the safety-stock limit, AIS can directly invoke the inventory-replenishment process.

Conclusion

In order to aggregate, analyze and present relevant

information in real-time from RFID networks and to make enterprise information systems respond in real time, there needs to be an analytics and integration services layer at the edge of the enterprise systems. RFID data needs to be assimilated at the enterprise level and converted to actionable business intelligence so it complements the existing enterprise information systems without affecting them. AIS can make RFID solutions scaleable and powerful, while bringing a real-time visibility and true automation to the RFID-enabled enterprise system as a whole.

Hersh Bhargava is the founder of RafCore Systems, which provides software tools for optimizing development, integration, deployment and maintenance of RFID solutions.