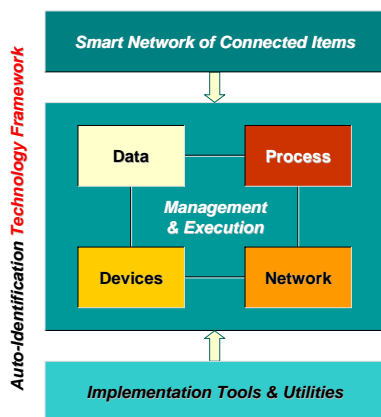


Managing Data from RFID & Sensor-based Networks

Implications and Considerations for Data Management Challenges

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This is the second in a series of six whitepapers that address significant issues around auto-identification technologies such as the strategic approach, business processes and operational challenges. In this



whitepaper, we focus on **data management** as an integral part of designing, implementing and maintaining RFID networks. With potentially billions of tags used in logistics and retail operations in the near future, **the amount of data that needs to be managed is going to drastically increase**. To complicate things, traditional enterprise systems were not designed to handle the vast amounts of raw data. At GlobeRanger, we have defined an Edge architecture and have developed the integrated platform that allows companies to manage the devices, networks, data and processes leveraging RFID technologies. As this whitepaper illustrates, it is essential that data is processed at the very point of its origination. This means that intelligence and data processing capabilities

cannot be located in large-scale, remote systems, but rather have to be readily available at the edge of the network where the individual items, cartons and pallets “live”.



White Paper

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Biography

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Chris has over a decade of experience in international management consulting, software design, change management and technology innovation. As Director of Enterprise Applications at GlobeRanger, he is responsible for the design and implementation of RFID-based solutions for companies in all industries and across all business processes. Chris' extensive experience is based on work in the US, Asia and Europe, where he has successfully completed business process reengineering and software implementation projects for over 50 clients.

Chris has authored over 45 publications and regularly speaks at major business and technology conferences. He holds an MBA from the University of Saarbrücken in Germany and teaches supply chain strategy at the University of North Texas in Denton and strategic management, global supply chain and e-logistics at the University of Dallas, Graduate School of Management.

The Data Challenge of RFID

RFID Creates Visibility

Can you imagine a world in which you know exactly where your assets, products, parts and supplies are at any point in time? A world where systems are smart enough to notify you when things go wrong? A world in which you receive near real-time feedback on daily and hourly sales across all channels? Welcome to the potential of RFID and sensor-based networks. RFID is a technology that tags items with electronic transmitters that contain a unique ID and potentially other information. Readers and antennae can be placed in warehouses, on trucks and in retail stores to report the "sighting" of an item back to a central system. The obvious advantage of RFID is that you now know exactly where your goods are at any given point in time and can develop processes to act on this information. The keen observer may have noticed that this can be accomplished with many other tracking technologies such as barcodes or simple word-of-mouth communication. This is true. However, if the number of uniquely-identified things grows exponentially, traditional tracking methodologies will soon become cost-prohibitive and thus unattractive. RFID technologies allow you to capture literally thousands of things in just a few seconds without human intervention. These new-found capabilities lead to both challenges and unprecedented benefits.

RFID Creates Challenges as well

Your first reaction in evaluating RFID may well be that you really do not want or need all of this extra information. You may have thought that you could not manage this data. This is a very legitimate notion and one that is very important. RFID technologies, while generating an unprecedented amount of data, are only as valuable as the resulting information, knowledge and wisdom that can be created. The mere data is of little to no value. This is precisely the reason why so many companies are struggling with extending their field trials and pilot implementations. It is easy to plug an antenna and a reader together and to connect both to a PC in order to proclaim "We are doing RFID!" Yet, it is a completely different ballgame to deploy hundreds of readers and antennae across multiple locations, intelligently transform RFID data into useful information, and succinctly interact with upstream systems such as ERP or supply chain software. This is the core challenge for companies implementing RFID today and emerging RFID technologies tomorrow.

Previous generation of enterprise systems were not designed for RFID data

What can you do about this problem? First and foremost, as with any technology, its utility is mainly determined by the way it is implemented. Quick fixes generally lead to trade-offs between immediate gratification and long-term benefits. Secondly, we have to ask ourselves if and how your existing information systems will make sense out of the data once you implement RFID.

Core ERP systems, architected in the early 70s to 80s, were not intended to take on vast amount of real-time data. Most of these systems were designed to handle aggregate data such as the line items on a purchase order, but not transactions on a unique-item-level. It would be

fairly safe to say that a new layer of architecture, designed for the enterprise edge is needed In light of emerging RFID technologies. In the following section we will venture into more detail.

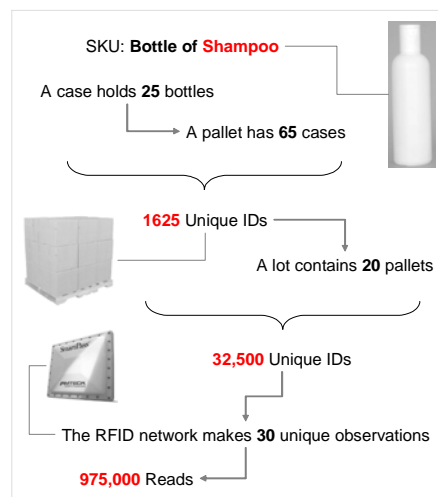
Data Management Considerations for Implementing RFID

The Devil is in the Details

Let's take a closer look at the most important issues around RFID data management. We have defined seven unique considerations that you should investigate when planning to implement RFID technologies. Each of these will be briefly discussed and illustrated.

(1) Manage Your Data Volume

Initially, we had stated that RFID technologies will generate a vast amount of data. Let's look at an example. If we take an average SKU of 16 oz. shampoo bottles that move from the manufacturer to a retailer distribution center (RDC), we have exactly 1,625 bottles on pallet. This also means that we have 1,625 unique RFID tags on every pallet. Let us assume for a brief moment that we can scan every single tag, then that means we will need to scan and recognize



1,625 items individually. It is not untypical that the RDC will receive a lot of several pallets per shipment. These will be broken into smaller shipping units that then make it to each of the stores that are satisfied through the RDC. If we further assume that there are 20 pallets in our lot of shampoo bottles, then we have 32,500 unique IDs in the lot. In summary, it will take a little over 30 reads by the RFID network to reach the astronomical number of 1 million IDs. And, this is only your inventory for one SKU and in one warehouse. What becomes readily apparent is that a new paradigm is needed to

manage the raw data generated by an RFID network. One option is to implement an "Edge" layer, EdgeWare, between your RFID hardware and your enterprise systems. EdgeWare are software platforms specifically designed to manage RFID networks and handle the resulting streams of data before they are passed on to interfacing systems. Among many other features, EdgeWare filters redundant data and only passes information along that is requested or constitutes a change of the situation.

(2) Determine Your Need for "Local" Intelligence

Let's think about the data itself for a moment. What you get from your RFID network is an ID commonly in the form of between 64 and 96 bits of data. That data by itself is not valuable unless you can correlate the ID to other information. For example, when your dock door RFID antenna registers the arrival of a new pallet you need to be able to correlate this receiving event

of a pallet and all the uniquely tagged cases to a purchase order, an invoice or an advanced shipment notice. Processing the reconciliation on a centralized system, could mean potential delays, communications disruptions, and depending on the amount of data, can lead to congestion and breakdown of your network. One solution is to have local intelligence to handle the transaction at the very point of its occurrence.

An intelligent edge layer can be used to execute business rules relative to RFID data, then send relevant events to enterprise systems, such as triggering a query for a transactional record based on an item or pallet ID and receives the right document back. This layer can orchestrate interfaces with multiple systems through a variety of means such as Web Services and it can draw on more than one document to reconcile a transaction (e.g. purchase order, manifest and invoice at the same time). The obvious easiest, fastest and most secure way of handling the transaction is to store reconciliatory data locally at the point where the transaction takes place. This implies that it is necessary to have intelligence at the edge of your supply chain, which is where EdgeWare (named for this very phenomenon) comes in. EdgeWare enables intelligent RFID data processing at the point of reconciliation, takes the onus away from centralized systems and allows for immediate reactions to unplanned events before these situations become more difficult to resolve and are also more costly to handle.

(3) Define Your Need for Configuration Flexibility

How many different business process scenarios do you have? While it seems fair to say that “a receiving transaction is like every other receiving transaction” this may not always be true. What if certain goods require specific handling, what if some goods need a quality check and others do not, what do you do if you receive goods not intended for you or what can you do if you handle goods differently based on geography (e.g. US versus Asia and Europe)? All of these questions hint at the fact that you need the ability to easily configure your RFID network for different business requirements.

In essence, there is a real need for RFID data administration relative to process and business rules. You should be able to easily configure your RFID network for different business scenarios that are specific to an item, a location, and other criteria. Again this is where an edge layer comes into play. By defining workflow scenarios, you effectively create as many different process scenarios as you need. This functionality also enables you to treat individual suppliers and customers differently.

(4) What Else Do You Need? Data Attributes!

We had found out that RFID greatly increases the amount of data in your system. Well, hold your breath: in addition to item-level IDs there is a whole slew of other data that you will need to carry along. You may need to know when an item was read for the first and the last time. You

may also need to know which reader and antenna processed the read. This is especially important when you are assessing inventory and would like to draw conclusions based on the antenna location. Good examples are retail stores. It is hard to imagine that we will see an antenna on every shelf. Rather, the stores will likely divide their space into individual sections and will then install a RFID antenna for each section. When a product leaves its section, we can assume that someone carries the intention of purchasing it. If the product is not read again (at least at the cashier), we can further assume that someone has left it in a different spot or has taken it without paying. Logic like this allows us to define and manage business rules based on antenna location. Same would apply for managing inventory in a warehouse with RFID.

It becomes apparent that an RFID network needs to handle a lot of different data attributes other than tagged product information. Others that we have not specifically discussed are daytime and time zone. Again, EdgeWare can help since it has been specifically engineered to recognize and make sense new data attributes directly related to managing RFID solutions.

(5) How do You Manage Historical Data

The issue we had initially raised about data volume generated by an RFID network leads to a second and equally important issue: how do you handle historical data? If just one of your customers relies on RFID and asks you about a specific item by unique ID, then your system has to be able to pull the information by that ID rather than PO or invoice number. Equally important are cases where you have product recall or returns management. These oftentimes require knowledge of the specific whereabouts of individual products.

The integration towards enterprise systems is not an easy task and requires extensive data synchronization. New data formats from evolving standards make this even more difficult. You will need the ability to pull up a record based on a unique ID and be able to share this information with trading partners. The challenges here are: where and how do you store the information of unique IDs, if your systems today are not architected for the new format and how can this information be easily accessible for queries and analysis. Here, too, some of the data from an RFID network needs to be fed into planning and forecasting systems.

An edge layer is one creative option to solve these challenges. EdgeWare and related information services have been designed with this precise goal in mind, giving the necessary flexibility to draw on data at any given point in time. The provided system interfaces allow companies to utilize the exact amount of data in exactly the right spots. Naturally, no single system will contain and retain all of the data that an Edge Network generates at any given point in time. Rather, we will differentiate between data that we simply do not need or want and data that is important to us. The former will be discarded. Within the latter category, we will identify the ownership of the data so that the EdgeWare system actually only holds the information on where to retrieve the data when it is needed. Obviously, this concept entails more sophisticated

issues such as data redundancy and standards compliance. Here, it should suffice to say that these can be built as easily as they are conceived.

(6) Assess Your Need for Reverse Read Loops

Reverse read loops are an interesting phenomenon and one that occurs most of the time. First of all, reverse read loops are reversals in business processes caused by exception conditions. Under normal conditions, the process comes to a halt when something goes wrong and an operator determines what to do next on a case-by-case basis. With Auto-ID in place, the system itself will handle some or all of the decision-making based on built-in business intelligence such as the enforcement of business rules. However, exceptional conditions have to be built into the system as early as possible. Examples are handling of missing items, damaged items or discrepancies between documents.

An early, but impressive application includes the integration of 802.11 wireless devices into the RFID network so that an operator can follow the process from anywhere in a facility. For process designers this means that they can build reverse read loops into the workflow right away. A second and equally important feature is that of notifications and alerts. Once you encounter exception conditions, you want to send immediate alerts automatically as opposed to an operator taking the initiative. These alerts will be sent to everyone who needs to know about the occurrence of exceptional conditions. In this sense, the requirement is closely tied to business intelligence. Messages, alerts and notifications, need to be directed to the right person at the right time and in the right place. In essence, EdgeWare can easily give you the ability to generate actionable alerts and notifications.

(7) How Do You Enable Collaborative Processes

Last, but certainly not least, you need to consider the impact of RFID on enhancing information sharing capabilities. With RFID data, for example, you can collect and use data on performance metrics such as on-time deliveries or in-transit time by case/item. These, at a bare minimum, can be shared among supply chain partners to enable everyone to improve their efficiency. In addition, the sharing of uniquely tagged case/item inventory data as well as triggering alerts and notifications directly to business partners will make the whole process faster and more efficient. For your suppliers this means that they could receive immediate notifications when their own products are in low supply and need replenishment, identify theft situations and prevent counterfeit products from flowing into your supply chain.

An Integrated RFID Data Management Architecture

In summary, RFID networks are not as easy as plugging an antenna to a reader. Comprehensive RFID solutions will require detailed planning and forethought as it will change a multitude of business processes. This is only natural as RFID technologies will provide substantial business benefits that can hardly be derived from doing things as you always have done them. The data management framework will be an important “anchor” in your RFID strategy and given most legacy systems are not designed with RFID data in mind, Edgware will bridge the gap between your needs today and the evolving future of RFID.

EdgeWare needs to be smart, scalable, configurable and highly flexible to fit the emerging market needs that will expand as a consequence of mass diffusion of RFID initially and other RFID technologies in the longer run. Figure 1 below illustrates the GlobeRanger iMotion platform, a market leading, comprehensive EdgeWare system. On the leftside are hardware components such as RFID and mobile devices that communicate with the EdgeWare through a standardized protocol. The middle of figure 1 shows EdgeWare capabilities such as device, network, data and process management. There are the business rules, adapters and interfaces that will provide of the necessary intelligence. On the right are interfaces to enterprise-level systems such as ERP or supply chain software.

EdgeWare is Available Today

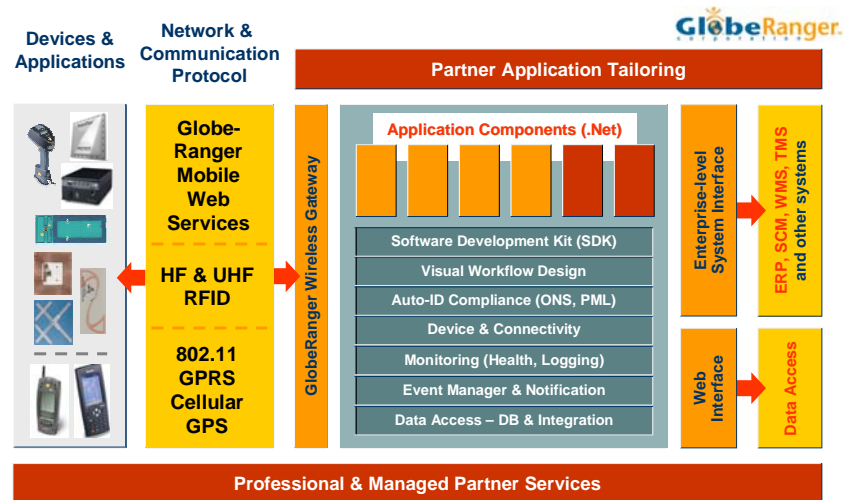


Figure 1: Integrated Process Intelligence through GlobeRanger EdgeWare

RFID technologies have already begun to revolutionize the way we do business: objects tomorrow will be smarter than objects are today, with an edge layer in place, process networks will be configurable in hours rather than months, new and innovative ways of doing business will



emerge as organizations better understand RFID technologies. At the end of the day, we as consumers and users will reap the benefits through far superior convenience and freedom from routine, time consuming tasks. Once you manage RFID data confidently and safely, you are a large step closer to achieving this vision.