Analysis of Integrating RFID technology in B2B applications

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Abstract-**Twenty-first century technology has modernized the way companies do business with each other and with their customers. The Internet has connected companies around the world and changed the global market as an entire. Certainly, the Internet has emerged as a most cost-effective means of driving application integration. A new concept has been work out: e-business - as the close connection between the Internet and application integration. Next today's economic globalization, e-business has become a necessity for companies to remain competitive. As one most important component of e-business, business to business (B2B or B-to-B) includes all applications intended to enable or recover relationships within compact and between two or more companies. In fact, B2B is commonly used to describe any electronic trade transaction occurring between two separate business entities. This includes the exchange of both products and service. Swapped products and services might include the selling of raw material inputs from one firm to another, the sale of capital equipment, the purchasing of commercial insurance or the contracting of one firm with another for the procurement of accounting services. B2B is all about product and materials procurement and the supply chain is the vehicle through which business-to-business is ultimately achieved. In fact, a B2B infrastructure links buyers, suppliers and logistics service providers into a global trading network. One of the new solutions that will additional defines traditional B2B Internet commerce is RFID.**

Keywords-**RFID, B2B, supply chain management, internet commerce, transaction**

1. Introduction

An important application of RFID technology is supply chain management, where RFID helps close information gaps by enabling real-time supply chain visibility. By placing RFID tag on a product, users can track the product throughout the supply chain- from the manufacturer all the way to the customer.In most cases the RFID tag can be written and rewritten so that the information in the tag doesn't remain static. For instance, at first, the tag may only contain manufacturing information; later on, additional information from the distributor may be added. RFID can enable the vision of real-time, extra ordinary coordination for all the company in the supply chain.

In reality, RFID is considered the most intelligent technology for managing and collecting product data or tracking it as it moves through the supply chain.

RFID have to deal with three key challenges:

1. RFID Hardware - Selecting tags, readers, and antennas; placing RFID tags on the products; placing and configuring readers and antennas in the stores, warehouses, and other locations.
2. Software Infrastructure - Capturing and managing data from the RFID readers, Integrating the data into different levels of enterprise information systems, and sharing data with trading partners for business collaboration.
3. Evolving business processes - Supporting finer granularity, more real-time product data, automating supply chain execution, and developing the new big business process for exploiting RFID technology.

2. RFID

Barcode, RFID, sensor, magnetic strip, IC card, optic character recognition (OCR), voice recognition, fingerprint, and optical strip are identification technologies that are being used in the enterprise environment. Among these identification technologies, bar-coding is the most widely used technology. In this chapter we will mainly discuss about RFID technology as well as barcodes and sensor technologies.

2.1 RFID technologies

RFID (Radio Frequency Identification) is a contactless interrogation method of automatic wireless identification and data acquisition. A RFID system essentially consists of three components: RFID tag, RFID reader, and backend information system. The RFID tag has a readable and writable memory chip together with an antenna, which can be attached or incorporated into a product, animal, and so on. The RFID reader device can communicate with multiple RFID tags simultaneously via radio frequency waves. The backend information system can provide the

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corresponding information of products attached by RFID tags.

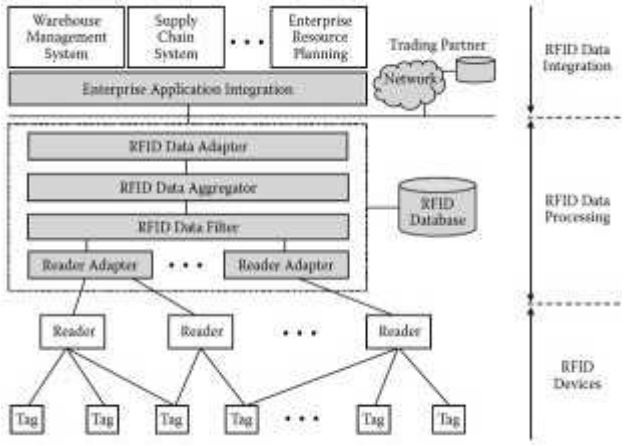
2.2 Components of an RFID System

An RFID system is a set of components that work together to capture, integrate, and utilize data and information. This section describes some of them. The components are as follows:

- Sensors, Tags, Antennas, Readers.
- Connectors, Cables, Networks, Controllers.
- Data, Software, Information Services.

Figure 1 depicts the main components of a generic RFID system. Interactions in such a system occur in three layers: devices, data processing, and data integration.

Figure 1: Architecture of an RFID system



2.3 RFID tags and readers

An RFID tag is a small device that can be attached to an item, case, container, or pallet so it can be identified and tracked. It is also called transponder. The tag is consists of a microchip and an antenna. These elements are attached to a material called substrate to create an inlay (1).

Tags are categorized into three types based on the power source for communication and other functionality.

- Active
- Passive
- Semi-passive
- Semi -active

Figure 2: Different types of tags

2.4 Carrier frequencies

Today, there are four carrier frequencies implemented for RFID that are popular globally: 125 KHz, 13.56 MHz, UHF ranging from 866 to 950 MHz depending on local country radio regulations and microwave frequencies of 2.45 GHz and 5.8 GHz. There is also frequency range 430-440 MHz, allocated to amateur radio usage around the world. The ISM band 433.05-434.790 MHz is located near the middle of the amateur radio band. The amateur radio band has emerged as an RFID channel in a number of applications. The frequency range has been called the "optimal frequency for global use of Active RFID".

RFID technology is classified as a wireless Automatic Identification and Data Capture (AIDC) technology that can be applied to the identification and tracking of entities. An RFID device called RFID tag or transponders can be attached to a product as a means of identification. This tag contains an integrated circuit for storing information (including serial number, configuration instructions, activity history, etc.), modulating and demodulating a (RF) signal, and other specialized facilities. The circuit is attached to a miniature antenna within a set upon a label to permit attaching the tag to the desired physical object. The RFID tag transmits their data in response to an interrogation received from a read-write device called RFID reader or interrogators. This device decodes the tag signal and transfers the data to a computer through a cable or wireless connection. The tags and readers are designed with a specific operating frequency. Given the wireless communication between the RFID chip and the RFID reader, all data may be read from a distance. The reading range varies in accordance with the operating frequency, the size of the reader antenna, the orientation of the RFID tag towards the antenna, the tag position with respect to the antenna core, as well as with the tag type.

RFID tags come in a large variety of designs; they can be classified in many different ways and multiple criteria could be used.

3. RFID PRIVACY & SECURITY

RFID data must be used in compliance with clear regulations concerning IT security as well as consumer and data protection a primary RFID security concern is the illicit tracking of RFID tags. Unauthorized readout of the RFID tag memory content has raised privacy concerns from both retailers and consumers. The issue of consumer privacy in RFID applications has received a great deal of attention from consumer groups and has garnered high visibility through the media. Therefore, it is necessary to provide counter measures which enhance consumer privacy and eliminate the concerns when consumer- sensitive data like pharmaceuticals are involved. In fact, RFID technology, when combined with a secure tag and data infrastructure, can assure both package authenticity and pedigree while creating new revenue opportunities.

A method of defense against unauthorized readers

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uses cryptography to prevent tag cloning. Thus, some tags use a form of "rolling code" scheme, wherein the tag identifier information changes after each scan, thus reducing the usefulness of observed responses. Nevertheless, cryptographically-enabled tags typically have dramatically higher cost and power requirements than simpler equivalents, and as a result, deployment of these tags is much more limited.

4. RFID APPLICATIONS

The RFID technology has been available for decades, but given the current significant lowering of tag costs, it is expected that their usage will be considerably increased. RFID allows the identification, location, tracking and monitoring of individual physical entities such as people, individual products or palette goods. RFID may be viewed as a means of explicitly labeling objects to facilitate their "perception" by computing devices; thus, real- time information about these objects can be easily obtained from the factory, through shipping and warehousing, to the retail location. In fact, the RFID term is often used to describe the entire system of supply chain management using RFID, from the physical tags to the processing of information on electronic databases.

Almost all industries have used automatic identification (Auto-ID) in many applications: access and security systems, item tracking systems, inventory management and simplified checkout at retail stores. For example, automatic identification technology offers the potential to achieve inventory accuracy and thus reduce supply chain costs as well as the out-of-stock level. The relatively new technology, RFID upgrades the Auto-ID capabilities and enhances implementation in various industries with significantly hard and soft savings. Employed in a wide range of applications, RFID technology has become an indispensable asset.

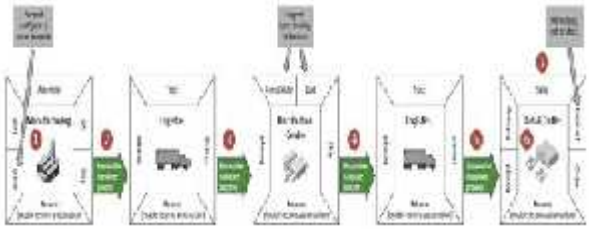
5. ROLE OF ELECTRONIC PRODUCT CODE (EPC)

The use of RFID in supply-chain application is based on EPC. The EPC was conceived as a means to uniquely identify all physical entities. In fact EPC is a numbering scheme that provides unique identification for physical objects, assemblies, components and systems. Information is not stored in the code, but serves only as a reference to on-line – or Internet-based – information.EPC ID numbers assigned to an entity are used with RFID tags in the same way that UPC (Universal Product Code) numbers are used with barcodes. In fact, the EPC is considered the electronic equivalent of the UPC barcode and a possible successor to the barcode. An RFID tag stores a single EPC number in its memory, just as a barcode holds a UPC number.

6. RFID IN SUPPLY CHAIN MANAGEMENT

RFID is essentially in the same position occupied by mobility and wireless technology a few years ago. It is poised to spark a global revolution—in supply chain visibility and management. Using RFID in pivotal points in the supply chain can help enable a vision of having goods available to customers at the right place and at the right time. RFID technology is an enabler of this vision aiding the synchronization between physical and information flow of goods across the supply chain from Manufacturer to Retail Outlet, represented on below diagram

Figure 3: Supply chain containing RFID



6.1 Manufacturing

As goods travel down the production line, RFID tags are physically applied and a unique ID is written and then validated for quality assurance purposes. The unique ID is automatically associated to the product/order details to facilitate further tracking and exception management.

During the pallet build process; goods (e.g. cases) are automatically identified to aid with customer order configurations. Finally, pallets are identified and tracked as they are delivered to the staging area ready for shipment.

6.2 Manufacturer - logistics pickup

As the logistics vehicle arrives at the loading dock, the RFID reader positioned at the loading dock communicates with the unique RFID tag to confirm that the logistics vehicle is authorized to pickup goods. Upon approval, pallets leaving the loading dock communicate with the RFID reader to alert B2B systems (ASN) and ERP systems to initiate electronic transactions, proof of pickup and potentially shipment invoicing.

6.3 Logistics delivery - distribution centre (DC)

As the logistics vehicle arrives at the Distribution Centre, the RFID reader and middleware initiates an event that captures the unique ID from the RFID tag, triggering the arrival of the manifest to initiate automatic routing of the goods to the next logistics vehicle.

6.4 Distribution centre - logistics delivery

As pallets are loaded onto the logistics vehicle the RFID reader positioned above the loading dock communicates with the RFID tags. The RFID tags broadcast their unique ID to the reader and via the

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RFID middleware transfer information to ERP systems indicating that the manifest is loaded.

6.5 Logistics delivery - retail outlet

As the shipments of goods arrive at the receiving dock (again being detected by RFID readers), Retail ERP systems are updated to manage inventory levels (automatically, accurately and at low cost) and initiate B2B messages to Suppliers to commence invoicing.

6.6 Retail outlet - customer

As items are removed at shelf level, the RFID reader can automatically detect the event and via the RFID middleware, initiate additional product supply requests. With such a system in place, the need to maintain costly volumes in remote warehouses is almost eliminated. At this point of the process, the customer is initiating direct demand generation on the supply chain management process.

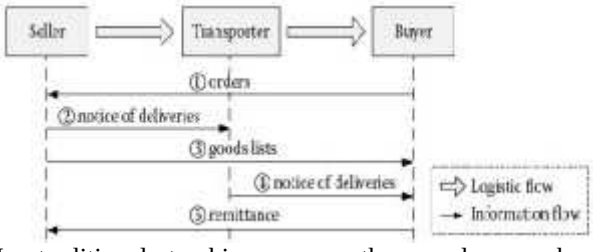
6.7 Customer

Rather than wait in line for a cashier, the customer simply walks out the door with the purchase. A reader built into the door recognizes the items in the cart by unique ID's. A swipe of the debit or credit card and the customer is on their way.

7. TRACKING SYSTEM IN RFID

Tracking application is very common in an asset security and logistics system. With the help of tracking, enterprise can instantly handle the asset location, operation status, and goods circulation information, so as to realize strict control of inventory and the avoidance of low turnover ratio. For the convenience of this discussion, we use a logistics delivery process to discuss a tracking model. As shown in Figure 5, most logistics systems can be simplified into a three party model, which involves the role of seller, transporter, and buyer.

Figure 4: Tracking model without RFID



In traditional tracking cases, the goods can be identified by barcode. However, it is well known that bar-coding has some shortages, such as the sight identification, single-item reading, and manual operation, which significantly reduce the efficiency of the tracking process. Compared to barcode, RFID can reduce the circulation time and manual errors, with the characteristics of contactless and remote interrogation, multiple-parallel readings. Then RFID technique can realize automatic information acquisition, which can reduce the time delay among the information flow interactions.

Figure 5: Tracking model with RFID

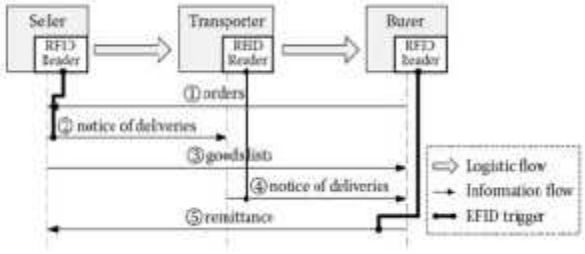


Figure 5 shows the benefit of RFID deployment in the tracking process. The RFID readers are installed at the gateway position, e.g., the door of the warehouse. When the goods reach each party, a RFID device will read the goods, and RFID middleware can find out the corresponding information of the goods, such as quantity, characteristics, etc. Then the notice of deliveries or reemitted information can be automatically delivered by the software triggers in the RFID middleware.

8. IMPROVING THE SYSTEM WITH RFID MOBILITY SOLUTION

Enterprise supply chain systems can offer access to desired tasks (for example, inventory management, demand projections, production planning) from handheld computers, such as Pocket PCs.Inefficient manual data-handling process in supply-chain management is a common problem with serious repercussions that affected the whole supply-chain, product traceability etc. There are needed solutions that could automate data handling. Integrating a mobile solution in an RFID-based supply chain system is the answer Handheld computers can perform many of the tasks that are commonly executed on a desktop computer or standard laptop. In fact, these devices can be used to extend the capability and reach of an existing information infrastructure by enabling workers to collect, access and analyze desired data at anytime from anywhere. Thus, the RFID labeled product can be read and tracked through the entire supply chain with handheld mobile devices (for example, PDA-Personal Digital Assistant) endowed with RFID readers. The collected data is stored on the mobile device using a mobile database software technology. The available system offers a high degree of flexibility and helps companies of all sizes enable their customers to do business on demand — when they want, where they want and how they want. Other system benefits are:

- Assures real-time inventories so the users can always receive accurate, up-to-date inventory information;
- Offers the possibilities to share meaningful data with supply chain partners;
- Permits strengthening customer and partner

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relationships with collaboration;

- Speeds and simplifies the deployment and management of e-commerce sites;
- Maximizes performance, scalability and adaptability of partners systems;
- Provides rich, ready capabilities for products catalog and content management;
- Permits a greater visibility through real-time product updates, availability and pricing information;
- Offers personalization capabilities.

9. RFID@B2B

In the case of B2B, RFID is supposed to benefit not only the identification of individual pallets, cases or items, but also the relationships between/among objects, between/among organizations, between space and time. RFID is about process level change that can streamline business-to-business operations and bring about major changes to organizational policies, culture, performance and structure. The RFID_B2B system architecture is flexible and easily extensible. The research team chooses to design a layered architecture arranged in such a way that the lower layers support and enable the upper layers. This architecture has some advantages: divide the complex system into several more manageable components, allow different groups to work on different layers concurrently etc. The RFID_B2B system is structured on three levels: the corporation level, the local level and data collection level at the material control departments.

10. FUTURE IMPROVEMENTS

With the growing number of B2B sites available through Internet, a useful addition to the RFID_B2B system would be an intelligent software agent for information gathering. The agent will be able to perform semantic query optimization and to offer data mining facilities. It will dynamically plan for alternative information source when a source or a B2B site goes down. This agent will organize the results and display them in an easily interpreted manner to the user. To face the new global market and to provide an effective collaborative relationship between trading partners, an environment to support the semantic integration could help. Another useful feature would be a special section that enhances the management of production planning to ensure good deliveries and productive efficiencies.

11. CONCLUSIONS

The paper helps to improve readers understanding of the RFID and EPC potential for business processes. RFID technology is classified as a wireless AIDC technology that uses digital data encoded into a radio tag embedding a microchip with an antenna. The data stored on the tag is collected by a reader using radio waves. There are a large variety of RFID tags designs; they also have many different functional characteristics such as power source, carrier frequency, read range, data storage capacity, operational life, cost etc. RFID has immediate benefits over barcodes. Thus RFID tags are an improvement over barcodes because the tags have read and write capabilities. The data stored on RFID tags can be changed, updated and locked. RFID technology offers a better way to track items with minimal human intervention, for stocking and marketing purposes. Benefits come in the form of inventory, shrinkage and labor reduction on the one hand, and sales' increasing due to reducing out-of-stock and getting real-time demand information on the other hand. RFID technology represents one of a number of possible solutions to enhance supply chain. It is therefore important to do a cost-benefit analysis to evaluate each alternative solution. The majority of the costs of integrating RFID in supply chain application come from IT, tags, hardware and services.

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