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Framework for Radio Frequency Identification Technology Implementation in Business

Dr.Manoranjan Dash[1], Dr.Ayasa kanta Mohanty[2], Dr. Jyoti Ranjan Das[3]

[1] *Asst.Professor, Faculty of Management Science, Siksha O Anusandhan University, Odisha, India*
[2] *Associate Professor, Faculty of Management Science, Siksha O Anusandhan University, Odisha, India*
[3] *Associate Professor, Faculty of Management Science, Siksha O Anusandhan University, Odisha, India*

Abstract - ***Customers are more demanding in terms of responsiveness, level of service, quality of products and costs. Firms only could reach these goals simultaneously if they invest in new technologies. A new technology that has received considerable attention from academics and practioners, especially among retailers, is the RFID because of its large scope of application, advantages and potentialities. The paper gives an overview of the radio frequency identification (RFID) technology, major classes of RFID tags, commonly used frequencies and identifier systems. It intends to highlight the benefits associated with the utilization of RFID Technology and also the steps involved in RFID implementation.***

Key Words: *RFID, Tags, RFID Implementation.*

1. INTRODUCTION

Radio Frequency Identification or RFID is the new generation Auto ID technology that uses radio or wireless communication to uniquely identify and transmit data relating to an item, object, or an individual. Radio Frequency Identification (RFID) can also be defined as wireless communication technology that uses radio-frequency waves to transfer information between tagged objects and readers without line of sight. This creates tremendous opportunities for linking various objects from real world. These objects are numbered, identified, catalogued, and tracked. Although RFID has been around for more than half a century, it is only in recent years that this technology has begun to attract a lot of attention, due to the convergence of lower cost and increased capabilities of RFID tags. Currently, RFID is emerging as an important technology for revolutionizing a wide range of applications including supply chain management, retail, anti-counterfeiting, baggage handling, and healthcare. Many organizations are planning or have already exploited RFID in their main operations to take advantage of the potential of more automation, efficient business processes, and inventory visibility. One important issue is how to process and manage RFID data, which is typically in large volume, noisy and unreliable, time-dependent, dynamically changing, and of varying ownership. Another issue is how to seamlessly integrate low-level RFID data into (existing) enterprise information infrastructures (e.g., upper-level business processes). Finally, given the ability of inexpensively tagging and thus monitoring a large number of items and/or people, RFID raises some serious security and privacy concerns. Indeed, RFID privacy and security are stimulating research areas that involve rich interplay among many disciplines, like signal processing, hardware design, supply-chain logistics, privacy rights, and cryptography. Invented in 1948 and first-used during the IInd World War by the US Army for identification of friend or foe (IFF) aircrafts; RF technology gained commercial acceptance during the 1980s and 90s. It has been widely used across a multitude of industry sectors, and applications as varied as access and security control, livestock identification, airline baggage tracking, automated vehicle identification and toll collection. With the recent ratification of Gen 2 ePC (UHF) standards, the adoption of RFID systems is set to explode as manufacturer, distributors and retailers rely on the technology for 100% real time supply-chain visibility up to item level. Benefits include significant improvements and increase in productivity, efficiency and ROI to businesses and consumers across the globe.

1.1 Elements of RFID Technology and working principles

An RFID system typically consists of following components:

Tag: A transponder, also known as RF Tag, uses a silicon microchip for storing large amounts of data. The tag or

label is usually attached to an item, asset, or an individual and provide the means for case or item level identification.

Reader: A reader is used primarily to read and write data to RFID tags. A reader can be either hand-held or work as a portable computer or mounted as a fixed device for access control purposes.

Antenna: An antenna is used to radiate and or/ receive energy in the radio frequency spectrum, to and from the tag. It could be either stand-alone or packaged together with a reader. In an RFID system, the data is carried in suitable transponders, commonly known as RF tags, and is retrieved at the appropriate place and time by means of an antenna and a transceiver/reader, in order to satisfy a particular application need. A radio signal emitted by the antenna activates the tag allowing it to be read and in some instances data written onto it (active tags). The tag passing through the electromagnetic field detects this activation signal and the microchip reflects back an altered signal to an RFID reader and/or middleware which decodes and filters the tag's encoded data to be then used by enterprise applications for information management and decision making. With the RFID network, companies can not only identify products in the supply chain, they can also share about the location of goods. Company A, for instance, could let Company B see-inreal time-what is in Company's A warehouse. Or Company A could let Company B know automatically that goods were scanned leaving the warehouse and will arrive in Company's B facility the next day. It is this ability to share information about the location of products anywhere in the supply chain that makes RFID a potentially powerful technology

Passive vs. Active Tags

Tags come in many form factors. The right tag depends on the application, end use environment, performance, and the cost. Passive tags are read only and gains its power from that generated by a reader and has no internal power source. The reading range is typically shorter up to 30 feet (3 meters) and the data storage capacity is comparatively less (96/128 bits) as compared to active tags. Active tags have both read/write capability and are powered by means of battery, either internal or external. This battery-supplied power enables data to be read and written on to a tag and thus gives it a greater reading range up to 300 feet (100 meters) and large data storage capacity (128 KB). Companies are increasingly focusing on passive UHF tags. The simple tags (96 bits) are cheaper to manufacture and are more useful for applications where the tag will be disposed of with the product packaging.

2. RFID FEQUENCY AND USES

An RFID device requires a defined radio frequency and communication protocol to transmit and receive data from RFID tags. The exact frequencies (and power levels) used in RFID systems vary by country or region; however, RFID systems typically utilize the following frequency ranges:

TABLE I

Frequency Range	**Characteristics**	**Applications**
Low Frequency 125-300 KHz	Short Range (To 18 Inches) Low Reading Speed	Live Stock ID Reusable Containers
Low Frequency 13.56 MHz	Medium Range (3-10 feet) Medium Reading Speed	Access Control Library Automation
Ultra High Frequency 400 MHz- 1GHz	High range (10-30 feet) High Reading Speed	Supply Chain Management Pallet & Container Tracking
Microwave Frequency > 1 GHz	Medium Range (10 +feet)	Automated Toll Collection Vehicle Identification

3. RFID STANDARDS

Standards are critical for many applications of RFID technology. There are a number of existing (ISO) and proposed RFID standards (EPC Global) that deal with air interface protocol (the way tag and readers communicate), data content (the way data is organized and formatted), conformance (ways to test that products meet specifications) and applications (how standards are used on shipping labels etc). Major retailers are using Electronic Product Code (EPC) specifications that were developed at the MIT Auto-ID Center and are now managed by EPC Global, a joint venture between the EAN International and the UCC- Uniform Code Council.

The EPC is a simple, compact "license plate" that uniquely identifies objects (items, cases, pallets, locations, etc.) in the supply chain. Like many current numbering schemes used in commerce, the EPC is divided into numbers that identify the manufacturer and product type. But, the EPC

uses an extra set of digits, a serial number, to identify unique items.

An EPC number contains:

1. Header, which identifies the length, type, structure, version and generation of EPC

2. Manager Number, which identifies the company or company entity

3. Object Class, refers to a stock keeping unit or product SKU

4. Serial Number, which identifies a specific item of the Object Class being tagged.

Additional fields may also be used as part of the EPC in order to properly encode and decode information from different numbering systems into their native (human-readable) forms.

4. RFID: BUSINESS APPLICATIONS

Common applications that are in use today:

1. Access Control/Security: RFID is increasingly being used as means for secure and hands-free access to a building or premises. It is also being widely used to track and control the movement of valuable equipments and/or personnel resources in real-time.

2. Airline Baggage Identification/Ticketing: RFID is enabling airlines to secure, track and speed up the movement of baggage at the world's busiest airports. It is being used to streamline passenger ticketing and boarding while maintaining a high level of security.

3. Automated Vehicle Identification/Toll Collection: RFID is being used for automatic identification of vehicles and toll collection at highways without the need for stopping at tollbooths. It is also being used for auto-refueling of vehicles and to provide contact less payments at gas stations.

4. Manufacturing/Supply Chain Management: Manufacturers are increasingly using RFID for identification and tracking of cases (items) through an assembly line in harsh manufacturing environments. In addition, it is being used for real-time inventory control and enabling 100% supply chain visibility – the ability to know the precise location of any product anywhere in the supply chain at any time.

5. Retailing: Major retailers are in the forefront of RFID adoption. RFID technology is enabling retailers to improve supply chain efficiency and make sure the products are on the shelf when customers want to buy it.

RFID developments now offer the compatibility with an express logistics and transport system to enable the following potential improvements to service:

• Increased security of your package and items within your shipment

• Visibility of items within your shipment without opening the package

• Later cut-offs due to automated and simultaneous identification.

• "Near" real time track and trace, which is dynamic, automated and proactive, through links to GPS (global positioning system) and communications systems

• Condition monitoring (eg, temperature, vibration, humidity) through links to micro sensors.

• Counterfeit protection through validation of genuine goods throughout the logistics process - Intellectual Property Rights (IPR).

• Dynamic multi-modal merges in transit.

5. BENEFITS OF RFID TECHNOLOGY

RFID provides considerable benefits over conventional Auto ID technologies like barcode, and helps to provide a more robust solution to critical business needs.

· RFID creates a truly automatic way, without any human interface, to collect information about a product, place, time, or transaction quickly, easily and without human error.

· It provides a contact less data link, without need for line of sight or concerns about harsh or dirty environments.

· RFID can be used as a data carrier, with information being written to and updated on the tag on the fly.

· It provides for multiple, and simultaneous collection of data

· RFID enables for track and trace of unique items in the supply chain In addition, RFID is providing real and

tangible benefits to organizations and consumers in the form of:

· Faster, more accurate, and effective data collection

· Reduced cost, time, and work-processes

· Increased speed, productivity, and business efficiency

· Better security, convenience, and customer service

6. STEPS TO RFID IMPLEMENTATION

The successful implementation of an RFID strategy depends on a clearly understood and well-supported plan in the company. These six steps are as follows:

1. Create an RFID Policy for the company. This basic step requires the company to agree on the objectives of RFID implementation, the technology to be deployed, define the data structure – i.e. what information needs to be stored about each item. This document should be regularly reviewed to ensure that it is updated as implementation issues are resolved, but it should be treated as the company policy for implementation to avoid different departments addressing the issues in their own

2. Document the Reasons for Adoption. This document should describe and quantify why the company is implementing RFIDs. These could include a mandate from a key customer; a desire to increase efficiency of internal processes, a move to integrate information between suppliers, the company itself and its customers, and the financial costs and benefits of adoption should be estimated and documented.

3. Develop an implementation model. This document will define the implementation strategy, covering such items as the proposed technology provider, safety issues associated with implementation, discussions and agreements with unions, staff communication plan, testing processes etc.

4. Deployment Plan. Choose the easiest and fastest implementation application so that the company can see an immediate gain, and the initial teething troubles will be manageable. Avoid the temptation to work on the area of maximum pain for this first implementation as the issues and problems may cause the whole project to flounder. Choose a small facility, where as many variables as possible can be controlled. Get the hardware implemented and properly tested and operational, and sort through the software issues in this test environment.

5. Manage the Constituents. Ensure that the plan is fully supported at all levels - from the Executive Board down to the shop floor, so that those directly involved or impacted by the introduction know what the aims are and are supportive of the changes. Make sure that the technology suppliers are fully involved as Partners in the plan, to maximise their support and have the ownership of the plan clearly understood.

7. CHALLENGES TO RFID ADOPTION

The adoption of RFID, along with an ease of management invites a series of challenges for early adopters. The challenges start right from integrating the readers for identifying the data, to monitoring the data in the ERP and SCM systems, to later manage this data. The most likely areas where challenges can be foreseen are:

Incomplete Packages and Inflexible Solutions

Organizations having partial packages - supporting functionality in chunks are likely to face a challenging stint with RFID. This is because of the fact that lot of amendments may be required in order to leverage the provisioning of RFID to the utmost.

Need to Integrate Legacy

While RFID is being integrated, organizations would want to re-use their existing systems. This will not only save cost and time, but also require less amount of familiarization time for in-house users.

Need To Incorporate New Functions

Even while organizations are looking only at the identification aspect of RFID, there are many areas where new functionalities would be required to automate the existing systems. Vendors providing integration packages would be expected to develop their products/solutions in a way that integration in such scenarios can be achieved with minimal customizations.

Diversity in Technological Standards

The ERPs and SCMs within organizations can be proprietary as well as vendor provided. However, in any case, with each ERP having different standards in the

technology aspects, Integration challenges are likely to soar up in this arena.

Complex Technology with Heterogeneous Platforms, N-Tier Distributed Computing and the Web

Distributed computing environments and the advent of Internet brought in a concept of Interorganization business communication through loosely coupled systems. eXtensible Markup language (XML) is accepted as a standard for such communications. The combination of Internet and XML gave birth to Web Services, which support multi-language and multi-platform systems. Integration aspects of RFID will cover a lot in this area with processes being automated and organizations reducing their cost of ownerships. RFID also invites a lot of challenges for early adapters

8. CONCLUSIONS

Radio Frequency Identification promises an era of ubiquitous computing. The "Internet of Things" is being realized as the means of low cost of ownership and a substance for real time monitoring. RFID is moving forward with a thrust and, the need for Integration at various stages with RFID becomes a crucial aspect for a smooth operation of the system. Vendors across the Information Technology spectrum are taking a plunge for providing solutions that are extensible and robust to meet the challenging demands of every vertical concentrating on RFID. And what is promised is a better management of data and information for organizations, in turn, boosting efficiency and optimization of the resources

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