RFID TECHNOLOGY: CASE STUDY OF ITS MULTI-APPLICATIONS IN WIRELESS COMMUNICATION

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ABSTRACT

RFID technology was developed in early 19th century but in the past few years, this technology went from being unimportant to orthodox applications. RFID technology provides more detailed visibility and tracking of assets and inventory and offers deliberate advantages. Initially, some virtual database with RFID tags, antenna and readers were created and verified. Then research and experiments were conducted to find trends in scientific and virtual environments. RFID provides detection from a relative far distance unlike bar code system. It does not even require product or asset to be in line of sight. In this paper, we discuss about basic working of RFID system, its evolution, some applications and limitations of this technology which need to be overcome to make it more efficient to use.

*Keywords: Scanning Antenna, Transponder & Radio Frequency Identification*

I. INTRODUCTION

Radio Frequency IDentification (RFID) is a technology that employs a microchip with an antenna that broadcasts its unique identifier and location to receiver. In this technology, radio frequency electromagnetic fields are used to transfer data to identify and track automatically the tags attached to various objects. These tags usually contain electronic information. RFID system can be used just about anywhere, from clothing tags to missiles to pet tags of food- anywhere that a unique identification system is needed. The tag can carry information as simple as a pet owner's name and address to as complex as instructions on how to assemble a car. Some auto manufacturers use RFID system to move cars through assembly line. At each successive stage of production, the RFID tag tells the computer what the next step of automated assembly is.

Any application of RFID needs to result in obvious business benefits. The last few years have seen several developments that have sped up the adoption of this technology:

- The emergence of major consumer applications that bring RFID from an experimental technology into the mainstream. As it gains understanding and credibility through highly visible consumer applications that prove its effectiveness, its place as a solution in supply chain automation also grows.

- The development of "smart labels"—a lower cost, easily integratable version of RFID tags that is beginning to take off on paths where bar codes cannot travel.

II. HOW RFID WORKS?
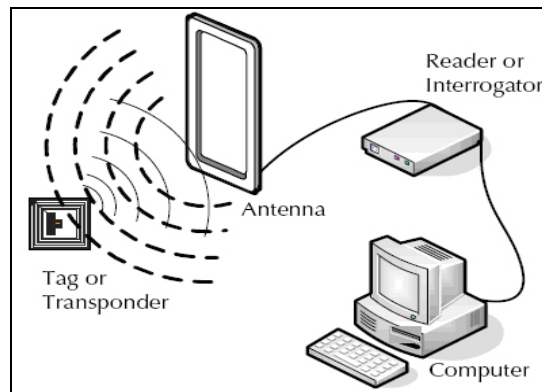
The RFID system has three components, these are:

- Scanning antenna

- A transreceiver with decoder to interpret the data.

- A transponder- a RFID tag – that has been programmed with information.

The RF radiation does two things:

- It provides a means of communicating with the transponder, and

- It provides the RFID tag with the energy to communicate (in case of passive RFID tags).

The scanning antennas can either be affixed to one place or they can be used as handheld antennas. For example, we can build them into door frames and accept the data from the persons or objects passing through the door. When RFID is brought in the field of antenna, it detects an activation signal from antenna and then it transmits the information on its microchip that is received by scanning antenna.

The signalling between reader and antenna depends on the frequency band used by the tag. The tags which operate on LF and HF are small percentage of wavelengths away from reader antennas. In this region, the tag gets cupled electrically with the reader and it modulates the field produced by reader by changing the electrical loading(represented by tag). Then because of switching in relative loads, the tag produces the change which is then detected by reader.

In case of UHF and higher frequencies, the approaches are different as the tags and readers are more than one radio wavelengths away. So, the tag may backscatter a signal. Active tags may contain seperated transmitters and receivers and the tag need not respond on a frequency related to the reader's interrogation signal.

III. TYPES OF RFID TAGS

The RFID tags can be of following types:

- Active Tags: these tags have their own internal power sources. Many active tags operate at fixed intervals. These tags are also called beacons as they broadcast their own signals. These tags have an advantage that the reader can be far away from the tag and still get signals. They have limited life spans, say upto 10 years.

- Passive Tags: these tags have no internal power supply. These tags, however, do not require any batteries and can be much smaller and have a virtually unlimited life span. In these tags, electrical current induced in antenna by the incoming signal proves power for integrated circuit in tag to power up and transmit response.

- Semi-passive Tags: these tags are similar to passive tags, with addition of a small battery. The external battery provides power to integrated circuit. They have longer range but limited lifespan.

The folloiwng table explains more about the difference between these types of tags:

Tags and Features	Passive Tag	Active Tag	Semi Passive Tag
Internal Power Source	No	Yes	Yes
Signal by backscattering the carrier wave from the reader	Yes	No	Yes
Response	Weaker	Stronger	Stronger
Size	Small	Big	Medium
Cost	Less expensive	More expensive	Less
Potential Shell life	Longer	Shorter	Longer
Range	10 centimeters to few meters	Hundreds of meters	Hundreds of meters
Sensors	No	Yes	Yes

IV. RFID V/S BAR CODES
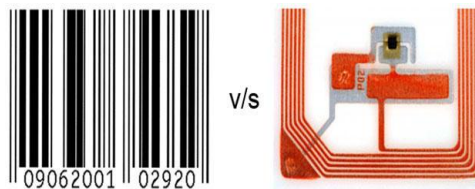
With the different sectors using the two forms of automated data collection i.e. barcode and RFID systems, there is much hype as to whether RFID will take over to barcode system. It is not compulsory that new methods are always essentially better than old ones. These two both carry product information however they both differ a great amount.

To know the difference between barcode and RFID system, first we should discuss what is a bar code.

What is a bar code?

A barcode is visual representation of data that is scanned and interpreted for information. Each bar code contains a certain code which works as a tracking technology for products. Originally this technology used the difference in width and spacing in parallel lines and its considered as one dimensional. Later it evolved into other two dimensional shapes like hexagonal and rectangular shapes. These barcodes can be scanned by barcode readers or by smartphones also.

Now, the difference between the two technologies is explained below:

Barcode	RFID
Require line of sight to be read	Can be read without line of sight
Can only be read individually	Multiple tags can be read simultaneously
Cannot be read if damaged or dirty	Can cope with harsh or dirty environments
Can only identify the type of item	Can identify a specific item
Cannot be updated	New information can be over-written
Require manual tracking and therefore are susceptible to human error	Can be automatically tracked removing human error

V. HISTORY OF RFID

[10] This technology was first used in world war II by american forces to identify enemy aircrafts and tanks. The systems deployed at that time are still being used in defence sector.

With time, the systems were further developed leading to technology expansion. For e.g. in 1970s RFID technology was being used to identify railroad cars or automobile parts in paint shops. Afterwards, electronic article surveillance appeared that was first large scale system of its kind in the market. The main function of this system was to guard against thefts in goods and clothings. The technology became known to a wide public a few years ago when large supermarket concerns decided to document the delivery chain of their goods by means of RFID. Since then there have been many reports on RFID in the media, and its use has also frequently been the subject of controversy.

VI. APPLICATIONS OF RFID

There are various applications of RFID technology emerging nowadays. Some of these are explained as follows:

- ASSET TRACKING: Earlier, static or in motion asset tracking or locating was not an easy task. But now, user can instantly determine general locations of tagged assets anywhere within the facility with the help of active RFID technology. Control point detection zones at strategic locations throughout the facility allow the user to define logical zones and monitor high traffic areas. Tagged assets moving through these control points provide instant location data. Asset tracking applications will see an almost vertical growth curve in the coming years and the growth rate in this area will be much higher than the growth rate of general RFID market.

- PEOPLE TRACKING: this is similar to asset tracking system. Hospitals and jails can be the most required places for this type of tracking. Hospitals employ this technique in tracking some special patients, emergency cases and essential equipments. Mental hospitals can also use this to keep an eye on every patient. This technology can be used best in jails, where every inmate can easily be tracked and located and then no jail inmate will try to escape.

- DOCUMENT TRACKING: with the availability of large amount of data and documents, it becomes difficult to keep manual records and locations of that data and documents. With introduction to RFID technology, both time and money can be saved because this will save: 1) time spent to search the lost documents and 2) the financial and legal impact related with document losses.

- GOVERNMENT LIBRARIES: this technology can also be used in various libraries. RFID technology can read multiple items or assets simultaneously which helps in reducing queues and increase the number of customers using self check. This result in reduction of the staff required at circulation desks.

- MANUFACTURING AND PRODUCTION: this technology gives out an easy way to manage huge manufacturing and production processes. This offers all benefits of small production parts to batch, processing and manufacturing. This helps in reducing time to locate parts and products, reduce and eliminate bottlenecks, and results in better analysis.

VII. LIMITATIONS OF RFID

Even though this technology has been developing over the years, but it has certain barriers or limitations that still need to be neutralised to make effective and easy use of this technology. These problems may be related to investments, security risks and some others. These are as follows:

- COST: although there is great potential in RFID technology, but its relative high cost is a drawback. RFID tag is comparatively costlier than barcode system. Besides the initial cost, there is a cost to be invested in

maintainence of the system also. In future, when prices are reduced then more retailers and manufacturers can implement this technology and then it will overcome the barcode system completely.

- SECURITY AND PRIVACY: this limitation has been a part of debate from the beginning. It will certainly violate the customer privacy as it can easily the person using the product.The tags(RFID tags) when used, may broadcast the EPC(electronic product code). For example, the size of the dress a woman wants to wear will be sent publically to the nearby reader by RFID tag. Many suggestions are being given to overcome this problem, simplest is " kill tag" in which the tag is electronically deactivated after the sale mof the item. Some other solutions are crptographic approach, hash function approach, faradey cage approach, active jamming approach, regulation approach etc.

- INTERFERENCE: since RFID is based on rado frequency technology, it can be easily interfered with some other radio wave transmissions occuring over the same place, or it can be interfered with some metals,liquids etc. the degree of interfernce depends on the frequency of tag and usage environment.

- LACK OF STANDARDISATION: RFID is still in initial stage and there are many hurdles ahead of it. At present, there are many different RFID systems that operate upon different frequencies and need different softwares and readers. So, the need is to be agrees upon that only one or group of frequencies have interoperability between the manufacturers, retailers and distributers.

VIII. CONCLUSION

For now, RFID technology can't overcome barcode technology completely because of its accuracy, cost and other limitations. Some large companies like tesco, prada, benetton, wal-mart etc are making use of this technology and they are exploring the impact also. Other industrialists can also use this technology. The base of success of this technology lies in understanding the technology and its features deeply to overcome its limitations and potential problems.

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