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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

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APPENDIX/ANNEXURE

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CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

JOURNAL AND OTHER ARTICLES

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

RADIO FREQUENCY IDENTIFICATION (RFID)

TANAJI D. DABADE
ASSOCIATE PROFESSOR
SINHGAD INSTITUTE OF MANAGEMENT
PUNE

DR. SHIVAJI U. GAWADE
HEAD-RESEARCH
SINHGAD INSTITUTE OF MANAGEMENT
PUNE

ALEKHA CHANDRA PANDA
ASST. PROFESSOR
SINHGAD INSTITUTE OF MANAGEMENT
PUNE

ABSTRACT

Radio Frequency Identification (RFID), has been around since the late 60's. It appeared in tracking and access applications during the 1980s. RFID is an automatic data capture (ADC) technology, which comprises of a small data carrying token called tag and a fixed or mobile scanner called reader, which allows non-contact reading. It is an advanced wireless technology, which is effective in manufacturing, asset awareness and other hostile environments where barcode labels cannot survive. The technological advances have both brought down the cost and allowed its use for far more applications.

KEYWORDS

Radio Frequency Identification (RFID), RFID tag, Active tag, Passive tag, Reader.

INTRODUCTION

RFID system consists of:

- **Reader:** It contains a transceiver, decoder and antenna or coil. It is also called interrogator.
- **Transponder:** It consists of a tiny chip of silicon (microchip), smaller than a grain of rice, with a coiled antenna. It can carry any information from retail price to medical records. It is also called *RFID tag*. It may also come in the form of RFID cards. It is electronically programmed with unique information. RFID tags have ability to store information, which can be transmitted wirelessly to RFID readers.

RFID is the generic name for technology that uses radio waves to automatically identify individual items that carry such identification tags. By using tags that can be monitored from remote readers, companies can collect accurate and detailed information in real-time. As the technology has developed "*the devices have become smaller, smarter, more durable and cheaper*" (Ferguson, 2002). The wealth of data available from deployed RFID could be a solution to the information-handling challenge that marketers increasingly face. Ferguson (2002) contends that the *'silent commerce'* of this object-to-object communication will be transformational, arguing that *"as RFID systems become more sophisticated and widespread, they will begin to reshape companies, supply chains, even entire industries. It is no exaggeration to say that a tiny tag may one day transform your business"*.

REVIEW OF LITRATURE

RFID promises a number of important benefits. Compared to existing technologies it offers operational advantages such as speed, ease of use, flexibility of deployment, and opportunities for unobtrusive use (see Lipide, 2004). Using these capabilities companies using RFID can monitor stock in real-time to prevent out-ofstock problems, an issue that costs Wal-Mart $600 million annually (www.rfidjournal.com). Moreover, RFID offers real-time visibility as tagged products can be tracked anywhere in the world. However, monitoring does not end when the product is sold; if active tags remain on goods after a purchase is made, there is nothing to stop retailers from tracking what other purchases consumers make, which products they place with their goods and where they buy them. As Glazer (1991) He posits that an interesting task is to compare the level of 'information intensity' between companies, i.e. the level of profits attributable to information assets. As an information-handling issue, it seems strange that in the information age many marketers still struggle with both the quantity and content of the information they are faced with.

Fisher et al. (2000) contend that the ability to "*offer the right product in the right place at the right time for the right price*" has remained "*frustratingly elusive*". They argue that *"you would think that we'd have captured it by now, particularly given the enormous amount of data that retailers and e-tailers can gather about points of purchase, buying patterns, and customers' tastes. But many retailers have a long way to go"*

Friend and Walker (2001) contend that "*the time is right for a technology that brings control to what was risky, rigor to what was intuitive, and science to what was guesswork*". Technologies like RFID may well be capable of providing the information required to bring much needed clarity to the increasingly complex role of marketing.

Zaltman (2003) argues that current practices such as CRM do not tell the marketer anything about "*why customers do what they do, think what they think, and why they like or don't like products…Getting that level of insight requires more intensive interactions with customers. It requires that you develop a poetic insight into customers- a deep knowledge that enables you to intuit their answers to questions you haven't even asked them"* (Zaltman,2003:2). Along with other marketing practitioners and academics, Zaltman contends that advanced ICTs such as RFID may provide a way to developing such deeper knowledge.

Bessen (2003) argues that ICTs can "*cut through the confusion and sort the most relevant data from the daily flood,…as despite the obstacles, few marketers dispute the need to coordinate and integrate information*".

Harvard Business School's Marketing Professor Gerald Zaltman (2003) along with many other marketing practitioners and academics, contend that advanced ICTs such as RFID is one sure way of achieving this deeper knowledge.

McCullagh (2003) states, "*it becomes unnervingly easy to imagine a scenario where everything you buy that's more expensive than a Snickers will sport RFID tags, which typically include a 64-bit unique identifier yielding about 18 thousand trillion possible values"*.

Andal-Ancion et al (2003) contend that "*new technologies…have well-known but often unrealised potential to transform businesses and industries*". In their empirical study of twenty North-American and European companies, the authors found that one of the major driving factors behind the digital transformation of traditional businesses was information intensity.

Codd (2005) argues that Irish retailers stand to benefit substantially from RFID in terms of improved supply-chain management and increased customer knowledge, urging marketers in the retail sector to initiate early links with advanced technologies. At the same time, a number of barriers to the adoption of novel ICT exist.

WORKING OF RFID SYSTEM

Radio frequency identification is a technology used to collect product, place, time or transaction data quickly and easily without human intervention or error.
To start with, the reader transmits electromagnetic waves (low-power radio signal), through its antenna. The tag receives it through its own antenna to power its chip. This signal serves as a request for the RFID tag to transmit the unique identifying number; similar to scanning a barcode, but using RF (radio frequency) instead of light. The RFID reader reads the information from the chip (RFID tag) without direct contact. This means the tag is not required to be swapped through the reader; however it has to be passed through the range of the reader. Readers are installed at locations where data capture is required or may also be in the form of portable readers. Thus the reader can be configured either as a hand-held or fixed-mount device.
The reader's antenna emits radio signals in the range from 1 inch to 100 feet or more, depending on the reader's output power and radio frequency (RF) used. When the tag passes through the electromagnetic zone it senses/detects RF signal i.e. the activation signal from reader. In response it sends the stored information. The reader decodes the data encoded in the tag's Silicon chip and passes this tag information to the host computer (back end system) via. wire or wireless serial communication links, for further processing. The reader can even deliver that information to any electronic device like a cash register, a video screen, a home appliance or directly into the internet.
The set of computers to which the reader sends data collected from tags is known as the "Savant." The Savant aggregates data from different readers, filters it and passes it on to other supply chain systems that make decisions based on the data.

MIDDLEWARE

In any supply chain there are millions of tags read. These tag codes have to be tied to meaningful information leading to large amount of data with complex interrelationships. RFID middleware standardizes ways of dealing with loads of information which the tiny tags produce.
The interrogators are available in a variety of shapes and sizes. They can be handheld or installed. They can be built into a doorframe to receive tag data from persons or things passing through the door. It can be mounted on an interstate tollbooth to monitor traffic passing by. The electromagnetic field produced, by an antennae can be constantly present, when multiple tags are expected continuously. If constant interrogation is not required the field can be activated, whenever required by a sensor device.

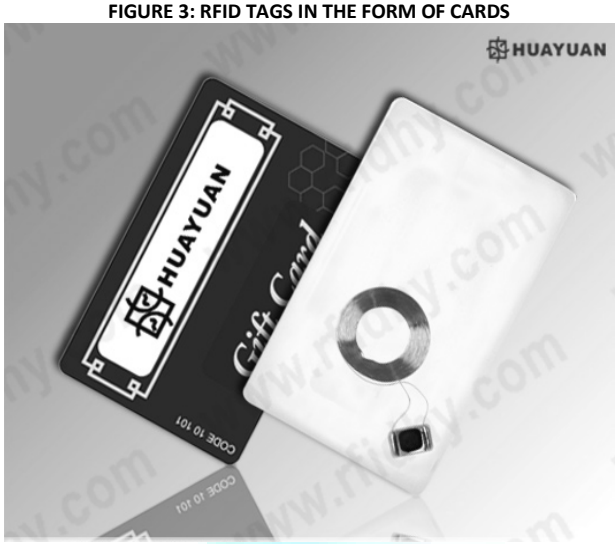
FIGURE 1: RFID READERS

Handheld RFID reader **Stationary RFID reader**

RFID tags come in a wide variety of shapes and sizes. Human and animal tracking tags, inserted beneath the skin, can be as small as a pencil lead in diameter and ½ inch in length. They come in the form of smart labels that are stuck on boxes; or are inbuilt in smart cards for paying for items or access applications. (Smart cards have dimensions of credit cards). In addition, RFID tags used to track heavy machinery, trucks and railroad cars for maintenance and tracking applications come in the form of 5 by 4 by 2inch rectangular transponders. Such tags are sticked on your vehicles windshield to enable you to pay tolls without stopping.
Size of tag depends on what you are tagging and how much intelligence you want the tag to have or whether the tag is read-only or read-write (programmable).

FIGURE 2: RFID TAG IN THE FORM OF SMART LABEL

FIGURE 3: RFID TAGS IN THE FORM OF CARDS



CLASSIFICATION OF RFID

I. RFID TAGS ARE CATEGORIZED AS EITHER ACTIVE, PASSIVE OR SEMI-ACTIVE

Active RFID tags are powered by an internal battery and are read/write i.e. tag data can be rewritten and/or modified. An active tag's memory size varies according to application requirements (some systems have memory up to 1MB). The power supplied by battery of an active tag generally gives it a **longer read range.** The trade off is **greater size, greater cost and a limited operational life** (which may yield a maximum of 10 years, depending upon operating temperature and battery type.)

Tags which, can operate without an external power supply, are called passive tags. These obtain operating power generated by reader. Actually when a reader emits electromagnetic waves they couple with antenna of tag to form a magnetic field. Passive tags gain/draw power from this magnetic field.

Consequently, passive tags are much **lighter** than active tags (no battery), **less expensive** and offer a virtually **unlimited operational lifetime**. The trade off is that they have shorter read ranges than active tags and require a high-powered reader.

Read-only tags are usually passive and are programmed with a unique set of data (32 to 128 bits), which can't be modified. Read-only tags most often operate as a license plate into a database.

Semi-active tags do have a battery, but depend on the energy provided by the reader to communicate with the same. That way semi-active tags tend to act like passive tags, while the on-board battery of the tag is used for other functions such as collection of environmental data i.e. data pertaining to environment to which the tagged object is exposed.

Type of tag / Characteristics	Active	Passive
Tag battery	Yes	No
Tag power supply	Internal to tag	Energy transferred to tag by reader
Availability of tag power	Continuous	Only when the tag comes in the field of reader
Range	Long range (> 300 feet)	Short range (< 9 feet)
Data storage of tag	High	Low

Traditional Bar Codes vs. RFID

A printer printing traditional bar codes to be applied to products

A roll of RFID chips ready to be applied to products

II. RFID SYSTEMS ARE DISTINGUISHED BY THEIR FREQUENCY RANGES AS LOW FREQUENCY SYSTEM AND HIGH FREQUENCY SYSTEM

Low frequency systems operate in the range of 30KHz to 500 KHz, they have short reading ranges and lower system cost. They are most commonly used in security access, asset tracking and animal identification applications.

High frequency systems operate in the range of 850 MHz and 2.4 GHz. They offer long read ranges (greater than 90 feet) and high reading speeds. They are used for applications such as railroad card tracking and automated toll collection. However the high performance of high frequency RFID system incurs higher system cost.

The read range for passive tags depend on a lot of factors i.e the frequency of operation, the power of the reader, interference from metal objects or other RF devices. In general, low-frequency tags can be read from a foot or less. Majority of high-frequency RFID transponders have read range of less than 3 feet while some have read range which extent up to 6 to 8 inches. Nowadays UHF tags come with a read range between 20 to 25 feet. Where still longer ranges are needed, active tags are used to boost read ranges to 300 feet or more. [1] Read range depends on many factors, but the size of the transponder's antenna, the size of the reader's antenna and its output power are the main ones.

III. THERE ARE TWO TYPES OF TAGS: READ-ONLY AND READ-WRITE TAGS

It is the microchip in the tag which makes a tag read only or read-write. In read-write tags EEPROM (electrically erasable programmable read-only memory) chip is used. Information can be added to the tag or written over existing information using a special electronic process. However the read-write tags are expensive and are used only in some specialized applications.

The read-only microchips have information stored on them during the manufacturing process itself. The information on such chips can never been changed.

ADVANTAGES OF RFID OVER BARCODES

RFID and barcode are two different technologies which have some common applications. However RFID automates cumbersome processes, such as manual recording and bar code scanning. As the costs go from dollars to pennies per tag, soon RFID will replace traditional barcode technology (where applications are same) due to several shortcomings of barcodes:

1. **NO STOCK STORAGE CONSTRAINT**

The biggest distinguishing advantage of all types of RFID systems (above mentioned) is the **non-contact, non-line-of-sight** nature of technology, unlike barcodes. Barcodes require line-of-sight to be read i.e. the barcode is required to be oriented towards the reader for it to read. RFID tags can be read as long as they are within the range of a reader. In fact, RFID tags can be read through a variety of constraints such as walls, snow, fog, ice, paint, grease, oil and other visually and environmentally challenging conditions, where barcodes and other optically read technologies are useless.

2. **HIGH SPEED**

Moreover RFID tags can be read in these challenging circumstances at **remarkably high speeds** i.e. less than 100 milliseconds.

3. **READ AND WRITE CAPABILITY**

The **read/write capability of an active RFID system** is also another significant advantage in interactive applications such as work-in-process or maintenance tracking. Once a bar code is printed, it cannot be modified whereas RFID tags can use programmable microchips. Thus the tags can be programmed and re-programmed to hold variety of data depending upon the application. It is actually the chip in the tag, which can be programmed and reprogrammed. Though RFID is a costlier technology, as compared to barcode it is widely used for automated data collection and identification applications.

4. **MINIMUM LOSS/DAMAGE**

Barcodes are prone to loss or damage as they are stuck to the outside of packages and so can be easily damaged. If the label is ripped, soiled or falls off, there is no way to scan the item. Tags are usually embedded in objects, which are to be identified.

5. **NO HUMAN INTERVENTION**

RFID helps to track items automatically without human intervention. Barcodes require human intervention to operate the barcode scanner.

6. **LESS OPERATING TIME**

As humans are not involved for operating RFID system i.e. it is not required to swap the tag across the reader, the reader automatically senses the tag, it minimizes the time involved in the identification process as compared to barcode system.

7. **CAPABILITY TO HOLD LARGE INFORMATION**

RFID system can store huge amount of data as it has larger memory (2KB) as compared to barcodes. In addition to large data, the tags also contain protocols that can determine who can read selected parts of that data; On the other hand barcodes can not be programmed and can provide only the most basic information like manufacturer and the product number and price. They do not have a unique ID. For example: The bar code on one drug bottle is the same as every other, making it highly impossible to identify which one reaches its expiration date first.

DISADVANTAGES OF RFID

1. **REDUCTION IN STRENGTH OF RF SIGNALS**

a. The RF signal strength falls off inversely to the distance traveled.

b. Though RF signals can pass through walls; their strength is degraded by passing through walls or any other such obstacles.

c. When RF signals are reflected by metallic surfaces their strength reduces.

2. **RF SIGNALS CAN NOT PASS THROUGH METALS**

Though RF signals can pass through opaque objects there are certain materials such as metals, through which they can not pass. Moreover their strength is further degraded by reflecting off metal surfaces.

This makes tracking metal products difficult, though with a good system design and engineering this problem can be overcome.

3. **RADIO WAVES ARE ABSORBED BY WATER AT HIGHER FREQUENCIES**

This makes RFID working difficult in water or with objects with high water content difficult, though a good system design and engineering can overcome this problem.

4. **RF SIGNALS COLLISION**

When RF signals from two RFID tags collide with each other the waves cancel each other consequently making the tag detection difficult for the RFID reader. This difficulty can be overcome by implementing anti collision algorithms. Anti-collision algorithms enable the reader to read more than one tag in the same field of the reader.

5. **HIGH COST**

RFID systems are costlier than barcode systems; though the Passive tags cost a magnitude less than Active tags. The Passive tags can cost as little as 30 cents or even less if bought in bulk whereas active tags can cost far more. Some Active tags even come with temperature or pressure sensors built in, which cost more than $100.

6. **VULNERABILITY TO COMPROMISE**

It is possible to compromise an RFID system by wrapping the tagged object in two to three layers of ordinary household foil to block the radio signal. Clearly, bringing household foil into a library using RFID would represent planned theft. It is also possible to compromise an RFID system by placing two tagged items against one another so that one tag overlays another. That may cancel out the signals. Of course, this requires knowledge of the technology and careful alignment.

APPLICATIONS

As RFID promises real return of investment, manufacturers and retailers have started adopting it aggressively. RFID business applications fall into three main categories:

I. **SECURITY**

RFID systems can be used for security of individuals as well as assets. RFID systems can track the location of individuals, pets or vehicles. RFID tags are used in proximity cards that allow an individual or item to pass through a doorway or checkpoint.

II. **REGULATORY COMPLIANCE**

RFID systems can be used to capture real-time information about an individual, item, or transaction and then automatically record the data to meet regulatory requirements, such as Food and Drug Administration regulations. It proves to be useful through out the manufacture cycle and logistics till a product reaches a customer.

III**. ASSET TRACKING**

RFID systems can be used to identify the precise location of assets such as products, supplies, materials and even people or patients in a hospital to give businesses end-to-end visibility and control, directly improving profitability.

VARIOUS APPLICATIONS OF RFID SYSTEM WHICH FALL UNDER SEVERAL ABOVE MENTIONED CLASSES ARE EXPLAINED BELOW

AUTOMATED TOLL COLLECTION

Nowadays RFID is used to automate toll collection at bridges and tunnels. Drivers are given small plastic box with a RFID chip (tag) inside, which allows them to drive through the tollgates without stopping. The RFID reader, in the tollbooth senses the information on the tag's chip and the toll is automatically deducted from the driver's account.

SMART SHELVES

Another wide scale application of RFID is in the retail shops, where smart shelves have come into use. A reader placed on retail shelf can automatically sense when the store is low on inventory and accordingly place order to restock. This is how inventory management is being transferred from manual chore to automated one. Thus for the retailer, RFID helps to indicate empty shelves.

ELECTRONIC ARTICLE SURVEILLANCE

As RFID devices are becoming inexpensive, manufacturers have started including them in several consumer items such as clothing, cosmetics as well as car tyres. For example, Gillette has planned to use RFID tags to track individual packages of razors.

At the same time, RFID reader is placed in the cash register. This allows the customer to simply walk past the cash register with their purchases and the RFID equipped register reads the RFID chips on goods purchased and automatically deducts the purchase amount from their account.

In this way, RFID can be used in checkout counters. The effective range of RFID devices is about 3-5 feet, making it easy to capture the ID reliably, when the person walks through the doorway of a super market. Thus RFID is used for accurate tracking of merchandise within the store. This has drastically reduced theft or "shrinkage" in retail business. It also speeds up the billing process. Thus self-aware products from RFID enable the efficient management of product through the back door of the store and all the way to selling floor.

Note: Unlike barcodes, which are identical for every unit of the same product, RFID no. is unique in each unit.

"Extra Stores" (part of Metro retail chain) of Germany is utilizing RFID tags for inventory management grocery shoppers are thus getting accustomed to electronic store management. The primary goal is cost reduction and increased speed. The "Extra Stores" features RFID checkout lanes and "smart shelves".

TRACKING PAPER CURRENCY

The European Union is planning to place a tiny chip in every paper Euro note for two purposes viz. providing counterfeiting protection and the ability to give each bill a unique serial number.

MAINTAINING MEDICAL RECORDS

An American company, **Verichip**, is developing an RFID chip, which will permanently store your **medical records**. This chip will be implanted under your skin, so that any hospital equipped with a reader can know all your health history even if you are unconscious.

ANIMAL TAGGING

A simple version of this chip is implanted in animals to help **track and identify pets.**

The following images show how RFID tags are implanted in human bodies

FIGURE: RFID TAG INJECTIONS IN HUMAN BODY

(1) (2) (3)

(4) (5)

Image (1) : The injection needle preloaded with the RFID tag EM4102 chip.

Image (2) : The doctor checks the hand out to give the approximate "landing site" for the implant before doing the injection.

Image (3) : Checking the hand - Iodine has been applied and the lidocaine is readied. Numbing the hand before injection helps separate the tissue as well as kill the pain.

Image (4) : The doctor injecting the RFID tag (chip) into the hand between the index finger and the thumb.

Image (5) : RFID chip ranging in dimension from 2x12mm to 3x13mm injected in the hand.

SURVEILLANCE

RFID technology can also be used by the police. If RFID tags are placed in clothing, it can be used to track individuals wearing these clothes. It can be used to **track prisoners** who break through (flee) from prisons.

AIRLINE BAGGAGE RECONCILIATION

An RFID is now being used in **Airlines** also. It is estimated that lost luggage costs the airline industry in excess of $100 million annually **tracking luggage** with RFID causes significant reduction in lost baggage. It reduces cost of compensation payments to customers and consequently improves customer service.

Vehicle anti-theft system and car immobiliser (which prevents the vehicle from moving or operating normally):

RFID is used in controlled access to vehicles, parking areas and fuel facilities- depot facilities being typical.

RFID immobilizer is used in automobiles to prevent the vehicle from being stolen. It has been ten years since the Ford Motor Company first introduced an RFID immobilizer and such systems are common in vehicles manufactured by the other major manufacturers as well.

RFID microwave would set itself to properly cook an entrée. An RFID equipped refrigerator can report on phone that it's out of milk. If you keep ingredients on a RFID counter it suggests appropriate recipes.

RFID can also directly connect physical objects to internet. For example, if you don't remember how to program your TV remote control, you can just wave it in front of an RFID reading internet terminal which will automatically bring up the latest instruction page from the manufacturer's website.

For the manufacturers, RFID provides labor savings and operational efficiency which return top-line benefit across production lines and through distribution**. Manufacturers can track products through all points of production on and off the line, throughout the product's life cycle**

This helps reduction of errors via automation, such as reduction in mis-shipments, lost inventory and errors in redundant data reads. Productivity gains are also generated by RFID, which enables better management of skilled resources through automation.

TRANSPORTATION AND LOGISTICS

Today RFID finds applications throughout the supply chain, in:

- Manufacturing
- Distribution
- Retail
- Consumer applications

RFID allows visibility across the supply chain from manufacturer to distributor, which increases efficiency throughout. This is possible because RFID technology's ability to collect real time information (where, when, condition) and store that information online, allowing for request based online access by all value chain players.

RFID has the potential to determine how far a product has traveled through the manufacturing cycle, determining how far downstream it is and offering true product visibility. This generates tremendous benefits, instantly detailing when a product was manufactured, whether the retailer has received it or where it is now. In this way, RFID ensures consistency of data throughout a business. Furthermore, this data can be shared across cooperative networks that feed the whole **supply chain: manufacturer, distributor, broker, retailer and end consumer.**

Gillette is among one of the manufacturers leading in implementing RFID in its products. Any merchandise shirts, shoes etc. can be tagged.

Some of the other prominent applications include:

1. Asset management: Protection of valuable equipment against theft, unauthorized access or removal.
2. Access Control: To Control access of personnel to secure or hazardous locations.
3. Time and attendance: To replace conventional "slot card" time keeping system.
4. Animal husbandry: for identification, especially in poultry farms etc., in support of individualized feeding programmes.
5. Sport time recording.
6. Electronic monitoring of offenders at home.
7. Postal, courier, cargo tracking.
8. Pharmaceutical Industry and healthcare
9. Waste management.
10. Building security, and library systems.

Use of RFID is endless. It is used in healthcare, pharmaceuticals, food industry, military, animal (pets) identification, security access, anti-theft retail systems, asset and inventory tracking, automatic toll collection, livestock and wildlife (endangered species) tracking, house arrest monitory system, manufacturing and processing (work in process data), shipping container and air cargo tracking, fleet (group of aircraft or ships sailing together commanded by the same person, especially during war) tracking. Thus the data stored in RFID tags is used for identification in any process, it may be merchandise, vehicle or any other asset, animals or individuals. RFID has applications in every sector of industry, commerce and services where data can be collected. The attributes of RFID are complimentary to other data capture technologies. Therefore RFID is used for those applications where other data capture technologies cannot survive.

STANDARDIZATION

If the unique advantages of RFID were the good news, then the incompatible RFID standards was the corresponding bad news. All major RFID vendors offered proprietary RFID systems a few years ago. The standards based on incompatible RFID systems existed for rail, truck, air traffic control and tolling authority usage. The lack of open systems interchangeability had severely crippled RFID industry growth as a whole. However, a number of organizations have been working to address and hopefully bring about some commonality among competing systems, both in the US and in the Europe where RFID has made greater market inroads. ISO has already adopted international RFID standards for animal tracking, ISO 11784 and 11785.

It is only recently that a few standards that define the various aspects of operation of the RFID Technology have come up. Some of them are: The Auto-ID standard set up by Uniform Code Council (UCC) and EAN International, and promoted by the Auto-ID consortium. At present, the UCC standards offer the most compatible technology for RFID systems, and are the de-facto standards for all commercial implementations. [1]

THREAT TO PRIVACY

If "live" unique RFID tags pass beyond the point of sale and are carried out into the consumer's world, they pose a strong threat to privacy. The unique ID in a garment or a car could be read silently by any organization, the organization doing the surveillance need not be the manufacturer or retailer, it may be a hobbyist snoop or a private investigator. (a snoop is a person who secretly looks around a place in order to obtain information, especially in ways that people do not consider proper or legal.) Thus people can misuse customer information. They may even sell it to some other organization. Businesses, which allow RFID devices to escape live from their premises, will be recklessly endangering the privacy of their customers. Vast databases of records of people's movements will become available to telemarketers, Government investigators and divorce lawyers. This scenario must be avoided, by ensuring that no RFID tags contaminate the consumer world.

To protect privacy, any business selling articles to consumers, containing an RFID device should permanently disable them at the point of sale. Alternatively, an explanatory warning must be attached to the tag indicating that the consumer must remove the tag before use. Another way is to attach the tag to the price tag, which the customer usually removes prior to use.

As such RFID is in controversy because it can track the customers who buy the merchandise. Consequently their privacy is at threat. It is essential to "kill" (destroy) the chip at the point of purchase, once it's pricing and inventory functions are completed. But some people disagree with the idea of "killing" RFID chips as they can imagine some post purchase uses for the tiny chip. For eg. A reader equipped washing machine could properly adjust itself for the clothes that have been loaded, provided the clothes have RFID chips in them.

RFID - MYTHS AND REALITIES

With increasing use of RFID technology in many applicable areas calls for better understanding of myths and realities of the said technology. Following are some of those which need clarification to the end users of the RFID.

HARMFUL TO HEALTH?

People have a misconception that RF waves are hazardous to health. However this is not true. RF signals are not harmful for human beings and the environment. The power levels used for any RFID applications are well below the power levels that have harmful effects. In fact passive RFID tags do not radiate RF energy, but simply reflects it. Therefore there are no health dangers caused by proximity to or wearing clothing containing RFID tags.

TRACKED BY CAR KEYS?

Some automobile manufacturers include RFID system in the vehicles for vehicle tracking, as immobilizer, for vehicle safety in general. People think that they can be tracked by their car keys. This is not possible because the transponders used have a very short reading range (typically a few inches) and use encryption between the key and the reader. During manufacture of the vehicle, the engine management computer generates a different random number (that is, the secret key for encryption) for each and every key. Unless that secret number is known, the vehicle key will not respond. In addition, the reader would have to be within inches of the key to give the key enough energy to even work.

CITIZEN'S PRIVACY?

The general public has a threat that governments will implement RFID system to keep an eye on every citizen to deter crimes. But this is just a misunderstanding as the infrastructure costs for a government entity to track all citizens would be astronomical. It would require a tremendously large data base to keep a track of each and every citizen moving from point to point. The practicality of such an application is well beyond any government's capability to afford the infrastructure and data management issues.

INTERFERE (ELECTROMAGNETIC INTERFERENCE) WITH OTHER SIGNALS USED BY GOVERNMENT BODIES?

Some people fear to use RFID system thinking that the RF signals may interfere with other signals used for tracking by Government bodies and consequently create problems for them. This is not true as governing bodies worldwide restrict the output power of RFID systems. It is illegal to exceed these limits, and in most countries it is a condition of sale that the RFID equipment operates at regulated frequencies.

REPLACE BARCODES?

Though RFID have a lot of advantages over barcodes RFID will not replace bar codes.

RFID and bar code will live side by side in the supply chain for years to come. Certain transactions will be executed automatically as goods pass through RFID portals, while other operations will take place by workers scanning bar-code labels. RFID can be layered-in on top of existing ERP or Warehouse Management System (WMS) solutions, letting both forms of data capture transact with a single system of record with out disruption to the ERP or Warehouse Management System.

CONCLUSION

Radio Frequency Identification (RFID) is an automatic data capture (ADC) technology, which comprises of a small data carrying token called tag and a fixed or mobile scanner called reader, which allows non-contact reading.

The reader transmits electromagnetic waves (low-power radio signal), through its antenna. The tag receives it through its own antenna to power its chip. This signal serves as a request for the RFID tag to transmit the identifying number. The RFID reader reads the information from the chip (RFID tag) without direct contact. The interrogators and the transponders are available in a variety of shapes and sizes.

RFID systems are distinguished by their frequency ranges as low frequency system and high frequency system. RFID tags are categorized as either active, passive or semi-passive. There are two types of tags: read-only and read-write tags.

RFID technology has several advantages over barcode system; they are: No stock storage constraint, High Speed, Read and Write capability, Minimum Loss/Damage, No Human Intervention, Less Operating time, Capability to hold large information etc. however it has a few drawbacks as well; they are: tag collision, cost, RF waves are reflected by metallic surfaces, absorbed by water at high frequencies, RF signal's strength reduce when passed through walls and through large distances, RFID system can be compromised etc.

RFID find applications in almost all known areas like automated toll collection, personnel surveillance, tracking assets, vehicles, paper currency, animals, airline luggage and even prisoners, throughout supply chain: in manufacturing, distribution (transport and logistics), in retail (electronic articles surveillance and smart-shelves), consumer applications (in washing machine, refrigerators),time and attendance marking, sport time recording, postal, courier, cargo tracking, pharmaceutical industry and healthcare,, waste management, in library system and the list is unending.

Though there are a few myths regarding RFID, a greater awareness is overcoming the hurdles, and more and more people from diversified domains are embracing RFID technology.

REFERENCES

1. Angeles, R., (2005) 'RFID Technologies; Supply-Chain Applications and Implementation Issues', Information Systems Management, Vol.22, Issue 1, Pg.51-61
2. Brady, M., (2003) 'Managing Information Technology Assimilation; A Marketing Perspective', Irish Journal of Management, Vol.24 Issue 1
3. Del Conte, N.T., (2006) 'HP Unveils RFID's Future Competitor', www.pcmag.com
4. Glazer, R., (1991) 'Marketing in an Information-Intensive Environment; Strategic Implications of Knowledge as an Asset', Journal of Marketing, Vol.55 Issue 4, Pg.1- 19
5. Holland, C.P & Naude, P., (2004) 'The metamorphosis of marketing into an Information-handling problem', Journal of Business & Industrial Marketing, Santa Barbara, Vol.19, Issue 3, Pg.167-177
6. McGovern,G., (2000) 'Managing Information in the Digital Age; How the Reader is King', Irish Marketing Review, Vol.13, Issue 2
7. D.D & Gordon, G.L., (1995) 'Marketing Information systems for consumer products companies: a management overview', Journal of Consumer Marketing, Vol.12, Issue 5, Pg.16-36
8. Piercy, N., (1981) "Marketing Information bridging the quicksand between technology and decision-making', The Quarterly Review of Marketing, Autumn, Pg.1-15
9. Twist, D.C., (2005) 'The impact of radio frequency identification on supply chain facilities', Journal of Facilities Management, Vol.3, Issue 3, Pg.226-236
10. Smith, A. (2005), 'Exploring radio frequency identification technology and its impact on business systems', *Information Management & Computer Security*, Vol.13 No.1, pp.16-28.
11. http://analytica-india.com/rfid/ (Date of view: 25 Aug 2011)
12. http://www.afeindustries.com/rfid_faq.htm(Date of view: 25 Aug 2011)
13. http://www.infologixsys.com/products/RFID(Date of view: 27 Aug 2011)
14. http://www.ala.org/ala/pla/plapubs/technotes/rfidtechnology.cfm(Date of view: 2 Sept 2011)
15. http://www.msu.edu/~sarbjenn/shoebox/school/TC201/index.html(Date of view: 2 Sept 2011)
16. http://www.flickr.com/photos/28129213@N00/sets/1631755(Date of view: 4 Sept 2011)
17. http://www.printronix.com/public/productsolutions*(Date of view: 4 sept. 2011)*
18. http://www.Rfid.org(Date of view: 5 Sept 2011)
19. http://www.Aimglobal.org(Date of view: 5 Sept 2011)
20. http://www.Junkbusters(Date of view: 5 Sept 2011)
21. http://www.Msnbc(Date of view: 6 Sept 2011)
22. http://www.msu.edu(Date of view: 5 Sept.2011)
23. http://www.tri-mex.com (tri-max- transport security for a changing world) (Date of view: 7 Sept 2011)
24. ISO/IEC JTC1 SC31 WG4 SG3 18000-6 Proposal, 2002: Information Technology AIDC Techniques-
25. RFID for Item Management - Air Interface, Part 6 - Parameters for Air Interface Communications at UHF.
26. Lewis, S., 2004: A basic introduction to RFID technology and its use in the supply chain, Laran RFID,
27. White paper.
28. Rieback M. R., Crispo B., Tanenbaum A. S., 2006: Is Your Cat Infected with a Computer Virus?, 4th Annual
29. IEEE International Conference on Pervasive Computing and Communications, Pisa - Italy,
30. http://www.rfidvirus.org/papers/percom.06.pdf.
31. Shutzberg L., 2004: Radio Frequency Identification (RFID) In the Consumer Goods Supply Chain, Rock-
32. Tenn Company, www.packagingdigest.com/newsite/Online/RFID_IWP.pdf.

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