A

Seminar report

on

Radio Frequency Identification

Submitted in partial fulfillment of the requirement for the award of degree of MCA

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Preface

I have made this report file on the topic **Radio Frequency Identification**,, I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to ……..who assisting me throughout the prepration of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

Introduction

In context of Radio Frequency Identification (RFID), the phrase RFID infrastructure describes the IT-infrastructure which is necessary to collect, filter and enrich raw RFIDdata before processing it to the backend-systems (business intelligence systems like ERP,etc.). In our case, we are focusing on the software components doing this job. Hence middleware and infrastructure are to be used synonymously in this report.

In order to standardize the technical description of each vendor"s solution, we have derived a set of evaluation criteria. Furthermore we have defined three phases the act of processing RFID-data typically has to go through if working properly. This was done by identifying and generalizing the several steps to be performed. Hence the abstract task of preprocessing data could be distinguished into three phases:

1. collecting data by managing the RFID-reader(s)

2. enriching this collected data for further use (e.g. by filtering, accumulating, etc.)

3. exchanging enriched data with backend-systems

Thus we have an n-tier design approach for RFID-middleware (usually a 3- tierarchitecture presuming one layer for each phase). As further reading will show, nearly all solutions meet this approach.

History

In 1945 Léon Theremin invented an espionage tool for the Soviet Union which retransmitted incident radio waves with audio information. Sound waves vibrated a diaphragm which slightly altered the shape of the resonator, which modulated the reflected radio frequency.

Even though this device was a covert listening device, not an identification tag, it is considered to be a predecessor of RFID technology, because it was likewise passive, being energized and activated by waves from an outside source.

Similar technology, such as the IFF transponder developed in the United Kingdom, was routinely used by the allies in World War II to identify aircraft as friend or foe. Transponders are still used by most powered aircraft to this day.

Another early work exploring RFID is the landmark 1948 paper by Harry Stockman, titled "Communication by Means of Reflected Power" (Proceedings of the IRE, pp 1196–1204, October 1948). Stockman predicted that "... considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved, and before the field of useful applications is explored."

Mario Cardullo's device, patented on January 23, 1973, was the first true ancestor of modern RFID, as it was a passive radio transponder with memory. The initial device was passive, powered by the interrogating signal, and was demonstrated in 1971 to the New York Port Authority and other potential users and consisted of a transponder with 16 bit memory for use as a toll device.

The basic Cardullo patent covers the use of RF, sound and light as transmission media. The original business plan presented to investors in 1969 showed uses in transportation (automotive vehicle identification, automatic toll system, electronic license plate, electronic manifest, vehicle routing, vehicle performance monitoring), banking (electronic check book, electronic credit card), security (personnel identification, automatic gates, surveillance) and medical (identification, patient history).

An early demonstration of *reflected power* (modulated backscatter) RFID tags, both passive and semi-passive, was performed by Steven Depp, Alfred Koelle, and Robert Freyman at the Los Alamos National Laboratory in 1973. The portable system operated at 915 MHz and used 12-bit tags. This technique is used by the majority of today's UHFID and microwave RFID tags.

The first patent to be associated with the abbreviation RFID was granted to Charles Walton in 1983

What is RFID?

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects.

There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag).

The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it

COMPONENTS

Basically, a RFID system consists of the following three components:

1. An antenna
2. A transceiver (with decoder)
3. A transponder (commonly called a RF tag) that is electronically programmed with unique information. Often the antenna is packaged with the transceiver and decoder to become a reader.

The fig above shows a RFID system where the data can be read from as well as written to the tag. It consists of a reader which is used to read/write data to RFID tags and a tag is used to transmit data to the reader. The communication between them is made possible by the use of defined radio frequency and protocol to transmit and receive data from tags. The controller is the interface between one or more antenna and the device requesting information from or writing information to the RF tags.

1 ANTENNA /READER

Antennae are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. The antenna emits radio signals to activate the tag and read and write data to it. Each RFID system includes at least one antenna to transmit or receive the RF signals. It may have a single antenna as a transmitter and receiver or may have separate antennae to transmit or receive. A reader and an antenna may be two different pieces of equipment or may be integrated into one. An antenna is designed to read in a certain range. When selecting a combination of tags and antenna, it is important to keep in mind the desired purpose of the tags. Depending on application the range of antennae is selected. If the tag is placed near to the antenna then an antenna with a short range may be selected and if it is desired to find something in a warehouse then, it is important to select an antenna that is able to read the tags from a long distance.

Another consideration in selecting a reader and antenna is the no of tags that can be read at one time. It is possible for an antenna or reader to read hundreds of tags at once. This is useful when the user want to gather some information regarding inventory on a truck leaving a ware house or entry of all packages at a checkpoint that are traveling in a large pallet and have gone through a specific routing center.

2 RF TAGS

RF tags come in all shapes and sizes depending on the application. Animal tracking tags inserted beneath their skin, can be as small as pencil lead in diameter and 1.3 cm in length. Tags can be of screw shaped to identify trees or wooden items, or credit cards shaped for use in access application. The anti theft hard plastic tags attached to merchandise in stores are RF tags. RF tags can even be integrated into labels or composite blocks or can be even mounted on non ferrous magnets. The fig below shows a Keyring RFID tag.

There are two types of tags:

1. Passive tags, and
2. Active tags

a. PASSIVE TAGS

Passive tags do not carry on-board power and derive it from the reader to enable reading and writing to the tag. This gives a tag practically unlimited life but a shorter range. They are activated only when they are read or interrogated by another device first. Data storage on a passive tag is a fairly limited. Hence capacity is often measured in bits rather than bytes. However for most application, a relatively small amount of data is needed to be codified and stored on the tag. So the limited capacity doesn't pose a major problem.

Passive tags are ideal for tracking of high value and critical items like designer clothing, ammunition, computer equipments and chemicals. The range of passive tags is principally determined by the type and size of reading antenna. These can be read or written from up to 10 meter away. Up to 500 individual tags can be read in a second.

The ability to precisely locate items makes passive tags more conducive to remote monitoring than conventional bar coding or other inventory tracking methods. Passive tags don't require a battery as this draw operating power from the RF beam of the device that reads or interrogates the tags which is why passive tags can be made as small as a grain of rice. With no battery and no moving parts, Passive tags have a very long life.

The drawbacks of passive tags are limited data storage capacity, small output power and short range of communication. Also these don't perform well in electromagnetic environments.

b. ACTIVE TAGS

Active tags are the true transmitters of the information. These tags can initiate communication

with the antenna and provides faster and higher storage capacity. Active tags have a built in power cell. These offer a higher communication range but there life is limited to the life of the power cell. These can be read and updated from hundreds of kilometers away. In addition to locating items, these systems can determine the physical condition of the items being tracked and monitored. For this, the tag is connected to multiple sensors used to monitor temperature,

humidity, breakage and other data. The tags can then communicate the data gathered by the sensors to the users. Active tags must be large enough to accommodate a powerful battery and are typically more expensive than passive tags. Frequent use of transmitter tends to shorten their lifetime.

3 Controllers

The controller is the interface between one or more antenna and the device requesting information from or writing information to the RF tags. There are controllers for interfacing antenna to PCs servers and networks. The selection of controller and interface device will affect the antenna's transmission speed. Some controllers can be programmed to perform data translation and interrogation. This transfers some of data processing load from the devices to the controllers.

How does an RFID system work?

- An RFID system consists of a tag, which is made up of a microchip with an antenna, and an interrogator or reader with an antenna.
- The reader sends out electromagnetic waves.
- The tag antenna is tuned to receive these waves.
- A passive RFID tag draws power from field created by the reader and uses it to power the microchip's circuits.
- The chip then modulates the waves that the tag sends back to the reader and the reader converts the new waves into digital data.

How is RFID used in the real world?

Many consumers are already familiar with one form of RFID – the toll-pass that drivers can keep inside their cars to go through toll booths without having to stop to pay.

The chip in the toll-pass sends information to a reader located in the toll booth. This information, the reader's location, and the time and date of the reading are then transmitted to a computer system, which may be linked to databases containing other information such as the toll fee and the bank account that will be billed for the toll.

Another use of RFID that some consumers are familiar with are payment systems that allow them to wave a tag in front of a reader on a gas pump to fill up a gas tank. RFID technology is also being used to control entry into certain buildings.

Some pet owners are having their dogs or cats implanted to help track them in case they get lost, and the U.S. Food and Drug Administration has approved a tag to be implanted in humans containing their patient records for use in hospitals.

RFID is being used in supply chains to track the movement of products from a manufacturer to a distributor to a retailer and any points in between. Depending on their intended use, RFID systems vary in capability, the complexity and cost of the tag, the amount and sensitivity of the information that the chips contain, and the distance from which readers can pick up the signals from the tags.

APPLICATIONS

1. **Consumer availability**

- Monitors self level usage.
- Calculates replacement to avoid self level out of stock condition.
- Extension of retail solution store business functionality.

2. **Automatic check out**

- Detects unit level items gathered for purchase at point of purchase.
- Processes payment generates billing documents and clears theft protection.
- In store functionality.

3. **Security /Access control**

- Validate personal for security clearance, building and system access.
- Utilize for movement tracking.
- Notify secure personnel through SCEM of unauthorized activity.

4. **Theft protection**

- Monitors store level inventory at the SKU level.
- Validates that a particular SKU has been purchased.
- Alerts store personnel if invalid through SCEM.

Advantages and Disadvantages of RFID Technology

Advantages

- The tag does not need to be in line of sight with the receiver to be read (compare to a barcode and its optical scanner) (Shepard, 2004, p. 58).
- RFID tags can store a lot of information, and follow instructions
- Has the ability to pinpoint location
- Technology is versatile: can be smaller than a thumb tack or can be the size of a tablet, depending on its use
- According to a report that studied the use of RFID within the average Vendor Managed Inventory (VMI), carried out by Professor Tsan-Ming Choi of the Hong Kong Polytechnic University, it was concluded that the use of RFID actually enhanced each supply chain's system performance and increased expected profit (2011).

Disadvantages

- Active RFID can be expensive because of batteries
- There still needs to be regulations about RFID guidelines
- There is a privacy concern towards RFID devices, for example some claim that Wal-Mart is infringing on natural rights by overseeing what customers buy
- RFID may be easily intercepted, even if it is Encrypted (Shepard, 2004, p. 58).
- It takes a lengthy time to program RFID devices

Problems with RFID

1.Technical problems with RFID

Problems with RFID Standards

RFID has been implemented in different ways by different manufacturers; global standards are still being worked on. It should be noted that some RFID devices are never meant to leave their network (as in the case of RFID tags used for inventory control within a company). This can cause problems for companies.

Consumers may also have problems with RFID standards. For example, ExxonMobil's SpeedPass system is a proprietary RFID system; if another company wanted to use the convenient SpeedPass (say, at the drive-in window of your favorite fast food restaurant) they would have to pay to access it - an unlikely scenario. On the other hand, if every company had their own "SpeedPass" system, a consumer would need to carry many different devices with them.

RFID systems can be easily disrupted

Since RFID systems make use of the electromagnetic spectrum (like WiFi networks or cellphones), they are relatively easy to jam using energy at the right frequency. Although this would only be an inconvenience for consumers in stores (longer waits at the checkout), it could be disastrous in other environments where RFID is increasingly used, like hospitals or in the military in the field.

Also, active RFID tags (those that use a battery to increase the range of the system) can be repeatedly interrogated to wear the battery down, disrupting the system.

RFID Reader Collision

Reader collision occurs when the signals from two or more readers overlap. The tag is unable to respond to simultaneous queries. Systems must be carefully set up to avoid this problem; many systems use an **anti-collision protocol** (also called a **singulation protocol**. Anti-collision protocols enable the tags to take turns in transmitting to a reader. (Learn more about RFID reader collision.)

RFID Tag Collision
Tag collision occurs when many tags are present in a small area; but since the read time is very fast, it is easier for vendors to develop systems that ensure that tags respond one at a time. (Learn more about RFID tag collision.)

2.Security, privacy and ethics problems with RFID

The following problems with RFID tags and readers have been reported.

The contents of an RFID tag can be read after the item leaves the supply chain
An RFID tag cannot tell the difference between one reader and another. RFID scanners are very portable; RFID tags can be read from a distance, from a few inches to a few yards. This allows anyone to see the contents of your purse or pocket as you walk down the street. Some tags can be turned off when the item has left the supply chain; see zombie RFID tags.

RFID tags are difficult to remove
RFID tags are difficult to for consumers to remove; some are very small (less than a half-millimeter square, and as thin as a sheet of paper) - others may be hidden or embedded inside a product where consumers cannot see them. New technologies allow RFID tags to be "printed" right on a product and may not be removable at all (see Printing RFID Tags With Magic Ink).

RFID tags can be read without your knowledge
Since the tags can be read without being swiped or obviously scanned (as is the case with magnetic strips or barcodes), anyone with an RFID tag reader can read the tags embedded in your clothes and other consumer products without your knowledge. For example, you could be scanned *before* you enter the store, just to see what you are carrying. You might then be approached by a clerk who knows what you have in your backpack or purse, and can suggest accessories or other items.

RFID tags can be read a greater distances with a high-gain antenna
For various reasons, RFID reader/tag systems are designed so that distance between the tag and the reader is kept to a minimum (see the material on tag collision above). However, a high-gain antenna can be used to read the tags from much further away, leading to privacy problems.

RFID tags with unique serial numbers could be linked to an individual credit card number

At present, the Universal Product Code (UPC) implemented with barcodes allows each product sold in a store to have a unique number that identifies that product. Work is proceeding on a global system of product identification that would allow *each individual item* to have its own number. When the item is scanned for purchase and is paid for, the RFID tag number for a particular item can be associated with a credit card number.

CONCLUSION

After examining the three fields Health care, Games and Human Activity Detection with regard to the usage of RFID technology we will now try to present the overall observations and draw some conclusions. The scenarios presented show that RFID technology is a technology with a promising future, even if there are still some problems and limitations that need to be solved.

Above all there is the need for small tags but especially for smaller readers. In the field of gaming, small tags are necessary for cards, puzzle pieces or counters. There is also a demand for smaller readers that can be integrated into areas of board games. Regarding Healthcare the wrist band scenario indicates the requirement for smaller tags as well, so the wrist band may be built very small and does not handicap the patients.

In the human activity scenarios describing the GETA sandals and the iBracelet the need for small erreaders is obvious. Of course there are quite small tags available but not for a price that allows an unlimited extensive integration. Ina card game with 52 cards like the smart playing cards presented in section, very small tags need to be attached to each card.

The same applies to puzzles like the smart jigsaw puzzle with 1000 smart pieces and of course to healthcare systems since each test tube, blood bottle and all patients may be equipped with tags or readers.

If you consider only one tag, a price of about 20 Cent is no object, but if you have to integrate thousands of tags in a small application it gets relevant. The matter of size becomes even more problematic as the RFID tags and readers are combined with other technologies leading to enriched functionalities but also to larger sizes as the motion sensitive WISPs.

Reference

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