RFID: Big Brother Gets Small

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Introduction

Imagine going to the grocery store, filling your cart with the goods that you need, and simply walking out of the store without stopping at the check-out counter. This situation is quickly becoming a reality, and if the major supermarkets get their way, waiting in the check-out line will soon become a thing of the past. Soon, a computer will automatically scan every item in your basket as you exit the building and the credit card or checking account of your choice will automatically be billed for your purchase.

The technology responsible for this remarkable scenario is Radio Frequency Identification (RFID), and it is becoming more and more present in our daily lives. RFID, especially in the form of RFID tags, is quickly permeating every aspect of our lives. Soon almost every item we see in our every day lives will possess some sort of RFID tags, silently beaming its content to anyone who requests the information.

Background – The Function and History of RFID Tags

RFID and the subsequent RFID tags focused on in this paper have been around longer than one would think. RFID tags are small electronic circuits which rely on the RF band of the electromagnetic spectrum to receive and transmit data. They are typically composed of a very small transceiver (typically possessing some small amount of memory) and an RF antenna. To make them small, there is no battery, but instead, a

small pulse of energy is sent from the requesting host which activates the RFID tag and provides enough energy for the tag to perform its task.

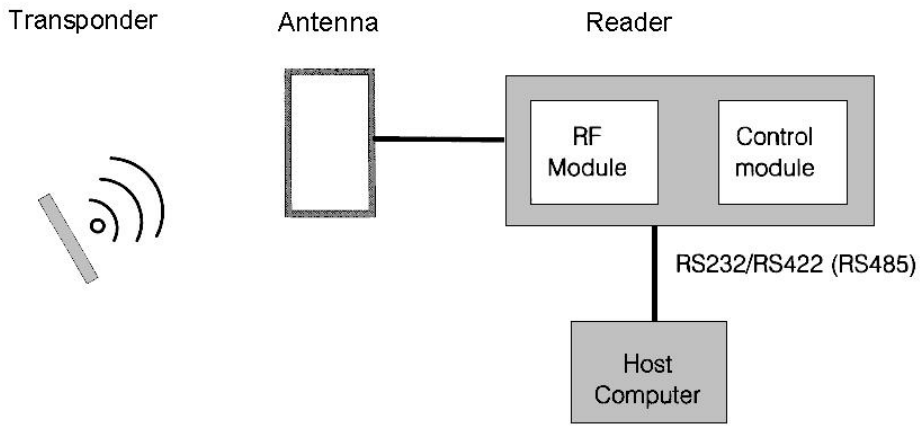

Figure 1 - A basic RFID send/receive setup

The first practical use of an RFID-like device occurred during World War II. During this time, radio frequency transponders, coupled with newly developed radar, were used to help distinguish between "friend" and "foe" aircraft. This same basic system is still employed today in air traffic control systems. The 1950's and 60's were a busy time for researchers in the radio communications field, but it was not until the 1970's when RFID began to find its place in the consumer market.

The first major RFID tag breakthrough came in 1972 when Schlage Electronics—now known as NexWatch—developed a simple RFID card. This card contained several circuits which were contained in a military-grade fiberglass card. This was an analog card which was "tuned" for a specific purpose. These cards were simple proximity cards which transferred information when they were passed near a card reader. Another company that made use of RFID technology in the 1970's was Identronix, which began implanting tags into animals. These tags were used for identification, temperature

monitoring, and automatic food dispensing. RFID tags were also developed for use in transportation, security, and wireless garage door openers.

The 1980's brought about even more advancement for RFID tags, especially in the areas of size and cost – both power consumption and dollar cost. This lead to RFID tags becoming popular for use in access control and security cards. France, Italy, and a few other countries also adopted systems for toll roads using RFID tags, though these systems were rarely implemented in the U.S. at this time.

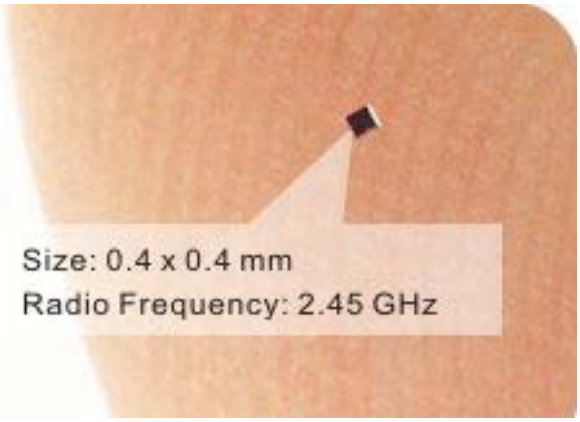

Figure 2 – Hitachi's μ-Chip (pronounced mu-chip).[1]

The 1990's brought tremendous growth in the RFID market, especially with the implementation of advanced tolling programs that would allow travelers to be tolled while still traveling at highway speeds. Other areas of expansion included retail product markets, medical technology, and anti-counterfeit measures for currency. This decade also brought the emergence of standardization for RFID protocols, which cemented RFID as an everyday part of our lives.

Today, RFID is advancing forward at an incredible pace, with new technologies emerging almost as fast as new companies are coming forward promising sweeping change in our lives. RFID tags are now field programmable (programmable outside of

the factory) and are moving towards a true read/write on the fly technology. On the forefront of this movement are new applications in retail markets, which include vending machines, mass transit, parking systems, gasoline dispensing, airline baggage tagging, and just about every other market imaginable. RFID promises to change the world, and as technology pushes forward, it is clear that many things that we take for granted today are going to be different tomorrow.

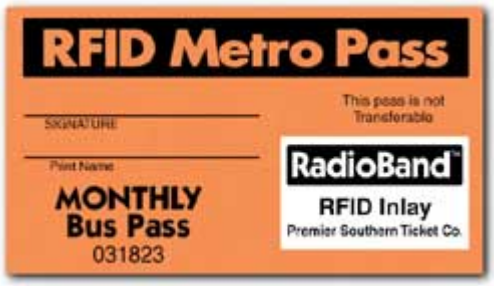

Figure 3 - Example of a RFID enabled bus pass[2]

Privacy and Security Issues

What are you buying?

You would be hard-pressed not to admit that RFID can make improvements to many everyday situations and change the lives of billions of people in one swift stroke. There are, however, very difficult and complex security and privacy issues raised by RFID tags and similar technology.

Imagine you are shopping at your friendly neighborhood grocery store. You walk the aisles, filling your cart with all the necessary products, when you come to the personal hygiene aisle. You reach for your favorite pack of razor blades, and without your knowledge, the RFID tag embedded in that box of razor blades signals a computer

located in the store that they are being removed from the shelf. The computer then instructs a camera that is focused on the aisle to take your picture. The picture is then sent electronically to the blade manufacturer, who immediately adds you to their database of customers. This database can then be used to send you mailings, product info, coupons, or be sold to other companies who can do the same. Within days of purchasing those razor blades, you could be inundated with junk mail. Is all of this worth it for razor blades?

This scenario may be frightening, but it is true. Recently, Tesco, a large supermarket chain in England, "reportedly photographed customers removing Gillette razors from the shelves."[3] The idea was that Tesco was going to be the test market for Gillette's new RFID product tags, but privacy groups got word of what was happening and immediately began protesting the invasion of privacy that the photographs were causing. The group also called for a world-wide boycott of all Gillette products. "'We want to send a clear message to Gillette and other companies that consumers will not tolerate being spied on through the products they buy,' said Katherine Albrecht, director of Caspian."[4]

Clearly, a company should not be able to photograph you without your knowledge whenever you buy their product, especially if they intend to use the information for their own gain. Gillette claims that they did not intend to use the RFID information for anything other then the improvement of the efficiency of their supply chain. This is all well and good, but what happens when someone with the wrong intentions gets a hold of this information. Even worse, what happens when the RFID tag that is transmitting this information is not located on a disposable product?

Where are you?

In the past, people were worried about the government spying on them from the sky with sophisticated spy satellites. Now, those spy satellites are almost microscopic and can be sewn into the fabric of your clothes. This technology is quickly becoming a reality. A German company named KSW-Microtec has developed an RFID tags that can be washed in a washing machine, and can be sewn into clothes without adding bulk to the product. While fascinating, this technology creates some very alarming problems. Imagine that "the Gap links your sweater's RFID tag with the credit card you used to buy it and recognizes you by name when you return. Grocery stores flash ads on wall-sized screens based on your spending patterns, just like in 'Minority Report.' Police gain a trendy method of constant, cradle-to-grave surveillance."[5]

Crooks with high tech scanning devices could scour malls and stores looking for RFID tags from expensive items, giving them a clue to the nature of one's wealth. RFID tagged clothing will allow anyone with the right equipment to track your every move. Shoes are already being targeted with RFID tags for athletic events, and many clothing manufacturers are exploring the possibility of tagging all garments. Unfortunately clothing is not the only item that will allow you to be tracked.

Many new cars come equipped with RFID enable keys. These keys contain a unique code which, when inserted into the ignition, sends a signal to the starter that the key is for that car, and allows you to start the car. Automobile manufacturers could also conceivably use the RFID technology in your key to record your position and movements.

Another potentially technology which may be abused is the Controller Area Network (CAN) system found in many of today's vehicles. This system is a group of protocols used for in-vehicle communication between different systems in an automobile. The problem arises in the fact that this system could be used to monitor every action that the car makes. Then, when you take the car into the dealership for scheduled maintenance, the company could download the car's information. They would then have a record of everywhere you went, when you went there, and how fast you were traveling. They could even setup the system to monitor for erratic driving behavior. Imagine receiving a speeding ticket in the mail, but no policeman or photo radar ever saw you speeding. While this may not hold up in court today, in the future, laws may be in place allowing this CAN evidence to be used against a driver.

What's in your wallet?

Another application of RFID tags currently being heavily invested in is in the area of anti-counterfeit measures for money. The main constituent in the push for RFID tagged currency is the European Union (EU). On January 1, 2002, the EU introduced the Euro, a unified currency that would replace the currency in twelve different European nations. To help counteract counterfeiting of the new currency, the EU is hoping to have a new RFID tagging system in place by 2005. Each piece of currency will have a tag with a unique code which should be irreproducible by counterfeiters. "In theory, an RFID tag's ability to read and write information to a bank note could make it very difficult, for example, for kidnappers to ask for 'unmarked' bills. Further, a tag would give governments

and law enforcement agencies a means to literally 'follow the money' in illegal transactions."[6]

Figure 4 - The Euro[7]

Regrettably, this also means that the governments would also be able to track the money when it is not being used in illegal transactions. This would mean that any money you had in your possession could be used to track you, no matter which EU country that you were in. "This private data can be used against you," said Katherine Albrecht, founder and director of Consumers Against Supermarket Privacy Invasion and Numbering. 'It will essentially eliminate the anonymity of cash.' She outlined a nightmare scenario in which 'it would be possible to track all the cash issued to an individual and invalidate it with a couple of keystrokes' -- a literal case of 'your cash is trash."[8] It is ironic that a technology developed to protect us from criminals may not protect us from our own governments.

Conclusion

It is clear that RFID technology promises sweeping changes in almost every aspect of everyday life, but unfortunately, those changes do not come without some serious dangers. The issues listed in this paper are just a sampling of the more severe

problems caused by this technology. One could spend days listing all of the ways that this technology could be abused and the violations of privacy and security that could be created. Luckily, the people developing this technology seem to have good intentions, but only time will tell whether we will be able to minimize the "big brother" effect, or whether we will be controlled by it.

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[1] http://www.hitachi.co.jp/Prod/mu-chip/
[2] http://www.premiersouthern.com/ radio.htm
[3] Caroline Humer, Radio Tags Face Technical Hurdles, Deadlines, 03 November 2003, <http://story.news.yahoo.com/news?tmpl=story&cid=581&ncid=581&e=3&u=/nm/20031102/tc_nm/bizretail_tags_dc> (03 November 2003)
[4] Andy McCue, Gillette shrugs off RFID-tracking fears, 14 August 2003, <http://zdnet.com.com/2100-1103_2-5063990.html> (07 November 2003)
[5] Declan McCullagh, RFID tags: Big Brother in small packages, 13 January 2003, <http://news.com.com/2010-1069-980325.html> (09 November 2003)
[6] Junko Yoshida, Euro bank notes to embed RFID chips by 2005, 19 December 2001, <http://www.eetimes.com/story/OEG20011219S0016> (08 December 2003)
[7] http:// www.wienerzeitung.at/ frameless/eu.htm
[8] Janis Mara, Euro Scheme Makes Money Talk, 09 July 2003, <http://www.wired.com/news/privacy/0,1848,59565,00.html> (09 November 2003)