RFID Practical Application in the Marijuana Industry

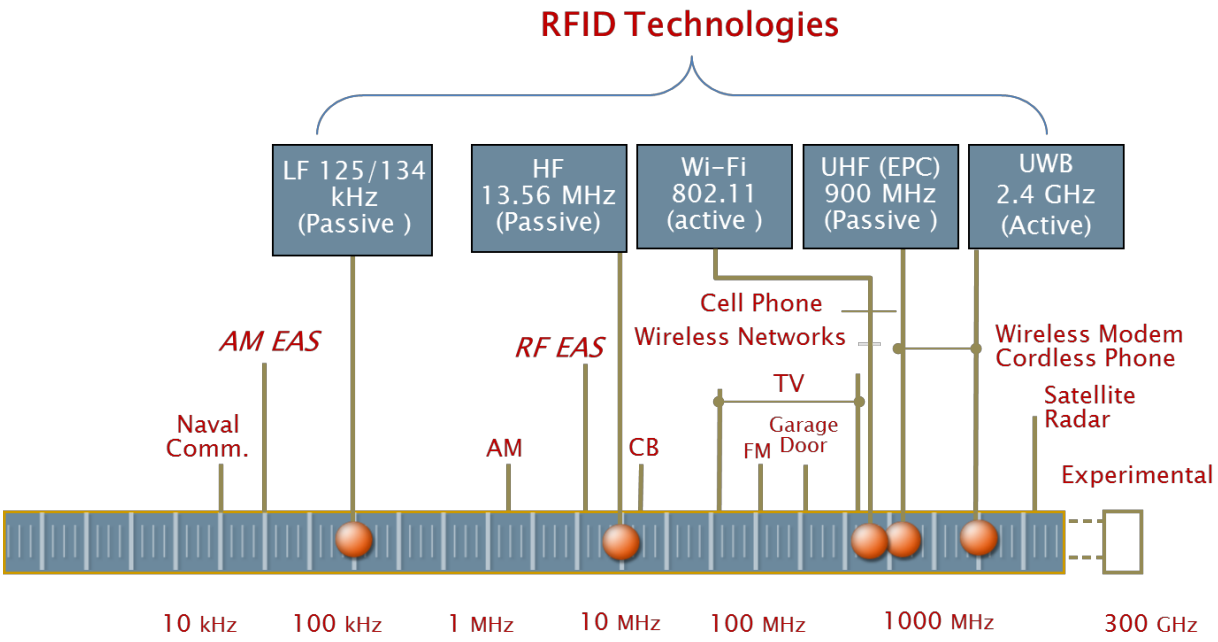
By Scott Denholm

Much has been made regarding Radio Frequency Identification over the past decade. Indeed RFID technology has been heralded as the future of the supply chain by advocates, while opponents of the technology have denounced it as invasive and infringing on personal information. The purpose of this white paper is to define and develop a deeper understanding of the RFID technology, alleviate common misconceptions and explore the benefits and why it was chosen as a positive technology for the marijuana industry.

RFID technology is not new; to the contrary, it has in fact been around since the late 1940's in different forms and fashions, like the IFF systems used on commercial and military aviation. The true ancestor of today's passive RFID was first demonstrated to the New York Port Authority in 1971, and later patented by Mario Cardullo on January 23, 1973. This device was a passive 16 bit tag with a use case defined for automotive vehicle identification and automatic toll collection systems. An early demonstration of reflected power, which is the way RFID tags communicate today, (known as modulated backscatter), was performed by Steven Depp, Alfred Koelle, and Robert Freyman at Los Alamos in 1973. This demonstration used 915 MHz and a 12 bit tag. The concept behind RFID has always been a simple one, automate redundant data capture tasks that are slow and prone to error but are still a necessary requirement.

Through the 1970's, 80's and 90's RFID began to find its way into practical applications in the automotive, livestock and security industries. The tags and technology were expensive and were generally proprietary in nature, making the applications limited and the costs higher than most uses cases could justify.

As is the case today, there are many different forms of RFID, each having advantages and limitations. The application and choice of the technology is primarily derived from the use case it addresses. The chart below shows the different frequencies and the methods of communication.



As examples of practical applications of RFID technology in commercial use today:

- Low Frequency or “LF” – Used for livestock tracking – consumer safety
- High Frequency “HF” – Employee access – safety and security
- Wi-Fi or 802.11 – Asset tracking - Hospital equipment location and status
- Ultra High Frequency “UHF” – Supply chain – consumer product management
- Ultra Wide band “UWB” – precise location of assets or people in a location.

Each of the technologies and frequencies described above come in both passive and active tag formats. An active tag has on-board power in the tag itself while passive tags use energy harvested from the reader device that interrogates the tag. More information about the tag is forth coming.

Of the varying types of technology listed above, the UHF 900 MHz passive technology was chosen as the appropriate technology for the Marijuana industry. To further benefit the industry, the open standard EPC technology was identified as the most cost effective and readily available.

Standards - EPC Gen2

EPC Gen2 is short for *EPC global UHF Class 1 Generation 2*.

EPC Global is a joint venture between GS1 and GS1 US, working on international standards for RFID and the Electronic Product Code. The EPC standard is designed for use in the identification of items between trading partners in the global supply chain. This continues to be a cooperative effort driven by retailers and consumer goods manufacturers working together to lower costs and improve business operations.

The original mission of EPC global was the simplification of several protocols in the RFID development world in the late 1990's and early 2000's. At the time, two air interface protocol's (the air interface protocol is the method of information exchange between a tag and a reader) were defined. These protocols, commonly known as Class 0 and Class 1, saw the beginnings of commercial interest. Retailers like Wal-Mart, manufacturers like Boeing and the US Department of Defense saw the benefits of the technology on their own supply chains.

In 2004, a Hardware Action Group created a new protocol, the Class 1 Generation 2 interface. The EPC Gen2 standard was approved in December 2004. The EPC Gen2 standard was adopted as ISO180006C.

With the development of low cost RFID tags and open standards like EPC Gen 2 / ISO 180006, the adoption of the technology has begun in earnest thus becoming feasible in large or small scale deployments in both open and closed supply chains. These deployments have opened up new possibilities for improving visibility and the elimination of structural problems, such as theft and out of stocks. With better visibility, managers can better enable monitoring and coordination within supply chains. The practical benefits also include, but are not limited to:

- More efficient running business environments
- Precise knowledge of inventory and raw materials locations and stock levels

- Increased throughput and productivity
- Reduced costs, leading to competitive pricing
- Shorter order cycles
- Faster shipping
- Better inventory management
- Better utilized labor costs by redistributing the workforce needed for inventory tracking
- Increased revenues/higher profits
- Better customer service

What is RFID Specifically?

First and foremost RFID is a system. An RFID system is a hands free or wireless way of reading data (usually in the form of an ID number), from a distance, using a specific radio frequency. An RFID system includes: an RFID tag, followed by a reading device, which has radio-enabled communication with the tag and a software component that can interpret the data read from the tag. As mentioned above, there are several variants of RFID technology that also may be passive or active in nature.

Active RFID technology uses a tag that has a power source, located inside of the tag, which helps the tag communicate its data back to the reading device. The data storage and distance it can communicate are significantly greater than that of a passive tag. Active tag capabilities are often confused with passive tag capability. As an example, data storage of an active tag can be thousands of characters while passive tags are hundreds of bytes. Active tags can be read hundreds or even up to 1000 feet, while passive tags are generally less than 20 feet. It is important to not confuse the two types of technology.

For the practical use of this white paper, we will limit the discussion to the passive UHF EPC based technology.

Components of the passive system

The “Tag”, also known as transponder, is made up of several components including:

- An ASIC or “chip”
- An antenna used to harvest energy and transmit data (comes in many shapes and sizes)
- A strap that attaches the chip to the antenna
- A substrate that will capture and maintain the integrity of the assembly

A passive RFID tags utilizes or “harvests” the energy transmitted by the reading device to power the ASIC or “chip” on the RFID tag.

Power is generated from an active RF field emitted by a corresponding RFID reader (interrogator). Passive tags are currently limited in the amount of data they can store, usually from 96 to 512 bytes; information stored on the tag however, is rewritable. Passive tags are also limited in read distance, as mentioned above, and have even greater limitations to the write distance of a few inches.

The Reader or “Interrogator” provides the active RF field, used to energize the tag and read the response from the tag. The reader usually comes with its own antennas as well. Each antenna on the reader can be used to read multiple tags simultaneously and may even be able to be located in different areas. Readers can be of a fixed nature such as a portal, or mobile in nature like a hand held device, or attached to a mobile piece of equipment like a forklift.

The “Reader,” also known as an interrogator, may be made up of several components including:

- The device itself would contain: a radio for communication with the tag, a network interface, logic, memory, some level of data storage that maybe used to run on board programs and antenna connections.
- An antenna(s), used to create the active RF field and return data to the reader (comes in many shapes and sizes)
- A power supply, to power the device
- Examples of fixed and mobile devices below:

Software or Middleware, used to decode and interpret the information from the reader, is the final piece of the RFID system. RFID readers can read tags hundreds of times per minute and can create a significant stream of data. RFID devices are also network appliances. Because of these facts, the RFID middleware or software is unique in that it requires a different level of logic and understanding that traditional data capture devices like a bar-code devices do not. The RFID middleware will control this data flow as well as process, validate and pass on the data to a host system, along with the health and status of the appliance.

How does passive RFID work?

With the basic understanding of the components described above, the functions can be broken out into simplistic operations:

- The RFID Reader generates a radio signal & broadcasts, via its connected antennas configured in an RF field.

- A tag passes through the RF field and receives the corresponding radio signal.
- Radio signal is received by tag's onboard antenna.
- The tag's chip is energized and releases its preprogrammed data.
- A portion of the radio signal is modulated and reflected back to reader.
- A Reader decodes the reflected signal, passes the data on to the data aggregation software, and subsequently on to the host system.

Passive RFID limitations

Although RFID systems offer a great many advantages, it does have some limitations. In particular, passive RFID is limited by several factors:

- Distance – The RFID tag's read distance is controlled by the size of its antenna. The smaller the antenna the shorter the read range. A small tag of less than 1" in diameter will only have a read range of a few inches. A tag of 1" X 4" will still be limited to several feet.
- Metals – RF energy is reflected by metal and can subsequently disturb or reflect the limited amount of energy sent by the tag. Thus tags surrounded by or attached to metals may not work.
- Liquids – Liquids absorb RF energy. RFID tags attached to materials composed primarily of liquids will absorb the tags transmitted RF energy.
- Data – tags are limited in the amount of data they can store. While the amount of data is significant from an ID perspective, an RFID tag's information is not particularly useful unless it is tied to a database.

RFID Place in today's world

Since the mid 2000's, RFID has continued to move forward, advancing with more and more practical applications. RFID technology today is now becoming ubiquitous with applications in the supply chain, hospitality, sporting and entertainment, security, logistics, food, transportation, retail and even garbage and recycling industries. As the world moves in a path

to better control our environment, RFID plays a crucial role in reducing the amount of materials manufactured, transported and disposed of. By increasing visibility and providing better analytics; manufacturers, producers, retailers and logistics companies can provide better demand planning and forecasting reducing the impact on our environment.

Advantages of RFID on the Marijuana industry

The advantage of these more "intelligent" systems is that, unlike barcode-based data collection, an RFID system can read the information on a tag without requiring line of sight, without a particular orientation or from short read distances. While looking at these advantages it is important to note the particular application benefits. The Marijuana industry has a fragile product that is highly susceptible to damage, as communicated by several companies and industry organizations. Specific benefits:

- Read Distance – Rooms can be read without having to touch or disturb plants. The ability to read a plants ID number from a distance of 10 to 15 feet will mean not having to touch or brush against plants unnecessarily. This would be a stark contrast to a bar-code system.
- Read Speed – RFID read speed is 90% or faster than bar-code. Performing inventory of a room will be dramatically faster. Less time in doing inventory means less possible damage to plants.
- RFID's unique ability to isolate and cingulate a single ID number from a group will allow operations to quickly locate and find misplaced or misallocated items.
- If you make a mistake with a bar-code based system you effectively have to start over. RFID's unique ability to capture and ignore ID's it has already identified, allows it to take a 2^{nd} or 3^{rd} pass without having to begin again.
- RFID improves and simplifies reporting and compliance processes.
- Creates a strong chain of custody and traceability.

RFID's traditional supply chain benefits apply to the Marijuana industry just as any other manufacturing or retail operation including:

- Improve cycle counting
- Inventory taking
- Improve inventory accuracy
- Improve FIFO
- Improve check in / out
- Improve data accuracy
- Improve disposition
- Quickly locate missing items

This means that RFID systems can be largely automated, reducing the necessity of manual scanning for exceptions management. RFID is an excellent business tool that helps manage supply chains, increase margins and profits, and decrease costs.

RFID is an ever changing technology. The information provided is not intended to be a thorough or complete examination of the technology. Several technologies were not discussed and several variations of the technology exist, and may to some degree alter some attributes of the information discussed. This document is meant to be a reference or guideline for some of the key attributes and utilization of the technology. For more information about RFID you can visit any of the following websites for more detail:

http://www.gs1.org/epcglobal
www.rfidjournal.com
www.rfidinstitute.org
http://www.understandrfidstandards.com

Sources:

Matrics Inc. White Paper, "Passive Radio Frequency Identification (RFID) Kevin Powell, SR. Director
Motorola White Paper, "synchronize your supply chain"
Alinean White Paper "Shrinking the Supply Chain Expands the Return: The ROI of RFID in the Supply Chain"
Analyst: Thomas Pisello
Wikipedia
GS1