

Technical Review Paper Evaluation Form

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_____ / 30 Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

_____ / 30 Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

_____ / 40 Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

_____ / 100 **Total - Technical Review Paper**

The State of RFID Technology

Introduction

Radio Frequency Identification (RFID) has existed since 1973¹ and its usefulness has exploded in every direction with new applications being found every day. The RFID tag solves an inventory problem in industries where conventional tagging methods such as bar codes are too slow to work. Companies with vast inventories such as Walmart or Cattle Farms use an automated method to keep track of their inventory without the need for human data input. Each tag works on a particular wavelength and interfaces with a separate piece of hardware which sends and records data to and from the tag, this device is often called an interrogator. Once the tag has been “interrogated”, an identifying feature like a serial number is transmitted, the tag can also store information such as the amount of times it’s been read. This technology finds uses in the retail industry, tagging animals, tracking nuclear or critical materials, supply chain verification, and many others. In 2015 the total value of the RFID market worth was appraised at \$10.1 billion, up from \$8.8 billion in 2013². Clearly this technology is growing very quickly and is already a huge part of our lives. Looking into the future RFID is expected to replace the usage of barcodes in supermarkets, rendering the checkout process a practice of the past.³

Existing Technology

Tags are divided into two types: passive and active tags. Both technologies will be explained and their qualities measured against each other.

Passive tags do not have a power source on the tag, instead an electromagnetic wave from the interrogator excites the tag, causing a current to flow through the circuitry and emit a wave in response to the one received. This is called “backscatter”⁴, the reader (or interrogator) receives this signal and decodes the information stored in the tag. Passive tags work in different frequency bands: low frequency (125-134 KHz), High frequency (13.56 MHz), and ultra-high frequency (865 – 960 MHz). The lower the frequency the longer the wavelength, which in turn means that the range is decreased. Low frequency bands typically work to within 10 [cm], high frequencies work up to a meter, and ultra-high frequencies can get over 30 meters in range. A downside of using high frequencies is that the signal is more easily distorted by non-friendly materials such as water. The best qualities of this technology is that they are smaller and cheaper (\$0.15 – \$5.00)⁵ than active tags, they can also last a lifetime since they require no internal power source as they work purely off of the geometry and structure of the tag.

Active tags in turn have a power source built into the tag itself and do not rely on high-energy incident waves to power the circuitry. These tags work on two typical frequencies, 433 MHz and 915MHz. These tags have a much longer range than its passive counterpart (about 90 meters), but the batteries usually last only 3 to 8 years⁶, after which the more expensive tag (costing \$15 to \$100+) must be replaced. Looking forward there is a need to incorporate a replaceable battery on these tags to improve product lifetime. This tag can work in either a transponder mode or a beacon mode. In the transponder operation mode the tag waits to receive a “starter” signal from the reader and then send out the encoded information. The beacon mode of operation is less efficient because it just regularly sends out its data once every period of time, typically every 5 seconds.

Supporting Technologies

The use of this technology requires several supporting units including hardware and software systems. The interrogator, or the unit which reads the signal coming from the tag can either be stationary or hand-held. A stationary unit would be placed at “choke” where all the inventory must pass through, or at strategic locations like waypoints if tracking movement on a supply chain. Hand-held units find their use largely on cattle farms where ranchers will disperse into the herd to find a specific animal. Supporting software is required to display the RFID tag information on a screen, and an inventory program is required to keep all the data orderly and readily accessible.

The current state of RFID technology illuminates a bright future for what is to come: specifically the integration of higher frequency bandwidths to extend range capabilities and the refinement of supporting software systems. There is even potential for each tag to communicate with other tags and gather big-data to analyze inter-unit dynamics.

References

- [1]B. Violino, "The History of RFID Technology", *RFID Journal*, pp. 1-2, 2010.
- [2]R. Das and P. Harrop, "RFID Forecasts, Players and Opportunities 2016-2026: IDTechEx", *Idtechex.com*, 2016. [Online]. Available: <http://www.idtechex.com/research/reports/rfid-forecasts-players-and-opportunities-2016-2026-000451.asp>. [Accessed: 07- Mar- 2016].
- [3]K. Bonsor and W. Fenlon, "How RFID Works", *HowStuffWorks*, 2007. [Online]. Available: <http://electronics.howstuffworks.com/gadgets/high-tech-gadgets/rfid.htm>. [Accessed: 07- Mar- 2016].
- [4]S. Smiley, "Active RFID vs. Passive RFID: What's the Difference?", *RFID Insider*, 2016. .
- [5]"Active vs. Passive RFID", *Atlas RFID Solutions*, 2016. [Online]. Available: <http://atlasrfid.com/jovix-education/auto-id-basics/active-rfid-vs-passive-rfid/>. [Accessed: 07- Mar- 2016].
- [6] InLogic, "Passive vs. Active RFID Comparison", 2016.

(3 websites, 1 press release, 1 blog, 1 journal)