Technical Review Paper Evaluation Form

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- Implementation of the technology
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Radio Frequency Identification Frequencies and Applications

INTRODUCTION

Radio frequency identification (RFID) technology utilizes various electromagnetic frequency ranges and network protocols to exchange information between a reader and a tag. Determining appropriate carrier frequencies, protocols for how data are exchanged, and transmission power are all driven by the needs and limitations of the application. This paper reviews RFID technology with respect to its impact and use in commercial applications, as well as RFID basic functionality and tradeoffs in frequency of operation.

COMMEERCIAL APPLICATIONS

RFID systems are mainly used in tracking, authentication, and access control. Identification is implied in all of the uses due to the nature of tracking, authenticating, and controlling access of objects that have already been identified by the RFID tag/chip.

Tracking

Tracking applications use RFID technology to locate and identify specific packages, boxes, or even animals. Companies like Wal-Mart use RFID to streamline their supply chain and cut costs by tracking every step of their supply chain process and identifying slow processes [1]. Tracking is also used in animal control shelters to control the population of dogs within an area and be able to identify lost or stray dogs.

Authentication

Authentication is used when an object needs to be verified that it indeed is that object. Some casinos in Las Vegas insert RFID tags in their chips in order to authenticate its own chips. This prevents counterfeit chips from circulating within the casino and helps ensure that chips don't get stolen [2]. Another example is when a sensitive meeting is held and all participants need to be authenticated by scanning their personal RFID card. This method increases the efficiency of authenticating a human being rather than the more error prone method of picture ID.

Access Control

Access control applications are observed when access to specific areas are granted through identification badges. For example, when a student at a university wants to access a classroom during late hours, a school ID card with an RFID tag built into it is brought near the RFID reader and access is granted. Applications can also be seen in parking garages, at gyms, etc.

COSTS

The major factor in RFID cost is between passive and active tags. Active tags, which require power electronics and more sophisticated circuits, are $25 and up. Active tags that need extra battery life or

multiple sensors can reach $100 and more. A simple passive tag with an antenna and a 96-bit data storage costs 7-15 cents [3].

BASIC FUNCTIONALITY AND BUILDING BLOCKS

RFID uses a reader to read a tag's information by sending out an electromagnetic (EM) wave containing interrogation information and then listening to the tag's response [4]. The procedure of this two-way communication varies with the frequency and the type of tag. The underlying technology needed to make this happen is an antenna to propagate and collect the EM waves, DSP algorithms on the reader to extract useful data, and access to a database for the reader to identify the tag.

Frequency Tradeoffs

RFID technology is currently allowed to work in four frequency bands: 125-134.2 kHz, 13.56 MHz, 856-960 MHz, and 2.45 GHz per ISO standards listed in [5-8]. Choosing a frequency of operation is based on application of RFID and range. Lower frequencies like 134.2 kHz and 13.56 MHz have an advantage in less attenuation when going through media such as water [9]. They also exhibit less interference from the presence of metals [10]. The disadvantage of lower frequencies is the low data rates and shorter signal range. Higher frequencies have longer reading ranges with higher data rates but suffer from interference from metals and attenuate at a higher rate when going through various media, such as water [9][11]. The most commonly used frequency in the market is 856-960 MHz as it seems to have the best compromise between reading speed, distance, multiple tags handling, and cost [12].

Active vs. Passive Tags

Passive tags do not have any onboard power, rather they use a capacitor that gets charged from the backscatter of the transmission waves from the reader [13]. Once the capacitor has enough stored energy, it transmits its information to the reader. The advantage of this type of tag is its zero power technology, however, due to its low power capability, its range is highly limited. Active tags do have on board power such as a battery. The tag can use the battery power as opposed to the EM energy to transmit its information. A significant advantage is the increase in range and sensitivity, however, they are more costly to manufacture and need maintenance when the battery runs out of power.

CURRENT RESEARCH

Research efforts are trying to increase RFID capability by adding a network layer to RFID technology [14]. This will allow for intercommunication among "smart" tags and the capability of utilizing a mesh network as alternative solutions. This has a direct effect on the future of industries that use RFID technology for tracking of its need for extended range.

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