Concepts of RFID (Radio Frequency Identification) and Their Applications to Port Logistics

Sérgio Leite Pereira
Federal University of Rio de Janeiro, Brazil

Armando Carlos de Pina Filho
Federal University of Rio de Janeiro, Brazil

INTRODUCTION

With globalization and fierce competition for market share, handling business expanded significantly worldwide. Imports and exports generate a fantastic exchange of products and more sophisticated technologies required intensely by consumers, thus quickly affecting developed or emerging countries. In the face of this situation, new demands emerge, becoming increasingly necessary the modernization of the links in the logistics chain. Therefore, several technologies have been developed to enable an efficient accounting and control of goods. One of the most efficient, no doubt, is the RFID (Radio Frequency Identification), which is a technology that uses electromagnetic waves to access data stored on a microchip developed by Massachusetts Institute of Technology (MIT), in the USA.

A special mention can be given to the advances that have occurred in the port handling of cargo, with regard to the management of containers in a dynamic, secure and real-time information via the web. Thus, this article aims to present an overview on RFID and demonstrates that its use provides the improvement, development, contribution, quality and speed in processing flows of containers at ports of some cities in the world, representing a powerful technology applied to port logistics.

BACKGROUND

According Miller (2000), radio frequency identification (RFID) is a technology that allows the identification of tagged items without line of sight. It includes a tag, a reader and a computer system. It contains chips and antennas that allows to respond to radio signals sent by a transmitter base. In addition to passive tags, which respond to the signal sent by the transmitter base, there are semi-passive and active tags, with batteries, which allows them to send the signal itself. These tags are much more expensive than passive tags. Following, a history and some concepts of RFID will be presented.

History of RFID

The first passive RFID system was reported in radar systems used in World War II, in 1935, by Sir Robert Alexander Watson-Watt, a Scottish physicist. Advances in technology have continued through the 1950s and 1960s. The history of RFID really begins in 1973, when Mario W. Cardullo ordered the first U.S. patent for a system of active RFID with rewritable memory. In the 1980s, research of RFID technology was focused on performance improvement, cost reduction and size reduction. In 1999, the Massachusetts Institute of Technology (MIT), together with other research centers, started a study of an architecture that utilizes the features of technologies based on radio frequency, to serve as a reference model for the development of new applications and tracking location of products. From this study was born the Electronic Product Code (EPC), which defined an architecture for the identification of products that used the resources provided by the RF signals and that was later called RFID (Revista Mundo Logística, 2009).

Nowadays, RFID technology is everywhere. Its use is now so routine that does not realize its presence. Thus, as in many other cases of new technologies, it may be said that it was a rapid rise, strong and rooting ever deeper into all sectors of society (Gomes, 2007).

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Concepts of RFID

RFID technology streamlines the flow control of products throughout the supply chain of an organization, allowing its tracking from manufacturing to the end point of the distribution. With a response time very low (less than 100 milliseconds), RFID is presented as a solution for processes with necessity to capture information about products even being in motion (Pinheiro, 2004). Another distinguishing feature of RFID-based systems is the fact that these systems allow coding into unhealthy environments, and even in products where the use of bar code is not efficient.

RFID consists of smart tags (or transponder) that are programmed with information, and fixed in products that need to be identified and tracked, and other key components for its operation. The system works with a reader (transceiver) that collects a label identifier via RF and communicates with a system via middleware, using any network connection, either wired or wireless. Readers capture the data label (which may be a simple identification, as more complex data) and send to the middleware. This, in turn, translates the data from the reader and transmit to existing systems, as shown in Figure 1.

In relation to readers, they are devices that have their own power source, processing capacity and an antenna for communication. These devices request data from identifiers, and can also write data on identifiers, if they allow (Mota, 2006). While the middleware forms the interface between the hardware and software elements of RFID, and has the function of integrating external systems and RFID. There is a connection to a computer system that manages the information of the RFID system. Data transmission occurs from the input object or product containing the label, in the area covered by the reader. From the identification tag, the reader sends an electromagnetic signal that is received by the antenna of the label. In return communication, the tag transmits a modulated signal to the reader with the information stored.

According to Weinstein (2005), the tags are divided into three general categories: active, passive and semi-passive. The active tag has its own power source, supplied by an internal battery, which ensures the process of writing and reading. Their service life is estimated at ten years, with higher cost. A passive tag has lower cost and size, being base of the growing in the development of RFID. Efforts are being made to increase its storage capacity information, and its durability is indeterminate. The major disadvantage that these labels have less range than active tags, requiring a more powerful reader for reading data. In semi-passive tag battery is only used by microchip, and this tag have a low cost compared to the active and high in relation to passive.

RFID can be applied in various sectors, such as: port, rail, and road logistics, hospitals, human implants, industrial, and commercial uses, in libraries, security, animal identification, maintenance, livestock, etc. According Mangueira (2011), RFID systems are distinguished by their frequency. Systems of low frequency (30 KHz to 500 KHz) have short read range and low cost, and are most commonly used in access control and animal identification applications. Systems of high frequency (850 MHz to 950 MHz, and 2.4 GHz to 2.5 GHz) with range and high reading speeds, are used for applications such as location of railcars and automated toll collection. However, the best performance of high frequency implies higher costs.

Figure 1. Basic diagram of a RFID system (adapted from GS1 Brasil, 2011)