Chapter 9
Passive UHF RFID Technology Applied to Automatic Vehicle Identification: Antennas, Propagation Models and Some Problems Relative to Electromagnetic Compatibility

Salvador Ricardo Meneses González
ESIME Zacatenco, México

Roberto Linares y Miranda
ESIME Zacatenco, México

ABSTRACT
In this chapter, propagation channel aspects in current passive UHF RFID systems applied for automatic vehicular identification (AVI) are presented, considering the antennas design for passive UHF RFID tag and some problems relative to the electromagnetic compatibility. These issues are focused on RFID link, reader-tag-reader, and the channel modelling that is supported with measurements, and reader-reader interference problems are analysed.

1. INTRODUCTION
Automatic identification is the broad term given to a number of technologies used to help identify objects. This process is coupled with automatic data capture. That is, the capture of information should carry out without the human being involved in the process, only in the interpretation. The goal of most automatic identification systems is to increase efficiency and reduce errors in data capture.

There are number of technologies that can be included in the process of automatic identification. These include bar codes, smart cards, voice recognition, some biometric technologies (retinal scans, for example), optical character recognition, radio frequency identification (RFID) and others.
Currently, passive RFID technology at UHF band (860–960 MHz) is being widely used for identification of different objects, retail inventory management, and tracking applications. This is due to low production cost of tag with reasonable readable range. Recently, passive UHF RFID systems have been also applied to wireless sensor. Respect to the automatic identification of vehicles with passive RFID technology, the applications are for the payment of tolls road and something about the traffic control, but this issue is briefly mentioned (Blythe, 1999).

Passive UHF RFID technology is basically a wireless communication. Communication takes place between a reader and a tag. The reader is an interrogator and tag is a transponder. Tags can be presented in different ways depends on the objects to identify, and they must be coupled electromagnetically with the material of the object where they are stuck, for the case of the AVI, the tag is strapped on the vehicle windshield.

Passive UHF RFID technology presents a better solution for AVI with respect to other near-field technologies currently available, such as: barcode, magnetic cart, passive LF (Low Frequency) RFID tag, and passive HF (high frequency) RFID tag. The passive UHF RFID systems can carry out the automatic vehicle identification in far field to several meters, depending of tag characteristics (sensitivity-chip and antenna-gain). This technology can be used in heavy rain, snow, cold, or in subzero temperatures. Readers of passive RFID UHF technology recognize tags placed on the windshield of moving vehicles, so that drivers do not even need to stop for identification, or to open the vehicle window to enter access codes or push buttons to get a ticket.

Most wireless communication systems operate in high electromagnetic pollution environments. These environments in addition to multipath effect are problems for the RF signal propagation that also affects to passive UHF RFID systems. Even though passive UHF RFID systems normally operate in line-of-sight (LOS), they are also affected by typical electromagnetic environment and for AVI application is required to consider other propagation problems, such as: if the vehicle identification takes place on a highway, the tags detection probability decreases with increasing vehicle speed; the multipath effect (reflections diffraction and scattering) if the vehicle moves at slow speed (city traffic); the interference reader-reader when they operate at the same time (toll booths) and each one is close to the other.

The communication protocol used normally for the identification of vehicles is based on the standard ISO / IEC 18000-6 C, this is a standard that has a good performance. However, the vehicle detection at speed greater than 90 km/H, even the communication protocols proprietary are used, these ones require some modifications. The AVI in roads using passive UHF RFID technology has not yet been discussed extensively, in spite of being applied. Typical problems of propagation of the RF signal in passive UHF RFID systems, such as: coupling and alignment of the tag for a high performance in LOS are described perfectly by (Nikitin, 2008). However, the issue of the propagation problems of RF signals for AVI application has not been identified widely, because the scenarios where the vehicles pass at different speeds are complex, for example, with heavy traffic (slow speed) or/and light traffic (high speed).

The purpose of this chapter is to describe the main problems of Automatic Vehicular Identification with Passive UHF RFID Technology on roads, with three issues: antennas, propagation channel and electromagnetic compatibility, which is organized as follow: Section 2 both Active and Passive UHF RFID Tag Technologies are described. Section 3 antennas for passive UHF RFID tag are presented. Propagation model for passive UHF RFID system applied to the vehicular identification in the roads is presented in Section 4. Electromagnetic Compatibility aspects are described in Section 5; finally conclusions and remarks are given in Section 6.