Chapter 13

Data Dissemination in Vehicular Networks: Challenges and Issues

Nitin Maslekar
IRSEEM-ESIGELEC, France

Mounir Boussedjra
IRSEEM-ESIGELEC, France

Houda Labiod
Telecom ParisTech, France

Joseph Mouzna
IRSEEM-ESIGELEC, France

ABSTRACT

Vehicular ad hoc networks (VANETs) represent an important component necessary to develop Intelligent Transportation Systems. Recent advances in communications systems have created significant opportunities for a wide variety of applications and services to be implemented in vehicles. Most of these applications require a certain dissemination performance to work satisfactorily. Although a variety of optimizations are possible, the basic idea for any dissemination scheme is to facilitate the acquisition of the knowledge about the surrounding vehicles. However, the dynamic nature of vehicular networks makes it difficult to achieve an effective dissemination among vehicles. This chapter provides an overview on those challenges and presents various approaches to disseminate data in vehicular networks.

INTRODUCTION

Every year, millions of traffic accidents occur worldwide, resulting in many casualties and billions of dollars in direct economic costs. To combat this problem, for many years now, transportation planners have been pursuing an aggressive agenda to increase road safety. In 2001 the European Transport Policy set the goal of reducing road fatalities by 50% by 2010. Similarly, in 2008 the US DOT’s Research and Innovative Technology Administration (RITA) challenged the industry to reduce traffic crashes by 90% by 2030. To achieve...
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In this vision, new applications are proposed to assist drivers which will help avoid traffic collisions and increase the road safety. One technology which has drawn a lot of attention of industries and academia to establish intelligent transportation systems and to reduce traffic causalities is Vehicular Adhoc Networks (VANETs).

Simply put, VANETs can be described as wireless platforms that allow vehicles to exchange information for safety and non safety requirements. In this context, VANETs use different technologies to ensure the implementation of Intelligent Transportation System (ITS). Today, among all existing technologies, Dedicated Short Range Communications (DSRC) and IEEE 802.11p Wireless Access for Vehicular Environment (WAVE) have been approved as standards for PHY and MAC layers for vehicular networks. The IEEE 802.11p WAVE standardization process originates from the allocation of the DSRC spectrum band of 5.9 GHz with a bandwidth of 75 MHz and approximate range of 1000m. Morgan (2010) presents a detailed survey of the architecture, design, and characteristics of DSRC & WAVE standards.

The main aim of DSRC and the IEEE 802.11p WAVE standard is to define rules for low connection setup delay, fast network recognition and the differentiation of applications for normal and emergency use. They allow a high throughput communication with low delay among vehicles. This leads to efficient emergency communications. For example, in the case of accidents, an alerting message transmitted among vehicles can be faster and, thus, well-timed, rather than communications sent through an infrastructure network (such as cellular systems).

Although safety has been the prime impetus for the inception of VANETs, they also provide a promising platform for a much broader range of efficiency and comfort applications. Safety refers to applications that render protection to the people in the vehicle as well as the vehicle itself. Efficiency applications are focused on increasing the productivity of road resources by managing traffic flow and monitoring the road conditions. Lastly, comfort services provide entertainment or information to drivers and passengers which make driving more comfortable.

For each class of applications, exchanging data among vehicles is one of the key technological enablers. However, due to inherent properties and limitations of VANETs, distributing information among the vehicles is a very challenging task. The fundamental property of vehicular networks is inconsistent topology which changes rapidly due to the movement of vehicles. Under such circumstances, maintaining connectivity between vehicles is difficult. Secondly, the density of vehicles keeps on varying. In high density scenarios, if all vehicles participate in dissemination, the available bandwidth will be wasted due to redundancy of data. However, on the contrary, for low density scenarios to increase the reliability multiple copies of the same data has to maintained and exchanged when vehicles come within the communication range of each other. Thus, the dissemination technique should be scalable to compensate for varying vehicle densities.

In order to address these limitations, various works for data dissemination in VANETs have been proposed e.g. Little and Agarwal (2005), Nadeem et al. (2006), Leontiadis & Mascolo (2007a), Yu & Heijenk (2008), Maslekar et al. (2010). This chapter classifies these existing works into three major techniques, namely geo-cast, cluster based and opportunistic. Through this classification, an overview is provided for how each method addresses the various issues relevant in VANETs. The rest of the chapter is organised as follows. First the various requirements of data dissemination in VANETs are discussed. Then the classification of the dissemination techniques is presented, followed by the description and various works related to each method. The chapter ends with a brief summary and future perspective of how DSRC can be of advantage in the field of data dissemination.