Chapter 78
TraffCon:
An Innovative Vehicle Route Management Solution Based on IEEE 802.11p Sparse Roadside-Vehicle Networking

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ABSTRACT

Traffic congestion is a major issue in the modern society, and unfortunately, it continues to worsen as the number of cars on the road grows behind the ability of existing road infrastructures to cope. Additionally, vehicle fuel consumption and gas emissions are increasing, and concentrated efforts to propose solutions to reduce these and consequently the pollution are needed. In this context, this chapter presents TraffCon, an innovative vehicle route management solution, which makes use of a novel best route selection algorithm for vehicular traffic routing and of vehicular wireless communications to reduce not only journey times but also fuel consumption and as a direct consequence vehicle gas emissions. The chapter shows how TraffCon can be supported by an IEEE 802.11p sparse roadside-vehicle network with very good results in comparison with classic approaches.

INTRODUCTION

Over the past number of years, employing vehicular communications to support intelligent traffic management services has garnered much attention in both industry and academia. A variety of communication technologies has been used including; optical (infrared) (Kwak and Lee, 2004), ultra-wideband (UWB) (Elbahhar, Rivenq, Heddebaut and Rouvaen, 2005),, Bluetooth (Sugiura and Dermawan, 2005), and cellular (Santa, Gómez-Skarmeta and Sánchez-Artigas, 2008). However it appears that IEEE 802.11 (Wi-Fi) based solutions are emerging as the most popular. This trend looks set to continue as the IEEE 802.11p (Jiang and Delgrossi, 2008), (Uzcátegui and Acosta-Marum, 2009) amendment to the standard is attracting increasing interest.

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With the problem of a suitable communications technology for vehicular communications addressed, the next challenge is that of market introduction. A range of appealing applications are required to drive the uptake of vehicular communications and numerous solutions have already been proposed, with safety applications being the most prominent (Yang, Guo and Wu, 2009), (Zhang, Festag, Baldessari and Le, 2008), (Jiang, Chen and Delgrossi, 2008). Many safety applications rely on Inter-vehicle Communications (IVC) and the formation of Vehicle Ad-hoc Networks (VANET). Given the dearth of successfully deployed commercial examples of ad-hoc networks these types of application are unlikely to be viable in the early stages of vehicular communications. Also certain safety applications by their very nature require; very high up to 100% penetration rates of the technology e.g. co-operative collision avoidance (Taleb, Ooi and Hashimoto, 2008). The distribution method is also a problem with safety features being either fitted as standard or provided as optional extras in new cars, after-market introduction seems unlikely. This reduces the potential for them to be introduced quickly.

What is needed to drive the uptake of vehicular communications are other practical applications which benefit the user regardless of the number of other vehicles so equipped. The obvious platform for deployment is the widespread in-car satellite navigation system. This in-car technology can be provided as standard in new cars or added later with a portable solution. In Western Europe alone, approximately 14.4 million portable sat-nav systems were sold during 2007 and the number is expected to increase in the following years (Skog and Handel, 2009). There is already a trend toward allying this technology with wireless communications, many existing sat-nav units can receive live traffic data via FM traffic receivers or via connectivity provided by their mobile phone. However it is expected that most portable navigation devices will feature real-time two-way connectivity based on cellular or Wi-Fi technology.

For early adopters of Wi-Fi enabled sat-nav devices any enhanced functionality must be provided by roadside-vehicle communications (RVC). Assuming that a full infrastructure network is unavailable then the vehicle can be said to be travelling in a sparse infrastructure network. The connectivity availed by this network allows for the provision of new services as shown in Figure 1. Given the sat-nav platform it makes sense to offer location based services such as the traffic information services which have already proven popular.

This chapter presents TraffCon, an innovative vehicle route management solution (Collins and Muntean, 2008b) which makes use of the novel best route selection algorithm for vehicular traffic routing and of vehicular wireless communications to reduce not only journey times, but also fuel consumption and as a direct consequence, vehicle gas emissions. The best route selection algorithm is described and the provision of TraffCon as an enhanced traffic management service in the communications landscape outlined above is explored. Testing results shows how by employing TraffCon fuel consumption is greatly reduced in comparison with existing state-of-the-art solutions. The remainder of the chapter is structured as follows:

Figure 1. Provision of in car services with a sparse infrastructure network