Chapter 7
Employing Traffic Lights as Road Side Units for Road Safety Information Broadcast

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ABSTRACT

There is great concern over growing road accidents and associated fatalities. In order to reduce accidents, improve congestion and offer smooth flow of traffic, several measures, such as providing intelligence to transport, providing communication infrastructure along the road, and vehicular communication, are being undertaken. Traffic safety information broadcast from traffic lights using Visible Light Communication (VLC) is a new cost effective technology which assists drivers in taking necessary safety measures. This chapter presents the VLC broadcast system considering LED-based traffic lights. It discusses the integration of traffic light Roadside Units (RSUs) with upcoming Intelligent Transportation Systems (ITS) architecture. Some of the offered services using this technology in vehicular environment together with future directions and challenges are discussed. A prototype demonstrator of the designed VLC systems is also presented.

INTRODUCTION

Fatality rates on road are becoming severe even with the introduction of many intelligent communication devices on board vehicles and alongside the road. Road crashes are the second leading cause of death globally among young people aged five to 29 and the third leading cause of death among people aged 30 to 44 years. Over 1.2 million people are killed annually because of road accidents (World Health Organization, 2008). The study predicted that road accidents would become the sixth largest cause of death in the world in 2020 whereas it was the ninth largest cause of death in 1990.

To minimize road accidents and fatalities, various modes of vehicular communications, such as Vehicle-to-Infrastructure (V2I), Vehicle-to-Vehicle (V2V), and Infrastructure-to-Vehicle (I2V), are being investigated. The emergence of the IEEE 802.11p standard (IEEE 802.11p, 2010) for short to medium range inter-vehicle communication and the allocation of a dedicated frequency band for ITS communication in Europe have paved the way for future implementations of communication-based ITS safety applications. ITS (2010), which interrelates humans, roads, and vehicles through state-of-art Information Technology (IT) are new transport systems for the purpose of the solution of the road transportation problems, aiming for efficient traffic flow and reduction of the environmental load. Recently, ITS have drawn a lot of attention to solve various traffic problems.

There are many projects being investigated and realized related to ITS worldwide, such as PREVent (Prevent IP, 2010) and CALM (ISOTC-204WG16, 2010) to reduce road fatalities. VIDAS (VIsible light communication for advanced Driver Assistant Systems) is another challenging project which promises to be used over existing infra-structures, resulting in low cost communication systems by exploring traffic lights as road side units based on VLC. VLC is normally based on Light Emitting Diodes (LED) which has many advantages such as highly energy efficient, long life, harmless to human and friendly to environ-ment (green technology).

LED-based VLC (Akanegawa, Tanaka, & Nak-agawa, 2001) systems can be deployed in vehicular environment on existing infrastructure such as LEDs traffic signal lights. The VLC systems can broadcast road traffic safety information minimiz-ing the possible accidents and increasing smooth flow of traffic on road. Furthermore, LED-based road light can offer Ubiquitous Road to Vehicle Communication (URVC) (Kitano, Haruyama, & Nakagawa, 2003) throughout travel.

This chapter presents LED-based traffic lights as RSU for traffic information broadcast (I2V mode) using VLC systems. A VLC system's architecture suitable for information broadcast is discussed. Some of the related works in this area are also presented. The concept of VLC system integration with RSUs and ITS architecture is briefly introduced. Few important road safety ser-vices offered by VLC systems are also discussed. Finally, chapter highlights some of challenges in the technology and implementation issues.

ITS AND VEHICULAR COMMUNICATION

With the growth of population in major urban areas and accelerated increase in number of cars, traffic is becoming generically chaotic. The prob-lem of congestion, differently from what many might think, not only affects the day-to-day life of citizens but also has a great impact on business and economic activities. These issues therefore generate less income, affecting the sustainable growth of cities throughout the world.

Considering current problems of traffic man-agement, control, and planning, especially fearing the consequences of their medium and long-term effects, both practitioners and the scientific com-munities have strived to tackle congestion in large urban networks. Research has been carried out basically towards the design and specification of future transport solutions featuring autonomy, putting the user in the center of all concerns and largely oriented to services. Such efforts were eventually to culminate in the emergence of the concept of ITS. Now the user is a central aspect of transportation systems, forcing architectures to become adaptable and accessible by different means so as to meet different requirements and a wide range of purposes.

Two of the main features of today's intelligent transportation are as follows:

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