IATSS Research xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

IATSS Research

Overview

Solutions for urban traffic issues by ITS technologies

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ARTICLE INFO

Article history:
Received 2 March 2018
Received in revised form 2 May 2018
Accepted 18 May 2018
Available online xxxx

Keywords:
ITS
Smartway
ETC 2.0
MaaS
TDM
PPP

ABSTRACT

In recent years, traffic congestion, traffic accidents, and deterioration of the environment because of growing population, increasing urbanization, and increasing car ownership have become serious problems in the Asia-Pacific regions. Intelligent transport systems (ITS) are systems that try to solve various road traffic issues using information communication technologies. Several countries are endeavoring to solve such traffic issues by deploying an ITS and achieving positive results. However, there are some problems in advancing ITS deployment in these countries, such as lack of technical know-how, a lack of coordination among systems, lack of a master plan, and financial constraints. In order to introduce ITSs, it is important to select suitable technologies and applications appropriate for each country. An appropriate plan and evaluation of the ITS project are also important for the introduction of ITS.

In this paper, we propose methods for the utilization and introduction of ITS technologies to solve urban traffic issues in various countries, based on the lessons learned from the deployment of an ITS in Japan.

Contents

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Peer review under responsibility of International Association of Traffic and Safety Sciences.

https://doi.org/10.1016/j.iatssr.2018.05.003

1. Introduction

Both emerging and developed countries suffer serious urban traffic problems, such as traffic congestion, accidents, and environmental problems owing to concentrated populations and economic growth. Certain cities are using intelligent transport Systems (ITS) to solve these urban traffic issues by utilizing state-of-the-art information communication technologies, and some of them have achieved success in their implementation. However, even countries that have introduced ITS are experiencing various issues, such as uncoordinated complex silo systems, a shortage of deployment strategy knowledge, the lack of a master plan, and stalled deployment due to financial constraints. In order to introduce ITS, it is necessary to select suitable technology and applications appropriate for each country and region, as well as an appropriate introduction plans and project schemes.

Japan has been implementing the practical applications of ITSs such as the vehicle information communication service (VICS) and the electric toll correction (ETC) nationwide, based on the "Smartway" concept [1] shown Fig. 1. It is one of the concepts of cooperative vehicle-infrastructure systems (V2I).

A novel project called "ETC 2.0," which combines VICS and ETC functions on one on-board unit (OBU) and adds several new functions, was launched in 2011. ETC 2.0 has enabled a variety of applications through high-speed, high-capacity communications by utilizing characteristics of a dedicated short-range communications (DSRC) at 5.8 GHz. This could contribute to alleviating urban traffic problems.

This paper suggests policies that make use of ITS technology for solving urban traffic problems based on the expertise gained and lessons learned through the introduction of ITS in Japan. The policies are beneficial for countries which are developing expressway (motorway) by public finance initiative (PFI) or public private partnership (PPP).

2. ITS in Japan

2.1. Features of ETC 2.0

Fig. 2 shows the features of ETC 2.0. The system is simple because ETC 2.0 OBUs and a road-side-unit (RSU), called "ITS SPOT," communicate with each other on a dedicated area. The OBU has a basic application interface consisting of common functions such as command/response function, memory access function, an IC card access function, a push-type information delivery function, onboard unit ID communication function, and onboard unit basic command function, which enable the use of various ITS services by combining these common functions. It has great merits such as cost reduction and long-term use on OBU because if we want to add a new service, all we need to do is develop a new RSU with a new application.

ETC 2.0 uses a two-piece system that supports multiple users. Vehicle information is stored in OBU and personal information is stored on IC cards, enabling the separation of the vehicle owner and the toll payer. This allows people other than the owners of the vehicle, such as car rentals, to pay ETC tolls. Security and privacy protection is also important for mobile payment. ETC 2.0 is able to guarantee security and to protect privacy because it uses an IC card having an IC chip with a built-in CPU, which enables a two-way authorization and the encryption of recorded data using DSRC security platform (DSRC-SPF). The high-speed, high-capacity active DSRC at 5.8 GHz enables the provision of information for supporting safe driving, and wide-area traffic congestion information for over approximately 1000 km. Two-way communications also allow probe data collection from GNSS on it. This 5.8G-Hz active DSRC was certified as ISO 14906 by the International Telecommunication Union's recommendation M.1453.

The name ETC 2.0 indicates that it is completely compatible with the conventional ETC. It can offer new mobility applications such as safe driving support and dynamic route guidance for car navigation systems using a larger capacity and high-speed communication than a conventional VICS. A remarkable application of this is for "probe data [2]" collection by utilizing the uplink function. Probe data consist of the two kinds of data: travel records and behavior records. The travel records show each vehicle's time and position along its path. The behavior record can reveal dangerous points on the road where a driver may need to stop suddenly or adjust steering.

Approximately 2.4 million OBUs were shipped on the market by the end of December 2017. More than 3000 RSUs have already been installed along expressways and national roads by the Ministry of Land, Infrastructure, Transportation and Tourism (MLIT).

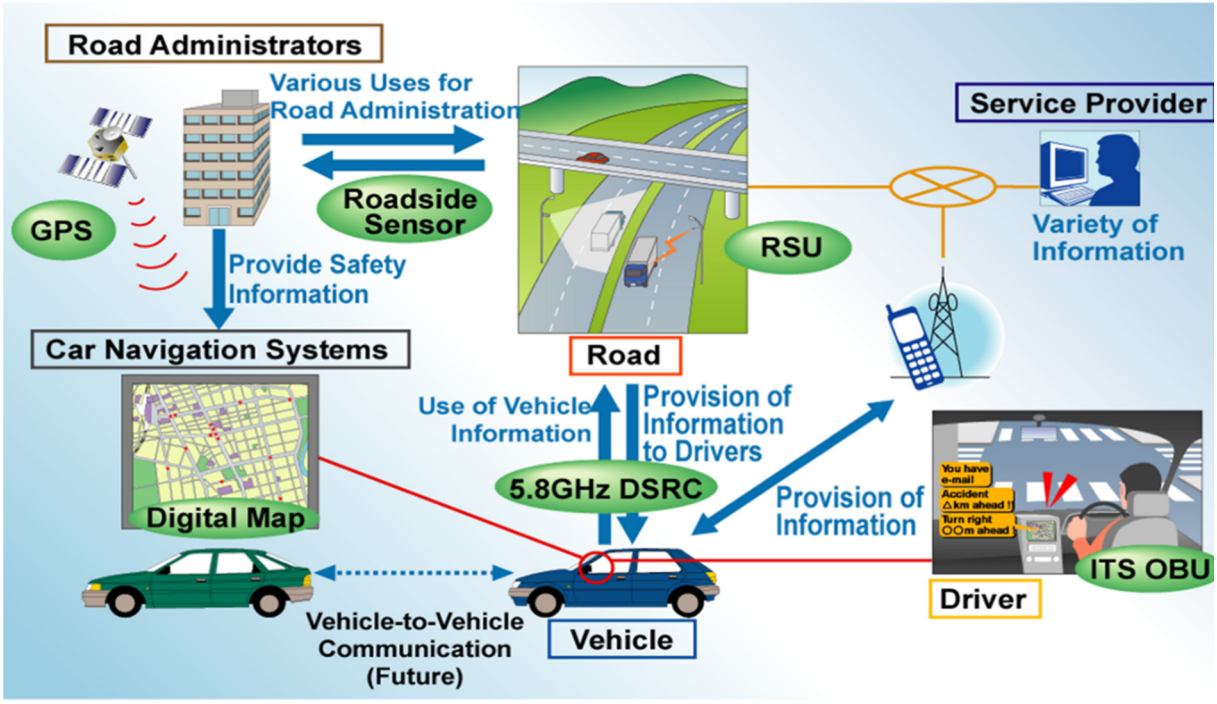

Fig. 1. Smartway concept in Japan.

Please cite this article as: H. Makino, et al., Solutions for urban traffic issues by ITS technologies, IATSS Research (2018), https://doi.org/10.1016/j.iatssr.2018.05.003