Enabling ITS Applications with Affordable Communication Technologies

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Abstract

Intelligent Transport System (ITS) aims to make travel and transportation safer, faster and more efficient. ITS includes but is not limited to emergency services, road safety, transportation infrastructure, traffic management as well as commercial and infotainment applications. This paper experimentally investigates the feasibility of using low-cost wireless technologies as an enabler for introducing ITS to Sri Lanka. We interpret our results with relevance to two ITS applications.

With the growing vehicular traffic in the country, the need for ITS applications has become imperative. For instance, while the current manual highway toll collection is ineffective during traffic peaks, the electronic version causes delays and congestion due to its stop-and-go process. Poor control of level crossings has become a major cause of fatal accidents. Road signs are often unnoticed or are deliberately ignored by drivers and dynamic road situations such as pedestrians, constructions, landslides, etc., will make the driver indecisive until alerted.

Dedicated Short-Range Communication (DSRC) is a standardized wireless technology for ITS, with its reliable operation in dense, high-speed vehicular environments. However, the high cost of the technology has restrained its penetration in the automobile industry and adoption by governments. DSRC is based on the IEEE802.11p standard. The IEEE802.11 family of standards also defines versions *b*, *g*, and *n*, better known as *WiFi*. The common root makes it possible to use WiFi which facilitates a subset of ITS applications with a significantly lower cost.

Several types of wireless links are fundamental to ITSs; between vehicles (mobile to mobile), between vehicles and roadside infrastructure (mobile to fixed), infrastructure to vehicles (fixed to mobile) and between infrastructure nodes (fixed to fixed). ITS applications rely on regular exchange of information (location, speed, bearing etc. or event-driven information such as the presence of a pedestrian) among vehicles in the neighbourhood via broadcast messages (data packets). Factors that influence the performance of the applications include packet loss, packet delay and communication range. This paper presents the experimental evaluation of fixed-to-fixed and fixed-to-mobile communications links established via WiFi. We study the packet

loss, delay and the communication range in each case. We then discuss the applicability of the results in relation to the following ITS applications:

- An Active Road Sign system which allows for messages to be relayed to drivers in the vicinity. Our results show that such messages can be received reliably over a range of 150m.
- A railway intersection warning system which allows warnings of approaching trains to be delivered to vehicles approaching the intersection. We demonstrate that vehicles within 200m distance of the intersection can be warned when the approaching train is 700m away.

Further, our design achieves an end-to-end delay less than 100ms, satisfying the criteria stipulated for safety-related ITS applications. Furthermore, our system allows the warning messages to be conveyed via audio-visual means, with the intensity proportional to the level of attention required by the driver.

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