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ITS BASED V2I SYSTEM

Omkar Pabshetwar[1], Prabhat Vishwakarma[2], Karan Zende[3]

[1,2,3]*E&TC, JSPM's Rajarshi Shahu College of Engineering, Savitribai Phule Pune University (India)*

ABSTRACT

Vehicles equipped with intelligent systems designed to prevent accidents, such as collision warning systems (CWSs) or lane-keeping assistance (LKA), are now on the market. The next step in reducing road accidents is to coordinate such vehicles in advance not only to avoid collisions but to improve traffic flow as well. To this end, vehicle-to-infrastructure (V2I) communications are essential to properly manage traffic situations. This paper describes the AUTOPIA approach toward an intelligent traffic management system based on V2I communications. A fuzzy-based control algorithm that takes into account each vehicle's safe and comfortable distance and speed adjustment for collision avoidance and better traffic flow has been developed. The proposed solution was validated by an IEEE-802.11p-based communications study. The entire system showed good performance in testing in real– world scenarios, first by computer simulation and then with real vehicles

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Keywords –road safety, traffic, optimize, edge detect, accidents

I. INTRODUCTION

Vehicular Networks have recently raised the interest of network operators, as they can meet both requirements in terms of driving safety and traffic leveraging and the users' demand for ubiquitous access to communication services. The realization of a so-called Intelligent Transport System pursuing such objectives relies on a vehicle to vehicle (V2V) based communication as well as on a vehicle to infrastructure (V2I) setup. Different radio technologies can be employed to realize inter vehicle communications in a V2I based scenario, ranging from Wireless LAN (Wi-Fi), such as IEEE 802.11x standards, to WiMAX solutions, up to 3G/4G cellular networks.

Vehicular networks involve two types of Dedicated Short Range Communication (DSRC) services, namely: a) vehicle-to-vehicle (V2V) and b) vehicle-to-infrastructure (V2I). These two types of communication enable diverse applications (e.g. traffic safety and management, on-the-fly Internet access and infotainment, etc). Also, vehicular networks contribute to increasing the broadband coverage as they are poised to become the most widely distributed and largest ad-hoc networks. However, vehicular networking applications are bandwidth intensive and their dedicated 75 MHz band will soon become insufficient. Further spectrum allocation for these applications will add more stress to the already crowded spectrum.

Vehicular networks should foster vehicles to participate in the selection process in order to account for their specific and stringent requirements and their dynamic context conditions. In this context, this paper proposes and evaluates a context-aware heterogeneous V2I technique where vehicles select the most adequate radio access technology with the assistance of the infrastructure. The decision is driven by the

objective to satisfy the vehicular application requirements at the minimum cost in terms of radio resources to maximize the transmission efficiency. The results obtained demonstrate the benefits of introducing context-aware heterogeneous V2I policies in connected vehicles, and the robustness of the proposed technique against the variability and inaccuracy of relevant context factors.

This paper describes an intelligent V2I-based traffic management system. The goal is to coordinate traffic in a limited urban area, in which different driving scenarios can coexist. A control station is in charge of evaluating the traffic conditions to prevent collisions well in advance and improve traffic flow. To this end, a Driving state indicator—representing tradeoffs between safety and fluidity in driving—is sent to the drivers with a recommended action to adjust the vehicle's direction and speed toward an optimal state. Given the key role that communications play for the operation of this system, an evaluation of their requirements was carried out. The performance of the V2I management system was tested in simulations and in an experiment using real cars on a test circuit.

II. STATE OF THE ART

From the standardization point of view, connected vehicles have been designed from the ground up to facilitate the introduction of heterogeneous networking. ISO standardized the ITS station reference architecture that enables the use of multiple protocols and radio access technologies in vehicular networks (ISO 21217). This architecture has been adapted to the European context by ETSI (ETSI EN 302 665). ISO and ETSI ITS station reference architectures have been designed to support all types of applications. Applications are abstracted from the radio access technologies, network and transport protocols. A transversal management layer (under development) will be in charge of aspects such as networking management, management of congestion control, management of service advertisement, a common management information base (MIB), cross-interface management, etc. Standardization bodies are defining the components needed for the dynamic selection of the radio access technology and protocols.

Several methods has been used to measure driver inattention. Dingus [5] measures the glimpse length, number of glimpse and frequency of use. The glimpse parameters requires a image observing for the drivers face and eyes. Some other approaches has been used for time period and accurateness for the replacement of secondary task such as Peripheral Detection Task (PDT). These measures are yet not measures in real time for everyday driving. Boer [6] used a driver performance measure, steering entropy, to measure workload, which unlike eye gaze and some of the secondary tasks is practical for everyday monitoring, and can be calculated in real-time. In this work indicates that it is able to detect driver inattention and driver distraction while engaged in other tasks while driving.

III. PROBLEM STATEMENT

The problem of allowing the access to users is to guarantee connectivity without incurring in outages. It is a common experience that when connectivity is available and the quality starts to fall the connection remains active until an outage occurs; the outage event triggers the handover process that switches the communication to either a different network (VHO) or a different base station within the same network (HHO). The switching process requires set-up time, so the outage state may result prolonged in time. Here we aim at minimizing the outage effect by designing an handover strategy able to proactively execute the switching phase without waiting for the outage to manifest, thus minimizing undesired out of service intervals. Such a proactive framework is pursued by suitably monitoring and sensing selected parameters from the available networks and merging them in FSM structure in order to detect the most favorable network to switch to in order to minimize the outage probability. The outage probability is a probabilistic measure that no network connectivity is available, or in a more wide sense, that no network connection, assuring the minimum quality requirements, is available.

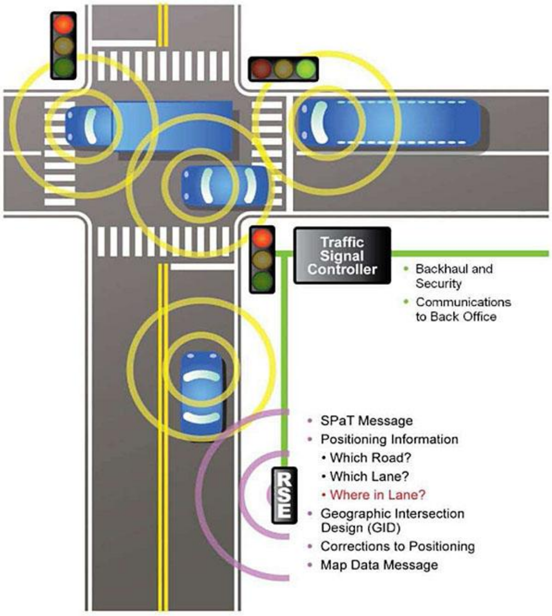

Fig1. Car safety module Fig2. V2I (Vehicle to infra-structure)

The proposed intelligent traffic system is based on having reliable V2I communications. The following paragraphs will describe the solution adopted and an analysis of its capacity to support reliable information exchange in the face of delays and packet losses. The V2I-based intelligent management traffic system uses WAVE for the V2I communications. WAVE is based on the IEEE 802.11p standard for physical layer (PHY) and medium access control (MAC), and on additional standards of the IEEE 1609 family that deal with logical link control, multichannel management, security, and other issues. IEEE 802.11p is an amendment to the IEEE 802.11-2007 standard that proposes enhanced distributed channel access (EDCA) for the MAC and a PHY similar to IEEE 802.11a but using channels of 10 MHz EDCA defines four different traffic classes or "access categories" that are given different priorities: 1) AC_VO (Voice Access Category); 2) AC_VI (Video Access Category); 3) AC_BE (Best-Effort Access Category); and 4) AC_BK (Background Access Category). Depending on the priority assigned to a given packet, it will be queued for the corresponding access category (see [17] for details). Another important characteristic of WAVE is its multichannel feature. There are several 10-MHz channels in the DSRC band that can be used. One is the control channel (CCH), and the other channels are SCHs.

All the stations vehicles must listen to the CCH, in which packets can be sent and received without any prior association, but only stations that have joined a wireless basic service set (WBSS) may exchange packets over an associated SCH. Time is slotted into 100-ms super frames, each one starting with about 50 ms of contention in the CCH, followed by a similar time in which stations belonging to a WBSS may exchange packets in an SCH. In summary, WAVE has introduced into the IEEE 802.11 standard all the improvements that make efficient and stable communications possible at normal road speeds without any significant performance drop relative to static communications (see [3] and [18] for good tutorials about WAVE).

IV. RESULTS

In order to test the effectiveness of the proposed method, we consider the rate achievable by the generic user, power level, BER and congestion in terms of delay in queuing(scheduling/buffering). The behavior of some parameters is different among the networks as for the above cited rate parameter $\chi(n)4$ .In Fig.1 the effect of considering more than one parameter is shown. The set-up is the following. There are 400 nodes in the network and we take care of the movement on only one node at an average speed of 10Km/h. Furthermore, an area of 4 squared kilometers has been considered with 3 Wi-Fi, 1WiMAX and 2 cellular base station have been

V. CONCLUSION AND FUTURE SCOPE

We have presented a V2I-based traffic management system with a twofold objective: First, our approach proposes a solution to the problem of regulating traffic flow in urban areas, in which different bottleneck situations may coexist. Second, it contributes to avoiding accidents by alerting the driver in advance of potential collisions. The system includes an intelligent controller that uses a reference safety distance and the appropriate speed as fuzzy inputs. The output sent to the driver is information on how the vehicle is being driven. In this paper, for the sake of simplicity, only information on longitudinal actions has been communicated. The system has been tested in simulation and on a real test track. The results have shown it to perform well. This work constitutes starting point for the development of a complete traffic control system. In particular, the authors would like to highlight that this paper presents the first results on how to manage four real vehicles approaching an intersection from different directions. Future work will study new challenges involving scenarios with traffic light control and lateral maneuvers.

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