Intelligent Cooperative Sensing for Improved Traffic Efficiency

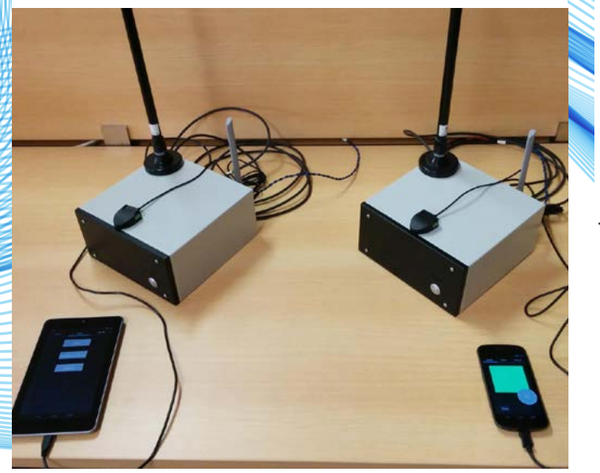

Fig. 1 ITS G5 stations (IT2S) with external antennas (GPS and 5.9 GHz) and Android devices.

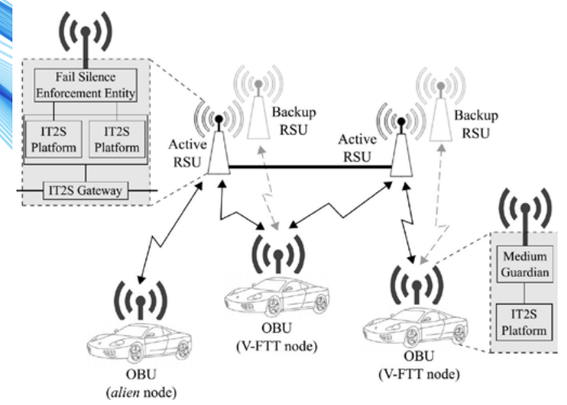

Fig. 2 Dependable vehicular network architecture proposed in the scope of ICSI project.

ICSI proposes a novel communication and data management architecture, in line with and complementing the efforts within the technical committees machine-to-machine and Intelligent Transport Systems of ETSI, and the implementation shows its feasibility in the use cases selected for the field trials. ICSI provides the prototypes of new ITS sensors for improved data gathering through cooperation and the technological solutions for optimized V2X and ITS communications for cooperative sensing and decision making.

PROJECT WEBPAGE URL
http://www.ict-icsi.eu

Main Project Team

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Funding Agencies

FP7 – European Union	**394,201€**
Start Date	01/11/2012
Ending Date	31/12/2015

Indicators

Books	1
Book chapters	7
Journal Papers	4
Conference Papers	12
Concluded PhD	1
Concluded MSc	7

Two Main Publications

B. Fernandes, M. Alam, V. Gomes, J. Ferreira, A. Oliveira, **Automatic Accident Detection with Multi-modal Alert System Implementation for ITS**, Vehicular Communications, Vol. 3, No 1, pp. 1 – 11, January, 2016

T. Meireles, J. Fonseca, J. Ferreira, **The Case for Wireless Vehicular Communications Supported by Roadside Infrastructure**, Chapter In Intelligent Transportation Systems Technologies and Applications, John Wiley & Sons, Aveiro, 2015

GENERAL MOTIVATION AND OBJECTIVES

Transportation systems are evolving towards Intelligent Transportation Systems (ITS), where there is closed loop interaction between vehicles/drivers and the transportation infrastructure, as enabled by cooperative V2X communications and cellular networks. While some of the enabling technologies are entering their mature phase, there is still the need of a complete integrated solution that can take the most benefits from a real-time analysis of the data gathered and appropriate reaction on the transportation system. This requires a higher level of intelligence to be integrated into the sensing and communication infrastructures, with decentralized aggregation and decision for robust and timely decisions to be taken. However, existing ITS architectures exhibit a hierarchal nature where the data is flowing from bottom (vehicles, sensors, road side units) to top (centralized management system). However, this approach does not scale adequately with the inclusion of a significant number of new elements, is not flexible in supporting an incremental growth or changes of the ITS, and exhibits latency and security issues.

The vision of ICSI is to make interaction between heterogeneous data sources as seamless as possible, by providing a common layer for data distribution, and to leverage such opportunity to shift the intelligence for decision making from humans in control centres to machines distributed within the ICT infrastructure itself. This machine-to-machine (M2M) interaction between sensors (e.g., traffic flow) and actuators (e.g., variable message signs) will be enabled with local scope, so as to keep it effective while being efficient and highly scalable.

CHALLENGE

The ICSI project proposed a new architecture where the intelligence for sensing and actuation is distributed over some of the elements, called gateways, which host a software platform for running ITS applications, using the local storage and computation capabilities available. ICSI ensures that the mobility and transport are more efficient, safer and energetically sustainable. To achieve the desired objectives undertaken in ICSI, various hardware and software implementations have been performed, such as, development of secure and dependable MAC protocols, ETSI ITS G5 station, data distribution platform, gateways supporting Cooperative Learning Units (CLU) and Human-Machine Interfaces (HMIs) (Applications and web-platform).

WORK DESCRIPTION AND ACHIEVEMENTS

The project ended in December 2015, with the field trials on the A5 motorway (Lisboa-Cascais). The field trials included the installation of six road-side units (RSUs) placed along the motorway, some vehicles equipped with OBUs and the integration with the ICSI Web and data distribution platforms. Several safety use cases were implemented and tested in the A5 field trial, notably: route guidance and intermodal support, wrong way warning, hazardous location warning, road works warning, traffic jam warning and emergency vehicle warning. Field trials are executed, on the highways in Portugal, with success, showing the feasibility and effectiveness of the proposed solutions under the defined realistic use cases.

IT led the consortium activities related with wireless vehicular communications and made contributions to the state-of-the-art, namely: a flexible ETSI ITS G5 station (IT2S), based on reconfigurable hardware, supporting time-triggered packet transmission and protection, at the medium access control (MAC) layer, against non-compliant on-board units (OBU); A TDMA based real-time MAC protocol, the Vehicular Flexible Time Triggered (V-FTT), providing both spatial and temporal redundancy; A fault-tolerant network architecture supported by the road-side infrastructure, including techniques to enforce fail-silent behavior and active replication in the critical nodes of the network; A HMI application, able to present safety events to drivers and passengers and enabling the implementation of the recent eCall system in Europe.