GIS ITS Bretagne: status and perspectives

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Abstract: A scientific coordination group devoted to Intelligent Transportation Systems has been set up in the Brittany region, called "GIS ITS Bretagne". This group federates research projects as well as innovative actions and experiments. The objectives of this group are described in this paper, as well as two first projects : CAPTIV an LoCoSS which are respectively devoted to intelligent signaling infrastructures and vehicles and geolocation and transmission services for terrestrial and maritime rescue applications.

Keywords: Vehicle to vehicle communications, vehicle to infrastructure communications, geolocation, positioning techniques, geographic information systems, search and rescue.

I.   OVERVIEW OF THE GIS

The existence of a significant research task force in computer science, computer engineering, electronics, signal processing and telecommunications in Brittany has recently led to the setting of the scientific interest group called "GIS ITS Bretagne" devoted to Intelligent Transportation Systems. It amalgamates research units of universities (Rennes and Nantes), graduate engineering schools (ENST Bretagne, ENSSAT, ENSIETA, INSA de Rennes), the Ministry of Equipment (CETE, LRPC, LCPC) and France Telecom R&D. After the signature of the agreement between the partners in June 2004, the GIS was officially launched in February 2005.

Its main objective is to stimulate and federate research projects as well as innovative actions and experiments using technological platforms. Moreover, it looks for synergies with other structures at the regional, national or international levels. It is strongly related to social needs in particular security issues by means of technologies or services (e.g., using embedded devices). One of its important missions is to attract and associate (big, medium range and small) companies in the R&D activities which will be undertaken.

The ITS domain is broad and the first discussions have focused on the identification of a priority: services to mobile users. This theme covers several issues and two projects (which are detailed later on) have been recently initiated and they have received funding by the Regional Council of Brittany. The LoCoSS project deals with geo-localization, communication and rescue services and the CAPTIV project aims at studying and developing intelligent signaling systems. Other research activities are planned in 2006 and projects about "real-time" transport on demand and dynamic route aid calling on distributed heterogeneous information systems should be defined.

II.   THE CAPTIV PROJECT

CAPTIV research project aims at proposing new low-cost energy-efficient mobile communications solutions to ease and make safer road traffic conditions. Considering "intelligent" road signs and vehicles, i.e. equipped with an autonomous radio communication system, drivers will be able to receive various information about traffic fluidity or road sign identification at any time.

In order to reduce deployment cost and increase lifetime of the whole system, Multiple-Input Multiple-Output (MIMO) signal processing techniques are used. Such techniques allow to dramatically increase the capacity of mobile communication systems or the quality of the transmission, thanks to the well known space-time codes. From another point of view, MIMO systems allow to significantly reduce energy consumed by communications in ad-hoc networks. Considering each crossroads as a communication node, the possible co-operation between road signs allows energy-efficient communications between crossroads (see figure 1).

Supported by the Scientific Interest Group GIS ITS-Bretagne and by industrial leaders in ITS domain, regrouping major research laboratories in the region, CAPTIV is a highly application-oriented program. A first prototype of such a communicating crossroads will be presented in the *Route du Futur* in Saint-Brieuc (portion of road devoted to ITS experiments).

Further research on MIMO channels characterization and modeling, on specific antennas conception, associated with signal processing techniques will then allow to optimize the energy consumption between nodes. Comparisons to other radio solutions, such as RFID (Radio Frequency Identification) will also be envisaged.

III.   THE LoCoSS PROJECT

LoCoSS aims at bringing significant improvements to the rescue brigades operations, terrestrial as well as maritime, thanks to ITS technologies.

In the case of an accident or a disaster occurring either on the road, in a factory, in a city, in a harbour or on a boat cruising close to the coast, three points are of the highest importance: the rapidity of the intervention of the brigade, the exactness and the completeness of the critical information which is available at the level of the headquarters vehicle and the possibility for the intervening agents to remain in permanent contact with it. The idea of the project is to combine the three basic ITS technologies, i.e. the wireless communication, the positioning and the geographic information systems (GIS), to facilitate and improve the above mentioned points.

Numerous wireless communication technologies standards (GPRS, Wi-Fi, WiMAX, DSRC, UMTS…) will be optimally used in the project to offer a permanent IPv6 connectivity through NEMO technology. Therefore, the headquarters vehicle will be able to download continuously before the departure to the site, during its travel and during the operation, the necessary information into its database to steer efficiently the operations. Wireless bidirectional links will also be established between the headquarters vehicle and some members of the team who could be equipped with a positioning pack, in order to trace their movements from the vehicle and to optimise the operations management. Since all pieces of equipment (in the vehicle and on the member of the team) will be provided with a full IPv6 connectivity, the headquarter will be allowed to directly request information from them.

Thanks to the positioning technologies, based on EGNOS, aided by additional sensors to ensure a high level of integrity, the intervening vehicles will be able to navigate precisely and accurately up to the accident or disaster location and the main stationary headquarters (typically the fire station) will be informed precisely about their progress. For the difficult issue of tracking the firemen inside a big site such as a factory of a ship, novel positioning techniques such as high-sensitivity or assisted GPS receivers, combined with inertial sensors or with Wi-Fi triangulation will be experimented.

Finally, novel dynamic geographic information management techniques will be used to build and to update the on-board database that will be necessary to support the operations. This base will have be extracted from the main, but too big to be used onboard the headquarters vehicle, data base existing at the fire station and will have to be interactively updated in real-time during the progress of the rescue operations, thanks to the wireless links established between all the main actors. A record of the various data exchanged can also be extremely profitable after the operation, for training and teaching purposes, inside a simulation tool that some fire brigades already possess.

IV.   CONCLUSION

The LoCoSS project, as well as CAPTIV, will last 3 years from February 2006 to January 2009. Although the core partners are research laboratories (from ENST-Bretagne[1], IRISA[2], ENSIETA[3], IRENav[4], LCPC[5], IETR[6], CETE[7] Ouest), SMEs in the field of mobile communication and embedded electronic equipment have already been contacted to join the project.

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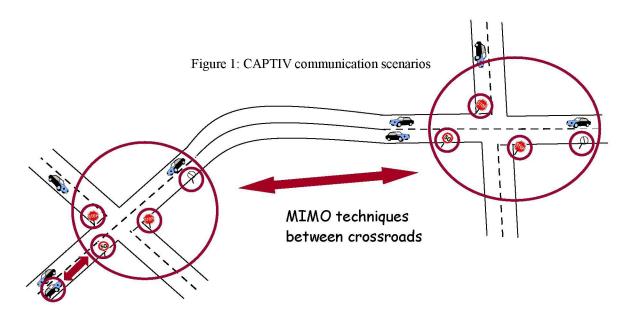[2] IRISA : Institut de Recherche en Informatique et Systèmes Aléatoires
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Figure 1: CAPTIV communication scenarios

MIMO techniques
between crossroads

MISO and SIMO techniques
between vehicle and crossroads