Project Title: Smart Network Models for Transportation Safety and Mobility (TransCom)

Institution/Name of Supervisors
1- University of Technology of Troyes-ERA team, France
   Dr. Lyes Khoukhi, Lyes.khoukhi@utt.fr
2- University of Montreal, Canada
   Prof. Abdelhakim Hafid, ahafid@iro.umontreal.ca

Background

Intelligent Transportation System (ITS) is a promising solution to facilitating road safety, traffic management, and infotainment dissemination for drivers and passengers. The distinctive set of candidate applications such as safety (e.g., collision warning), resources (rechargeable power source, licensed spectrum), and the environment (e.g., vehicular traffic flow patterns, privacy concerns) makes ITS a promising area of wireless communication [1, 2, 13]. Various ITS projects are underway in US and Europe (e.g. IntelliDrive [3], SAFESPOT [14], NoW [5]), or recently were completed (e.g. ITS-Safety 2010 [6], COOPERS [7]), and several consortia (e.g. Vehicle Safety Communications (VSC) consortium [8], Car-to-Car Communication Consortium (C2C-CC) [9]) were set up to explore the potential of ITS.

Example of vehicular networks

Project proposal

One of the vital aspects when designing ITS solutions is the integration of mobility models that reflect as much as possible the real behavior of vehicular traffic in a real transportation environment. Several mobility models have been proposed [10, 11]; they could be classified as either macroscopic or microscopic. In macroscopic models, motion constraints such as crossroads, streets, roads,
and traffic lights are considered; also, the generation of vehicular traffic such as traffic density, traffic flows, and initial vehicle distributions are defined. Microscopic models, instead, focus on the movement of each individual vehicle and on the vehicle behavior with respect to others [4]. However, almost of these models suffer from three limitations: (1) they are based on simplistic assumptions (e.g., the average number of vehicles per hour passing a specific cross-section and the average number of vehicles per kilometer); (2) they do not consider the dynamic and random feature of events (e.g., changes in vehicular traffic and the effect of weather conditions on traffic circulation); and (3) in their design, these models do not consider the constraints related to quality of service (of data traffic exchanged between vehicles and infrastructure) and to optimal use of resources (e.g., radio bandwidth utilization).

Accordingly, this project aims to propose new ITS mobility models permitting to alleviate the three limitations cited above. Our principal concern is to improve the reliability of the design of ITS solutions for real deployment in vehicular networks. The algorithms to be proposed in our project should consider a large number of constraints related to wireless communications (e.g. interferences, radio coverage, etc.), to vehicular network characteristics (e.g. density of vehicles and their speed and positions, etc.), and to data communications (flow rate, load balancing, etc.). Indeed, we believe that some environment factors (such as the impact of weather on traffic circulation) and ecological aspect (energy consumption minimization for reducing CO2 emission) would be interesting to consider in the design of our mobility algorithms. The models we plan to develop are based on several techniques coming essentially from optimization and distributed artificial intelligence areas.

References


[3] MDOT Website and Parsons Brinckerhoff Michigan Inc.,“Lessons Learned: Deployment of Public Sector Infrastructure for VII/IntelliDrive(sm),” Website, May 2011,


