Increasing the use of information technology (IT) in future vehicles can solve or mitigate many of the fundamental problems we face today in transportation such as energy efficiency, reduced carbon footprint for cars, greener environment, and several others. Specifically, the focus of the proposed work is on making vehicles more intelligent for increasing safety at intersections, mitigating congestion, reducing the commute time of urban workers, increasing productivity of the USA (as well as other countries), increasing the energy efficiency of cars, reducing the carbon footprint of cars, and supporting a greener environment.

In particular, we propose a new technology which migrate infrastructure-based traffic lights to in-car traffic lights, as shown in Figure 2. Using the emerging vehicle-to-vehicle (V2V) communications capability of modern cars through the DSRC standard at 5.9 GHz, it has been shown that this technology can make traffic control ubiquitous at every intersection in urban areas. Through V2V communications, the vehicles at different legs (or approaches) of an intersection can elect a leader which can manage the traffic flow at that intersection, thus acting as a “Virtual Traffic Light”. The results of our investigation in the last three years have shown that this technology can reduce the commute time of urban workers between 40-60% during rush hours which seems pretty significant in terms of reducing accidents at intersections, mitigating congestion, increasing productivity, reducing carbon footprint of cars, increasing the energy-efficiency of transportation, and supporting a greener environment.

Desired Outcomes and Metrics

**Year 1**: (a) Quantify the impact of RF obstructions and communications problems at intersections on the proposed VTL scheme and propose solutions to these problems; (b) Develop new algorithms and technologies that will take into account the presence of pedestrians and cyclists at intersections; (c) Quantify the severity of the “partial penetration” problem and generate practical solutions (hardware and software platforms) for addressing the problem.

**Year 2**: (a) Develop a large-scale simulator using open-source simulators (such as SUMO, OMNET++, VEINS, ns-2, ns-3, etc.) which will comprise a mobility simulator integrated with a network simulator and assess the performance of the developed solutions; (b) Experimental verification of the developed technology and solutions through test beds that are currently up and running.

Capabilities and Experience

*Lead: Prof. Ozan Tonguz (CMU).* The proposed activity has attracted about $1,500,000 funding since 2009. A joint CMU-Portugal project called DRIVE-IN has been funded since 2009 for about $1,200,000 (for 3 years). Prof. Tonguz is the PI of this effort at CMU which entails about 6 faculty members, 10 PhD students, and several post-docs from CMU, University of Porto, and University of Aveiro. In addition, Prof. Tonguz has been heavily involved in vehicular networks active safety research sponsored by GM using vehicle-to-vehicle communications over the last 8 years (2004-2012). Some of his other research over the last 5 years has also looked into non-safety applications such as traffic information systems (infotainment), entertainment, etc.

This research is funded in part by the U.S. Department of Transportation’s University Transportation Centers Program.