Mobile Networks to Enhance Vehicular Safety and Efficiency (VSE)

Objective: To explore the applications of 4G/LTE mobile cellular networks as a complement to Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) networks to improve driving safety and efficiency.

Abstract: Automotive vehicles can benefit significantly from communicating with other vehicles, roadside / remote sensors, as well as databases in the cloud to improve a variety of functions that can significantly enhance safety and fuel / time efficiency of commuting. Example functions include: pedestrian safety, collision-avoidance, improve navigation, support intelligent highway functions, smart lanes, congestion routing, parking spaces location and reservation, etc. The primary approach so far for such applications has been through special purpose V2V/V2I networks (e.g., Dedicated Short Range Communications: DSRC). However, with the rising performance and ubiquity of 4G mobile data networks, there appears to be opportunities to complement V2V/V2I. This research will pursue this approach as well as find specific areas to influence future 4G network evolution to better support such functions.

Motivation and Plan: Since the late 1990’s, when DSRC was envisioned, cellular technology has advanced dramatically to the current performance levels of 4G/LTE, which is vastly superior to DRSC in many parameters. Also, most importantly, 4G is already (or will soon be) widely deployed. This could allow VSE functions to be deployed years sooner, and could reduce or remove heavy investments that special purpose networks (DSRC) may otherwise require. It is therefore an opportune time to look at how / what 4G/LTE can do to support VSE.

To that end, we propose the following work elements for year one, which will be done in close consultation with industry affiliates:

- Conduct a literature review of existing work regarding VSE with cellular and DSRC standards.
- Identify candidate VSE functions that might be performed by 4G/LTE and their requirements in terms of latency, throughput, coverage.
- Define a model to simulate the performance of 4G/LTE regarding latency, throughput, coverage as a function of network load and actual network usage for the identified VSE functions.
- Propose a setup and research plan for a testbed to conduct initial real-world evaluation of the 4G/LTE performance and benefits regarding the identified VSE functions.
- Share findings with affiliates in seminars, reports, and research articles throughout the program.
- Deploy the evaluation test bed and conduct the proposed evaluations (at the earliest in year two).

Value to Affiliates: Industry affiliates will get access to wireless experts at Stanford, the knowledge base at V-CAP, in combination with the insights that are expected to emerge from regular affiliate interactions.

Staff: The principle investigator is Prof. (Emeritus) Arogyaswami Paulraj. A post-doctoral researcher will be hired once the funding from an initial group of industry affiliates is pledged, additional research staff might be hired at a later point. Prof. Fouad Tobagi and other faculty will complement the group of affiliated faculty.

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