GENI-Enabled Vehicular Sensing and Control Networking: From Experiments to Applications

Hongwei Zhang✦, Jing Hua✦, Jayanthi Rao*, Anthony D. Holt✦, Patrick Gossman✦, George F. Riley◆, Weidong Xiang♣, Yuehua Wang✦, Hai Jin✦, Chuan Li✦

✦ Wayne State University, Detroit, Michigan, hongwei@wayne.edu

*Research and Innovation Center, Ford Motor Company

◆Georgia Institute of Technology, ♣University of Michigan-Dearborn

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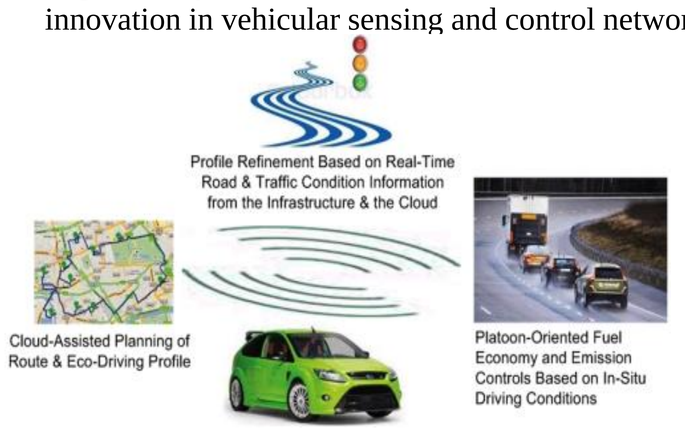
Overview

Context

- Road vehicle transportation has become a major source of societal concerns
- Next-generation vehicles will cooperate with each other and as well as transportation infrastructures to improve transportation safety and efficiency
- Large-scale, permanent deployment of research-only vehicles is infeasible in general
- High-fidelity and at-scale emulation as an enabler for innovation in vehicular sensing and control networking

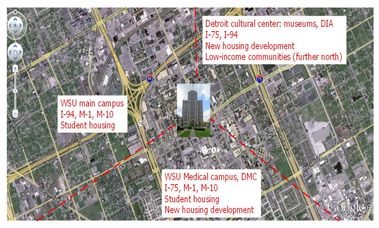


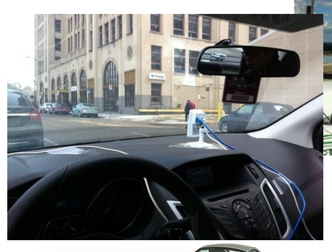
Project Objectives

- To enable evaluating Vehicular Sensing and Control (VSC) networking solutions in a wide range of scenarios and at scale
- To bridge the GENI and VSC research as well as application communities for self-sustaining GENI development
- To experiment with heterogeneous GENI resources

Expected Contributions to GENI

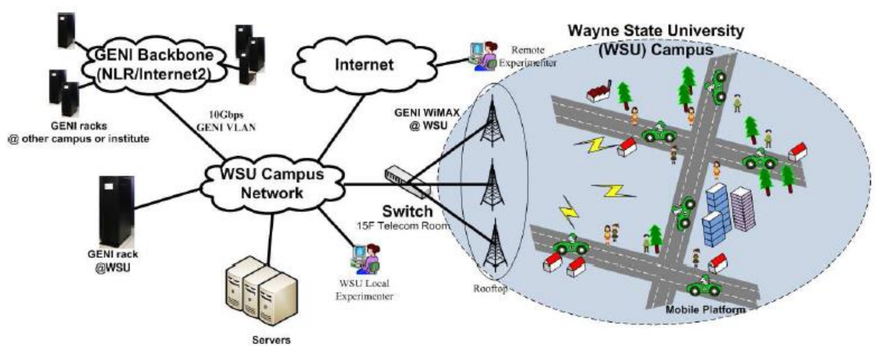
- New GENI capabilities: virtualized VSC platform, real-world vehicular sensing
- Stress-test GENI capabilities: WiMAX, rack, VLAN, VSC platform, ORCA, OMF, etc
- Create the technology foundation and community structure for self-sustaining development of GENI
- Stimulate community efforts for using GENI in VSC networking research





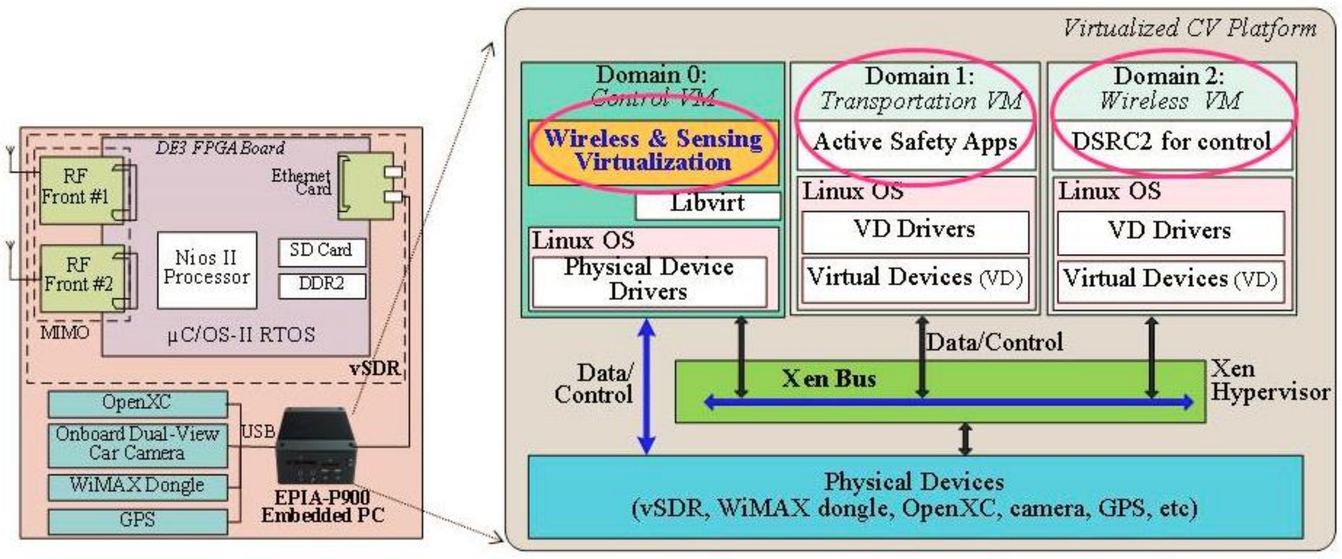
Software-Defined Platform & Infrastructure for Networked Vehicular Sensing and Control

System Architecture



- A research infrastructure developed for vehicular networks with the integration of GENI resources
  - Resource virtualization
  - In-field vehicle internal state sensing and surrounding condition sensing
  - Simultaneous operation of real-world applications and experiments
  - Parallel, distributed emulations on GENI racks with realistic sensing data

Software-defined Platform Virtualization: enabling concurrent, non-interfering access



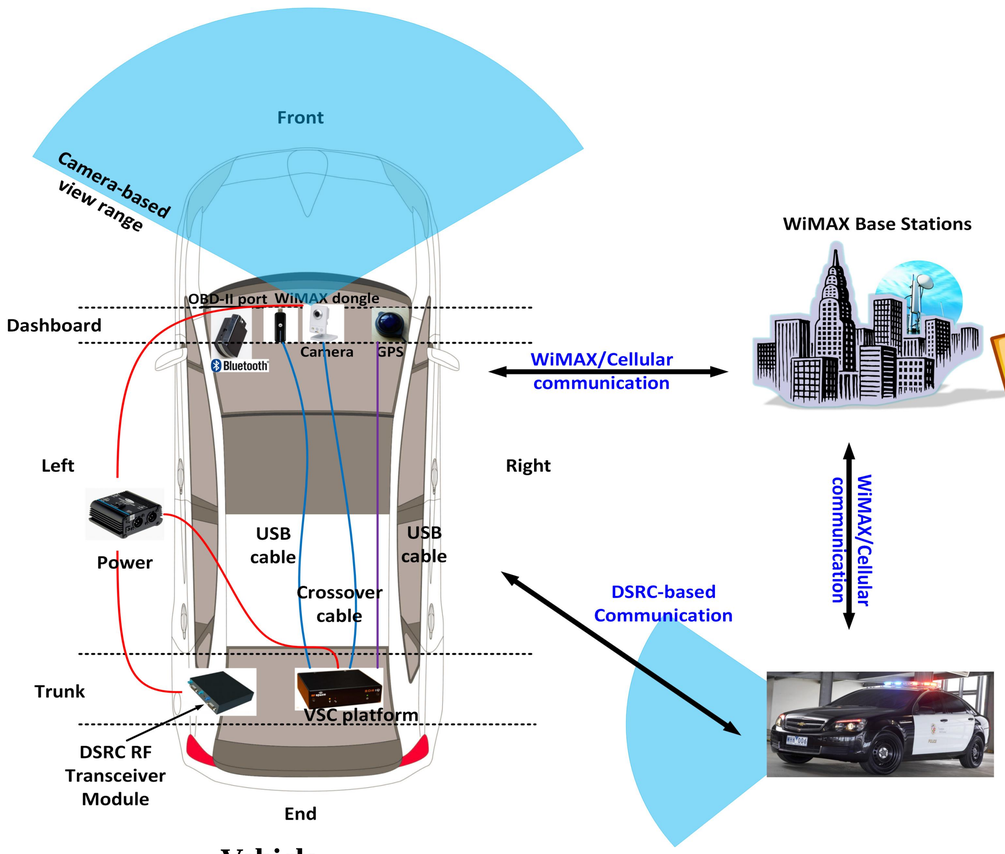
Physical platform **Virtualized platform**

- Cross-discipline fertilization and opt-in user engagement
- vSDR-based IEEE 802.11p and WiMAX wireless resource virtualization
- Software-defined isolation and resource-allocation
- Sensing data virtualization to serve different VMs and GENI Racks

Enabled Applications and Experiments

Example applications/experiments:

- Vehicle internal state sensing: fuel economy, vehicle dynamics, etc
- Camera-based vehicle external sensing
- Multi-dimensional emulation of networked VSC systems: wireless channel, vehicle dynamics/mobility (e.g., parameter estimation for car following models), application etc
- Real-world application deployment: 3D campus surveillance and police patrol



Vehicle **Applications/Experiments**