Project Overview

Mapping Technology Assessment for Connected Vehicle Highway Network Applications

CGSIC – Seattle Washington
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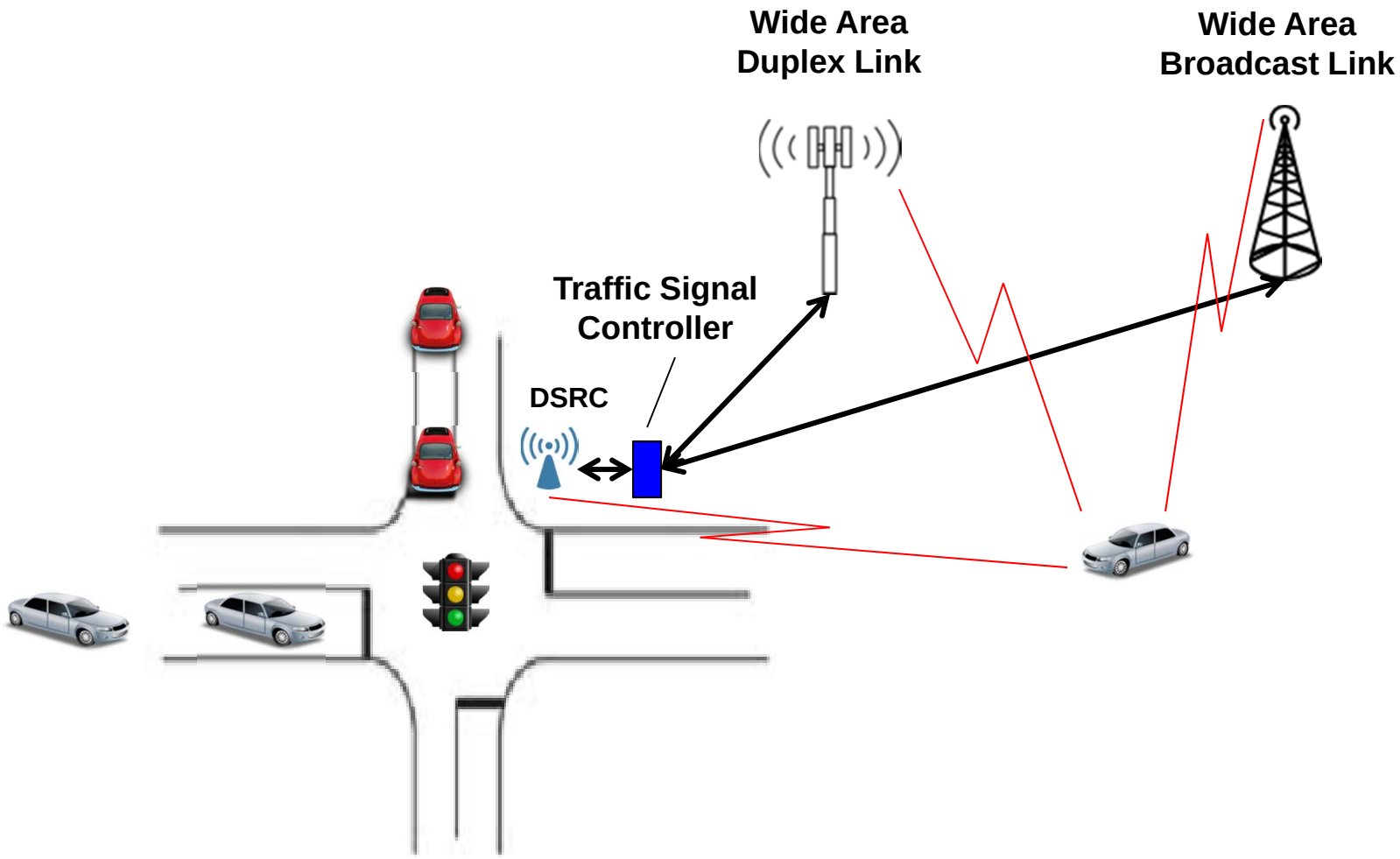
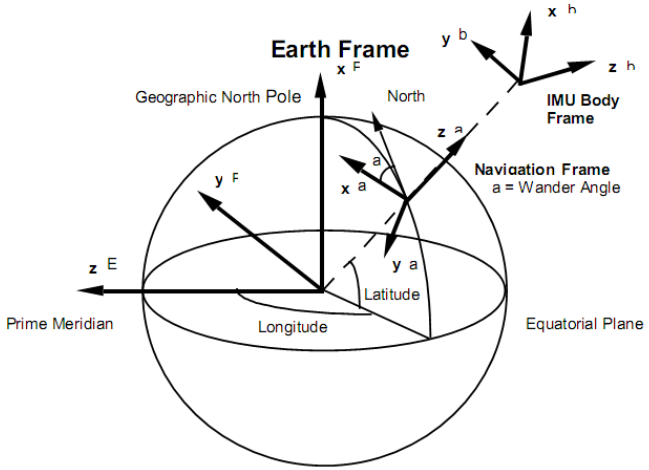
Connected Vehicle Program Goals and Objectives

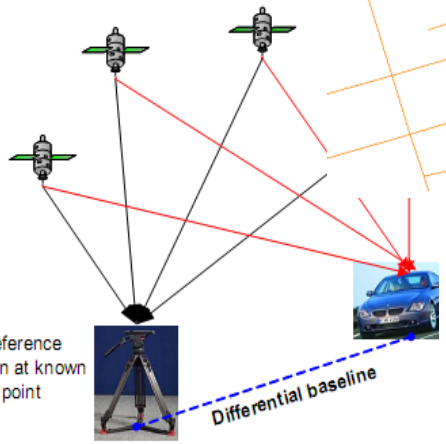
- FHWA's Connected Vehicle Program was established to facilitate the implementation of applications related to vehicles and/or infrastructure for helping to enhance safety, mobility, and the environment.
- These applications will utilize mapping, positioning, and communication technology for their operations to provide information on the location of vehicles in relation to the roadway, other vehicles, and pedestrians.
- Connected Vehicle is a large, multi-faceted program managed by the ITS Joint Program Office of the Research and Innovative Technology Administration (RITA)

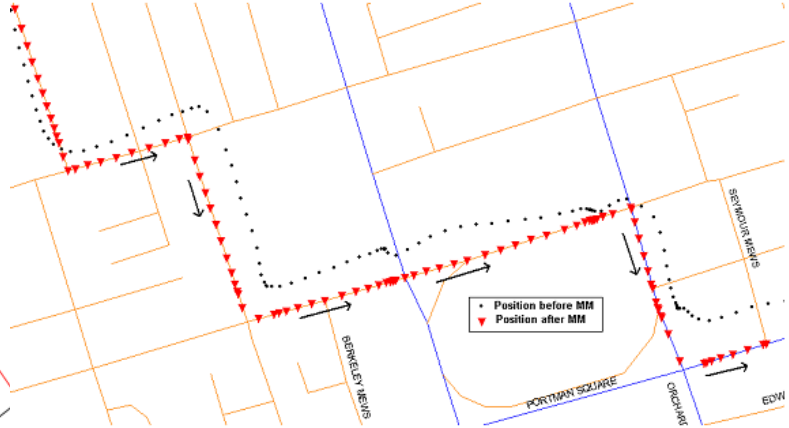
Communications Technologies

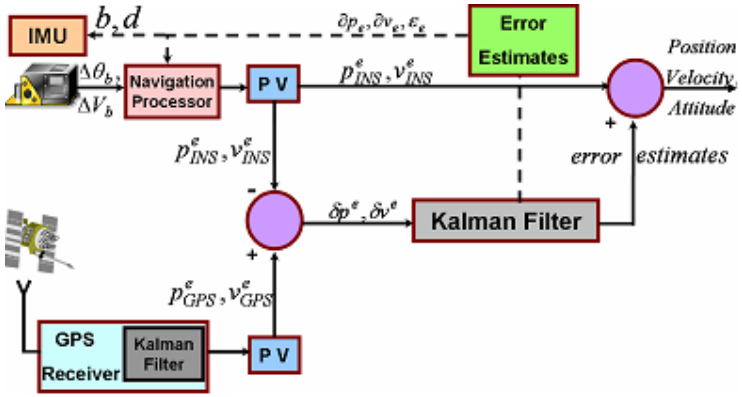


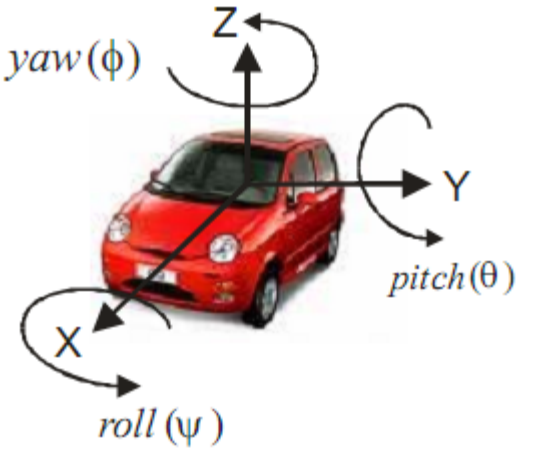
Positioning Technologies



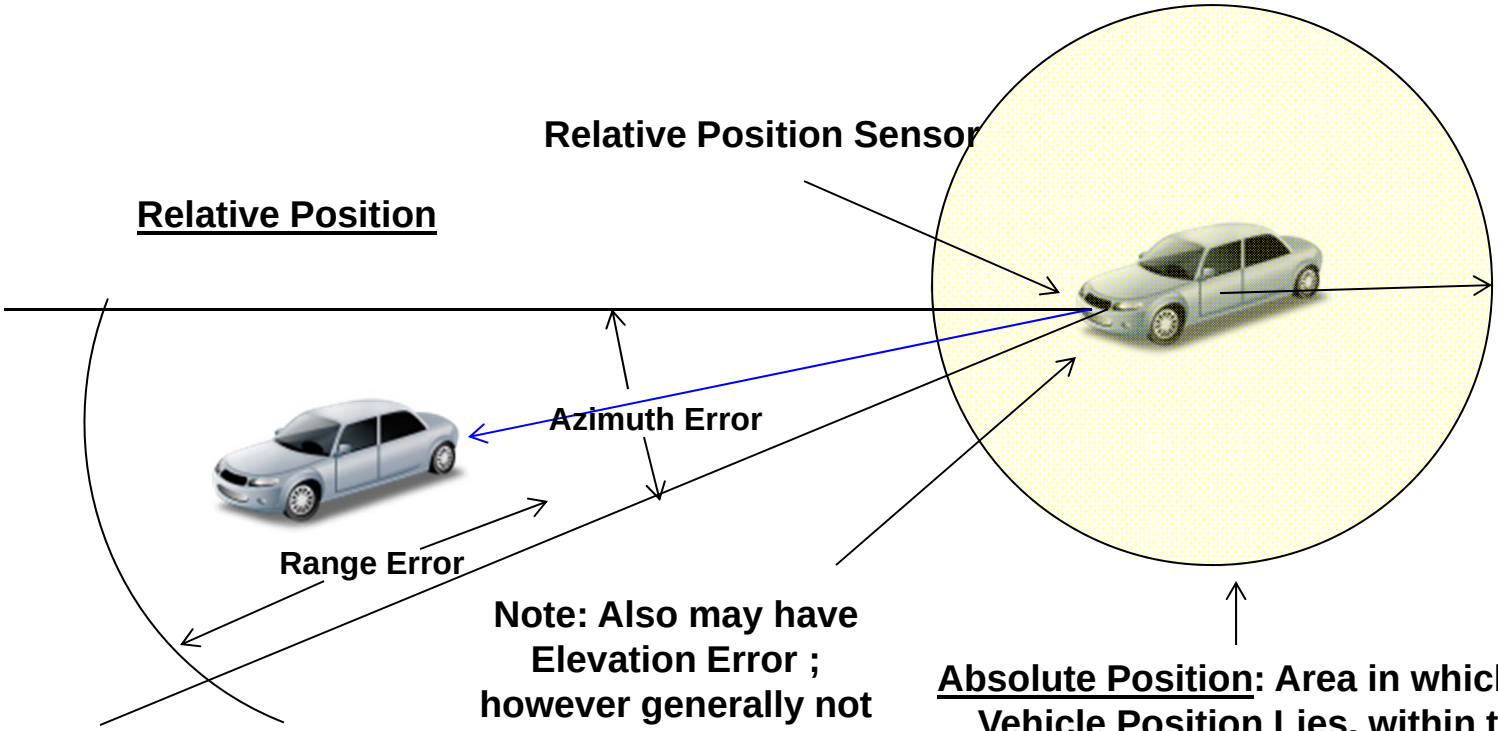




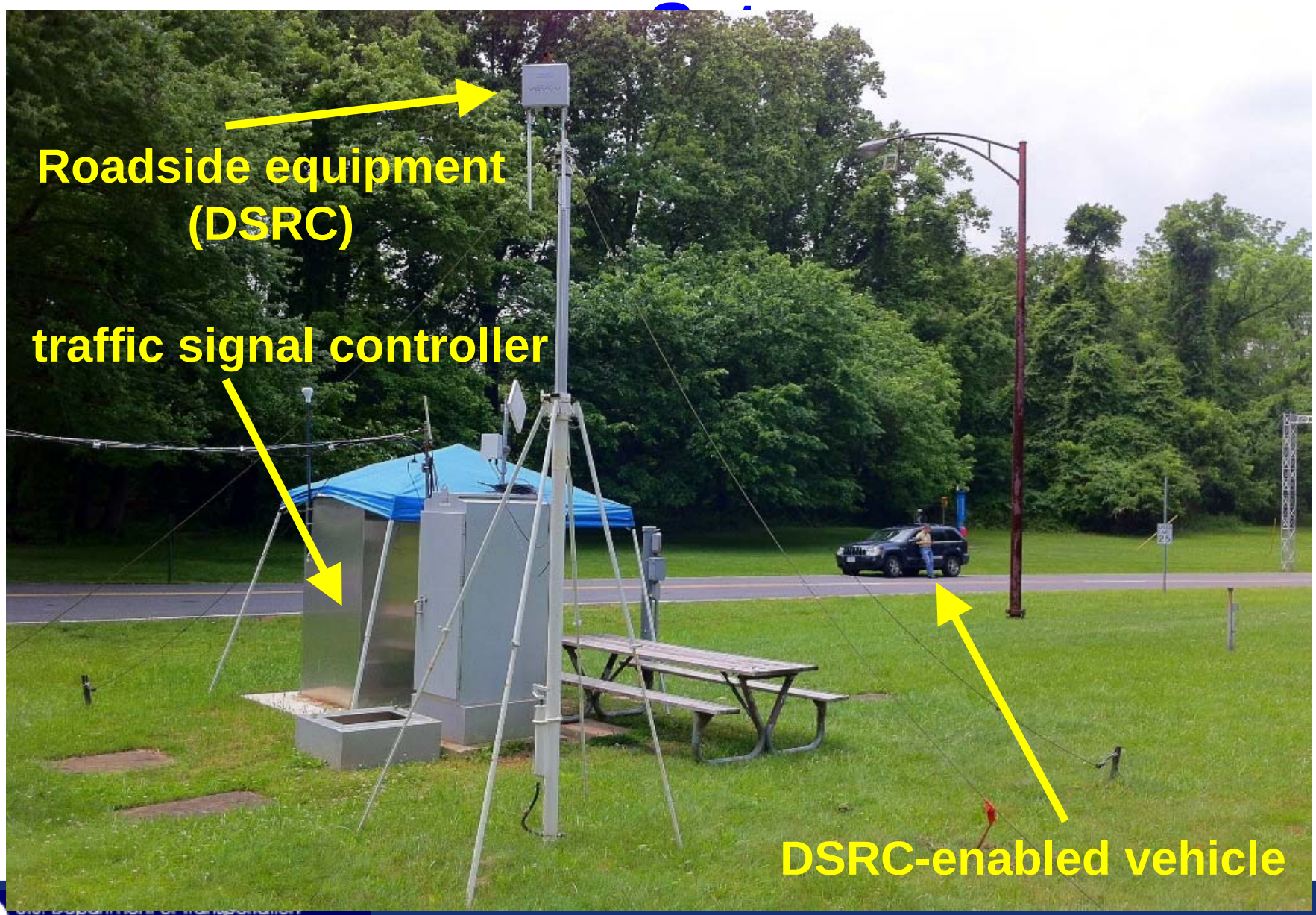




Relative Position of Targets Referenced to Absolute Position Provided by GPS

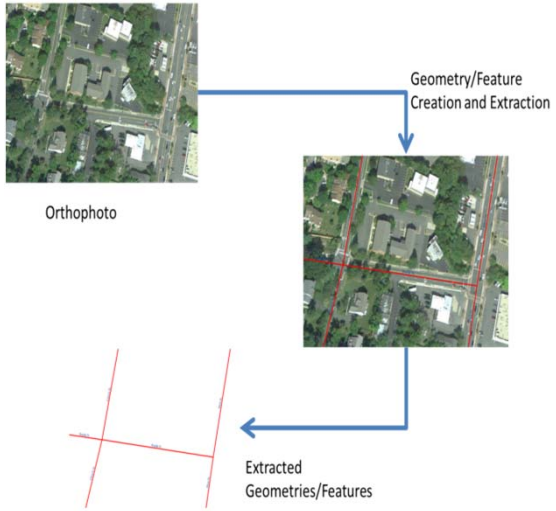


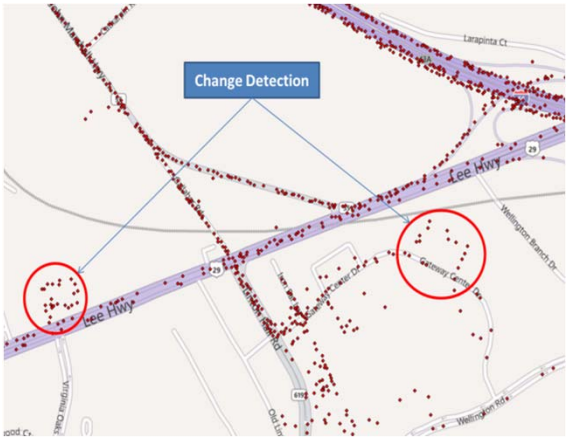
Signal Phase and Timing System



Mapping Technologies

- As one of the main supporting technologies of the Connected Vehicle Program, **Mapping Technologies** provide critical support across safety, mobility, and environment applications through the provision and update of roadway data
- The mapping of roadways involves developing an accurate geometric representation of the roadway and attribution of those geometries with application relevant data
- Roadways are usually represented in GIS databases as linear features. Lane configuration and connectivity may also be represented in the form of additional geometries in the database or through attribution
- The development of maps supporting Connected Vehicle applications requires the initial creation of the maps as well as ongoing, timely update of these maps





Mapping Technology Assessment Project

- The ***Mapping Technology Assessment for Connected Vehicle Highway Network Applications*** project aimed to analyze and determine the best current and anticipated geospatial technologies and mapping approaches to support intelligent transportation systems (ITS)

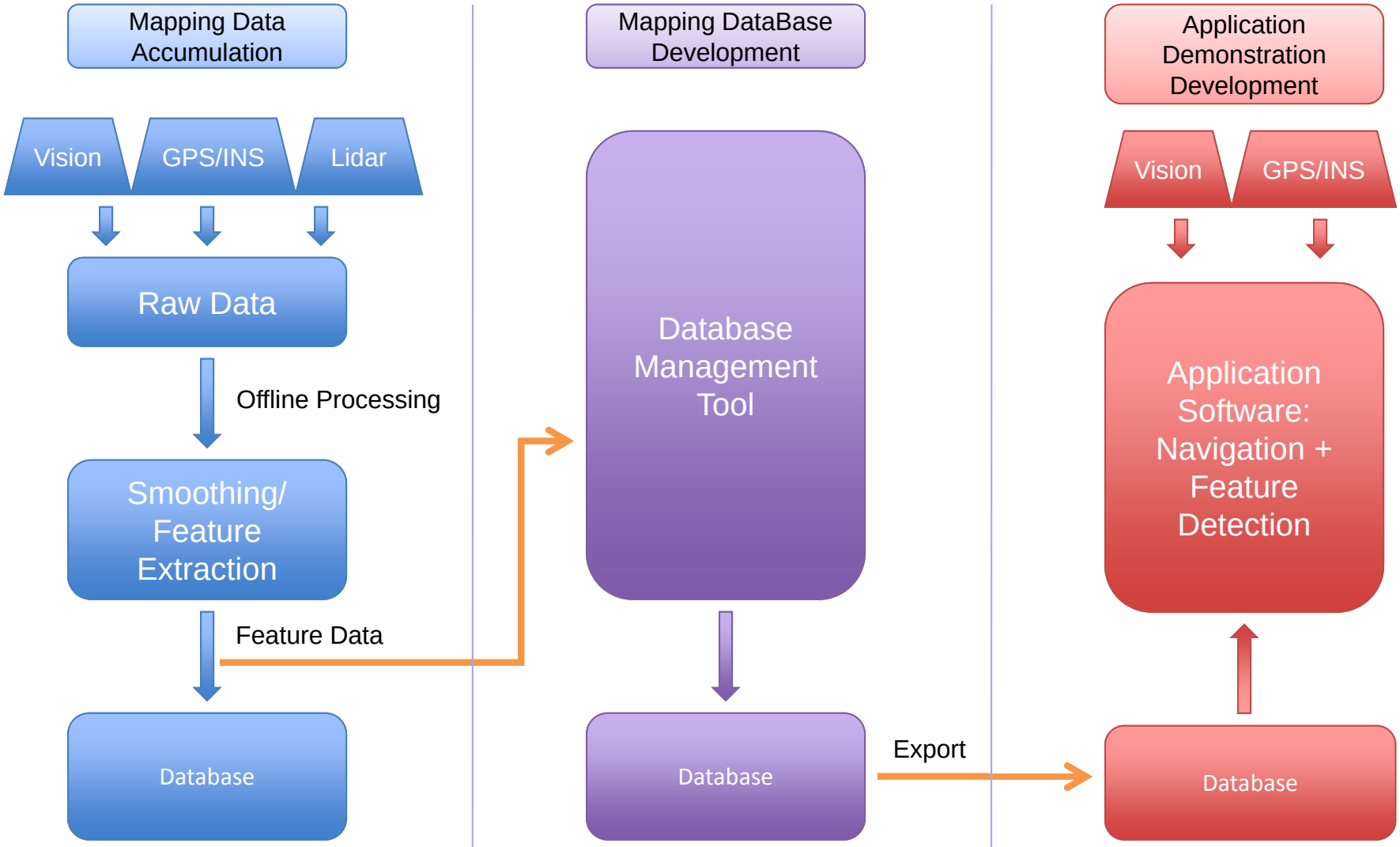
- This assessment is fundamental to providing solutions that allow connected vehicle network applications to bring about transformational improvements in the safety, mobility, and environmental performance of our nation's transportation systems

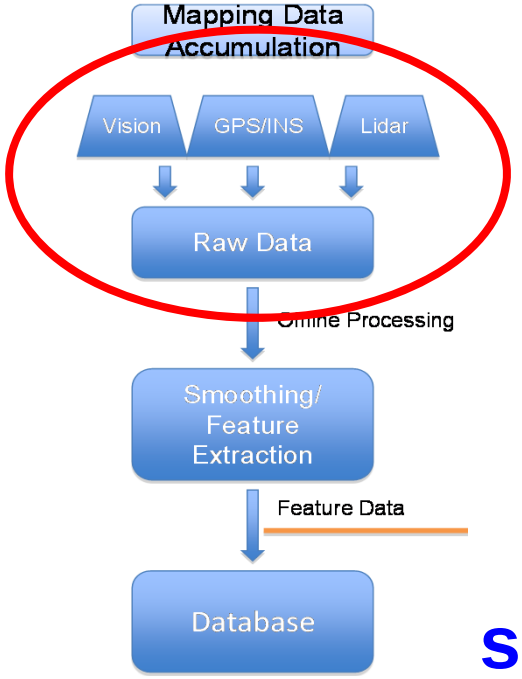
- Mapping Technologies are a key enabler for the Program and its applications
  - Vehicles need to know where they are in relation to other vehicles (relative position)
  - Vehicles need to know where they are in relation to the roadway (absolute position)

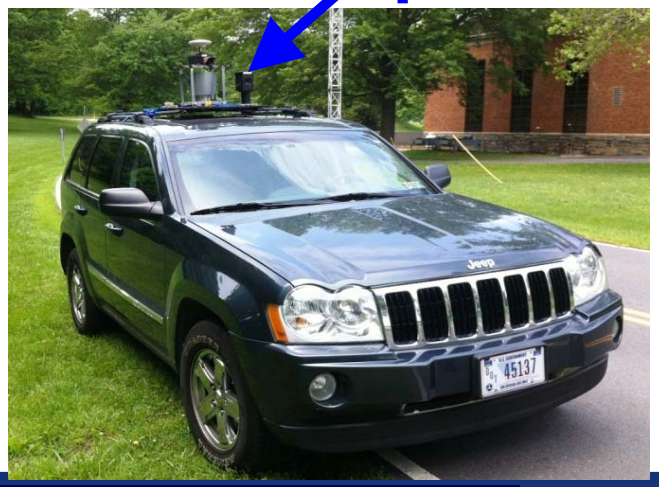
- The focus of the project is across 3 major areas:
  - Assess what mapping technologies meet the requirements of Connected Vehicle applications
  - Test relevant technologies in lab and in the Connected Vehicle Highway Testbed (CVHT)
  - Develop a data management framework for compilation, storage, and update of collected data

- The goal of the connected vehicle vision is high, but the potential benefits are significant as implementation of connected vehicle network applications can have far reaching impacts on transportation

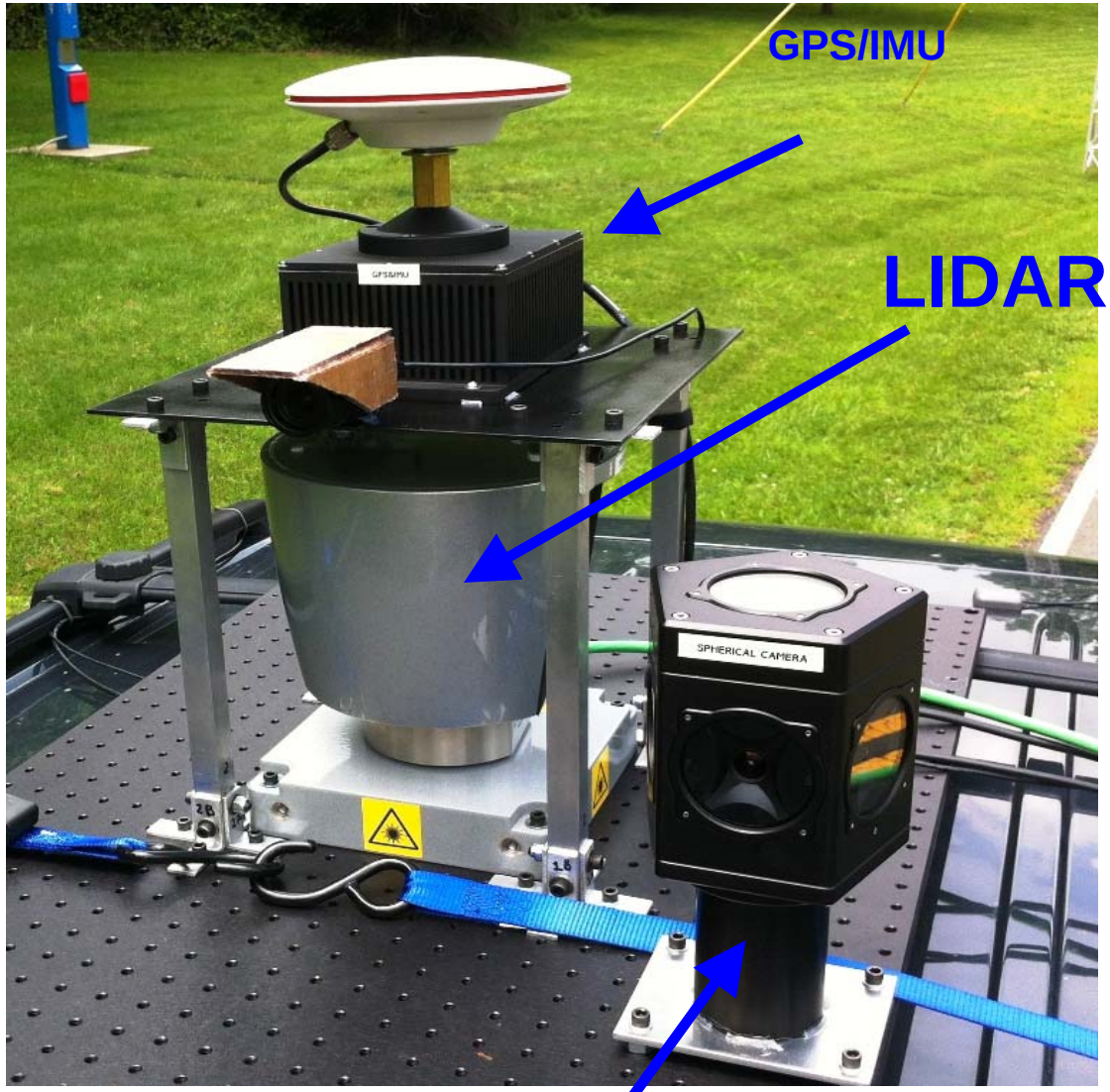
Overview of Field Test Data Flow Process



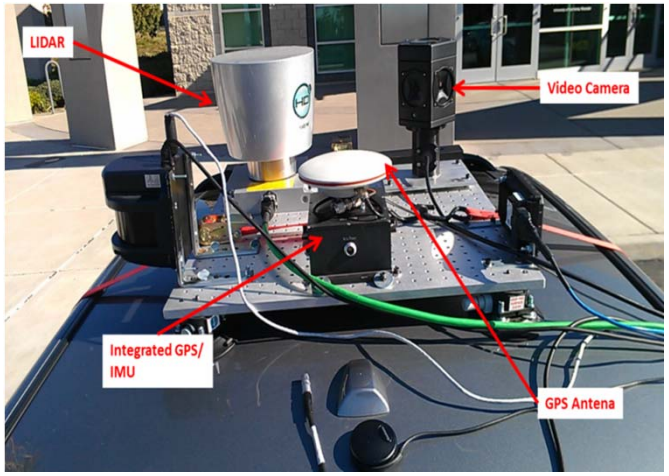




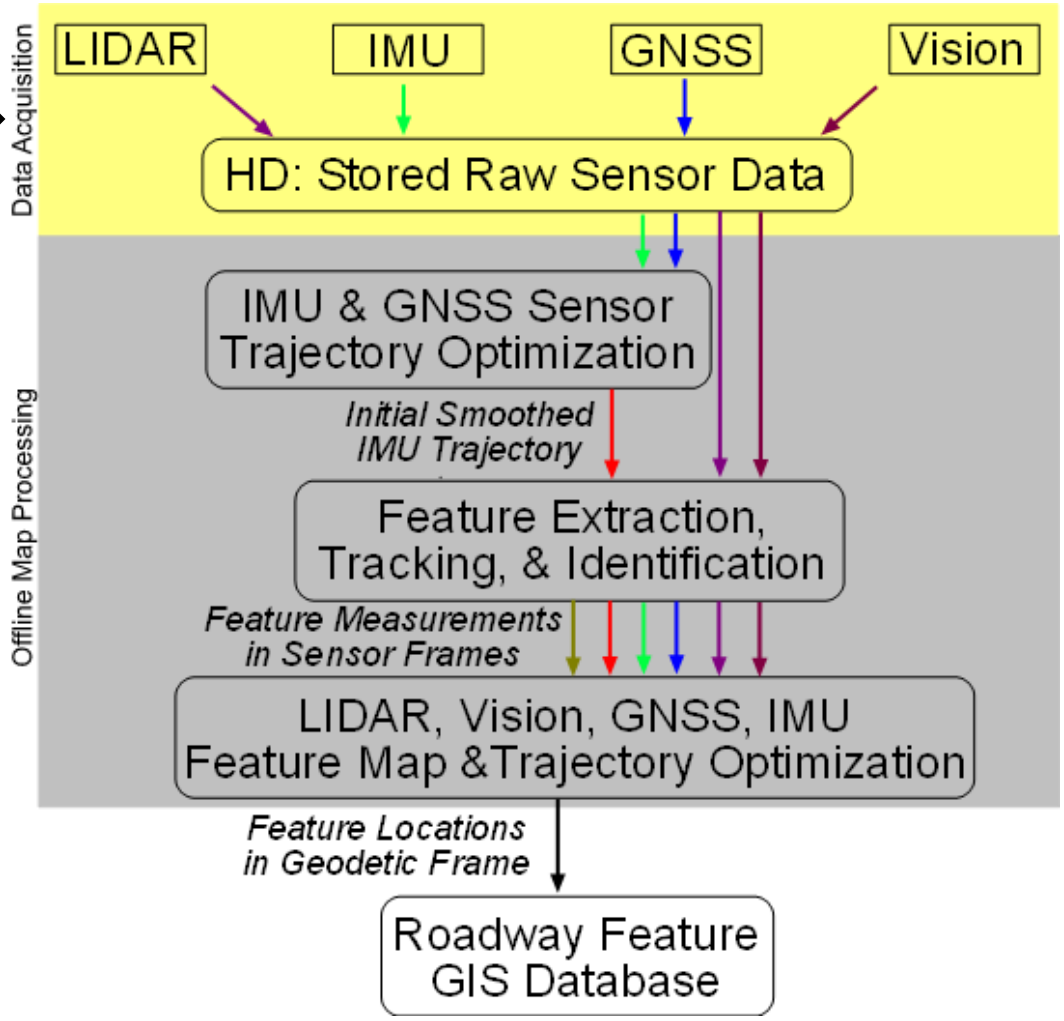
sensor platform



Equipment Configuration for Field Test

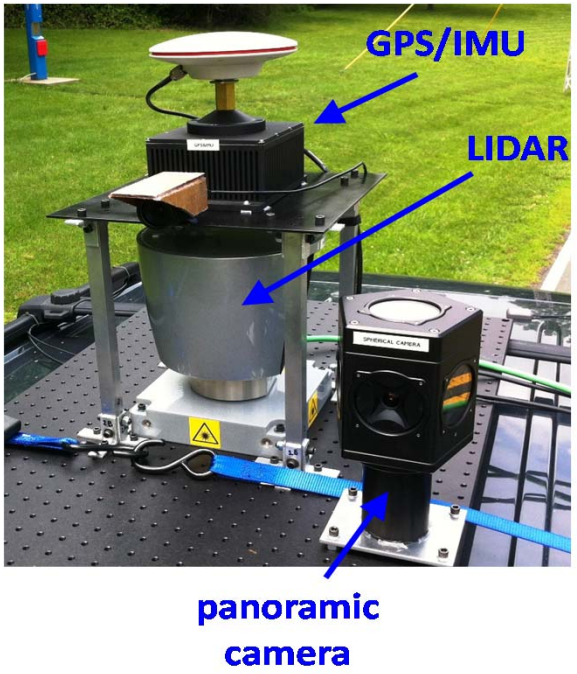


Vehicle Mounting of Equipment



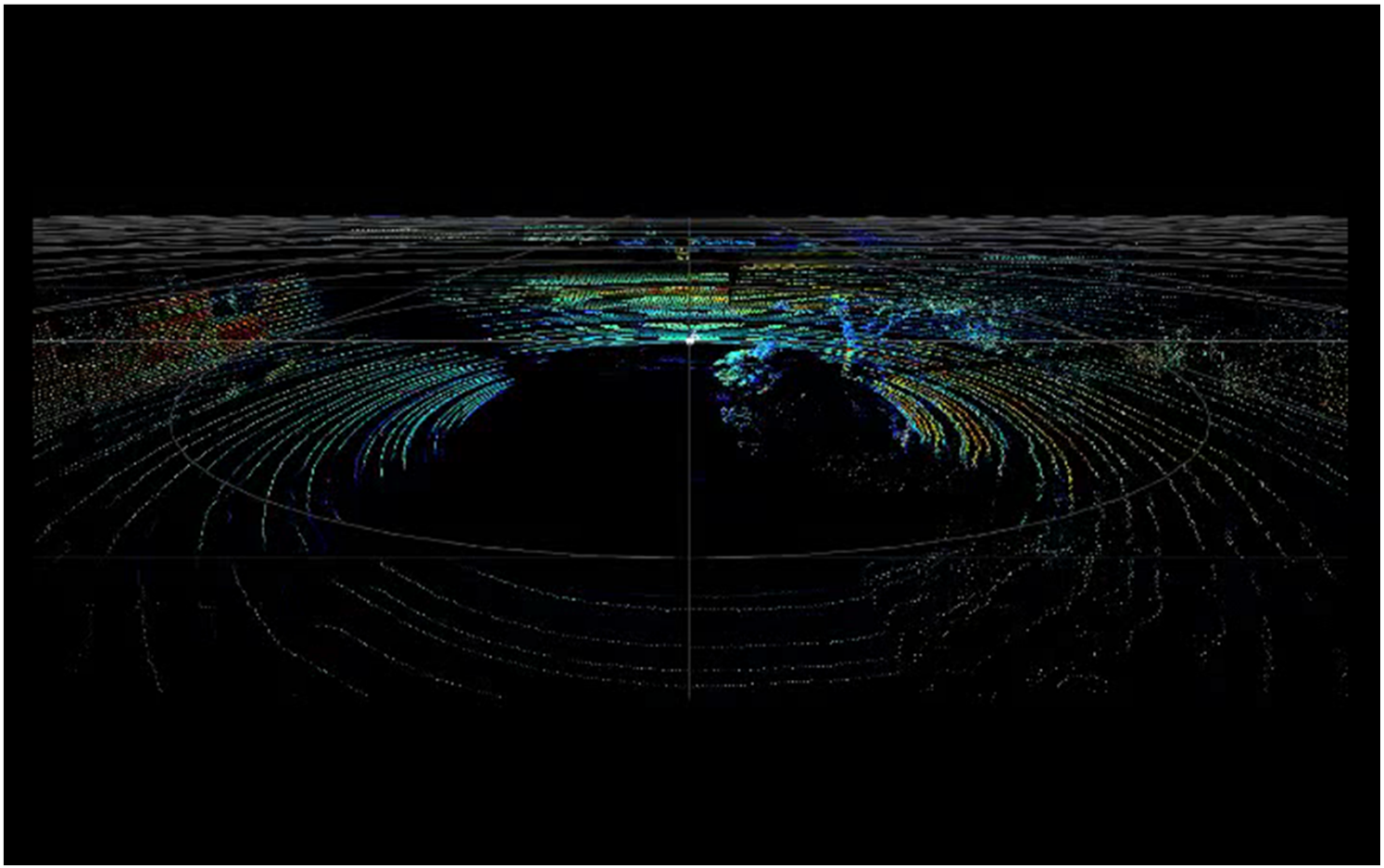
Mapping Sensors and Data Rates

- LIDAR
- Camera set
- IMU
- GNSS Receiver
- High capacity HD
- Roof Platform
- Power supply
- CPU

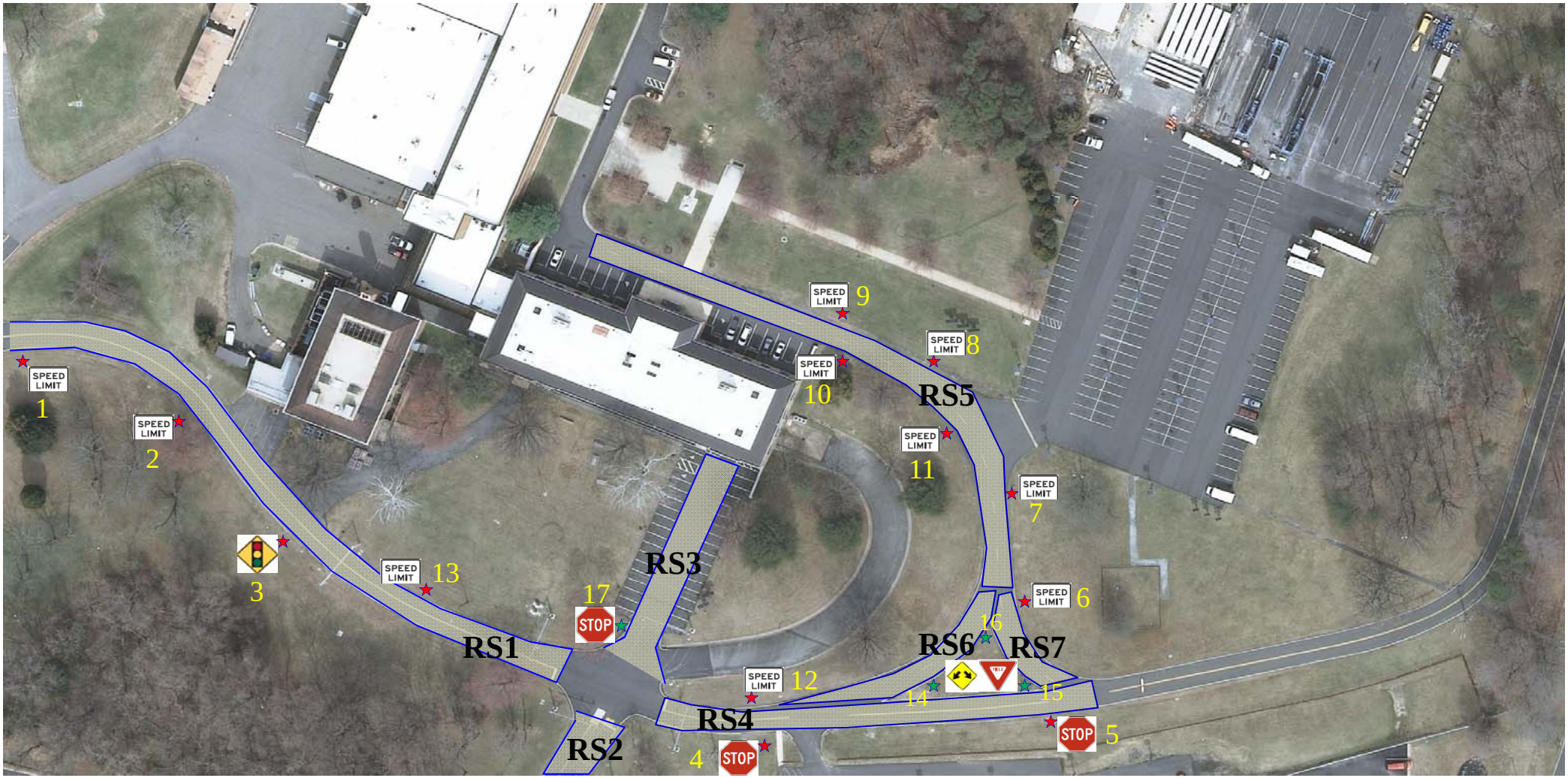


Sensor	Bytes/Msg.	Msgs./sec	Bytes/Sec	GB/Hr	GB/Hr (with timestamp overhead)
IMU	19	200	3800	0.013	0.232
LIDAR	1206	3473	4,188,438	15.08	15.278
Camera	35,836,416	7.5	268,773,120	967.583232	967.583
GPS measurement data	612	1	612	0.002	0.0374
GPS Ephemeris data	256	.002	.512	1.8432e-6	3.13344e-5
DGPS data	1071	1	1071	0.0038	0.0039
		Total:	273 MB /sec	982 GB/Hr	983 GB/Hr
		Hrs. of collection per TB:			≈1 Hr.
Miles of coverage per TB (assuming a speed of 30 mph):					≈30 miles

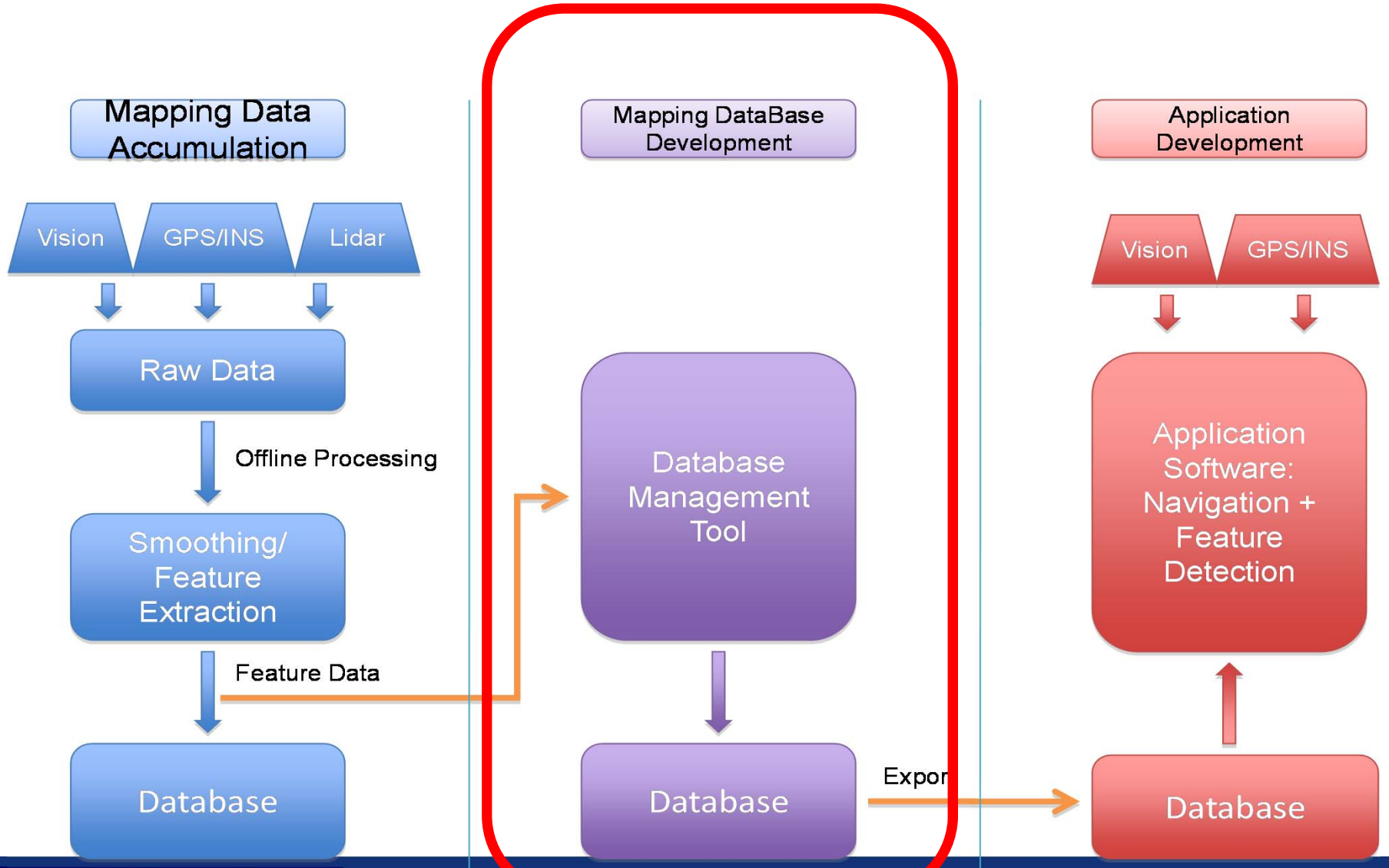
LIDAR Data Collection



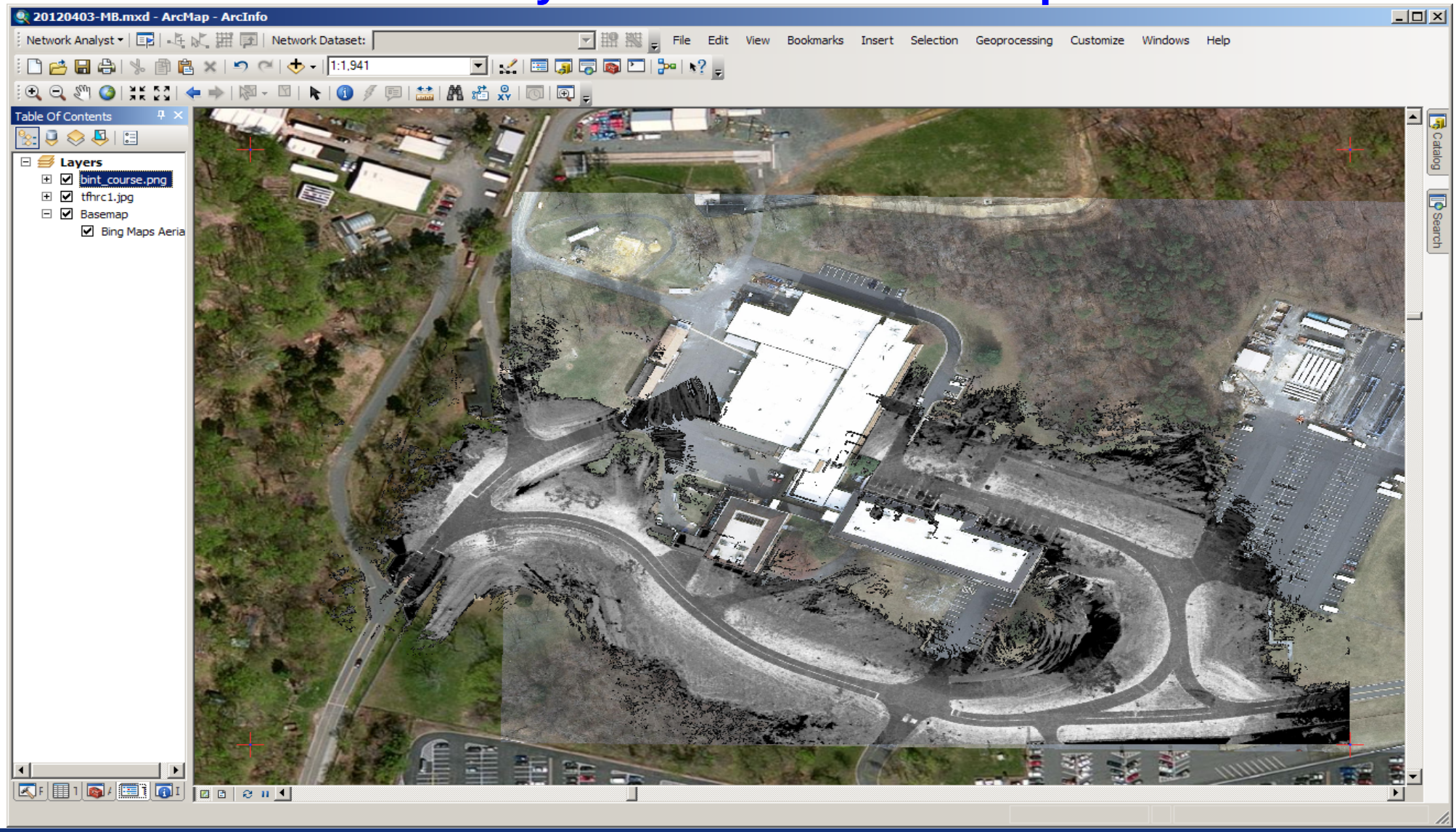
Road Signs Locations



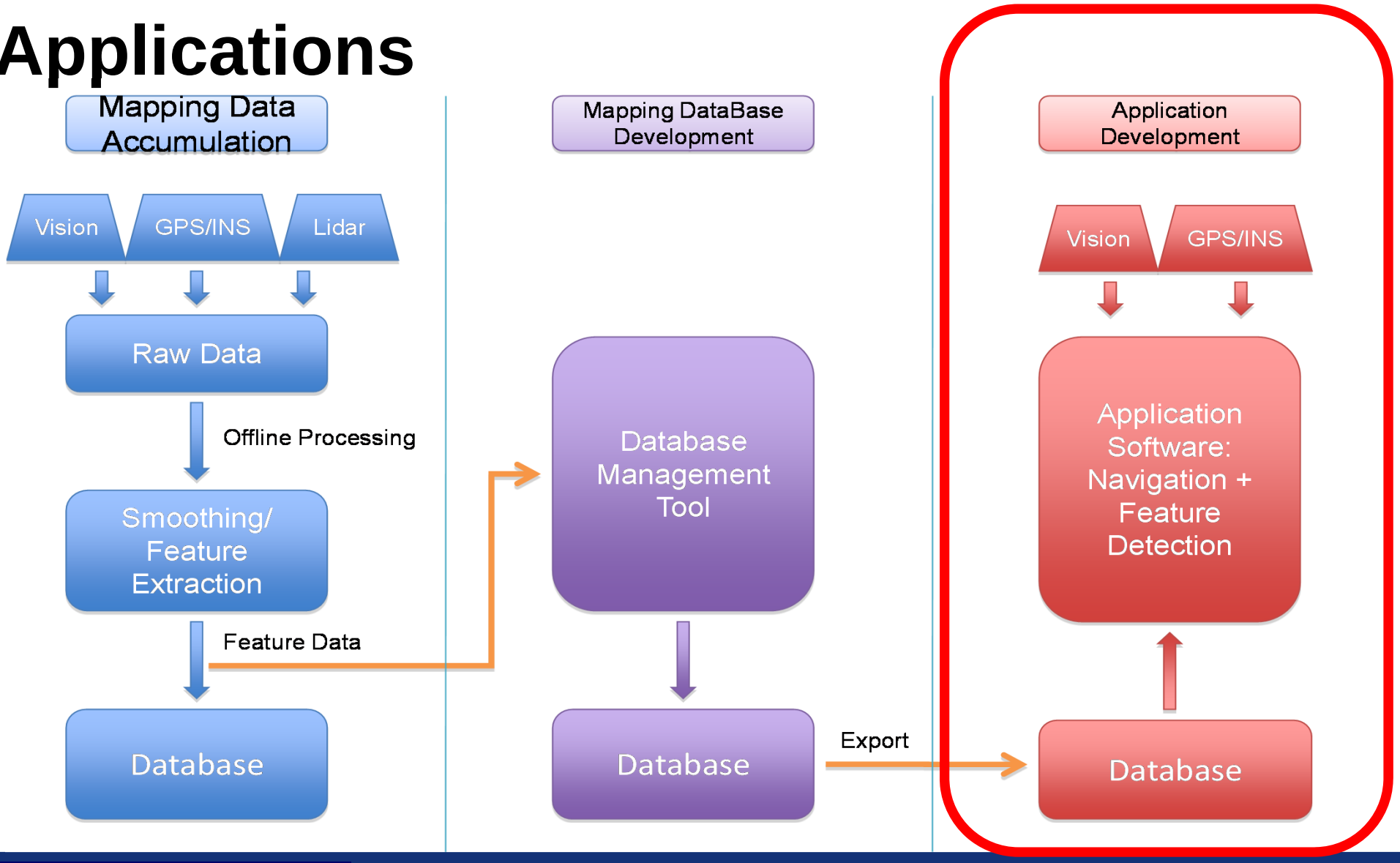
Map Database



Bing Map, TFHRC Aerial Image, LIDAR-based intensity image overlay – combined in ArcMap

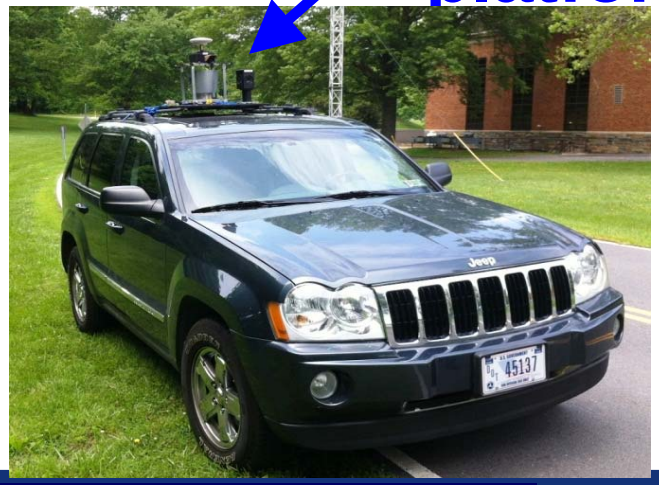


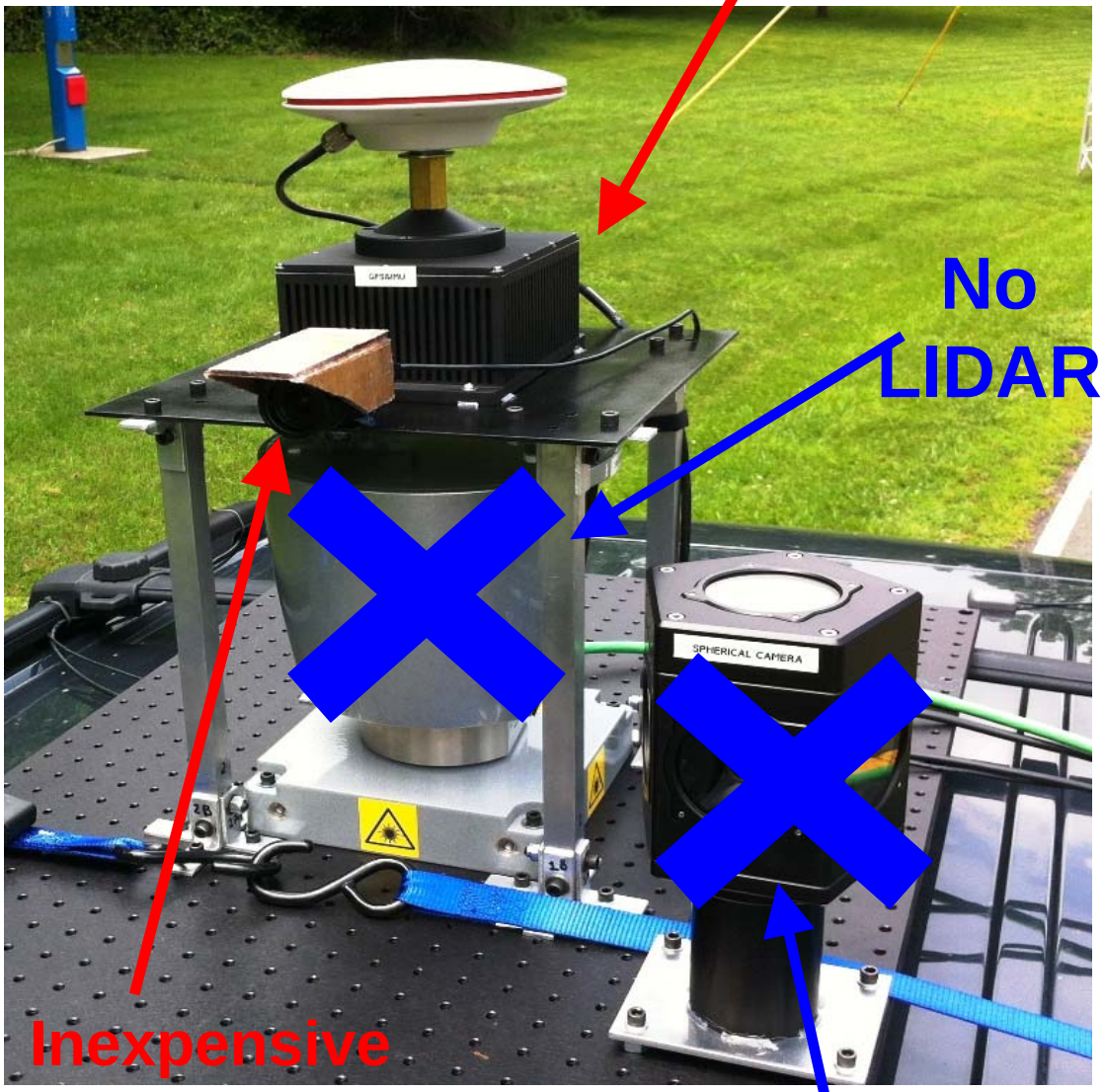
Applications



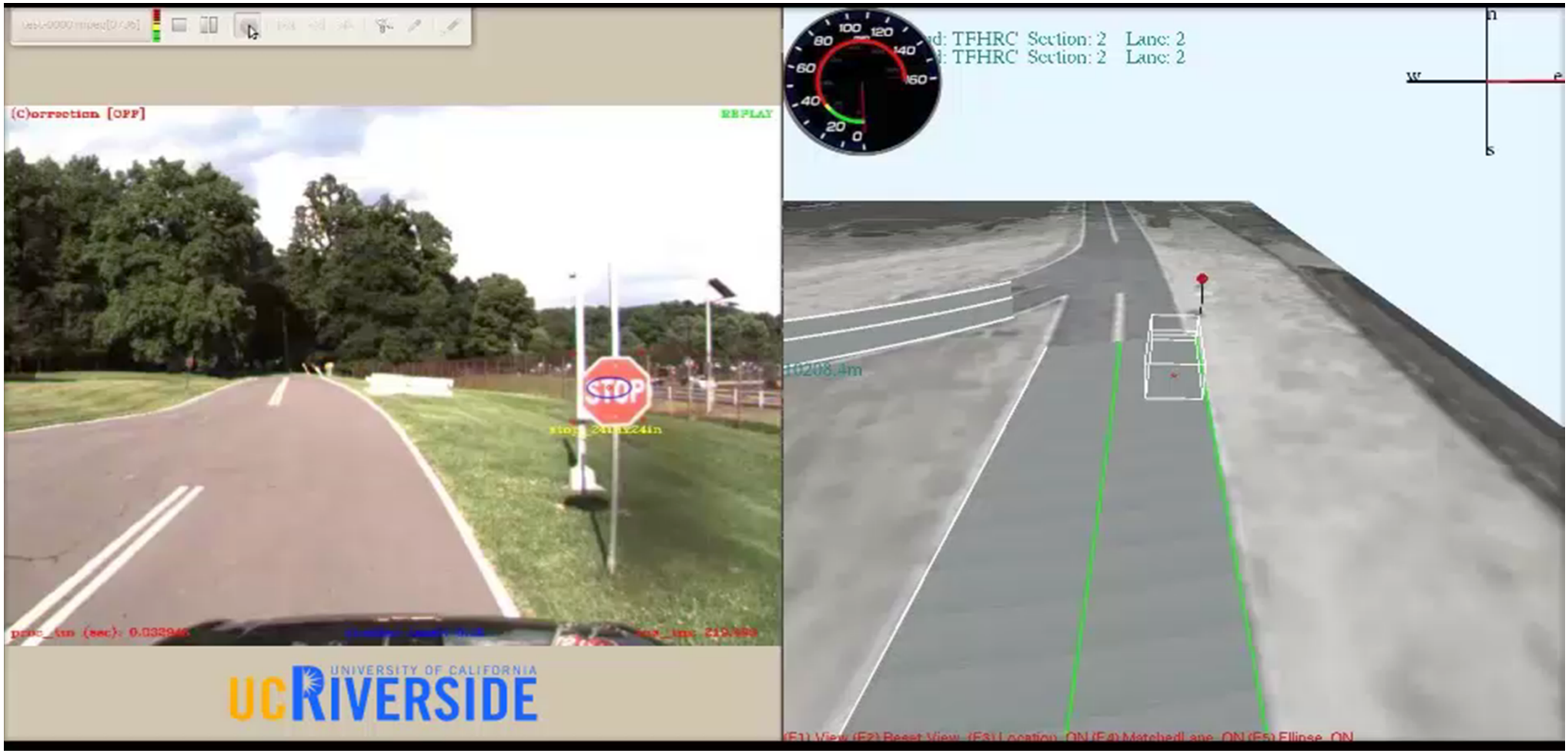
Sensor platform for *positioning*

sensor platform



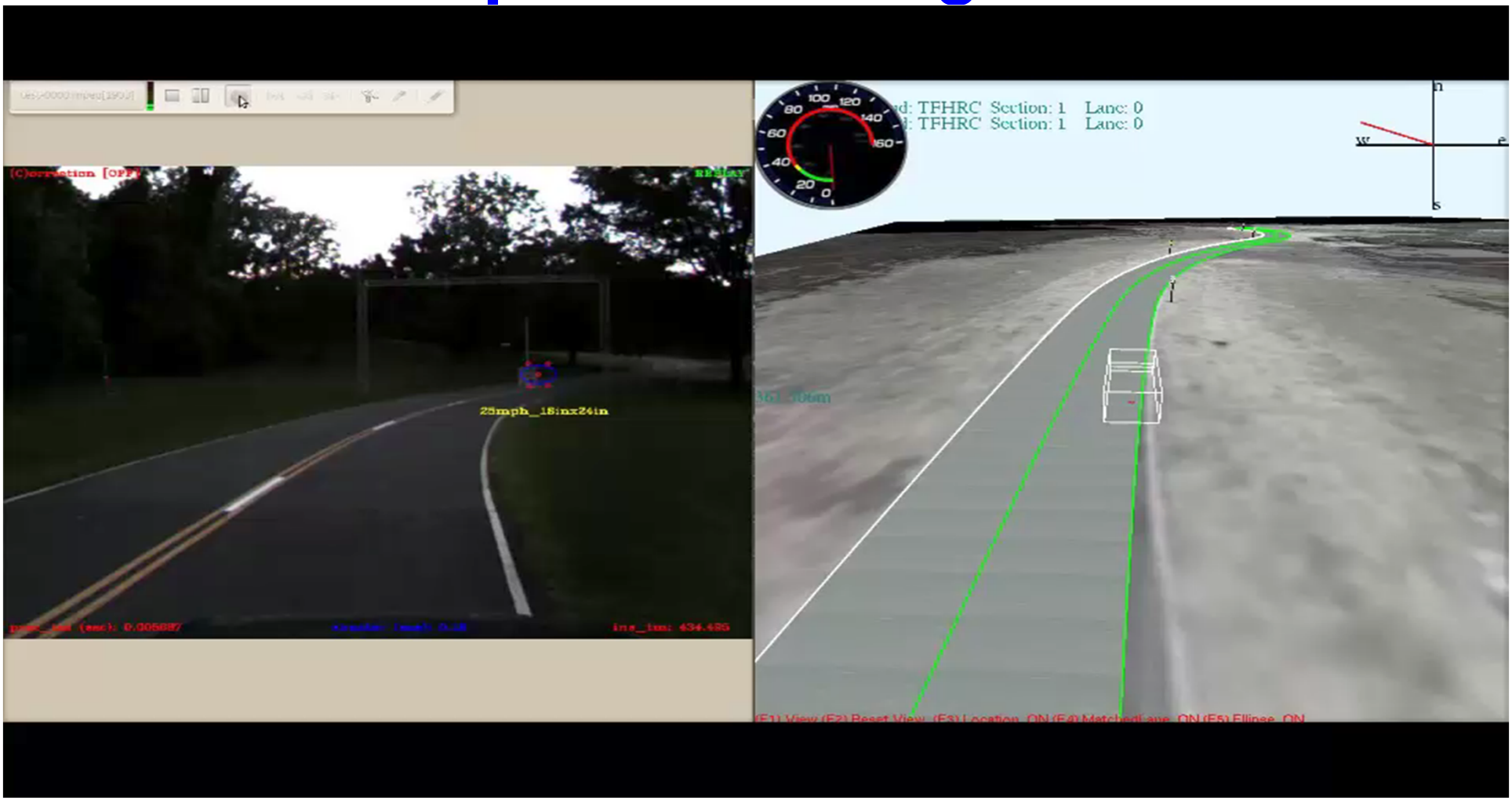


Application Graphical User Interface…



Lane Departure Warning…

Curve Overspeed Warning…



Field Study Summary

- **Automated sensor-based mapping is necessary for nationwide lane-level map production**
  - **This project task developed software and demonstrated that automated sensor-based mapping is feasible with centimeter-level accuracy**
- **Two lane-level applications built on the foundation of lane-level maps were demonstrated using decimeter-level positioning techniques**
  - **Lane departure warning**
  - **Curve overspeed warning**
- **Future lane-level application**
  - **Signal Phase and Timing, at lane-level**

Potential Areas of Future Research/Development

- Thorough process evaluation in less-structured, more-dynamic environments
- Transition from semi-automated to fully automated mapping process
- Maintenance of the precision map
  - Crowd sourcing
  - Targeted updates
- Large scale computer or cloud implementation for mapping larger environments

Questions ?

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