Safety Pilot Model Deployment
Lessons Learned

2014 Global Symposium on Connected Vehicles and Infrastructure

April 22, 2014

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Objective of Presentation

- Discuss Key Lessons Learned from Safety Pilot

- Focus on Four Interrelated Areas
  - Roadside Infrastructure Deployed
  - In-Vehicle Devices Deployed
  - Experimental Design
  - Data Collected
Roadside Infrastructure Deployment

- RSEs Deployed
- SpaT Updates
- IPv6 Installation Challenges / Radio Coverage Ranges
Planned Deployment of RSEs

- RSE Installed / Actuated Traffic Signal
- RSE Installed / SPaT-enabled Traffic Signal
- Originally proposed RSE freeway sites
Actual Deployment of RSEs

- RSE site removed due to lack of connectivity
- RSE connected to AA City backhaul
Fuller Road – Projected SPaT Range (300m)
Fuller Road – Actual SPaT Range (>300m)
What Did We Learn?

1. IPv6 connectivity was one of the biggest challenges to the RSE deployment and required the shifting of freeway sites

2. DSRC radio coverage ranges for the RSEs were much larger than expected

3. RSEs collected a much larger volume of data than was estimated due to the overlaps of coverage

Roadside Equipment specification needed an update (version 4.0)
In-Vehicle Device Deployment

- Types of Devices Deployed
- Device Testing
- Number and Types of Updates Needed on Devices
Vehicles & Devices Deployed

- 2,362 VADs
  - Light Vehicles
  - Trucks
  - Buses
- 289 ASDs (Light Vehicles)
- 64 Integrated Light Vehicles
- 19 Integrated / Retrofit Heavy Vehicles
- 3 Retrofit Transit Vehicles
Testing Conducted

- Multiple Stages of Testing
  - USDOT Testing (QPL)
  - Interoperability (4 rounds)
  - Pre-Model Deployment
- 8 Vehicle manufacturers (CAMP)

- Multiple hardware vendors
  - Savari
  - Cohda
  - Denso
  - Arada

- Multiple vehicle platforms/products
  - Light, heavy, and transit vehicles
Device Monitoring & Updates

- Approaches to Device Health Monitoring
  - Data Acquisition Systems – 183 devices/vehicles
  - Mining BSM data collected by RSEs – 2,554 devices/vehicles

- Every device deployed needed at least 1 software update

- Types of Device Updates
  - GPS Parameter
  - Path History
  - Security Credential Parameters
  - Device Stability

- Replacement of Damaged Units
What Did We Learn?

1. Deploying 2,700+ devices required different installation configurations for each vehicle class and type

2. Efficient end-of-line testing (configuration/quality) and baseline performance characterization testing would have been beneficial

3. Monitoring the health of the devices in the field was challenging as not all devices had health monitoring capabilities

4. Recalling and updating deployed devices was a labor-intensive and time-intensive process

Deploying, testing, and managing 2,700+ deployed devices required an extensive amount of planning.
Experimental Design

- Power Analysis
- Traffic Simulation Modeling
- Interaction Monitoring / Results
Scoping the Model Deployment – Power Analysis

- Prior to selection of Ann Arbor as Model Deployment Geographic Area
- What should the scope of the Model Deployment be to gather enough data?
  - Participants
  - Duration
  - Vehicles

- Conducted analysis using prior field test results

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<th>Variable</th>
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Estimating the V2V Interactions

- **Simulation of Estimates**
  - Utilized a traffic simulation model to estimate expected number of interactions
  - Interactions are communications between integrated light vehicles and other equipped vehicles within close proximity

- **Real-Time Monitoring**
  - All vehicles with data acquisition systems were remotely monitored via cell link

- **Total Interactions**
  - Observed interactions were within 15% of expected interactions
Actual Frequency of V2V Interactions

- UMTRI selected drivers with large number of trips in the Model Deployment Geographic Area
- Majority of drivers had interactions with other V2V equipped vehicles 4 out of 5 trips
What Did We Learn?

1. Previous field test data provided a good data point for developing an estimate for procurement (vehicles, drivers, time)

2. More detailed analysis (traffic simulation) after site selection allowed the development of performances measures (V2V interactions) and helped refine the experimental design

3. Selecting drivers based on trips in the Model Deployment Area instead of overall mileage or other metrics resulted in higher numbers of V2V interactions

A relatively small number of total equipped vehicles can generate a large number of V2V interactions with a multi-faceted experimental design.
Data Collection and Evaluation

- Different Types & Sources of Data Collected
- Volumes of Data Collected
Types of Safety Pilot Data

- **Numerical Data**
  - In-vehicle
  - Wireless/GPS
  - External Sensors

- **Volume of Data**
  - 2.3B database records

- **Video Data**
  - In-vehicle cameras

- **Volume of Data**
  - 63,000 hours of video
What Did We Learn?

1. Manually removing and replacing the hard drives was a labor intensive process for harvesting data

2. Volume of data generated was larger than any previous naturalistic driving field tests conducted by the USDOT

3. Sharing the data with entities outside of the project team (i.e. Research Data Exchange) required detailed analysis and cleansing of the data

It is vital to have well-defined and tested processes for data harvesting, storage and sharing
Questions

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