MDTA Dedicated Short Range Communication (DSRC) Pilot Project

V2I DC Strategic Initiatives Working Group
January 23, 2020
Agenda

- Introduction
- Project Background
- Implementation Details
- Architecture Concept
- Post-Installation Support
- Lessons Learned
- Open Discussion
Introduction

- Pilot initiative implemented by the Maryland Transportation Authority (MDTA)
- Design, install, and test Dedicated Short Range Communication (DSRC) equipment along MDTA facilities.
- Pilot Project Initiated in July 2017
Project Background

- Pilot Project to design, install, and test Dedicated Short Range Communication (DSRC) equipment along MDTA facilities.

Project Timeline

<table>
<thead>
<tr>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
</table>
| Research & Site Selection | • Vendor Reviews, Specification Development  
• Back-End Design  
• Equipment Purchase and Installation  
• Configuration, Integration, & Pre-Testing | 30-Day Testing | Post-Installation Support  
Data Collection, Monitoring, and Maintenance |
Phase 1 Pilot Project Goals

- Collect, store, and report on Basic Safety Message 1 (BSM) data received from up to 4 Roadside Units (RSUs)
- Gain better understanding of BSM1 message content and penetration of equipped vehicles
- Identify possible future applications/uses of DSRC BSM1 data
- Develop Backend Software, troubleshoot, maintain & monitor installed equipment
Implementation

- Four (4) RSUs
- Two OBUs in MDTA Vehicle Recovery Trucks
  - Cohda Wireless OBU
  - Lear Locomate OBU
- FHWA OBUs on short-term loan
On-board Unit (OBU) Installation

- Two OBUs in MDTA Vehicle Recovery Trucks
  - Cohda Wireless OBU
  - Lear Locomate OBU

- OBD/DB9 Cable to Truck Diagnostic Port
- Ground Wire
- Power and ignition wiring to fuse box
- Antenna cables inside and outside truck
- Antenna
Architecture Concept

- Vehicles with OBUs send Basic Safety Message Part 1 (BSM1) @ 10 times per second
- Nearby RSUs receive BSMs
- RSUs transmit data to a cloud Server
- BSMs include the following information:
  - Vehicle position (latitude/longitude)
  - Vehicle speed, acceleration, heading, and Brake status
Post-Installation Support: Data Collection

- Total Vehicle Encounters
  - BHT
    - BHT North Portal RSU
    - Lear OBU
    - Cohda OBU
  - BHT South Portal RSU
    - Lear OBU
    - Cohda OBU
  - FMT
    - FMT East Portal RSU
    - Lear OBU
    - Cohda OBU
    - FMT West Portal RSU
    - Lear OBU
    - Cohda OBU
<table>
<thead>
<tr>
<th>RSU</th>
<th>Time Logged</th>
<th>Encounter Begin</th>
<th>Encounter End</th>
<th>BSM Count</th>
<th>Old Location Count</th>
<th>Begin Lat</th>
<th>Begin Lon</th>
<th>End Lat</th>
<th>End Lon</th>
<th>Distance Traveled (Ft)</th>
<th>Avg Speed (MPH)</th>
<th>Avg Heading</th>
<th>Brakes Applied Count</th>
<th>Brakes Not Applied Count</th>
<th>Brakes Status Unavail Count</th>
<th>Temp ID Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMT East Portal (Lear 1)</td>
<td>2018-09-19 14:21:09</td>
<td>2018-09-19 14:19:22</td>
<td>2018-09-19 14:19:41</td>
<td>15</td>
<td>0</td>
<td>39.2665236</td>
<td>-76.5609661</td>
<td>39.2665101</td>
<td>-76.5609640</td>
<td>5</td>
<td>0.00</td>
<td>222.81</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>FMT East Portal (Lear 1)</td>
<td>2018-09-19 14:26:09</td>
<td>2018-09-19 14:25:16</td>
<td>2018-09-19 14:25:16</td>
<td>2</td>
<td>0</td>
<td>39.2665146</td>
<td>-76.5609623</td>
<td>39.2665146</td>
<td>-76.5609623</td>
<td>0</td>
<td>0.00</td>
<td>222.81</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
## Post-Installation Support: Data Analysis

### BSM Counts Summary at BHT

<table>
<thead>
<tr>
<th>RSU-&gt;</th>
<th>BHT NORTH PORTAL (LEAR 2)</th>
<th>BHT SOUTH PORTAL (COHDA 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lear OBU BSMs</td>
<td>Cohda OBU BSMs</td>
</tr>
<tr>
<td>Apr-18</td>
<td>-</td>
<td>389.98</td>
</tr>
<tr>
<td>May-18</td>
<td>-</td>
<td>250.89</td>
</tr>
<tr>
<td>Jun-18</td>
<td>301.63</td>
<td>311.04</td>
</tr>
<tr>
<td>Jul-18</td>
<td>338.92</td>
<td>124.52</td>
</tr>
</tbody>
</table>

### Vehicle Encounters at BHT

<table>
<thead>
<tr>
<th>RSU-&gt;</th>
<th>BHT North Portal (Lear 2)</th>
<th>BHT South Portal (Cohda 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Encounters</td>
<td>VRT 838 (Lear OBU) Encounters</td>
</tr>
<tr>
<td>Apr-18</td>
<td>632</td>
<td>-</td>
</tr>
<tr>
<td>May-18</td>
<td>834</td>
<td>-</td>
</tr>
<tr>
<td>Jun-18</td>
<td>1357</td>
<td>765</td>
</tr>
<tr>
<td>Jul-18</td>
<td>1213</td>
<td>955</td>
</tr>
</tbody>
</table>

1. Lear RSU is not detecting BSMs from OBUs with older standards. The 2016 standards uses UPER coding which is very different from the J2735 2014 Standard.
2. Lear OBU was sent to vendor for repair on 4/30/18 and re-installed on 5/10/18.
Post-Installation Support: Non-MDTA Vehicle Encounters Trend
Lessons Learned

- **Connected Vehicle (CV) Equipment and Vendor Maturity**
  - Limited Tech Support, High cost. Vendor options with system integration capabilities expected in the future

- **Equipment Installation Issues**
  - OBU Size was large, installed under rear seat, antenna cables too short. RSU installation did not pose challenges
Lessons Learned

- Maintenance Facility and Test Equipment
  - Budget for spares and troubleshooting/repair of equipment
- FHWA Loaner Equipment Experience
- GPS Performance Around Tunnels
  - OBU loses GPS connectivity in tunnels leading to erroneous lat/long data. Potential solutions are to use GPS Repeaters, Beacons, differential correction receivers, or radio triangulation
Lessons Learned

- **GPS Position Filtering and Map Matching**
  - Current backend application does no filtering on raw BSM data and captures all data within the omnidirectional radius of the RSU receiving antenna.
  - Some form of map matching algorithm is desirable to filter out all but the desired BSM data from the freeway of interest.

- **Architecture Upgrades**
  - Current architecture is designed to perform data storage and processing on the backend using data transmitted by RSU. Network and cloud processing resources can get overloaded. A scalable architecture will be required if more devices are deployed.

- **Network Evaluation**
  - Future system expansion should consider migrating to an all-IPv6 network. MDTA cellular modems and service presently do not support IPv6.
Lessons Learned

- Vehicle ID – BSM Part II Message Support
  - The BSM Part 1 message includes only a temporary ID to identify the OBU. The temporary ID changes at any time and so is not a reliable unique identifier. Future developments should consider BSM Part II message support.

- UPS Power for RSUs
  - Future installations should consider UPSs for RSUs. GPS processing issues at Cohda RSUs were resolved with UPSs.
Next Steps

- Develop scope for Phase 2 (In-progress)
  - Primary Goal – Enhanced Data Collection
  - Deployment of additional Devices (RSUs and OBUs)
  - Data Processing Architecture and Network Evaluation
  - Applications Development
  - Collaborate and Share Lessons Learned
  - Phase 3 Applications Needs Assessment
Open Discussion
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