I-95 Corridor Coalition

Vehicle Probe Project: Validation of INRIX Data

Monthly Report: Maryland

July 2014
Monthly Report

Prepared for:
I-95 Corridor Coalition

Sponsored by:
I-95 Corridor Coalition

Prepared by:
Ali Haghani, Masoud Hamedi, Xuechi Zhang, Kiana Roshan Zamir, Arezoo Samimi Abianeh

University of Maryland, College Park

Acknowledgements:

The research team would like to express its gratitude for the assistance it received from the state highway officials in Maryland during the course of this study. Their effort was instrumental during the data collection phase of the project. This report would not have been completed without their help.

July 2014
Evaluation Results for the State of Maryland

Executive Summary

The data from the Vehicle Probe Project is validated using Bluetooth™ Traffic Monitoring (BTM) technology on a near monthly basis. BTM sensors were deployed at the beginning and ending points of 14 segments of the MD-140 corridor for both directions. The Bluetooth sensor deployment covers the range from Fallstaff Rd to MD-27/Mansfield Rd along MD-140. Travel time data was collected for both directions along the arterial, between June 5 and June 17, 2014. The dataset collected represents approximately 2,399 hours of observations along 14 arterial segments, totaling approximately 32 miles. The number of effective five-minute travel time samples observed was 28,787 in total.

ES Table 1 summarizes the results of the comparison between the BTM reference and the INRIX data for arterial segments during the above time periods. As shown, the average absolute speed error (AASE) were within specification in all speed bins. Speed Error Bias (SEB) were within specification in all speed bins except for the 0-15 MPH category.

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<th>Speed Bin</th>
<th>Absolute Speed Error (&lt;10mph)</th>
<th>Speed Error Bias (&lt;5mph)</th>
<th>Number of 5 Minute Samples</th>
<th>Hours of Data Collection</th>
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Based upon data collected from June 5, 2014 through June 17, 2014 across 32.05 miles of roadway.
Data Collection

The data from the Vehicle Probe Project is validated using Bluetooth™ Traffic Monitoring (BTM) technology on a near monthly basis. BTM sensors were deployed on the beginning and ending points of 14 different segments along the MD-140 arterials corridor. The Bluetooth sensor deployment covers the range from Fallstaff Rd to MD-27/Manchester Rd along MD-140. Travel time data was collected for both directions along the arterial. The data was collected between June 5 and June 17, 2014 with the assistance of Maryland Department of Transportation (MDOT) personnel. Segment locations were chosen with a high-likelihood of observing recurrent and non-recurrent congestions during peak or off-peak periods.

Figure 1 presents snapshots of the placement of sensors for the collection of data on the MD-140 corridor in Maryland. Red segments represent arterial segments selected for analysis.

Figure 1 — Locations of segments selected for analysis on MD-140 in Maryland

TMC segments selected for validation in Maryland
Table 1 presents a list of data collection segments from Maryland. In total, these segments cover a length of 32.05 arterial miles. Data collection segments are comprised of one or more Traffic Message Channel (TMC) base segments, such that total length of the data collection segment is one mile long or greater on the arterial. When appropriate, consecutive TMC segments are combined to form a data collection segment longer than one mile. The results of the validation performed on 14 arterial segments for both directions are included in this report. Table 1 contains the summary information on each data collection segments. The latitude/longitude coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of Maryland are provided in Table 1 as well as an active map link to view the data collection segment in detail. Click on the map link to see a detailed map for the respective data collection segment. It should be noted that the configuration of test segments is often such that the endpoint of one segment coincides with the start point of the next segment, so that one Bluetooth sensor covers both data collection segments.

Table 1 also provides data on the precise length of the TMCs comprising the test segment as compared to the measured length between Bluetooth™ Traffic Monitoring (BTM) sensors placed on the roadway. Details of the algorithm used to estimate equivalent path travel times based on INRIX data feeds for individual data collection segments are provided in a separate report. This algorithm finds an equivalent INRIX travel time (and therefore travel speed) corresponding to each sample BTM travel time observation on the test segment of interest.
## Table 1
Segments selected for validation in Maryland

<table>
<thead>
<tr>
<th>SEGMENT (Map Link)</th>
<th>GEOMETRIC DESCRIPTION</th>
<th>TMC CODES</th>
<th>Bluetooth Data</th>
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<td></td>
<td></td>
<td>Min</td>
<td>Min</td>
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<tr>
<td><strong>Starting at</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Ending at</strong></td>
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**MD-140 Westbound, Arterial Roadway in Maryland known as Reistertown Rd**

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<th>GEOMETRIC DESCRIPTION</th>
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<th>AADT</th>
<th>Signals</th>
<th># Access Points</th>
<th>Median Barrier</th>
<th>Major junctions</th>
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All Lengths in Miles / Speeds in MPH

I-95 Corridor Coalition Vehicle Probe Project Evaluation
July 2014
### Table 1 (Cont’d)
Segments selected for validation in Maryland

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<tr>
<th>SEGMENT (Map Link)</th>
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<tr>
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**MD-140 Westbound, Arterial Roadway in Maryland known as Reistertown Rd**

**MD08-12**
- Chatsworth Ave
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2

**MD-140 Westbound, Arterial Roadway in Maryland known as Baltimore Blvd**

**MD08-13**
- MD-795
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2
  - MD-795: 2

**MD08-14**
- Gores Mill Rd
  - Gores Mill Rd: 3
  - Gores Mill Rd: 3
  - Gores Mill Rd: 3
  - Gores Mill Rd: 3
  - Gores Mill Rd: 3

**MD08-15**
- MD-91/Emory Rd/Gamber Rd
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2

**MD08-17**
- Reese Rd
  - Reese Rd: 2
  - Reese Rd: 2
  - Reese Rd: 2
  - Reese Rd: 2
  - Reese Rd: 2

**MD-140 Eastbound, Arterial Roadway in Maryland known as Baltimore Blvd**

**MD08-20**
- MD-97/Malcolm Dr
  - MD-97/Malcolm Dr: 2
  - MD-97/Malcolm Dr: 2
  - MD-97/Malcolm Dr: 2
  - MD-97/Malcolm Dr: 2
  - MD-97/Malcolm Dr: 2

**MD08-22**
- Green Mill Rd/Suffolk Rd
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  - Green Mill Rd/Suffolk Rd: 2
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  - Green Mill Rd/Suffolk Rd: 2
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**MD-91/Emory Rd/Gamber Rd
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2
  - MD-91/Emory Rd/Gamber Rd: 2**

All Lengths in Miles / Speeds in MPH
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### Table 1 (Cont’d)

#### Segments selected for validation in Maryland

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All Lengths in Miles / Speeds in MPH
Analysis of Arterial Results

Table 2 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. Specifications include the Average Absolute Speed Error (AASE) and the Speed Error Bias (SEB).

**Average Absolute Speed Error (AASE)**

The AASE is defined as the mean absolute value of the difference between the mean speed reported from the VPP and the ground truth mean speed for a specified time period. The AASE is the primary accuracy metric. Based on the contract specifications, the speed data from the VPP shall have a maximum average absolute error of 10 miles per hour (MPH) in each of four speed ranges: 0-15 MPH, 15-25 MPH, 25-35 MPH, and > 35 MPH.

**Speed Error Bias (SEB)**

The SEB is defined as the average speed error (not the absolute value) in each speed bin. SEB is a measure of whether the speed reported in the VPP consistently under or over estimates speed as compared to ground truth speed. Based on the contract specifications, the VPP data shall have a maximum SEB of +/- 5 MPH in each of speed ranges as defined above.

The results are presented as compared against the mean of the ground truth data as well as the 95th percent confidence interval for the mean, referred to as the Standard Error of the Mean (SEM) band. The SEM band takes into account any uncertainty in the ground truth speed as measured by BTM equipment due to limited samples and/or data variance. Contract specifications are assessed against the SEM band. (See the Vehicle Probe Project: Data Use and Application Guide for additional details on the validation process.) The AASE in the lower two speed bins have proven to be the critical specification (and most difficult) to attain, and are highlighted in Table 2. The AASE below 10 MPH met contract specifications. The AASE below 5 MPH are considered exceptional quality. As shown, the average absolute speed error (AASE) was within specification for all the speed bins.
Table 2
Data quality measures for arterial segments in Maryland

<table>
<thead>
<tr>
<th>SPEED BIN</th>
<th>Data Quality Measures for</th>
<th>1.96 SEM Band</th>
<th>Mean</th>
<th>No. of 5 Minute Samples</th>
<th>Hours of Data Collection</th>
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<td>SEB AASE</td>
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Table 3 shows the percentage of the time INRIX data falls within 5 mph of the SEM band and the mean for each speed bin for all arterial data segments in Maryland.

Table 3 Percent observations meeting data quality criteria for freeway segments in Maryland

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<tr>
<th></th>
<th>Data Quality Measures for</th>
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<th>Mean</th>
<th>No. of Obs.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percentage falling inside the band</td>
<td>Percentage falling within 5 mph of the band</td>
<td>Percentage equal to the mean</td>
</tr>
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<td>15%</td>
<td>48%</td>
<td>0%</td>
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<td>15-25</td>
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<td>48%</td>
<td>84%</td>
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<td>47%</td>
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Tables 4 and 5 present detailed data for individual TMC segments in Maryland in a similar format as Tables 2 and 3, respectively. Note that for some segments and in some speed bins the comparison results may not be reliable due to small number of observations.
Table 4
Data quality measures for individual arterial validation segments in the state of Maryland

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<tr>
<th>TMC</th>
<th>Standard TMC length</th>
<th>Bluetooth distance</th>
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*Results in the specified row may not be reliable due to small number of observations
## Table 4 (Cont’d)
Data quality measures for individual arterial validation segments in the state of Maryland

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*Results in the specified row may not be reliable due to small number of observations
### Table 4 (Cont’d)
Data quality measures for individual arterial validation segments in the state of Maryland

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*Results in the specified row may not be reliable due to small number of observations
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Data quality measures for individual arterial validation segments in the state of Maryland

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Table 5
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*Results in the specified row may not be reliable due to small number of observations
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*Results in the specified row may not be reliable due to small number of observations
Table 5 (Cont’d)
Observations meeting data quality criteria for individual arterial validation segments
in the state of Maryland

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### Table 5 (Cont’d)
Observations meeting data quality criteria for individual arterial validation segments in the state of Maryland

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