



I-95 Corridor Coalition

I-95 Corridor Coalition Vehicle
Probe Project: Validation of
INRIX Data
Monthly Report
Delaware



September 2009

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT: VALIDATION OF INRIX DATA SEPTEMBER 2009

Monthly Report

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September 2009

Evaluation Results for the State of Delaware

Summary

Travel time samples were collected along approximately 11 miles of freeways in Delaware from Tuesday, August 11, 2009 to Monday, August 24, 2009 and compared with travel time and speed data reported by INRIX as part of the I-95 Vehicle Probe project. The validation data represents approximately 1150 hours of observations along seven freeway segments in Delaware. The segments range in length from 1.1 to 2.5 miles. The validation data reflects a significant amount of congestion, over 100 hours with speeds less than 45 mph. Whereas previous data sets may have exhibited significant congestion in term of the total number of hours when speeds were less than 45 MPH, this data set stood out as having a good sampling of different types of congestion events. The table below summarizes the result of the comparison between the validation data and the INRIX data for the same period. Both the absolute average speed error and the speed error bias as measured against the SEM band are within the acceptable limits of the contract specifications.

DE Evaluation Summary						
State	Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples	Hours of Data Collection
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean		
0-30 MPH	5.51	6.82	2.70	3.06	500	41.7
30-45 MPH	5.90	7.63	2.18	2.93	796	66.3
45-60 MPH	2.39	4.48	-0.32	-0.30	4242	353.5
> 60 MPH	2.32	4.90	-2.12	-4.14	8247	687.3
All Speeds	2.66	5.00	-1.14	-2.29	13785	1148.8

Based upon data collected from Tuesday, August 11, 2009 through Monday, August 24, 2009 across 11.2 miles of roadway.

Data Collection

Bluetooth sensor deployments in Delaware started on Tuesday, August 11, 2009. The actual deployments in Delaware were performed with the assistance of Delaware Department of Transportation (DelDOT) personnel. Sensors remained in the same position until they were retrieved two weeks later on Monday, August 24, 2009. This round of data collections in Delaware was designed to cover segments of the highways along which both recurrent and non-recurrent congestions could be expected during both peak and off-peak periods.

Figure 1 presents snapshots of the roadway segments over which Bluetooth sensors were deployed in Delaware.

Table 1 presents a list of specific TMC segments that were selected as the validation sample in Delaware. In total, results of validation on seven freeway TMC segments are reported in this document. These segments cover a total length of about 11 miles. The coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of Delaware are reported in Table 2 which also presents the distances that have been used in the estimation of Bluetooth speeds based on travel times.

Analysis of Results

Table 3 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. In all speed bins, INRIX data meets the data quality measures set forth in the contract when errors are measured as a distance from the 1.96 times the standard error band. It should be noted that while the total number of observations in the low speed bins across all TMC segments are reasonable, as Table 3 indicates, the number of observations in low speed bins for some individual TMC segments are low.

Table 4 shows the percentage of the time intervals that fall within 5 mph of the SEM band and the mean for each speed bin for all TMC segments in Delaware. Tables 5 and 6 present detailed data for individual TMC segments in Delaware in similar format as Tables 3 and 4 respectively. Note that for some TMC segments in some speed bins the comparison results may not be reliable due to small number of observations.

Figures 2 and 3 show the overall speed error bias for different speed bins, and the average absolute speed errors for all segments in Delaware, respectively. These figures correspond to Table 3.

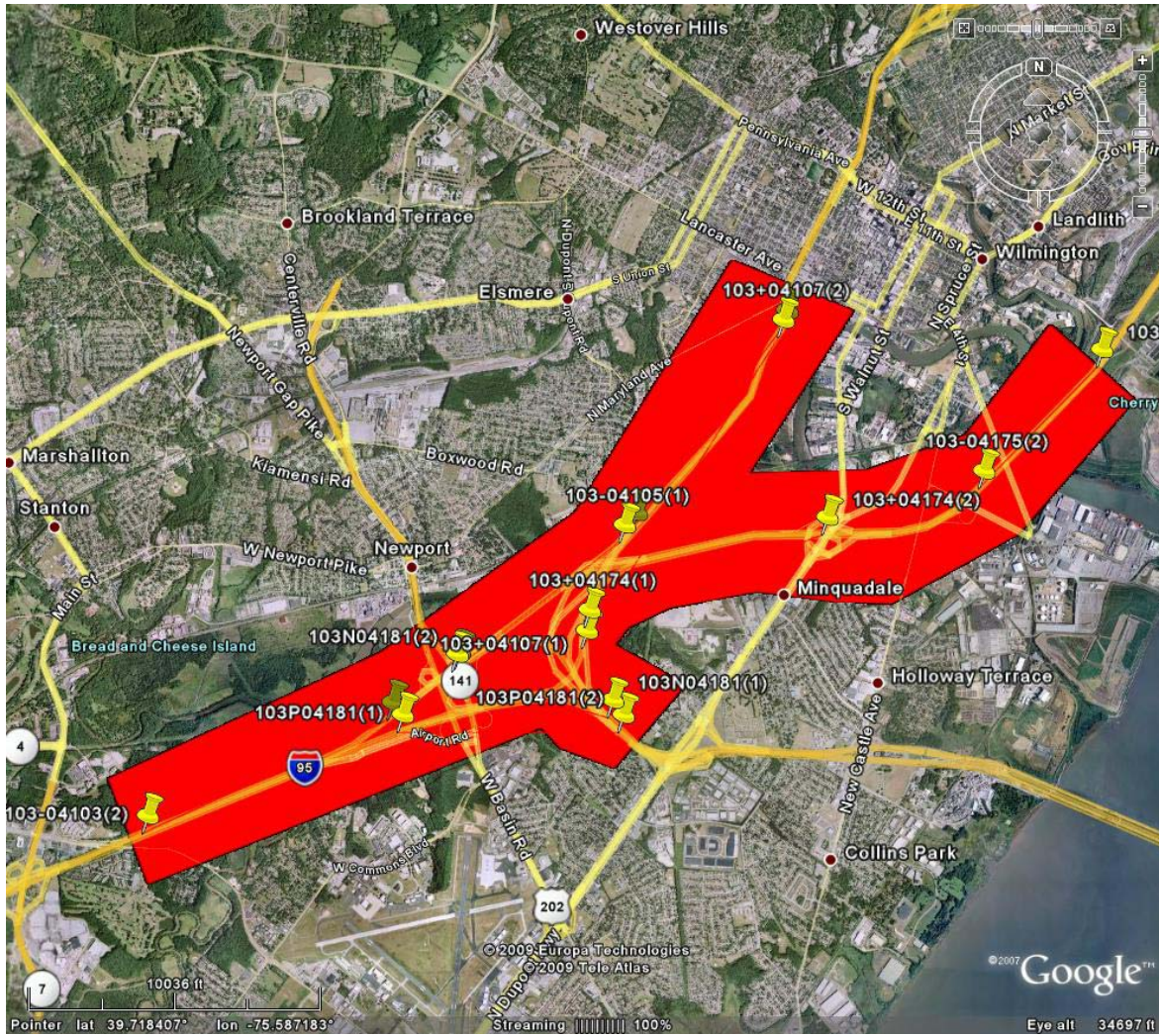


Figure 1
TMC segments selected for validation in Delaware

Table 1
Traffic Message Channel segments picked for validation in Delaware

TYPE	TMC	HIGHWAY	STARTING AT	ENDING AT	COUNTY	DIRECTION	LENGTH (mile)
Freeway	103P04181	I-295	I 295/I 495/EXIT 5	I-95	NEW CASTLE	NORTHBOUND	1.5
Freeway	103-04106	I-95	HWY 4/MARYLAND AVE/6TH AVE/EXIT 6	I-495/I-295/EXIT 5	NEW CASTLE	SOUTHBOUND	1.7
Freeway	103N04181	I-295	I 95	I-95	NEW CASTLE	SOUTHBOUND	1.3
Freeway	103-04103	I-95	EXIT 5A	DE-58/EXIT 4	NEW CASTLE	SOUTHBOUND	1.8
Freeway	103-04105	I-95	I-495/I-295/EXIT 5	I-295/US-202/DE-141/EXIT 5	NEW CASTLE	SOUTHBOUND	1.4
Freeway	103+04107	I-95	I 295/I 495/EXIT 5	DE-4/MARYLAND AVE/6TH AVE/EXIT 6	NEW CASTLE	NORTHBOUND	2.5
Freeway	103-04175	I-495	12TH ST/EXIT 3	TERMINAL AVE/EXIT 2	NEW CASTLE	SOUTHBOUND	1.1
TOTAL							11.2

Table 2
TMC segment lengths and distances between sensor deployment locations in the state of Delaware

SEGMENT TYPE	TMC	STANDARD TMC					SENSOR DEPLOYMENT					ERROR IN SEGMENT LENGTH (%)	
		Endpoint (1)		Endpoint (2)		Length (mile)	Endpoint (1)		Endpoint (2)		Length (mile)		
		Lat	Long	Lat	Long		Lat	Long	Lat	Long			
Freeway	103P04181	39.698225	-75.610400	39.698202	-75.583275	1.54	39.699523	-75.603898	39.696910	-75.581475	1.31	-14.7%	
Freeway	103-04106	39.736472	-75.563122	39.717357	-75.581666	1.67	39.730348	-75.567000	39.717832	-75.581308	1.15	-30.9%	
Freeway	103N04181	39.699608	-75.584586	39.703968	-75.603690	1.31	39.699845	-75.584803	39.704537	-75.603295	1.25	-4.3%	
Freeway	103-04103	39.699375	-75.611638	39.688650	-75.641743	1.77	39.700413	-75.610377	39.688152	-75.644640	2.02	14.1%	
Freeway	103-04105	39.716168	-75.583136	39.704166	-75.603425	1.36	39.713308	-75.587958	39.704537	-75.603295	1.02	-25.4%	
Freeway	103+04107	39.706171	-75.587758	39.735580	-75.563602	2.46	39.707063	-75.589332	39.737112	-75.562532	2.54	3.3%	
Freeway	103-04175	39.732740	-75.524405	39.721286	-75.538924	1.10	39.732087	-75.525102	39.721472	-75.538865	1.04	-6.2%	
TOTAL							11.21						10.33

Table 3
Data quality measures for freeway segments greater than one mile in Delaware

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE Band		Mean		
	Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
0-30	2.70	5.51	3.06	6.82	500
30-45	2.18	5.90	2.93	7.63	796
45-60	-.32	2.39	-0.30	4.48	4242
60+	-2.12	2.32	-4.14	4.90	8247

Table 4
Percent observations meeting data quality criteria for freeway segments greater than one mile in Delaware

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-30	15%	65%	0%	57%	500
30-45	15%	51%	0%	39%	796
45-60	42%	84%	0%	67%	4242
60+	39%	83%	0%	58%	8247

Table 5
Data quality measures for individual freeway segments greater than one mile in the
state of Delaware

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SE Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
103+04107	2.46	2.54	0-30	17.1	20.9	16.5	22.2	4*
			30-45	1.8	1.8	3.9	3.9	1*
			45-60	0.6	0.7	1.4	2.8	41
			60+	-1.7	1.9	-3.9	4.5	271
103-04103	1.77	2.02	0-30	2.5	4.8	3.4	6.6	139
			30-45	1.3	4.0	2.2	6.2	153
			45-60	0.2	2.0	1.0	4.3	332
			60+	-1.7	1.9	-3.2	4.0	2435
103-04105	1.36	1.02	0-30	0.3	3.4	0.2	6.1	61
			30-45	-1.8	6.9	-2.1	10.3	42
			45-60	-3.2	5.1	-2.9	7.6	236
			60+	-2.4	2.5	-4.8	5.6	1874
103-04106	1.67	1.15	0-30	5.1	6.9	5.9	8.7	104
			30-45	6.7	8.9	8.1	11.8	56
			45-60	-0.6	2.8	0.4	5.1	194
			60+	-2.0	2.3	-4.1	4.8	2034
103-04175	1.10	1.04	0-30	1.7	10.4	-0.3	13.6	4*
			30-45	1.7	5.0	1.8	6.4	7*
			45-60	0.3	3.2	2.3	6.5	107
			60+	-2.2	2.4	-4.4	5.3	2592
103N04181	1.31	1.25	0-30	2.5	4.7	2.7	5.8	96
			30-45	1.0	6.6	2.2	9.0	57
			45-60	-1.3	1.8	-2.2	3.9	1725
			60+	-3.2	3.2	-6.2	6.4	910
103P04181	1.54	1.31	0-30	1.0	5.2	0.8	5.8	153
			30-45	2.1	6.1	2.7	7.5	522
			45-60	0.5	2.9	1.0	4.9	1843
			60+	-4.8	5.4	-7.1	7.7	5*

*Results in the specified row may not be reliable due to small number of observations

Table 6
Observations meeting data quality criteria for individual freeway segments greater than one mile in the state of Delaware

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SE Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
103+04107	0-30	0	0%	2	50%	0	0%	0	0%	4*
	30-45	0	0%	1	100%	0	0%	1	100%	1*
	45-60	29	71%	39	95%	0	0%	35	85%	41
	60+	134	49%	229	85%	0	0%	166	61%	271
103-04103	0-30	20	14%	96	69%	0	0%	80	58%	139
	30-45	35	23%	101	66%	0	0%	69	45%	153
	45-60	148	45%	288	87%	0	0%	231	70%	332
	60+	960	39%	2124	87%	0	0%	1659	68%	2435
103-04105	0-30	17	28%	44	72%	0	0%	32	52%	61
	30-45	4	10%	18	43%	0	0%	9	21%	42
	45-60	93	39%	170	72%	0	0%	137	58%	236
	60+	851	45%	1531	82%	5	0%	1012	54%	1874
103-04106	0-30	27	26%	62	60%	0	0%	54	52%	104
	30-45	11	20%	20	36%	0	0%	15	27%	56
	45-60	93	48%	156	80%	1	1%	126	65%	194
	60+	811	40%	1720	85%	1	0%	1207	59%	2034
103-04175	0-30	0	0%	1	25%	0	0%	0	0%	4*
	30-45	3	43%	5	71%	0	0%	5	71%	7*
	45-60	40	37%	80	75%	0	0%	47	44%	107
	60+	1085	42%	2110	81%	3	0%	1418	55%	2592
103N04181	0-30	18	19%	64	67%	0	0%	55	57%	96
	30-45	8	14%	30	53%	0	0%	18	32%	57
	45-60	845	49%	1529	89%	1	0%	1251	73%	1725
	60+	252	28%	672	74%	0	0%	357	39%	910
103P04181	0-30	9	6%	102	67%	0	0%	97	63%	153
	30-45	64	12%	250	48%	0	0%	203	39%	522
	45-60	626	34%	1456	79%	0	0%	1144	62%	1843
	60+	0	0%	2	40%	0	0%	1	20%	5*

*Results in the specified row may not be reliable due to small number of observations

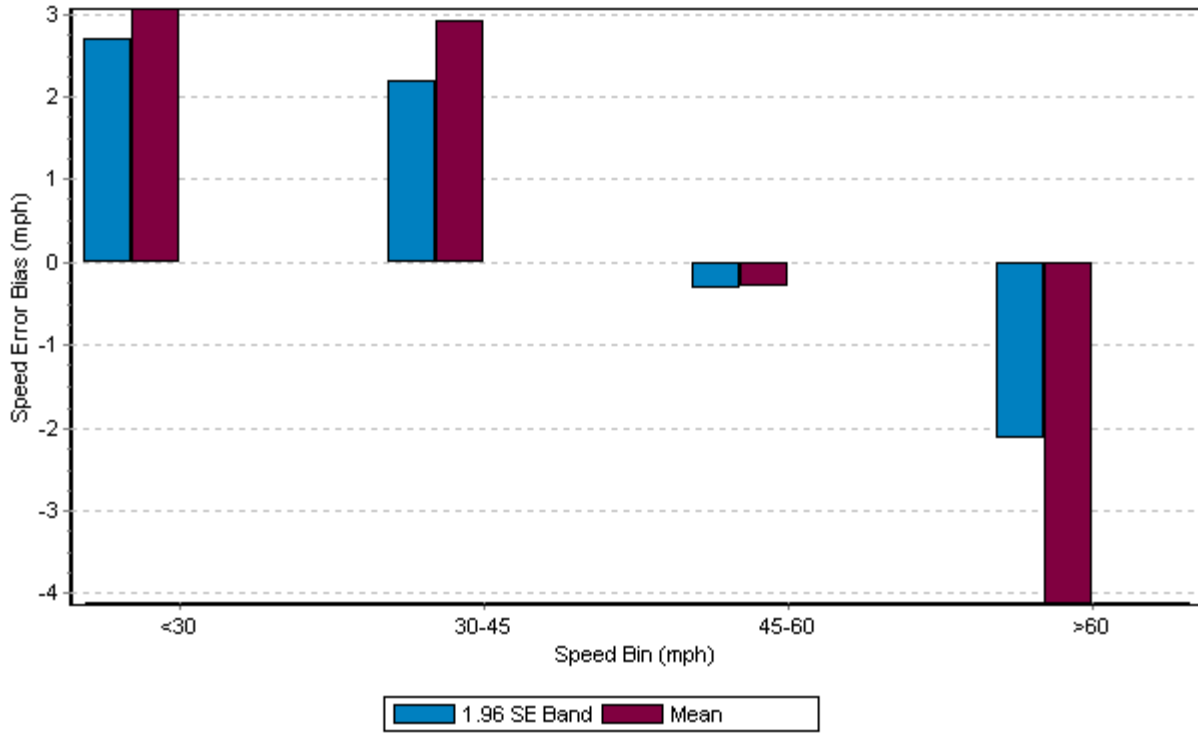


Figure 2
Speed error bias for freeway segments greater than one mile in Delaware

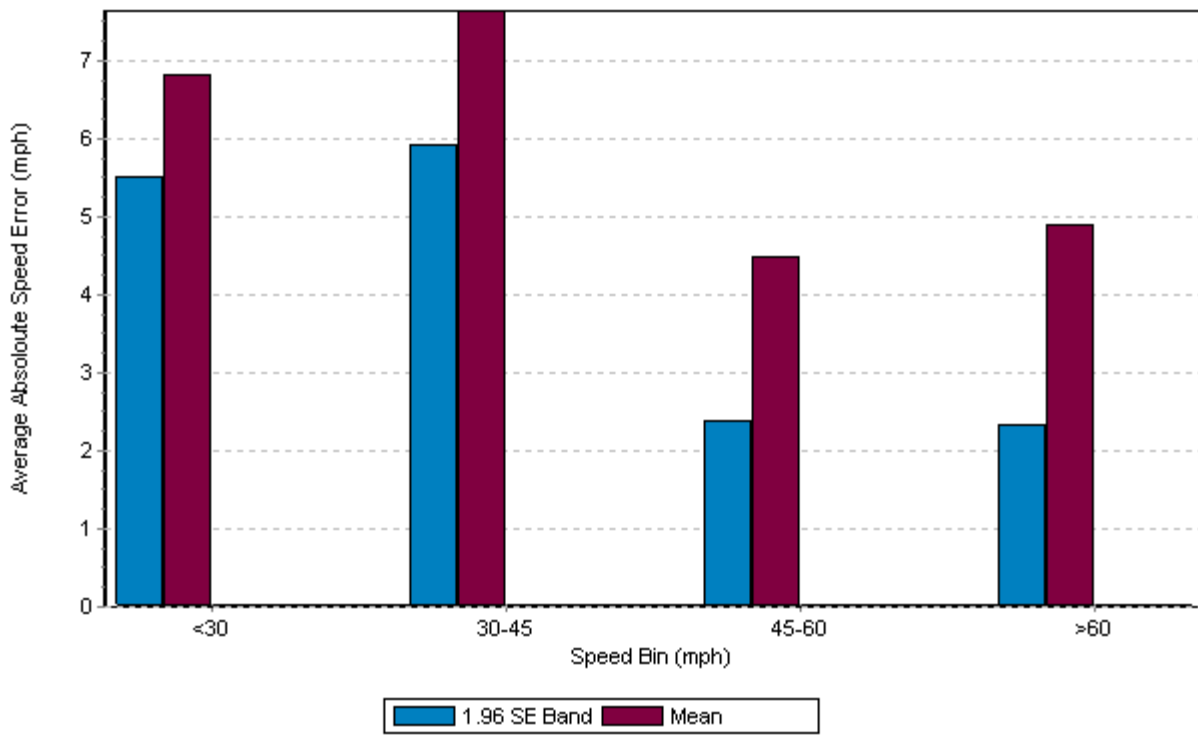


Figure 3
Average absolute speed error for freeway segments greater than one mile in Delaware