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Quality Assessment of Commercial Probe Data on Signalized Arterials

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Background

- The I-95 Vehicle Probe Project (VPP) began in 2008 with a vision of an East Coast wide traffic monitoring system which included both freeways and major arterials
- Within VPP, the performance of probe based travel time data on freeways has been extensively evaluated by using Bluetooth traffic monitoring (BTM) equipment
- From April 2013 through June of 2014, the UMD CATT focused on arterial data validation, by collecting data on various arterials in several states

Background

Three methods were incorporated into the initial arterial analysis:

- ✓ **Traditional analysis** using precision and bias speed metrics
- ✓ **Slowdown analysis** which quantified the percentage of significant traffic disruptions accurately captured in the VPP data
- ✓ **Sampled distribution method** to evaluate the quality of outsourced probe data for recurring congestion patterns

Summary of previous report

✓ RECOMMENDED	🔎 SHOULD BE TESTED	✖ NOT RECOMMENDED
● <= 1 signal per mile	● 1 to 2 signals per mile	● >= 2 signals per mile
● AADT > 40,000 vpd (2-way)	● AADT 20K to 40K vpd (2-way)	● AADT < 20K (2-way) - low volume
● Limited curb cuts	● Moderate number of curb cuts	● Substantial number of curb cuts
Principal Arterials	Minor Arterials	Major Collectors
Likely to be accurate…	Possibly accurate, test …	Unlikely to be accurate…

Report published July 2015, available online (link)

What's new?

- **Eight new case studies** conducted in six states (MD, VA, NJ, PA, NC, GA) are used and number of **probe data vendors increased** from one to three
- Ground-truth data collected on 20+ segments for 10~14 days for each case study using Bluetooth/WiFi sensors
- The results are compared with the recommendations made in the previous report

Slowdown Analysis

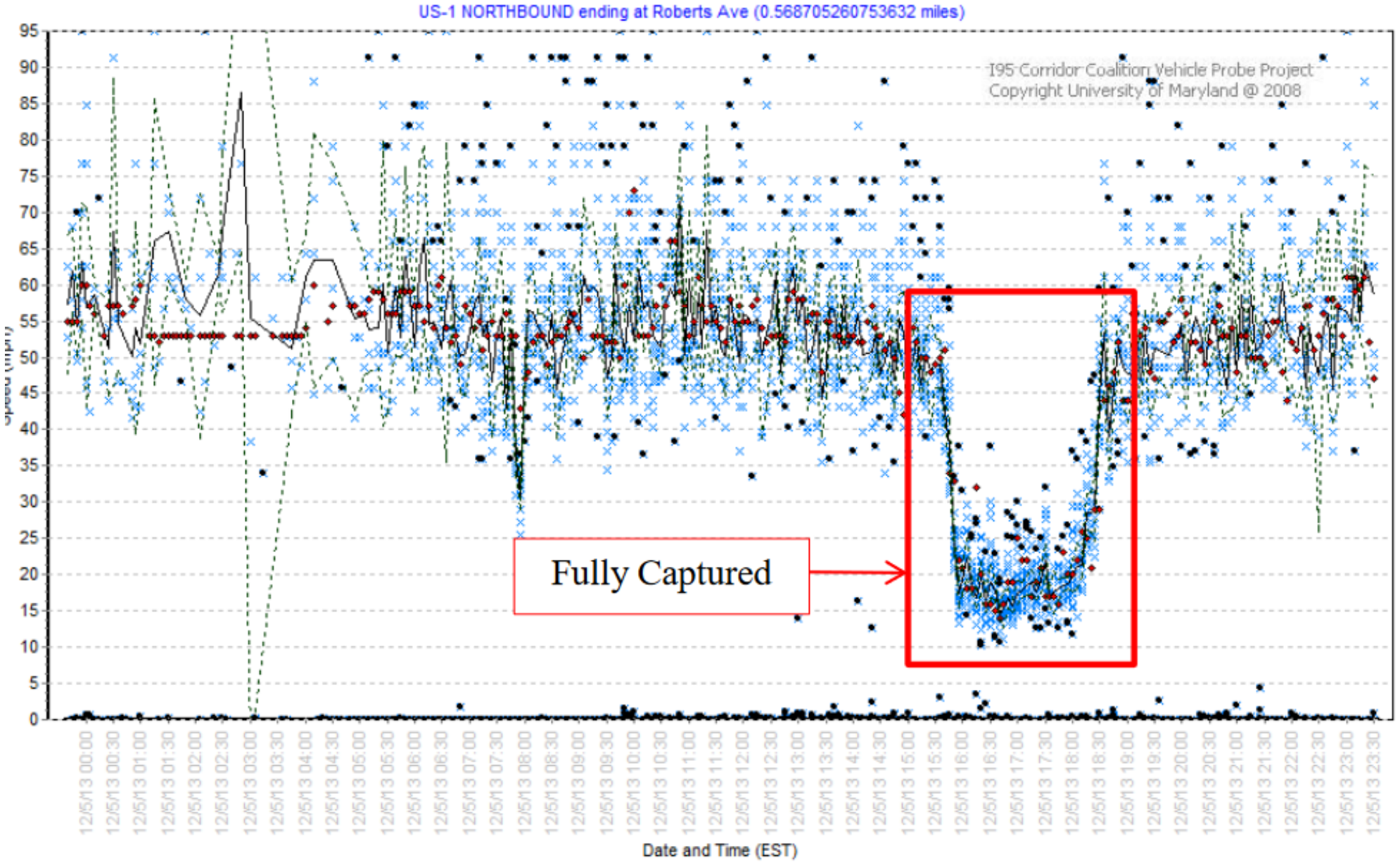
- A slowdown on arterials is defined as a **speed reduction of at least 15 mph** from nominal speed **for a period of one hour or more**. On slower speed arterial corridors, the threshold may be reduced to 10 mph, and the duration to 30 minutes.
- For each observed slowdown, the ability of the probe data to accurately capture the slowdown is analysed by an analyst.
- Accuracy is based on correctly reflecting the duration of slowdown and reduction of speed.

Slowdown Analysis

- Three categories are defined:

1. **Fully Captured Slowdown:** The probe data indicates a significant slowdown in traffic, and accurately characterized its magnitude both in length of duration and in reduction of speed by threshold of 80% or more.
2. **Partially Captured Slowdown:** The probe data indicates a significant slowdown, but the magnitude was not accurate either in duration of the slowdown or reduction of speed.
3. **Failed to Capture Slowdown:** The probe data either misses the slowdown completely, or the extent of severity of the slowdown is very different from the reference data.

Fully Captured Slowdown



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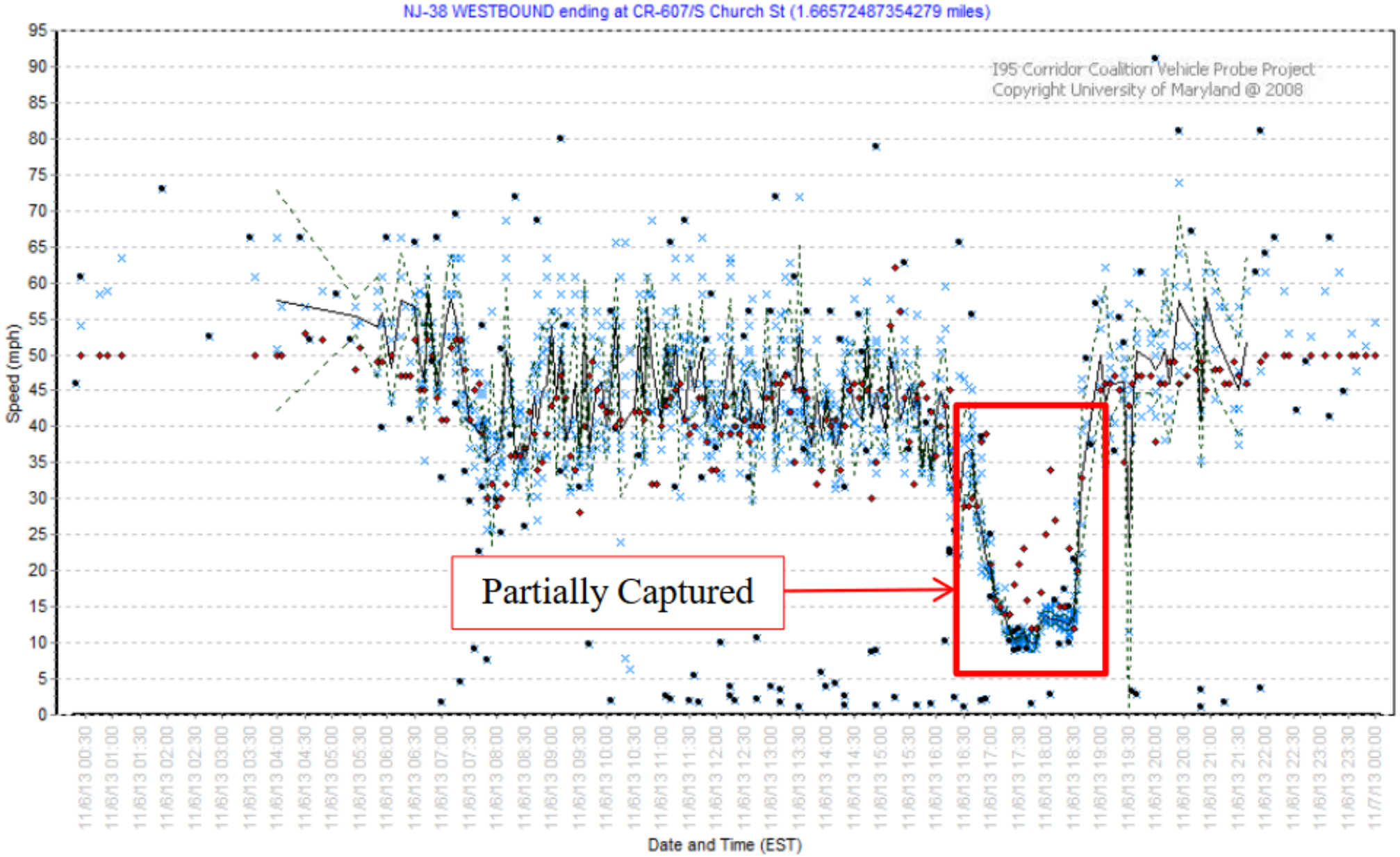
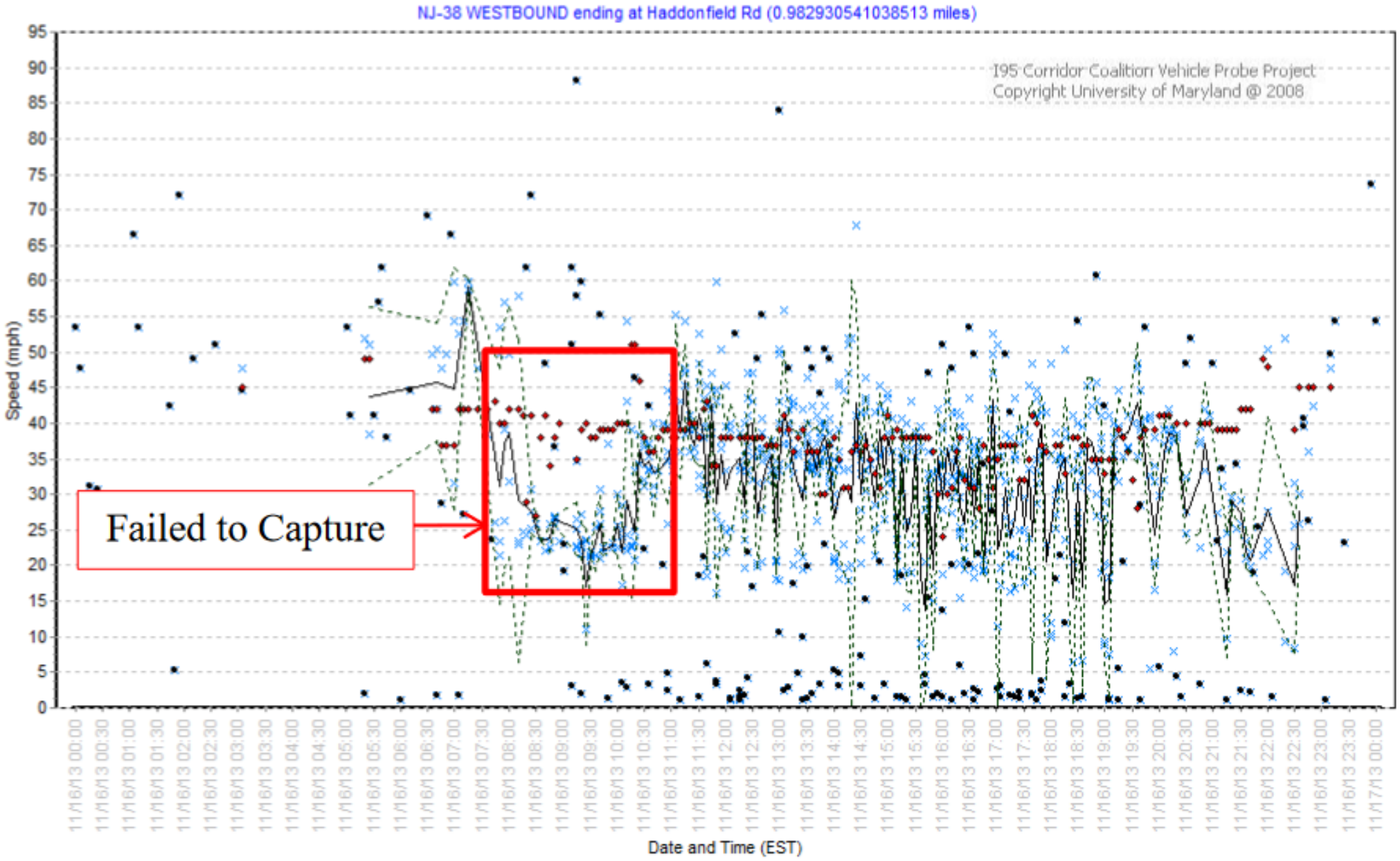
Partially Captured Slowdown



Failed to Capture Slowdown



Previous results

Case Study Number	Data Set (State-ID#)	Road #	Average AADT (in 1000)	Average Signal Density	Slowdown Analysis Results			
					Total Slowdowns	% Fully Captured	% Partially Captured	% Failed to Capture
1	NC-06	NC-55	25.0	2.1	54	15.0%	44.0%	41.0%
2	MD-07	MD-355	44.0	3.9	9	44.4%	22.2%	33.3%
		MD-586	34.0	3.1	8	0.0%	37.5%	62.5%
3	NJ-11	US-1	70.0	0.7	101	63.4%	36.6%	0.0%
		NJ-42	48.0	1.8	4	0.0%	100.0%	0.0%
		US-130	42.0	2.0	4	25.0%	50.0%	25.0%
4	NJ-12	NJ-38	46.0	1.8	57	40.4%	38.6%	21.1%
		NJ-73	52.0	1.7	89	41.6%	46.1%	12.4%
5	PA-05	US-1	45.0	4.1	78	28.2%	48.7%	23.1%
		US-322	25.0	0.5	58	50.0%	41.4%	8.6%
6	PA-06	PA-611	27.0	3.3	18	22.2%	33.3%	44.4%
		PA-611	21.0	11.5	5	0.0%	20.0%	80.0%
7	VA-07	VA-7	56.0	1.9	75	24.0%	42.7%	33.3%
		VA-7	55.0	1.6	22	4.5%	22.7%	72.7%
		US-29	21.0	5.0	1	0.0%	0.0%	100.0%
8	VA-08	US-29	33.0	3.6	49	8.2%	42.9%	49.0%
9	MD-08	MD-140	31.0	3.9	20	0.0%	35.0%	65.0%
			42.0	1.2	18	22.2%	66.7%	11.1%

Data collected from April 2013 to June 2014

New results (1/2)

Case Study Number	Data Set (State-ID#)	Road #	Average AADT (in 1000)	Average Signal Density	Vendor #	Slowdown Analysis			
						Total Slowdowns	% Fully Captured	% Partially Captured	% Failed to Capture
11	VA-09	US-1	36.0	2.9	1	79	40.5%	43.0%	16.5%
					2		59.5%	29.1%	11.4%
					3				
12	VA-10	US-1	22.0	1.2	1	18	27.8%	0.0%	72.2%
					2		27.8%	22.2%	50.0%
					3				
13	NJ-13	NJ-37	39.8	1.0	1	17	52.9%	41.2%	5.9%
					2		29.4%	58.8%	0.0%
					3		41.2%	58.8%	0.0%
14	NC-07	US-29	28.7	1.4	1	22	40.9%	54.5%	4.5%
					2		4.5%	36.4%	59.1%
					3		50.0%	31.8%	18.2%
		US-74	57.8	1.0	1	79	96.2%	3.8%	0.0%
					2		65.8%	26.6%	7.6%
					3		48.1%	41.8%	10.1%

Data collected from December 2014 to October 2016

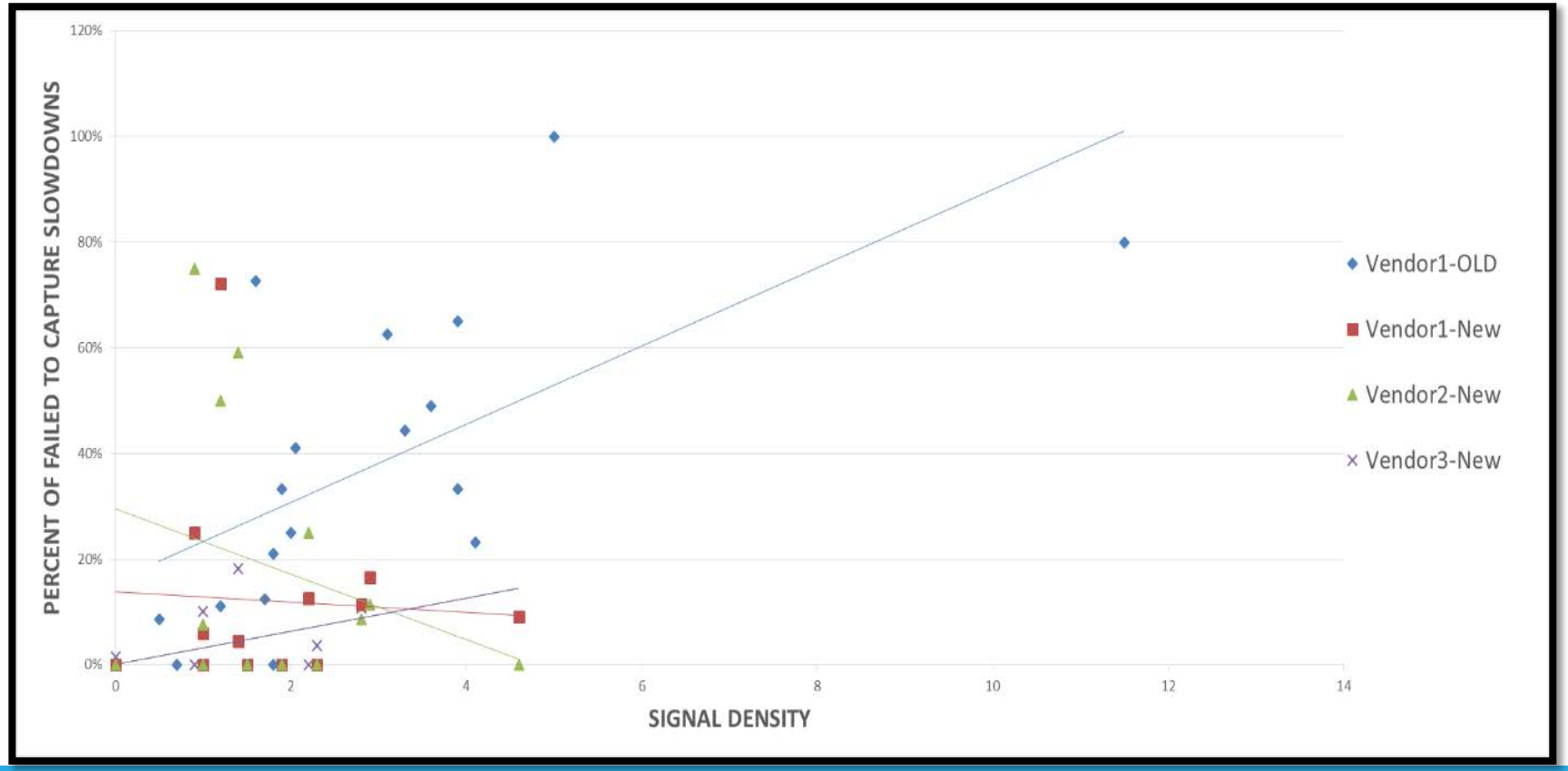
New results 2/2

Case Study Number	Data Set (State-ID#)	Road #	Average AADT (in 1000)	Average Signal Density	Vendor #	Slowdown Analysis			
						Total Slowdowns	% Fully Captured	% Partially Captured	% Failed to Capture
15	GA02	GA-141	43.2	2.3	1	56	83.9%	12.5%	0.0%
					2		71.4%	25.0%	0.0%
					3		67.9%	28.6%	3.6%
		US-41	30.8	1.9	1	11	81.8%	18.2%	0.0%
					2		54.5%	45.5%	0.0%
					3		63.6%	36.4%	0.0%
		US-19	146.5	0.0	1	68	88.2%	11.8%	0.0%
					2		98.5%	1.5%	0.0%
					3		91.2%	7.4%	1.5%
16	MD-10	US-1	29.2	2.2	1	8.0	75.0%	12.5%	12.5%
					2		62.5%	12.5%	25.0%
					3		100.0%	0.0%	0.0%
		US-29	62.0	1.5	1	30.0	86.7%	13.3%	0.0%
					2		86.7%	13.3%	0.0%
					3		90.0%	10.0%	0.0%
17	PA09	PA-3	28.3	4.6	1	11	27.3%	63.6%	9.1%
					2		90.9%	9.1%	0.0%
					3		45.5%	36.4%	18.2%
		PA-23	11.1	0.9	1	8	12.5%	62.5%	25.0%
					2		0.0%	25.0%	75.0%
					3		87.5%	12.5%	0.0%
18	VA-11	US-50	52.9	2.8	1	140	32.9%	55.7%	11.4%
					2		72.1%	19.3%	8.6%
					3		59.3%	30.0%	10.7%

Data collected from December 2014 to October 2016

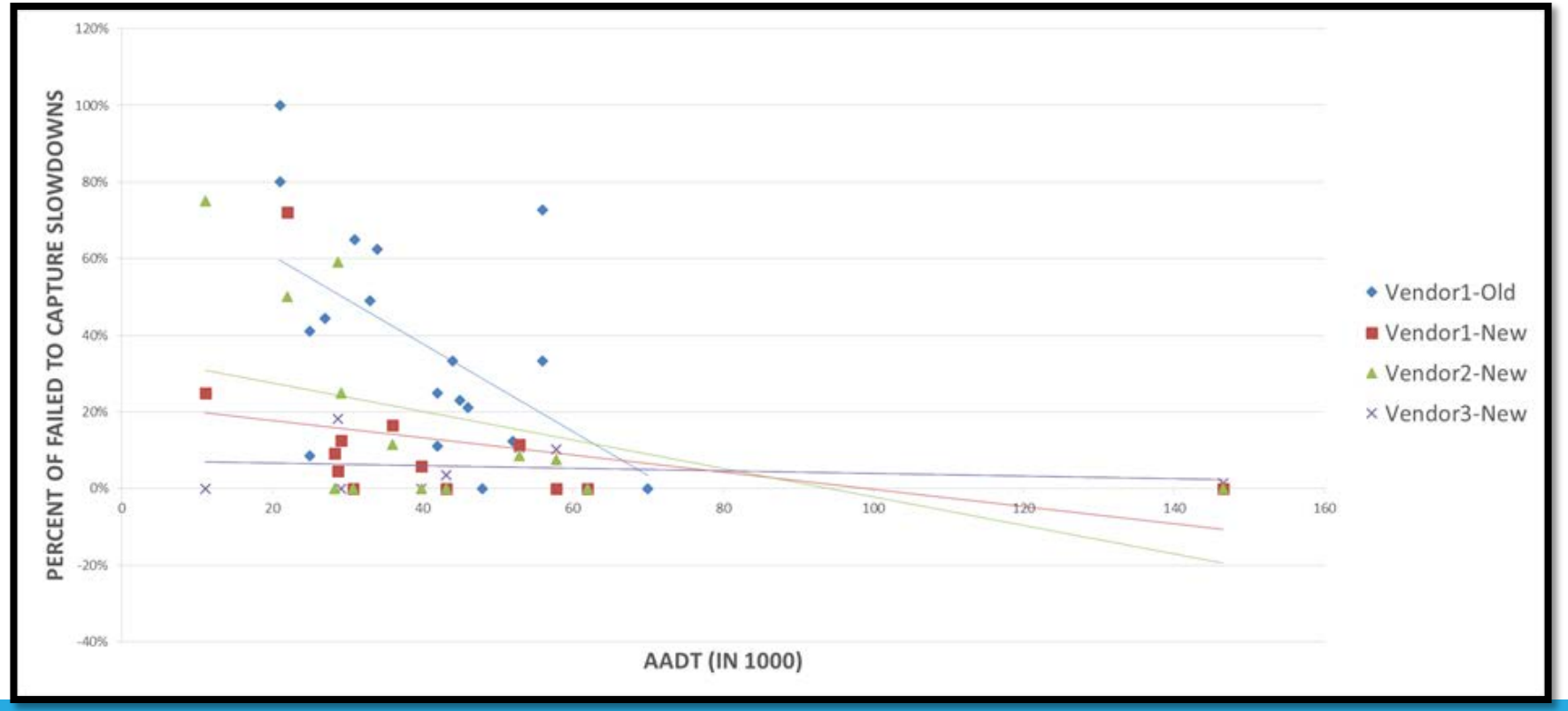
Results Comparison

Previous Study	New Study
By increasing the signal density the percentage of failed to capture slowdowns increases substantially	Correlation between signal density and failed to capture rate is **NOT** observed



Results Comparison

Previous Study	New Study
Increasing volume (as reflected by the AADT) correlates to a decrease in the percentage of failed to capture slowdowns	Correlation between AADT and failed to capture rate is **NOT** observed



Results Comparison

Statistics	% Failed to Capture Slowdowns			
	Vendor1-Old	Vendor1-New	Vendor2-New	Vendor3-New
Average	37.9%	12.1%	18.2%	5.7%
Median	33.3%	5.9%	7.6%	1.5%
STDEV	28.9%	19.7%	26.1%	7.4%
Percentile-25	12.0%	0.0%	0.0%	0.0%
Percentile-50	33.3%	5.9%	7.6%	1.5%
Percentile-75	63.1%	14.5%	37.5%	10.7%

Conclusions

- Commercial probe data performance, as measured in the percent of ‘failed to capture’ congestion events, is no longer strongly correlated to signal density or average AADT as it was in 2013 & 2014.
- The probe data performance **has improved** over time; for example 25 percentile of all three vendors’ failed to capture slowdowns is 0% but in the old case studies was 12%.
- **The improvements are significant for all vendors over all statistics**