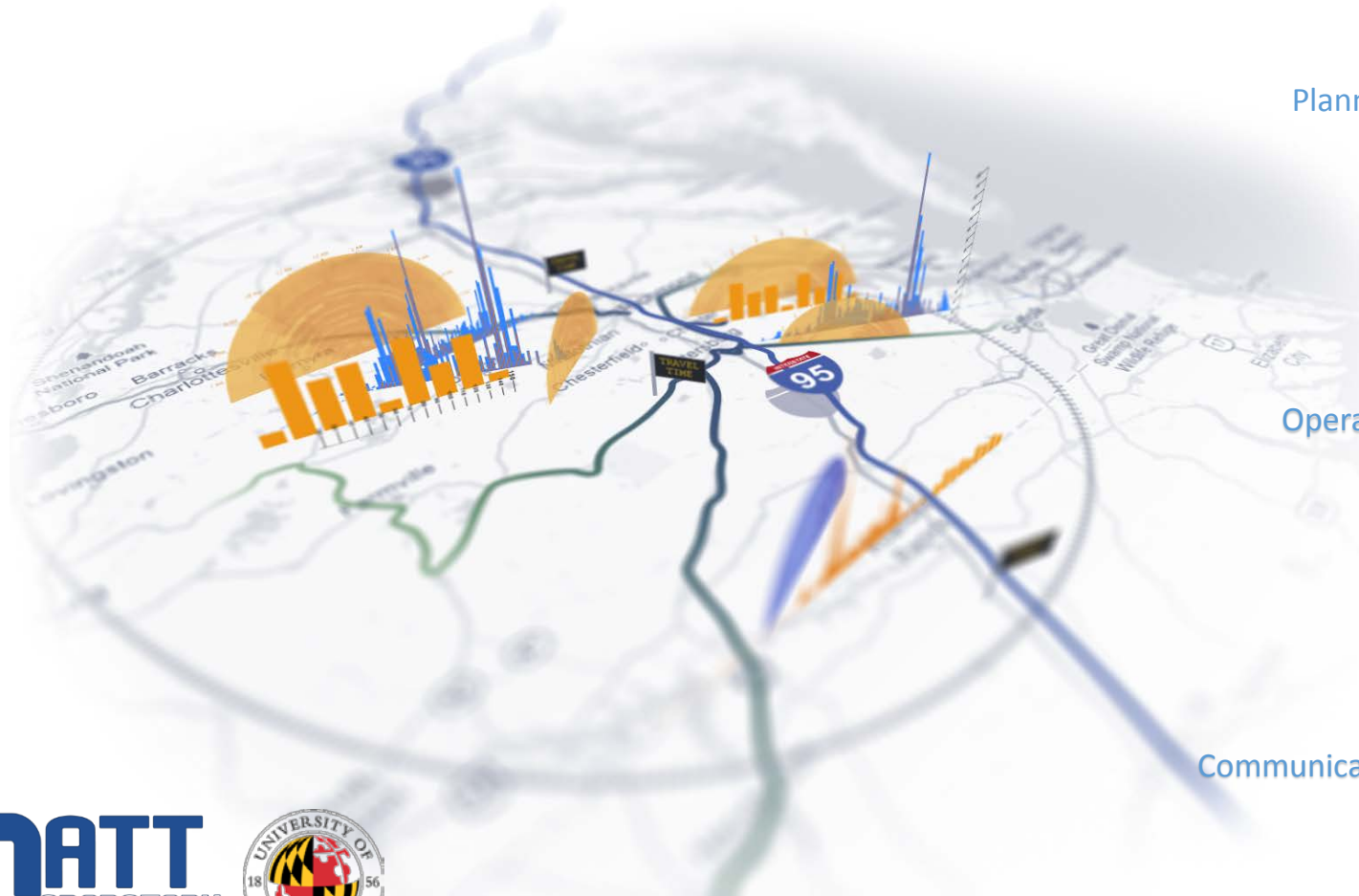
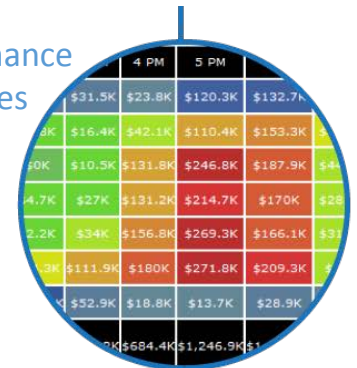


Computing Performance

With HERE, INRIX, TomTom & the NPMRDS



Performance Measures



Planning



Operations



Communications

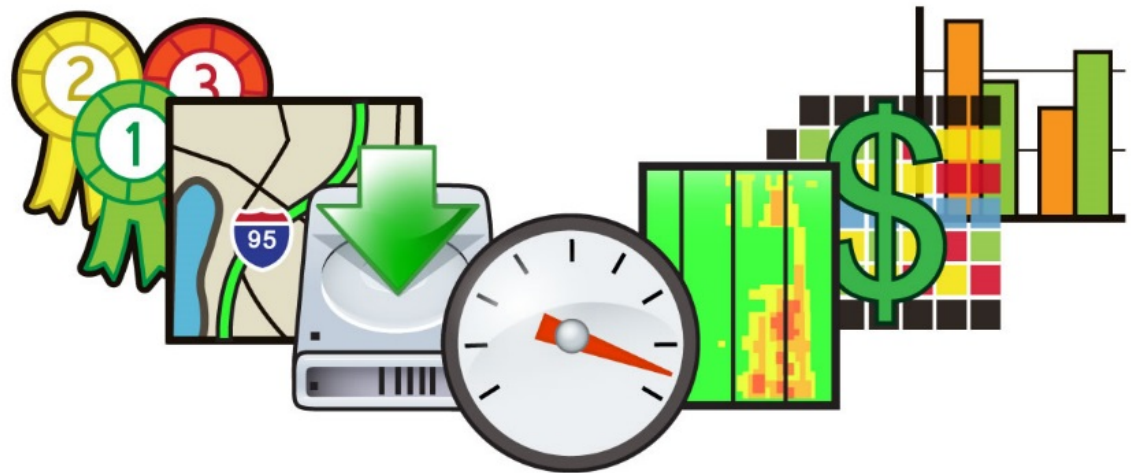


Some Background

2008: I-95 CC Probe Data Procurement

- One Data Provider—INRIX was chosen

CATT Lab sees potential beyond Traveler Information



Probe Analytics

Probe Data Analytics – Regional History

Choose any point in time to view historical accident stats, weather radar, queues, travel times, bottlenecks, and other conditions

Ranked Bottleneck List

Links to Timelines & Other Visualizations

Bottleneck Queue Stats and Travel Time Index

Ranked Bottleneck List

- I-395 N @ EADS ST
- MD-5 N @ MD-337/ALLENTOWN RD
- I-495 CW @ US-1/EXIT 1
- US-29 S @ MD-384/COLESVILLE RD
- I-495 CCW @ MD-185/CONNECTICUT AV
- I-495 OUTER LOOP AT EXIT 27 I 95
- VA-7 E @ TOWLSTON RD
- I-95 N @ MD-216/EXIT 35
- US-50 E @ I-66/US-50/THEODORE ROOSE
- I-495 CW @ CLARA BARTON PKWY/EXIT
- I-270 Local S @ I-270
- I-270 S @ MONTROSE RD/EXIT 4
- I-95 S @ I-495/EXIT 27-25
- MD-190 E @ LITTLE FALLS PKWY
- I-66 E @ VA-243/NUTLEY ST/EXIT 62
- MD-32 W @ MD-175/ANNAPOLIS RD
- I-66 W @ 25TH ST
- MD-295 S @ POWDER MILL RD
- I-66 W @ VA-123/EXIT 60
- US-50 W @ SOUTH DAKOTA AVE
- VA-267 E @ RESTON PKWY/PLAZA AMERI
- MD-5 N @ MD-414/ST BARNABAS RD
- SUITLAND PKWY W @ ALABAMA AVE
- BRADDOCK RD E @ BACKLICK RD
- MD-3 S @ MD-450/ANNAPOLIS RD
- MD-4 W @ DOWER HOUSE RD/MARLBORC
- I-495 CW @ VA-650/GALLOWES RD/EXIT 7
- MD-295 N @ ARUNDEL--PRINCE GEORGE'
- I-66 E @ FAIRFAX DR/EXIT 71
- MD-185 S @ MD-191/BRADLEY LN
- MD-190 E @ LITTLE FALLS PKWY
- MD-650 S @ ADELPHI RD
- VA-123 N @ WAVERLY WAY

Injuries Involved

Location: I-270 NORTH AT EXIT 4 MD 927 MONTROSE RD
 Started: Dec 03, 2014 8:01 AM
 Ended: Dec 03, 2014 9:13 AM
 Duration: 1 h 12 m 30 s
 Updated: Dec 03, 2014 9:13 AM

Time selection

What time would you like to see data for?
 Right now, and keep the data up to date in real-time
 A previous point in time
 12/03/2014 08:30 AM
 Fade out incidents that haven't been updated in the last 12 hours

I-270 S @ I-270

Show graphs: Queue over time Travel Time Index of maximum queue length

Queue: 16 miles

Queue over time

Queue (miles) vs Time (6:15 AM to 9:15 AM). Legend: Average queue (dotted line), Queue (solid line).

Travel Time Index: 1.23

Travel Time Index of maximum queue length

Travel Time Index vs Time (6:15 AM to 9:15 AM). Legend: Bottleneck Average TTI (dotted line), TTI (solid line), Historic Average TTI (dashed line), 5/95% (light grey bar), 25/75% (dark grey bar).

Started: Dec 03, 2014 6:19 AM
 Ended: Dec 03, 2014 9:21 AM
 Generate congestion scan

You're looking at data from December 3, 2014 @ 8:30 AM. Bottlenecks are shown at their maximum length. There are 655 bottlenecks and 3919 events.

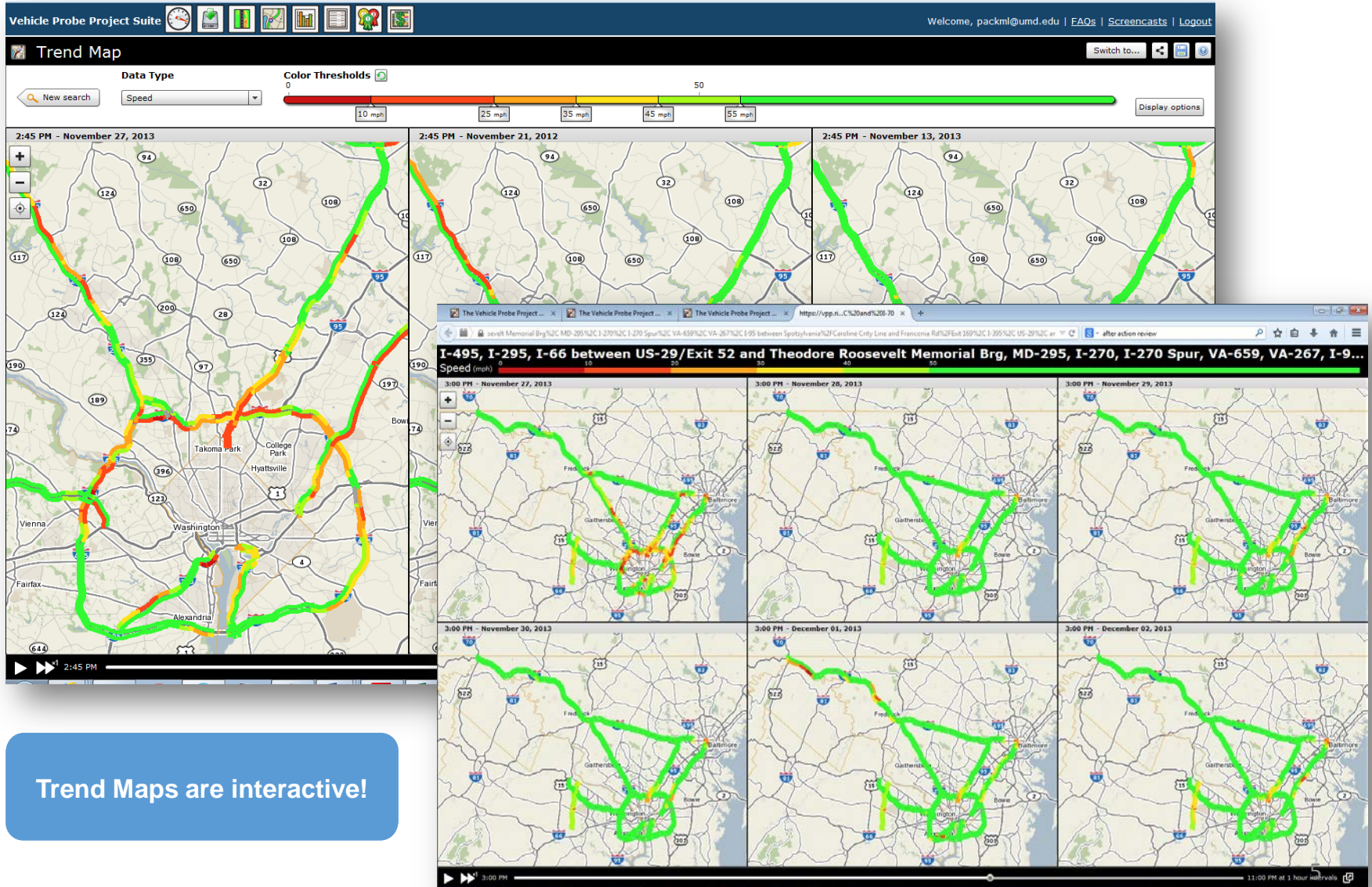
Congestion Scans

Congestion and other measures can be visualized in both directions of travel along a corridor. Accident and event data can be overlaid on the congestion scan to help determine causality.



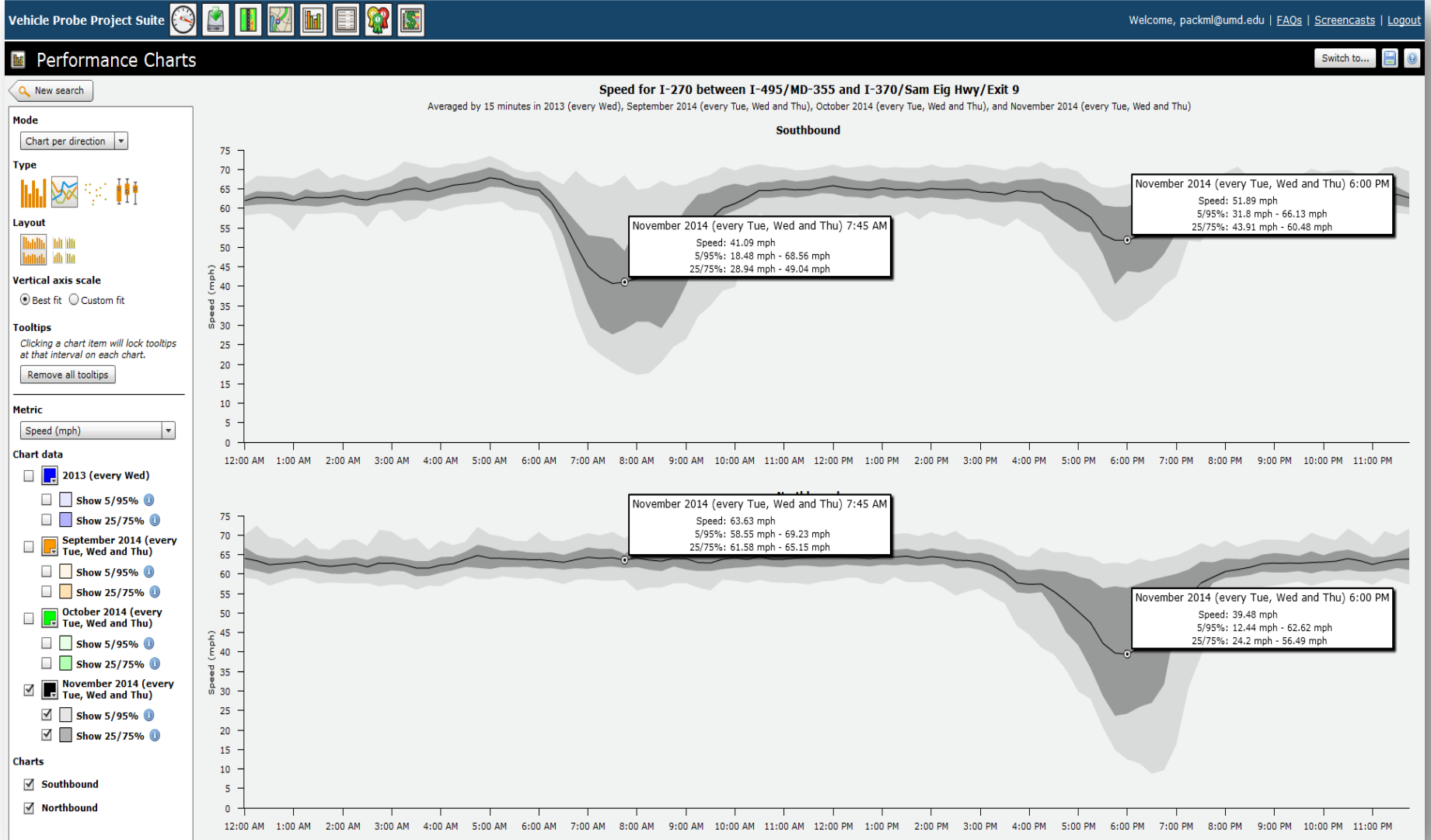
Trend Maps (Cont'd.)

Up to seven maps can be drawn and animated simultaneously with the Trend map tool.



Performance Charts

Line charts let users see average travel times, speeds, reliability measures, etc. and color bands depict the variability in the data over time. The dark blue band below represents the 25th/75th percentile, and the lighter blue bands represent the 5th/95th percentile.



Bottleneck Ranking – Results Summary Page

Useful for identifying problem locations, the bottleneck ranking tools allows a user to “rank” the worst the congested locations on a corridor, in a county, a state, or a larger region. The results (shown on the next few slides) provide details on how severe each bottleneck was in terms of queue length, average duration, and number of occurrences during a given date range. Event information has been overlaid to give a much more robust picture of conditions. All results summaries can be exported.

Vehicle Probe Project Suite

Bottleneck Ranking

New search

Bottleneck locations from Interstates in MD (1166 tmc) between October 1, 2014 and October 31, 2014 (588 total)

Rank	Map	Location	Average duration	Average max length (miles)	Occurrences	Impact factor	All Events/Incidents
1	<input type="checkbox"/>	I-270 S @ I-270	1 h 45 m	11.44	61	73,295	56
2	<input checked="" type="checkbox"/>	I-695 CW @ MD-41/PERRING PKWY/EXIT 30	2 h 03 m	6.98	70	60,091	153
3	<input type="checkbox"/>	I-495 CW @ MD-190/RIVER RD/EXIT 39	3 h 11 m	4.56	66	57,488	174
4	<input type="checkbox"/>	I-95 N @ MD-100/EXIT 43	2 h 06 m	8.53	51	54,834	73
5	<input checked="" type="checkbox"/>	I-695 CW @ I-795/EXIT 19	2 h 17 m	8.40	46	52,959	140
6	<input type="checkbox"/>	I-495 CW @ MD-214/CENTRAL AVE/EXIT 15	2 h 22 m	5.76	55	44,968	145
7	<input checked="" type="checkbox"/>	I-695 CCW @ US-40/EXIT 15	1 h 40 m	7.25	59	42,784	88

Show Events/Incidents:
 During selected time range
 Only during bottleneck conditions

I-495 CW @ MD-190/RIVER RD/EXIT 39

Show ranks
 Highlight selected bottleneck
 Show events/incidents (blue next to rank)

Occurrences

Line
 Spiral
 Table

From: Fri, Oct 10, 2014 1:07 PM
 To: Fri, Oct 10, 2014 8:14 PM
 Duration: 7 h 7 m
 Max queue length: 12.02 miles

Maximum queue length in miles
 Grayscale
 Compact View

Icon Legend

Each bottleneck location includes a column for “All Events/Incidents” indicating the total number of occurrences for the selected date range

3 visualization options

Maps provide a display of bottleneck conditions with the bottleneck rank and total number of incidents shown in the blue box

The line diagram shows detail over the course of each day for the month of October, 2014, for both bottlenecks and events

Hovering over a specific bottleneck or incident will give more detailed information. Clicking on a chart element will generate a Congestion Scan (bottleneck) or Event Timing (events)

7

Speed Threshold Breakdown

The Michigan Analytics Suite includes a Speed Threshold Breakdown Tool whereby users can choose a stretch of road to view speeds that occur above or below a threshold, using criteria of time-of-day and day-of-week for a specific date range(s).

Michigan Analytics Tools | Welcome, John | Help | Logout

Speed Threshold Breakdown

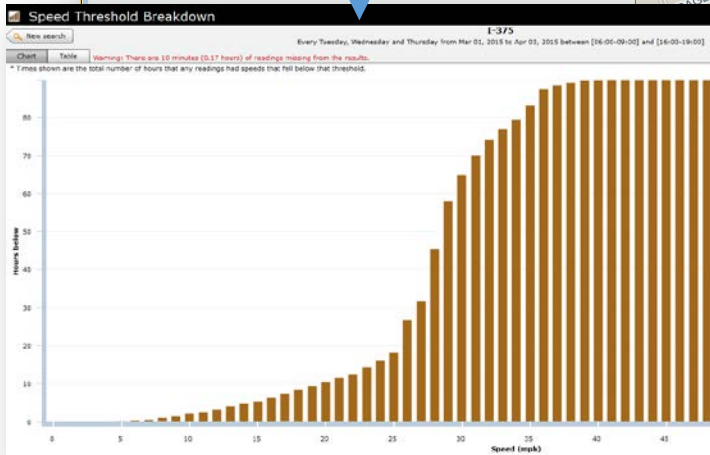
Choose a stretch of road and a date range you would like to view speed counts for.

- Road**
 - Region: List of TMC codes | Saved TMC Set
 - Search in Michigan...
 - Your selected roads: I-375
 - Directions: Northbound Southbound
 - Entire road Partial road
 - 3.37 miles of roadway selected (12 TMC codes)
 - Save as TMC set
- Date range**
 - 03/01/2015 - 04/03/2015
 - Add another date range
- Days of week**
 - Sun Mon **Tue** Wed Thu Fri Sat
- Time of day**
 - 06:00 AM -to- 09:00 AM | Reset time
 - 04:00 PM -to- 07:00 PM | Reset time
 - Add another time of day

Submit

Chart Results

Tabular Results



Speed Threshold Breakdown
I-375
Every Tuesday, Wednesday and Thursday from Mar 01, 2015 to Apr 03, 2015 between [06:00-09:00] and [04:00-07:00]

Warning: There are 10 minutes (0.17 hours) of readings missing from the results.

Speed	Number of readings	% of readings below	Hours Below	% of time below	Minutes Below	% of readings above	Hours Above	% of time above	Minutes Above
0	0	0.00	0.00	0.00	0	100.00	89.83	99.81	5000
1	0	0.00	0.00	0.00	0	100.00	89.83	99.81	5000
2	0	0.00	0.00	0.00	0	100.00	89.83	99.81	5000
3	0	0.00	0.00	0.00	0	100.00	89.83	99.81	5000
4	0	0.00	0.00	0.00	0	100.00	89.83	99.81	5000
5	2	0.01	0.02	0.04	1	99.99	89.80	99.78	5000
6	17	0.04	0.27	0.36	16	99.96	89.82	99.81	5000
7	36	0.09	0.56	0.76	30	99.91	89.81	99.81	5000
8	76	0.18	1.07	1.35	68	99.82	89.80	99.80	5000
9	109	0.25	1.43	1.78	88	99.75	89.83	99.81	5004
10	127	0.40	2.19	2.53	126	99.60	89.73	99.45	5002
11	189	0.48	3.33	4.03	183	99.52	89.73	99.45	5002
12	227	0.61	3.76	4.56	220	99.39	89.73	99.45	5002
13	302	0.79	4.90	5.94	295	99.21	89.73	99.45	5002
14	378	0.97	6.03	7.27	368	99.03	89.73	99.45	5002
15	460	1.16	7.27	8.85	448	98.85	89.73	99.45	5002
16	526	1.36	8.27	10.06	506	98.64	89.73	99.45	5002
17	612	1.59	9.33	11.27	585	98.45	89.73	99.45	5002
18	705	1.82	10.49	12.50	663	98.27	89.73	99.45	5002
19	809	2.06	11.67	13.81	742	98.11	89.73	99.45	5002
20	899	2.32	12.87	15.20	802	97.96	89.73	99.45	5002
21	1015	2.62	14.08	16.67	883	97.82	89.73	99.45	5002
22	1127	2.90	15.43	18.13	945	97.69	89.73	99.45	5002
23	1284	3.31	16.33	19.61	1003	97.58	89.73	99.45	5002
24	1484	3.79	18.03	21.21	1063	97.49	89.73	99.45	5002
25	1713	4.43	19.33	22.93	1107	97.41	89.73	99.45	5002
26	2103	5.43	26.50	29.78	1400	97.01	89.73	99.45	5002

User Delay Cost Analysis (Cont'd.)

Here is an example of UDC estimates for both passenger and commercial vehicles. The table is interactive - mousing over any cell brings up additional details about that hour of day and day of week. The user can switch what is displayed in the table from combined UDC to delay per person, per vehicle, person hours of delay, Volumes, Data Availability, etc. Tables can be exported to Excel.

Vehicle Type
All

Display
Total cost

Total Cost

	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	
12/01/14	\$0K	\$0K	\$0K	\$0K	\$0K	\$0.5K	\$17.7K	\$34.1K	\$50.7K	\$8.9K	\$0.3K	\$0.2K	\$0.3K	\$0.6K	\$3.1K	\$11.3K	\$31.8K	\$69.1K	\$48.3K	\$10.9K	
12/02/14	\$0K	\$0.1K	\$0K	\$0K	\$0.1K	\$2.4K	\$36.2K	\$43.5K	\$49.1K	\$23.1K	\$5.6K	\$12K	\$1.6K	\$2.1K	\$8K	\$15.9K	\$49.2K	\$82.4K	\$48.1K	\$5.3K	
12/03/14	\$0.1K	\$0K	\$0K	\$0K	\$0.1K	\$1K	\$20.4K	\$40.6K	\$33.3K	\$16.1K	\$2.8K	\$0.6K	\$0.5K	\$1.4K	\$4.5K	\$12.1K	\$33.7K	\$56.7K	\$27.3K	\$3.5K	
12/04/14	\$0K	\$0K	\$0K	\$0.1K	\$0K	\$0.5K	\$17.6K	\$35K	\$29K	\$8.4K	\$1.2K	\$0.7K	\$0.5K	\$0.5K	\$8.1K	\$18.7K	\$32.9K	\$58.8K	\$41.4K	\$1.8K	
12/05/14	\$0.2K	\$0K	\$0K	\$0K	\$0K	\$0.2K	\$5.2K	\$27.3K	\$22K	\$6.1K	\$1.1K	\$3.3K	\$2.9K	\$8.8K	\$13.4K	\$42.4K	\$66.4K	\$61.6K	\$23.9K	\$5.4K	
12/06/14	\$0.5K	\$0.1K	\$0K	\$0K	\$0.1K	\$0.1K	\$0.1K	\$0.1K	\$0.1K	\$0.4K	\$0.3K	\$0.6K	\$2.8K	\$11.9K	\$10.7K	\$12.4K	\$10.6K	\$14.7K	\$7.3K	\$2.6K	
12/07/14	\$0.2K	\$0.1K	\$0.1K	\$0K	\$0K	\$0.1K	\$0.1K	\$0.1K	\$0K	\$0.1K	\$0.2K	\$0.6K	\$0.2K	\$0.3K	\$2.9K	\$2.4K	\$9.4K	\$6.2K	\$1.4K	\$2.2K	
12/08/14	\$0K	\$0K	\$0K	\$0K	\$0.1K	\$0.4K	\$12.7K	\$26K	\$21.9K	\$5K	\$0.5K	\$0.5K	\$1.1K	\$0.6K	\$3K	\$10.2K	\$23K	\$27.7K	\$15.2K	\$1.1K	
12/09/14	\$0.1K	\$0.1K	\$0.1K	\$0.1K	\$0.1K	\$1.1K	\$26.2K	\$47.5K	\$51.9K	\$35.8K	\$13.5K	\$1.8K	\$5.1K	\$2K	\$6.8K	\$16.4K	\$43.3K	\$63.5K	\$41.9K	\$2.2K	
12/10/14	\$0.1K	\$0.1K	\$0K	\$0K	\$0K	\$0.3K	\$13.4K	\$37.7K	\$31.5K	\$12.1K	\$1.1K	\$0.3K	\$0.2K	\$10.4K	\$7.1K	\$40.7K	\$48.3K	\$54.2K	\$33K	\$0.1K	
12/11/14	\$0.1K	\$0K	\$0K	\$0K	\$0K	\$0.7K	\$19.7K	\$35.6K	\$37.5K	\$15.3K	\$3.6K	\$0.6K	\$0.5K	\$2.4K	\$12.8K	\$29.8K	\$37.1K	\$32.7K	\$33K	\$0.1K	
12/12/14	\$0.1K	\$0.1K	\$0K	\$0K	\$0K	\$0.4K	\$25.5K	\$32.9K	\$18.9K	\$5.4K	\$3.1K	\$1.7K	\$3.8K	\$6.4K	\$12.6K	\$29.4K	\$41.5K	\$37.8K	\$33K	\$0.1K	
12/13/14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	\$2K	\$11.1K	\$9K	\$9.2K	\$8.1K	\$8K	\$0.6K	
12/14/14	\$0.1K	\$0.1K	\$0.1K	\$0K	\$0K	\$0.1K	\$0.1K	\$0K	\$0K	\$0.1K	\$0.2K	\$0.2K	\$0.1K	\$0.3K	\$1.1K	\$1K	\$1.9K	\$1.9K	\$1K	\$0.3K	
12/15/14	\$0K	\$0K	\$0.1K	\$0K	\$0K	\$0.5K	\$16.7K	\$33.6K	\$27.4K	\$6.2K	\$0.2K	\$0.6K	\$6.6K	\$28.1K	\$30.9K	\$19.7K	\$31.8K	\$48.3K	\$4K	\$0.1K	
12/16/14	\$0K	\$0K	\$0K	\$0K	\$0K	\$0.6K	\$11.5K	\$26.3K	\$40.6K	\$18.3K	\$5.3K	\$8.5K	\$12.5K	\$6.4K	\$10.3K	\$21.5K	\$54.6K	\$57.5K	\$2K	\$0.1K	
12/17/14	\$0K	\$0K	\$0K	\$0K	\$0K	\$0.3K	\$15.6K	\$37.9K	\$26.2K	\$11.5K	\$6K	\$4.7K	\$6.2K	\$5.1K	\$8.2K	\$16.4K	\$55K	\$61.5K	\$41.9K	\$5.3K	
Hourly Totals	\$1.6K	\$1K	\$0.6K	\$0.5K	\$0.6K	\$9.2K	\$238.5K	\$458.2K	\$439.6K	\$172.7K	\$44.7K	\$36.9K	\$44.9K	\$89.4K	\$154.8K	\$309.3K	\$579.6K	\$742.6K	\$428.1K	\$68.2K	
																					\$4K
																					Grand Total
																					\$3,859,177.94

Tuesday, December 9, 2014 5:00 PM

Delay cost:
Total: \$63,510.48
Per vehicle: \$0.38
Per person: \$0.32

Hours of delay:
Person-hours: 2014h 13m 12s
Vehicle-hours: 1696h 11m 7s
Per vehicle: 36s

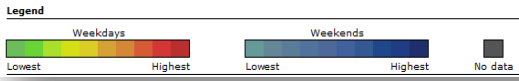
Volume:
Total: 168,319 vph
Passenger: 126,239 vph
Commercial: 42,080 vph

Data validity: 100%
[Click the table cell to see links to congestion scans](#)

[Export to Excel](#)

Want to know how the user delay cost is calculated? Read more in our [documentation](#).

- Notes**
- The values in the 'Total cost' display mode are rounded to the nearest hundredth and displayed in thousands when values larger than \$1K exist.
 - The range of values for the colored backgrounds of each cell are based on the data of the selected display mode.
 - Delay metrics are displayed for every hour of every day within the selected time range.
 - The totals for every hour are shown in the bottom row while the totals for every day are shown in the rightmost column.
 - The grand total for the entire time period is shown as the actual value and displayed at the bottom right corner.
 - Volumes shown for each hour are summed across all road segments.



Reporting Templates for Before & After Studies (Cont'd.)

▼ Average Speed Change

Before Condition (Data averaged across the entire year)
5 PM Average Speed: 47 MPH

After Condition (Data averaged across the entire year)
5 PM Average Speed: 53 MPH

During the PM Peak Hour (5:00 PM), there has been a **13% increase in speed** along the section of WB I-80 approaching the Squirrelwood Road interchange (blue highlight) since the implementation (and "shake-out" period) of the project. (the AM Peak Hour showed a **4% increase in speed**).

▼ Speed Threshold Change

Before Condition (Percent of readings below speed thresholds)
34% (below 45 MPH)

After Condition (Percent of readings below speed thresholds)
16% (below 45 MPH)

There has been a substantial improvement in speeds that fall below 45 MPH (a threshold indicating the beginning of congested conditions). In the "Before" condition, PM Peak Hour (5:00 PM), 34% of readings were < 45 MPH. In the "After", the percentage of readings dropped to 16%, an overall decrease of 53%.

▼ Congestion Comparison

Using a VPP congestion scan, comparisons between the before & after condition show improvement in congestion intensity and duration in the 5 PM WB direction of I-80, prior to the Squirrelwood Rd Interchange.

Performance ASSESSMENT

Reliability

The project was evaluated for changes in **Reliability** using the VPP Suite **Performance Summaries** module:

- Travel Time** – the time it takes to drive along a stretch of road
- Buffer Time** – the **extra** time you must add to your average trip to ensure on time arrival
- Planning Time** – the **total** time you should allow to ensure on time arrival

User Delay Cost

The project was further evaluated for changes in **Delay Cost** (total, per vehicle and per person) and **Hours of Delay** (person-hours, vehicle-hours and per vehicle) using the VPP Suite **User Delay Cost Analysis** module.

▼ Reliability Comparison

Before Condition

	Buffer time (minutes) 5:00 PM - 6:00 PM	Planning time (minutes) 5:00 PM - 6:00 PM	Travel time (minutes) 5:00 PM - 6:00 PM
Monday	1.12	4.88	3.81
Tuesday	1.76	5.56	3.91
Wednesday	1.17	4.91	3.87
Thursday	1.12	4.88	3.82
Friday	1.47	5.23	3.9
Saturday	1.07	4.62	3.64
Sunday	0.58	4.09	3.55
Weekends	1.78	5.23	3.72
Weekdays	2.69	6.14	4.23
All Days	2.35	5.8	4.06

After Condition

	Buffer time (minutes) 5:00 PM - 6:00 PM	Planning time (minutes) 5:00 PM - 6:00 PM	Travel time (minutes) 5:00 PM - 6:00 PM
Monday	1.1	4.85	3.72
Tuesday	0.62	4.42	3.7
Wednesday	0.61	4.35	3.66
Thursday	1	4.76	3.71
Friday	0.52	4.28	3.64
Saturday	0.41	3.96	3.43
Sunday	0.57	4.08	3.48
Weekends	1.07	4.53	3.61
Weekdays	2.03	5.48	3.85
All Days	1.57	5.03	3.76

25% ↓ (Weekdays) 11% ↓ (Weekdays) 9% ↓ (Weekdays)

Comparisons of changes in **Travel, Buffer and Planning Times** show favorable reductions in the After condition that can be attributed to the improved flow in the WB lanes of I-80 prior to the Squirrelwood Road off-ramp.

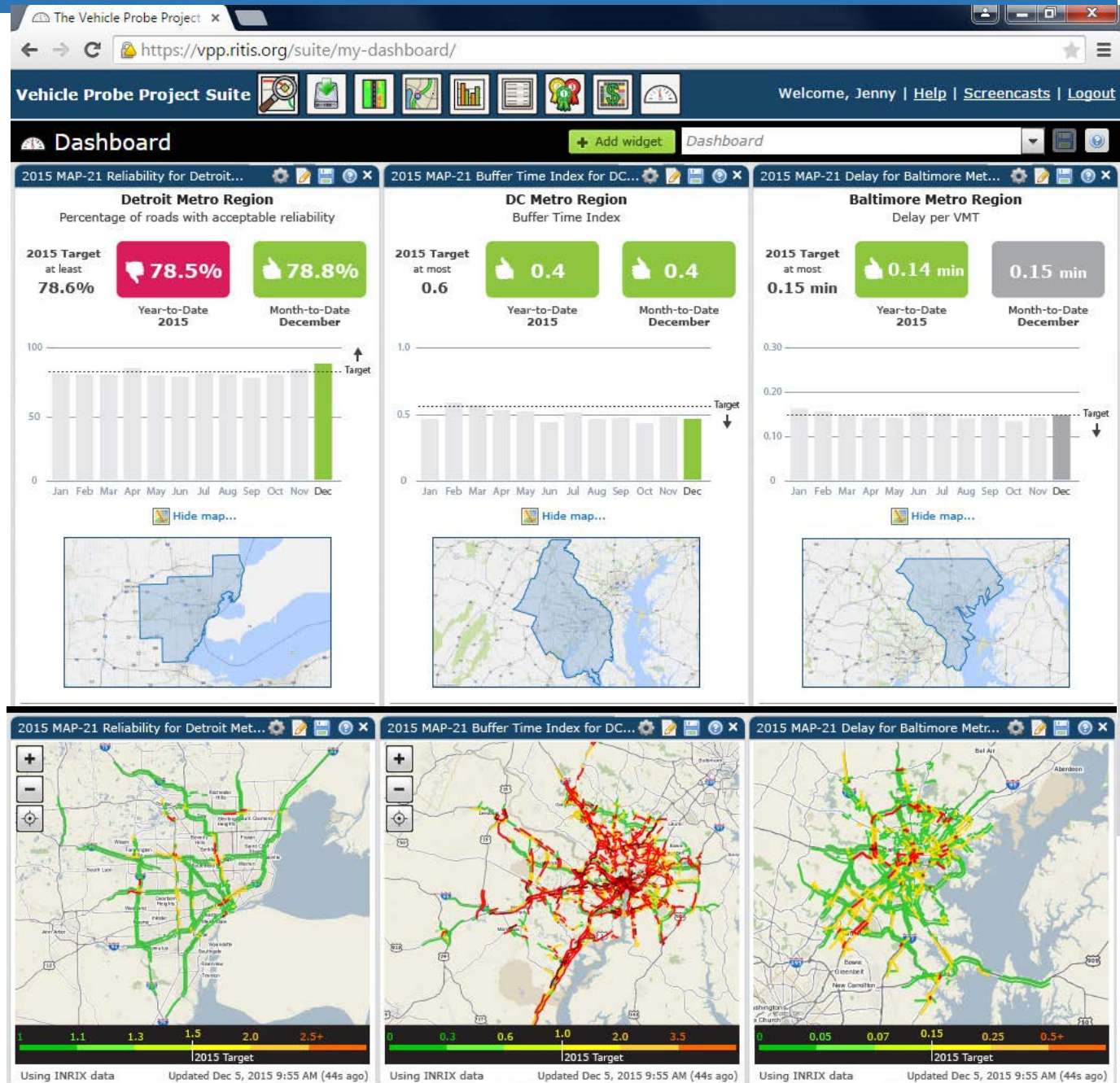
▼ User Delay Cost Comparison

	Before Condition 5 PM	After Condition 5 PM
Delay cost:		
Total:	\$4,903,322.13	\$902,379.14
Per vehicle:	\$1,151.86	\$192.3
Per person:	\$969.98	\$161.94
Hours of delay:		
Person-hours:	155,492.15 hours	28,719.9 hours
Vehicle-hours:	130,940.76 hours	24,185.18 hours
Per vehicle:	30.76 hours	5.15 hours
Data validity:	88.08%	95.89%

Comparisons of changes in **User Delay Cost** show **substantial** reductions in cost and hours of delay in the After condition, across all categories.

Customizable Dashboards – Region/Multi-corridor Widgets

Any number of congestion and reliability measures can be displayed including planning time index, buffer time index, travel time index, etc. Users can choose to generate these measures for a single corridor, a group of corridors, a single county, multiple counties, a single state, or multiple states. Each widget is interactive.



But then things changed...

More competition entered the game.

NPMRDS came into existence.

2014: I-95 CC Re-compete for East Coast

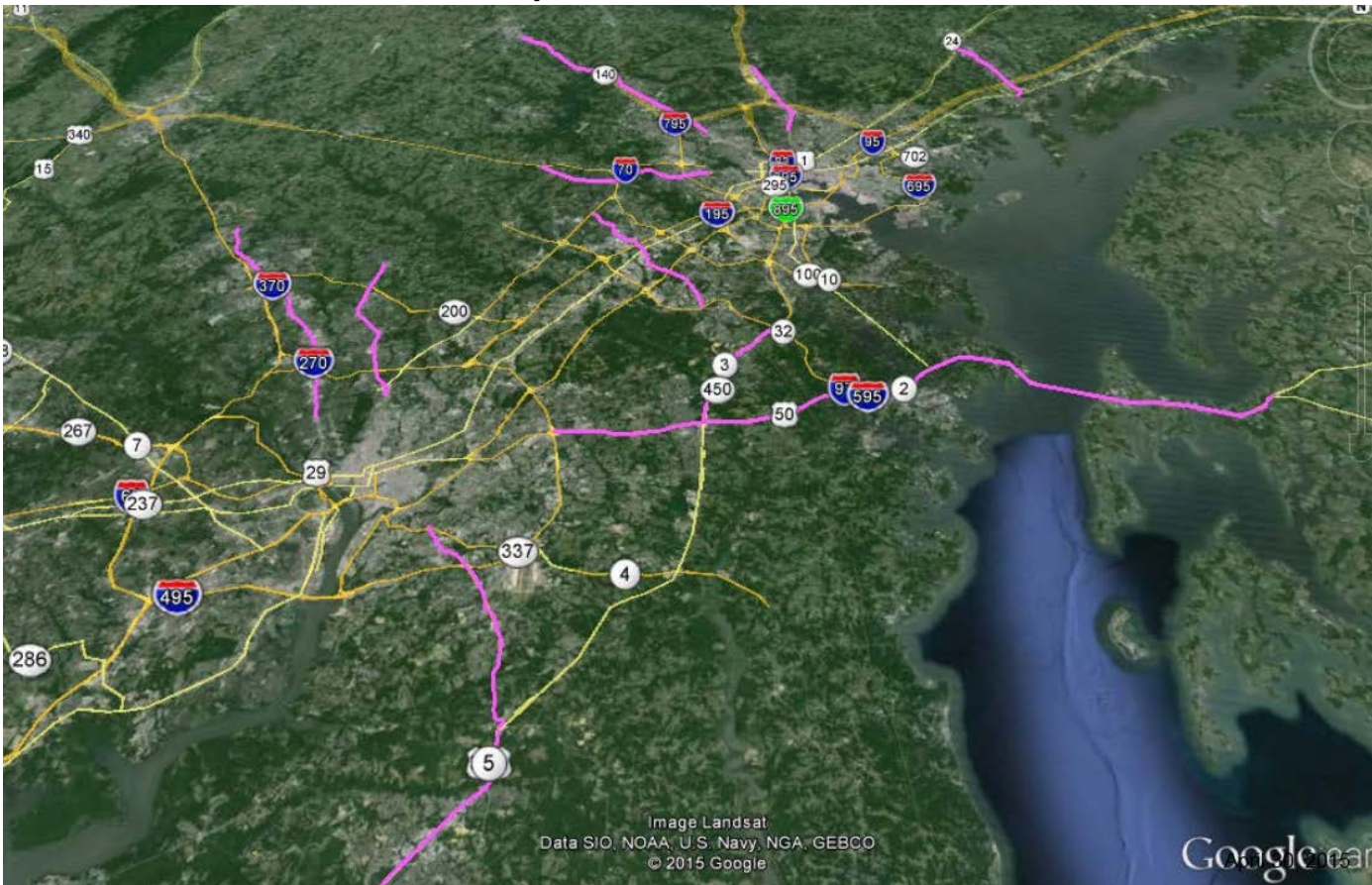
- Three data providers—“Marketplace” for
 - HERE
 - INRIX
 - TomTom



Probe Analytics

What are the challenges?

- Concerns over Quality:
 - non-issue with 3rd parties



What are the challenges?

- Differences in Data Feeds, Formats, Intervals, etc.
 - 1-minute vs. 2-minute vs. 5 or 15-minute backfills
 - Uncapped vs. Speed limit caps
 - Not all TMC Segments are the same
 - Sub-segments are reported differently
 - Distance variations
 - Format variations (offsets, deviations, etc.)
- Comparison to historic data
 - not all histories are the same (especially if you don't buy it)

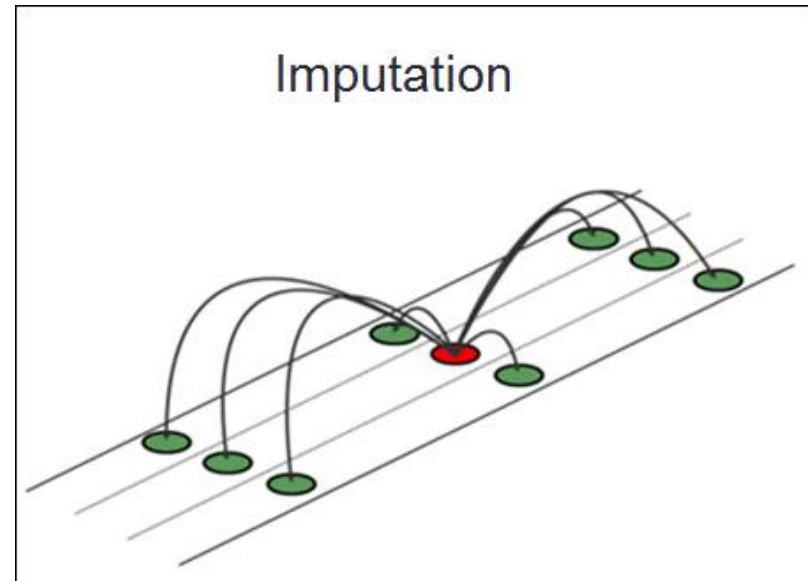
What are the challenges?

- Switching data providers
- Temporal overlap
- Geographic Overlap
 - Averaging
 - “best value” based on performance
 - Intelligent blending
- MPOs that cover multiple states (merging and normalizing)
 - DVRPC
 - MWCOG
 - Etc.
- States that buy from multiple vendors, but don't overlap



What are the challenges?

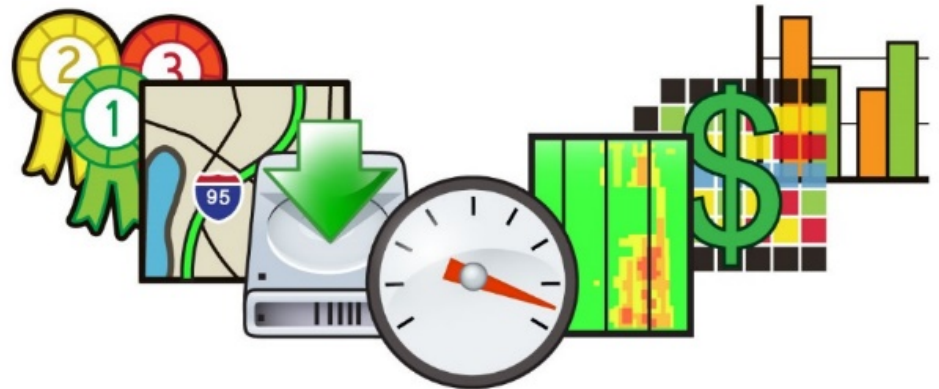
- NPMRDS gaps
 - Ignore?
 - Model?
 - Too many imputation options



- Are we better at imputing, or are the providers?

Opportunities

- More Options
- Comparisons of:
 - HERE
 - INRIX
 - TomTom
 - NPMRDS
 - Bluetooth & Other
- Intelligent Blending (for those who can afford it)
- Growth through sharing of resources, technologies, and data.



Probe Analytics

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