

## *UMD CATT*

# **Bluetooth Traffic Monitoring**

## **Technical Attributes and Application Potential**

Using New Technologies for Travel  
Speed and O/D Data  
July 1, 2010

7/1/2010

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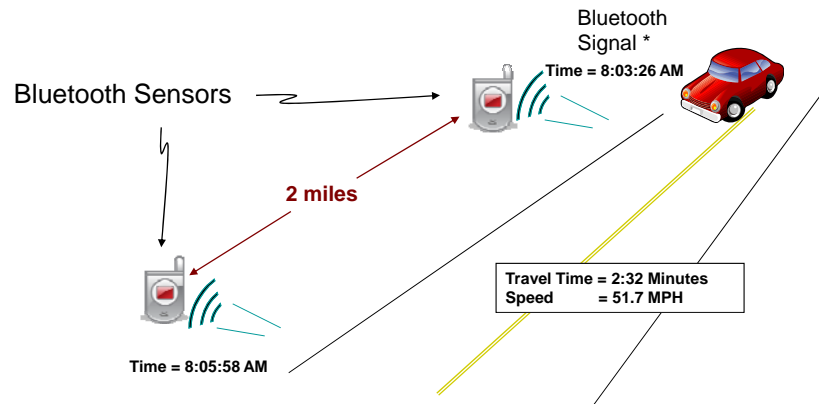
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### **What is Bluetooth?**

- IEEE Wireless Data Communication Standard
  - License Free Spectrum - ~2.4GHz
  - Cable Replacement Technology
  - Ubiquitous – worldwide proliferation
- Where is it found?
  - Cell phones / PDAs / PNDs / MP3 players
  - Laptops / Games / Cameras
- Essential characteristics
  - Three power ranges 100m / 10m / 1m
  - Anonymous ID / Privacy Protection / Voluntary
  - Approximately 1 in 20 sampling rate is the US

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### Bluetooth Traffic Monitoring



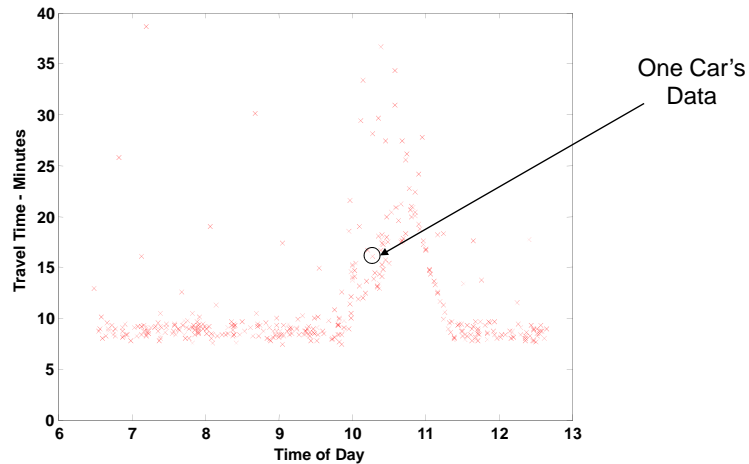
- \* Bluetooth signals come from cell phones, PDAs, laptops, GPS, car radios...
- \*\* Provisional patent received

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### Data from many cars ...



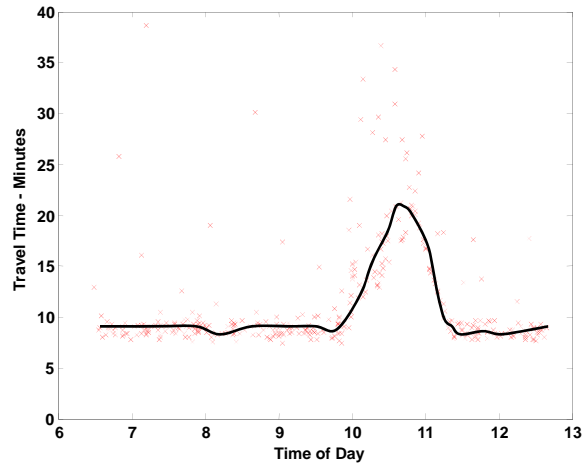
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Actual Travel Time Data from I-95 Northbound on April 2

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### Data from many cars ...



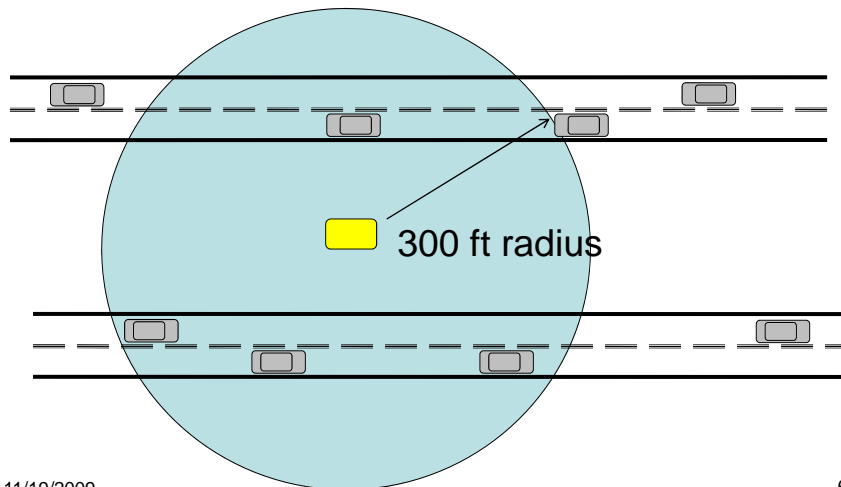
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Actual Travel Time Data from I-95 Northbound on April 2

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### Bluetooth Detection Range



11/19/2009

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### Typical Temporary Deployment



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Conventional  
DetectorsGPS Fleet  
TrackingCell Phone  
GeolocationToll Tag  
Tracking

### Bluetooth Traffic Monitoring Advantages

- ✓ Privacy guarantees
- ✓ Direct Travel Time measurement
- ✓ All roadways at any time of day
- ✓ Flexibility of deployment
- ✓ Validated against ATRs, Toll Tags, and Floating Car
- ✓ Ubiquitous – worldwide proliferation

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### Privacy and Legal Issues

- Bluetooth IDs inherently anonymous
  - No user account information
  - Compliant to IEEE standards
  - No packet sniffing
- Federal Rules and State Legislation
  - FCC anti-eaves dropping rules
  - State legislation against use of personal data

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### Application Potential

- Bluetooth applications:
  - Freeway travel time (VM)
  - Arterial travel time and Performance Measures (M)
  - Traffic signal studies (M)
  - Pedestrian travel time (E)
    - Airports, Evacuation Modeling, Transit
  - O&D studies (R&D)

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### Testing and Demos

- Accuracy against ATRS
- Comparison with Toll Tags
- Use in the I95 Corridor Coalition
- Assessment of signal timing on arterials
- Urban arterials, DC Demo on July 4<sup>th</sup>

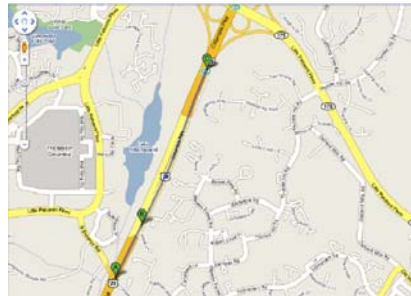
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### Comparison with ATR at US29

- Detection Volumes
- Speed Accuracy



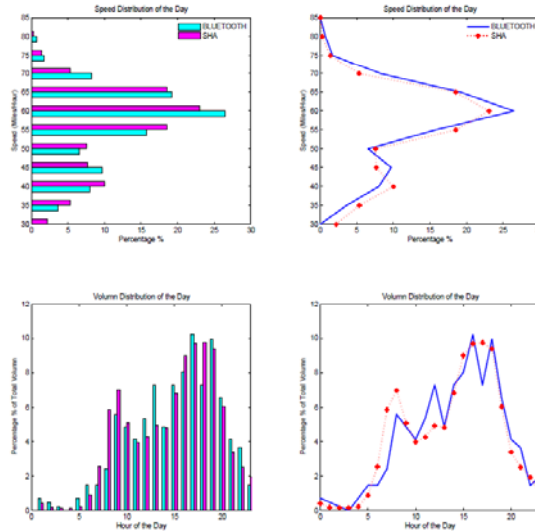
		Segment Detections		Station Detections				ATR Volume
DATE	DAY			A		B		NB
10/25/2009	Sat	835	3.0%	1330	4.9%	2129	7.8%	27411
10/26/2009	Sun	731	2.8%	1181	4.6%	1950	7.6%	25814
10/27/2009	Mon	1127	2.9%	1640	4.2%	2738	7.1%	38607
10/28/2009	Tues	1151	2.8%	1693	4.1%	2895	7.1%	40806
10/29/2009	Wed	1187	2.9%	1783	4.3%	2937	7.1%	41092
Totals		5031	2.90%	7627	4.39%	12649	7.28%	173730

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### Comparison with ATRs



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### Comparison with Toll Tag

- I-80 San Francisco
- 1.41 mile segment between existing toll gantries
- March 10-27<sup>th</sup>

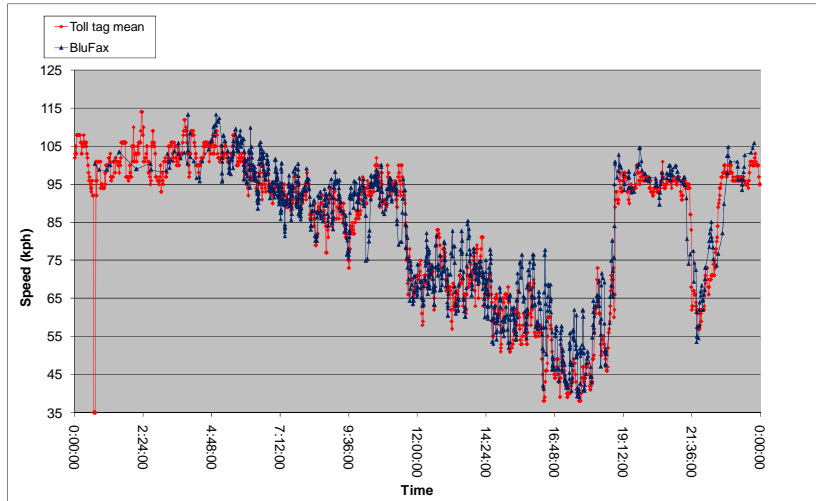


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### Comparison with Toll Tags

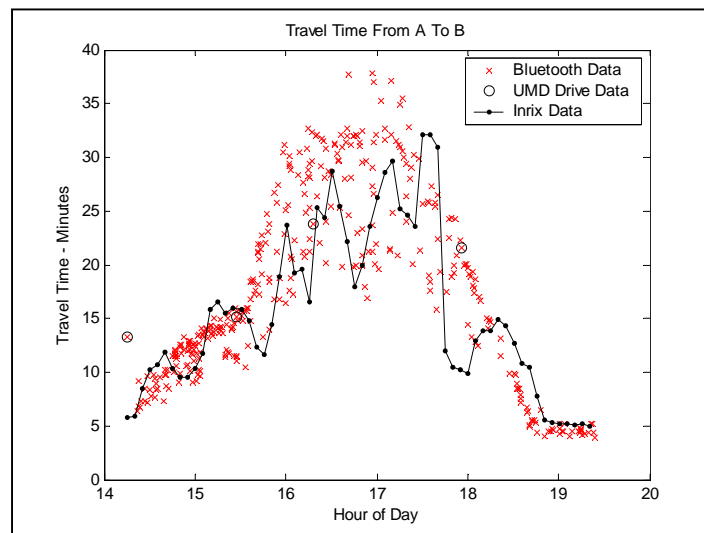


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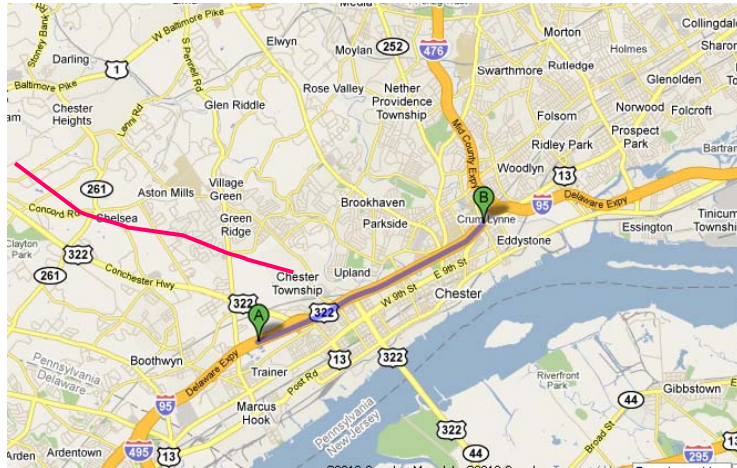
### Sample Data





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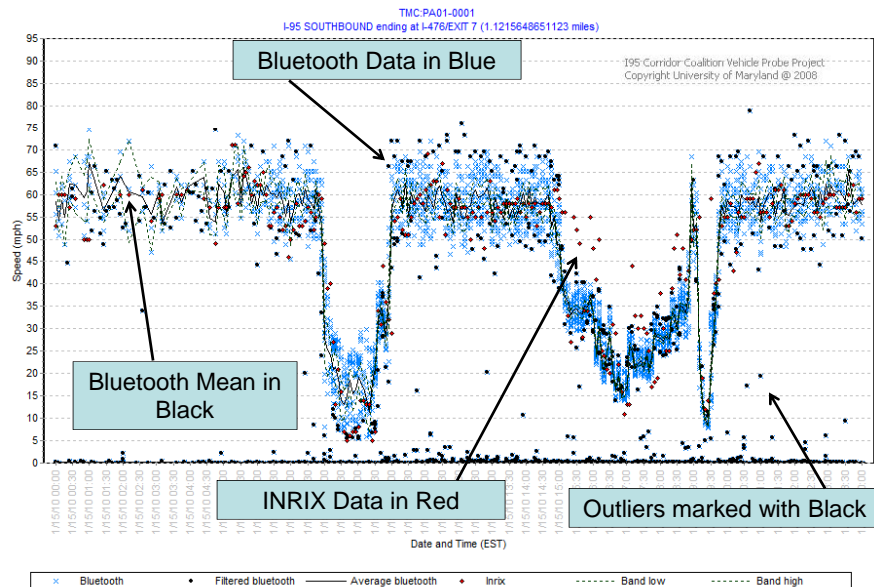
## PA Validation – Jan 2010

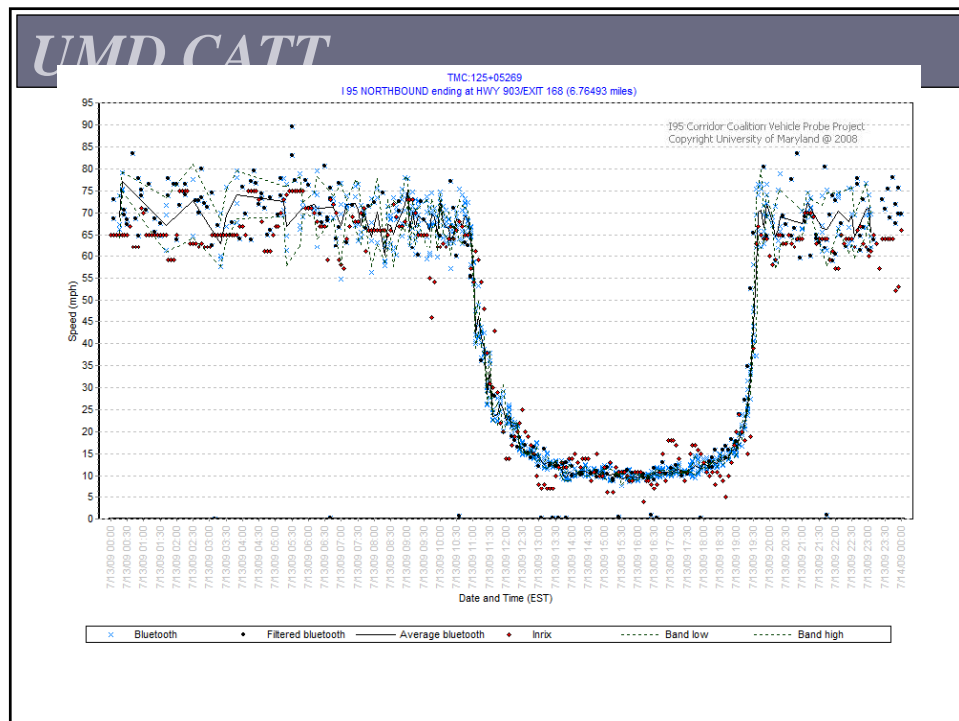
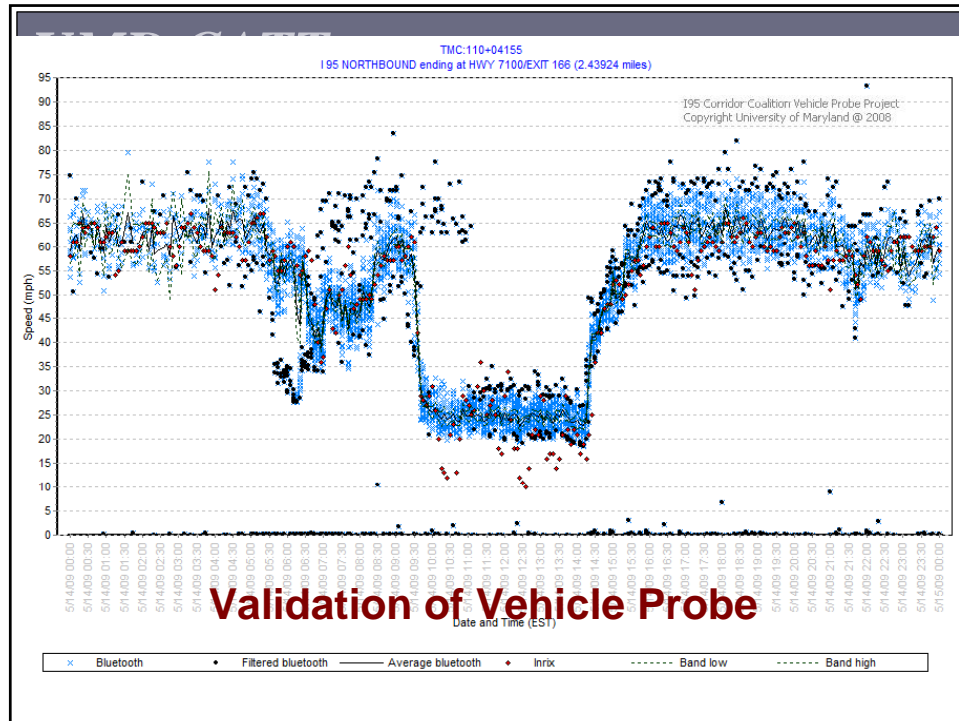


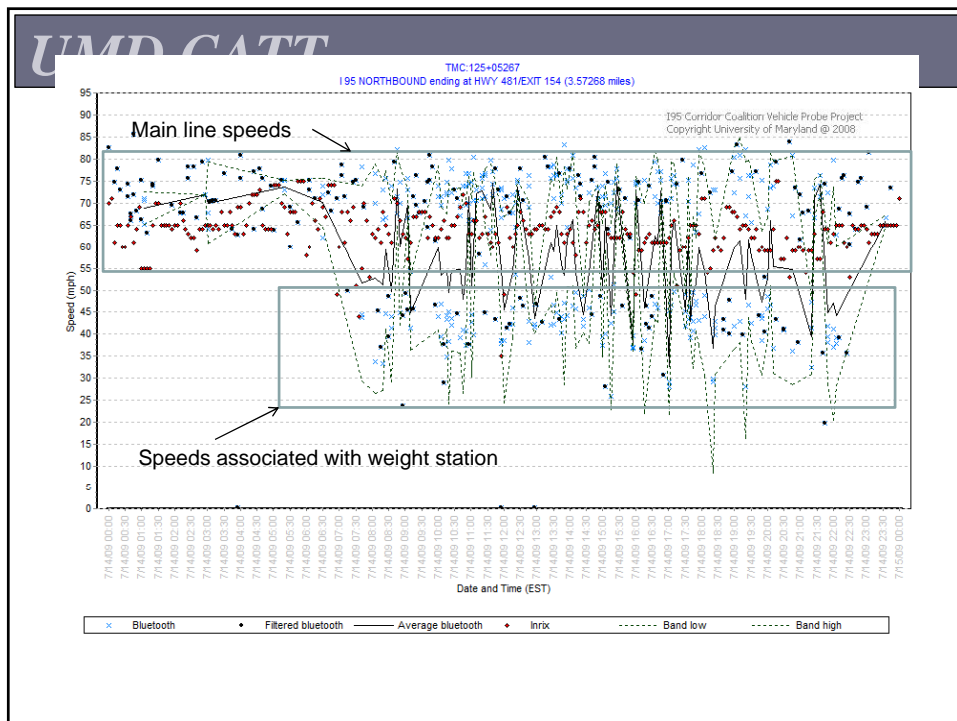
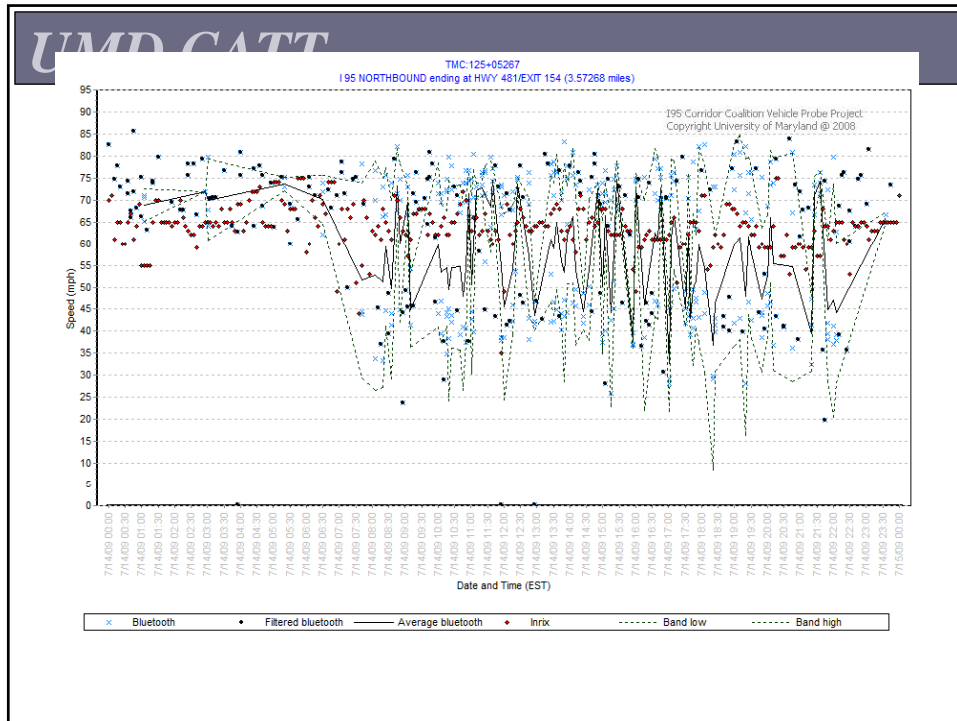
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## PA Validation – Jan 2010



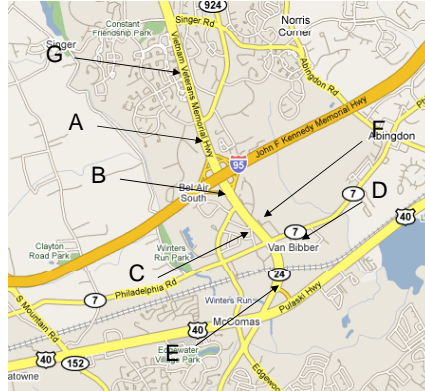




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### Arterial Assessment

- MD24 in Northern Baltimore
- Before/After impact of signal timing
- AM, Mid-day, and PM analysis
- February 23-27, 2009
  - New timing on 2/25/09

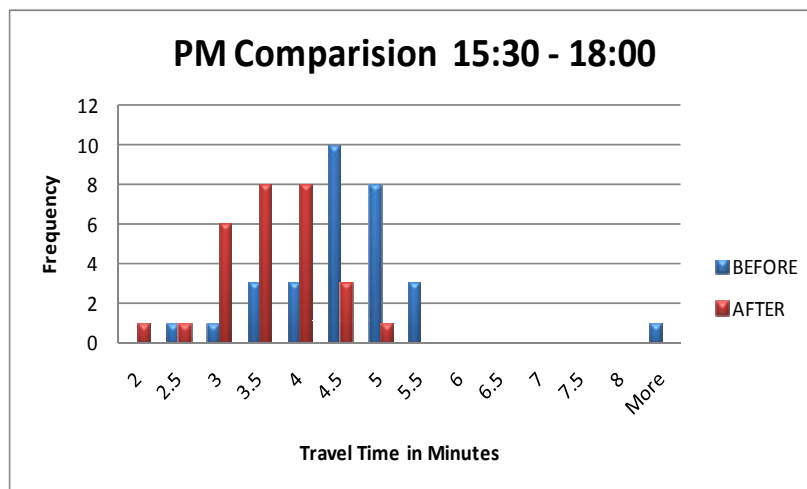


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### Results PM Comparison



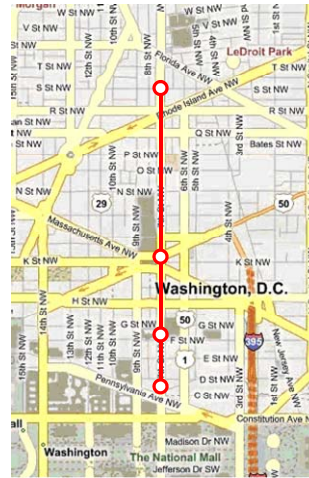
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## Washington DC Demo

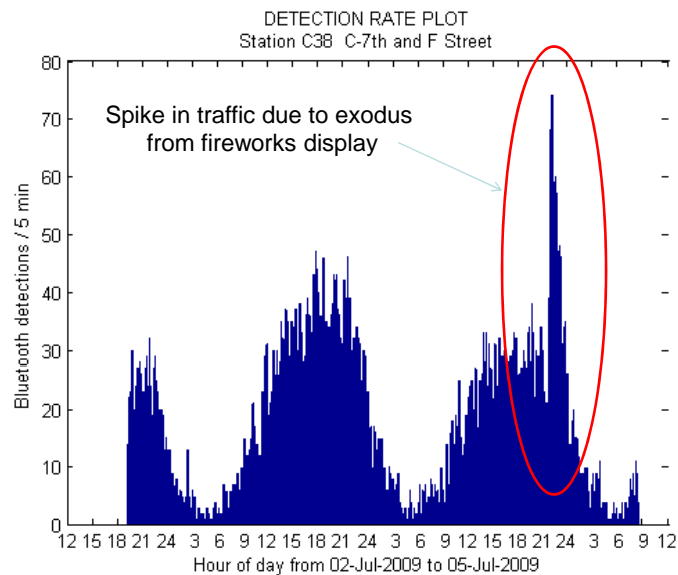
- Sensors placed along Georgia Avenue / 7<sup>th</sup> Street Corridor
  - 7<sup>th</sup> and Indiana Ave
  - 7<sup>th</sup> and F Street
  - 7<sup>th</sup> and K Street
  - 7<sup>th</sup> and S Street
- Data collected from
  - 7PM, Thursday, July 2
  - 7AM, Sunday, July 5



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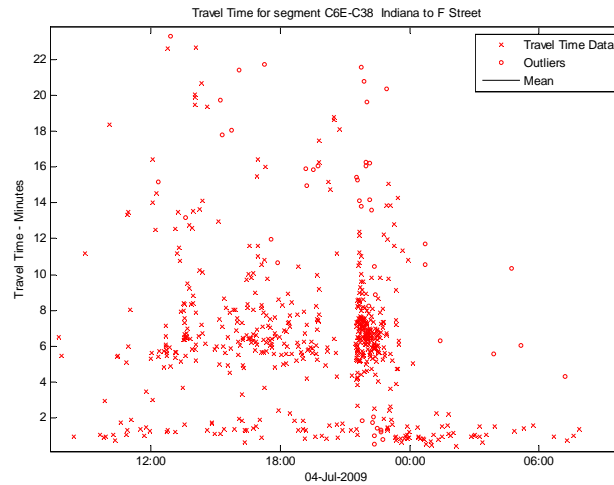


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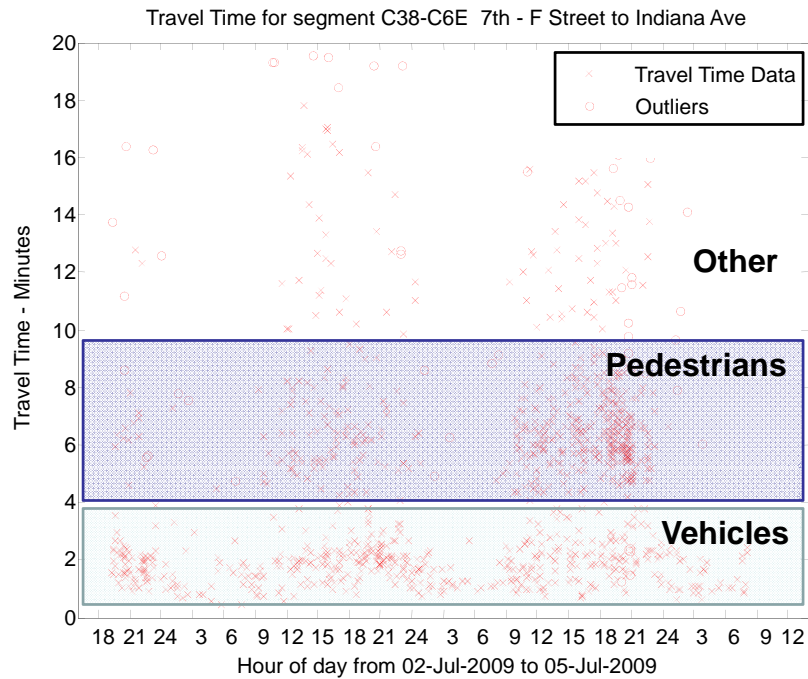
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## DC Travel Time Data



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**Questions?**

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