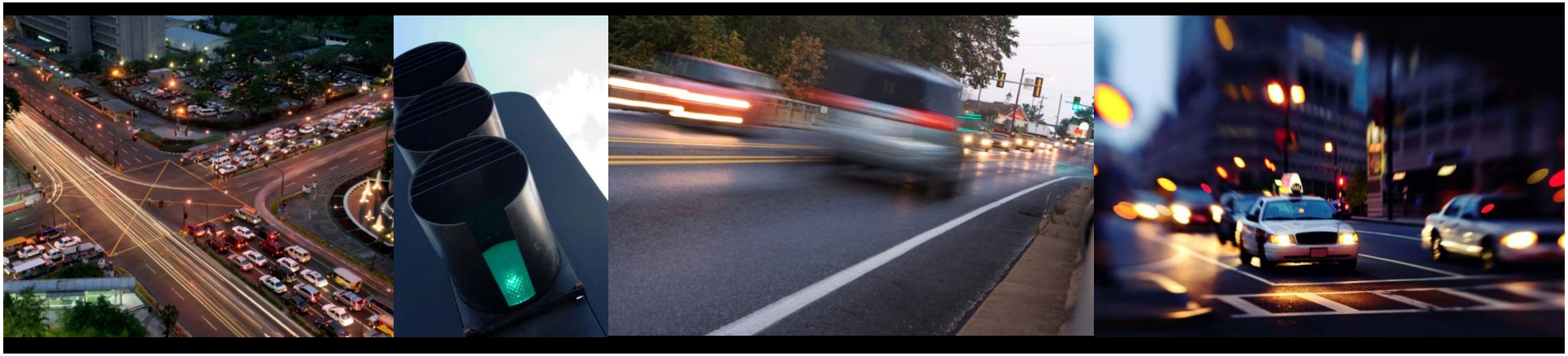


Myriad Urban & Rural Uses of Bluetooth-Derived Travel Times

Adam Lyons

Director of Marketing

Iteris, Inc.

Market for Travel Time Systems

- For metropolitan/urban environments, there is inadequate coverage and data for accurate travel times.
- Vehicle travel times are an excellent and direct measure of traffic flow.
- **Travel Time =**

  Measure of Effectiveness

Source: Skyline Products

Arterial T/T Estimation Issues

Current Travel Time Collection Methods

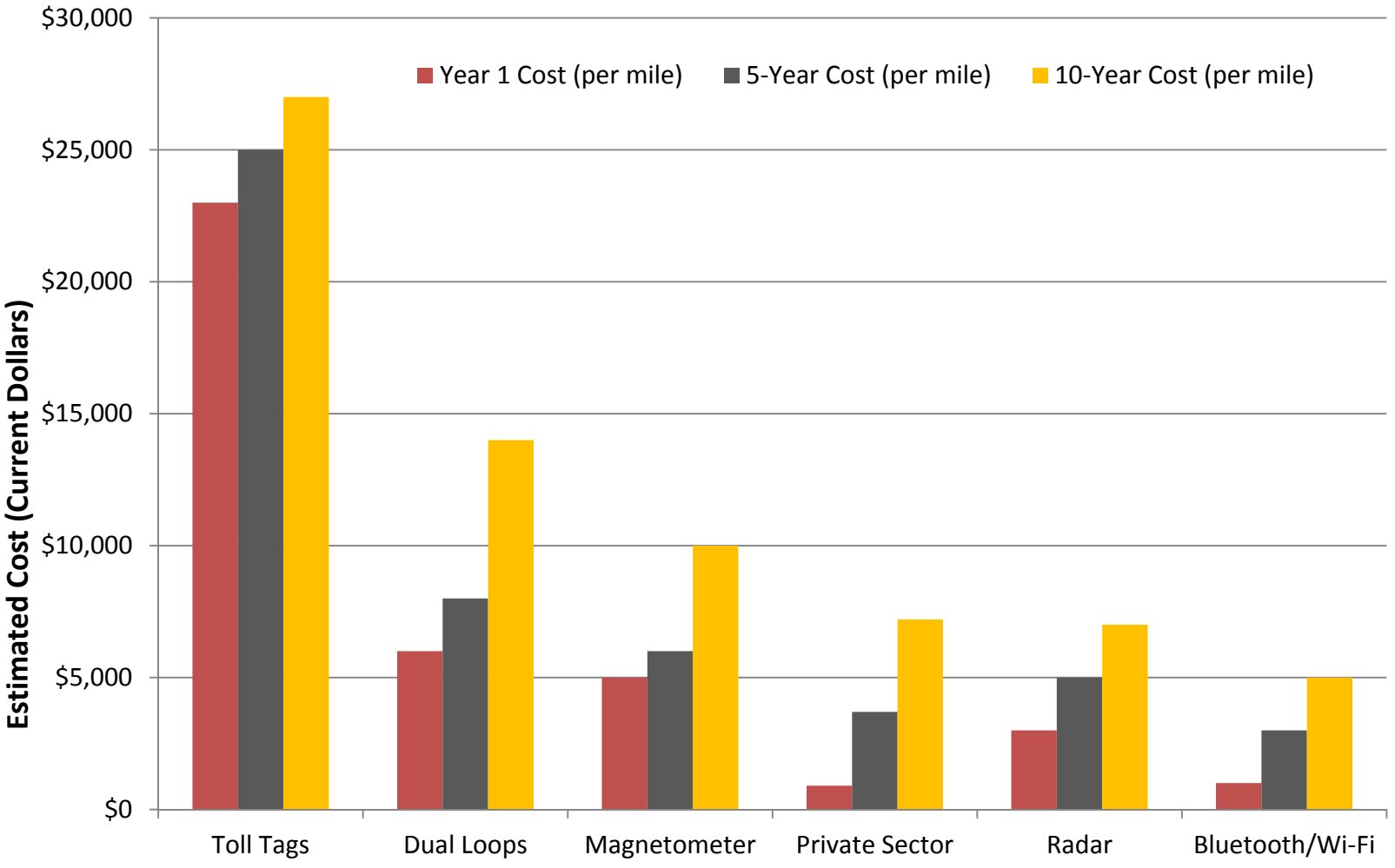
- Floating car runs
  - Temporary studies
  - Typically used for verification of other technologies
- Vehicle probe data
  - Real-time data, highly reliable on freeways
  - Limited coverage on arterials (getting better)
- Toll tags
  - Higher material and maintenance cost
  - Reliable for tollways, limited on arterials
- Radar
  - Spot speeds only, estimates travel time
  - Good traffic volume counter
- Loops
  - Excellent traffic volume counter
  - Higher maintenance cost
  - Long-time use and experience by agencies
- Magnetometer
  - Newer technology
  - Requires in-ground sensors = higher maintenance, limited life

MAC Address Matching Technology

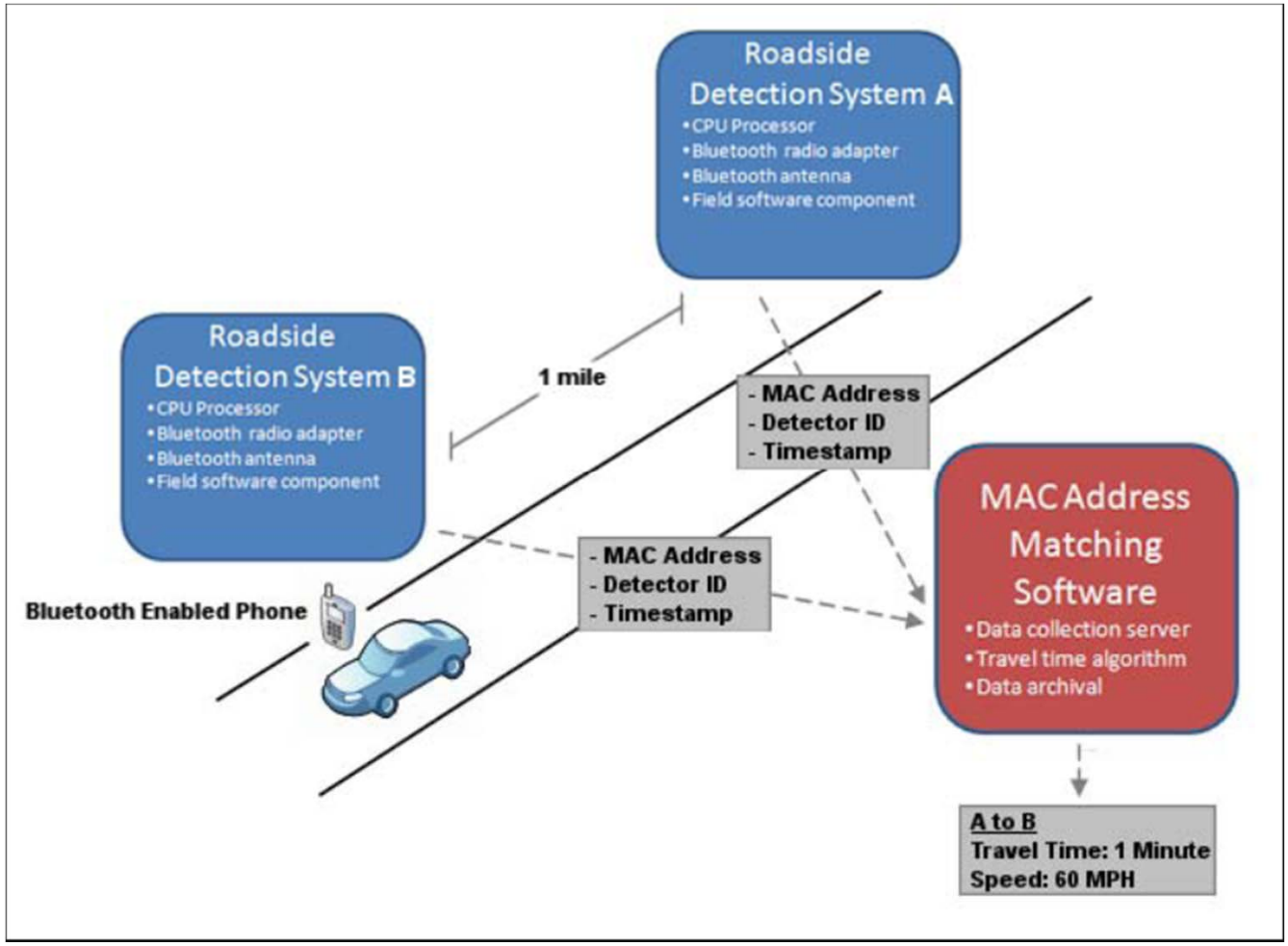
- ***Agencies want a cost-effective travel time system that delivers accurate real-time data***
- Bluetooth (or Wi-Fi) MAC address matching travel time systems provide that by being:
  - Low cost
  - Reliable
  - Accurate
  - Low maintenance
  - Low risk
  - Proven - ***<u>Many</u> studies done around the world verifying data sets, accuracy, and value***

Cost Comparison

Reference: Texas Transportation Institute



Bluetooth/Wi-Fi Technology



Deployment Options

- Existing Cabinets
- POE
- Portable
- AC Powered
- Solar Powered

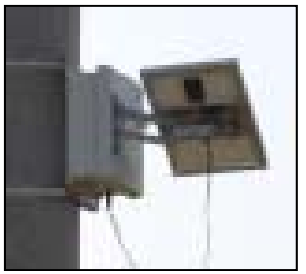
Source: Iteris

Source: Iteris

Source: TTI

Source: Iteris

Source: TrafficCast



Source: DigiWest

Source: TTI

Host Software Considerations

- Host SW uses sophisticated algorithms and filtering methods of the MAC IDs to process matches and calculate speeds and travel times
- Hosted Model
  - Outside hosting performed by vendor
  - Recurring licensing fees
  - Data is outside control of agency
  - Additional monthly or annual fees
- Agency-owned Model
  - Software resides within agency network
  - All data is owned by agency
  - Control over algorithms/filtering choices
  - No recurring fees

Typical Equipment Costing

	Equipment Cost	Maintenance Cost
Solar Unit	$5k - $7k	High
AC/POE Standalone Unit	$4k - $5k	Some
Rental Unit	$700 - $1000 per week per field unit	High
In-Cabinet Unit	$3.5k - $4k	None
	Equipment Cost	**Maintenance Cost**
Hosted Software	Initial Integration Fees	$100 - $700 per month per field unit
Agency Owned Software	None if agency supplies server	None

Note: not including any cell phone service if required – est. $60/month/unit

Bluetooth or Wi-Fi?

- Bluetooth
  - Continually *scans* for devices in proximity
  - Fast "grab" of MAC address, useful at all speeds
  - Very high re-identification rate – 90% and up

- Wi-Fi
  - Continually *listens* for devices in proximity
  - Field units act as a hotspot
  - Slower "grab" of MAC address
  - Results have shown that the re-identification rate of Wi-Fi devices is much lower than BT (~1/10TH)

Bluetooth or Wi-Fi?

Bluetooth

- 3-20% of volume includes Bluetooth-enabled devices
  - Mostly in-vehicle systems
- Bluetooth is a proven data set
- Bluetooth and Wi-Fi provide virtually identical travel time patterns in free flow conditions

Wi-Fi

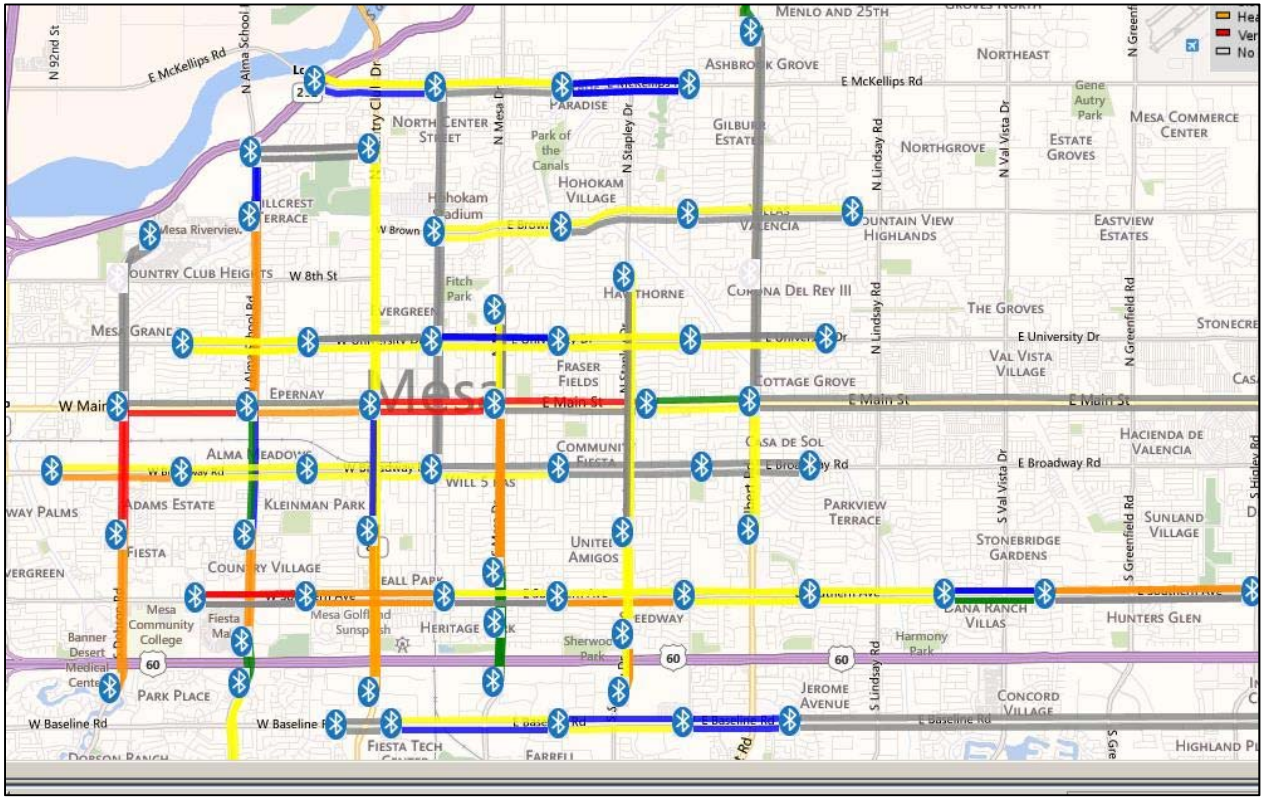
- Could be as much as 10X more reads at a given field unit
  - Mostly cell phones
- More reads can provide more robust O/D data
- Only useful when the traffic has the opportunity to slow or stop

What are we going to do with all this data?

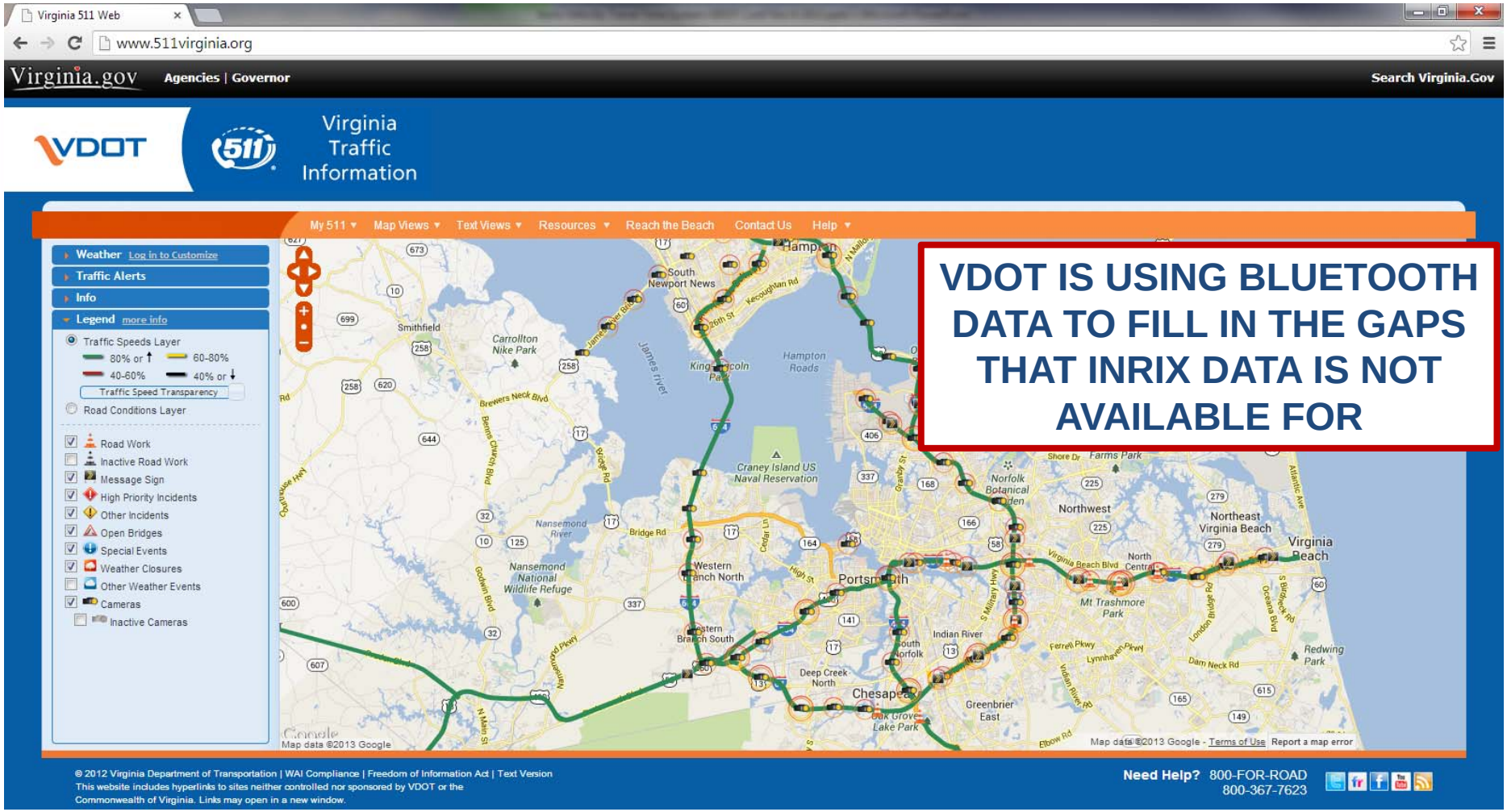
1. Congestion Mapping & 511
2. Smart Work Zones
3. Origin-Destination Information
4. Populating Dynamic Message Signs
5. Rural Applications
6. ATMS Integration
7. Performance Measurement/Operations

Congestion Mapping

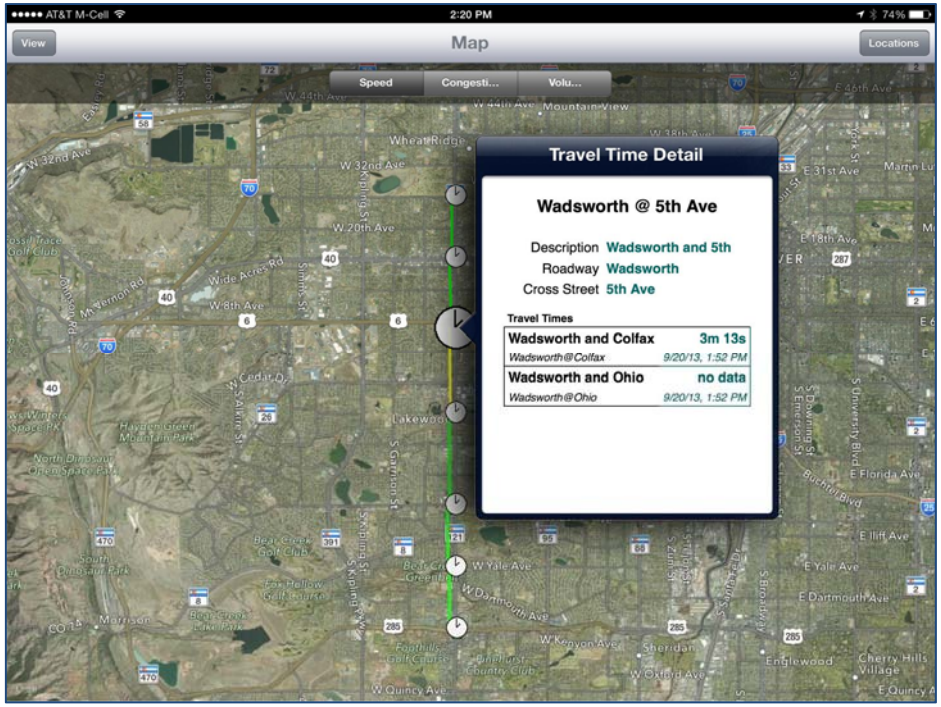
- Situational awareness

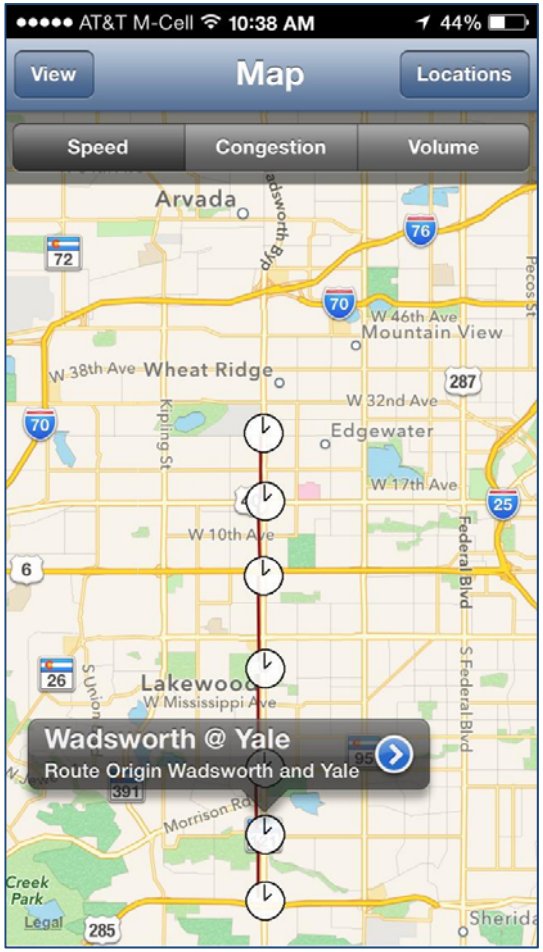


Applications – Virginia DOT



Apps


AT&T M-Cell
2:20 PM
74%
View
Map
Locations
Speed
Congesti...
Volu...
Travel Time Detail
Wadsworth @ 5th Ave
Description Wadsworth and 5th
Roadway Wadsworth
Cross Street 5th Ave
Travel Times
Wadsworth and Colfax 3m 13s
Wadsworth@Colfax 9/20/13, 1:52 PM
Wadsworth and Ohio no data
Wadsworth@Ohio 9/20/13, 1:52 PM


AT&T M-Cell
10:38 AM
44%
View
Map
Locations
Speed
Congestion
Volume
Arvada
Wheat Ridge
Edgewater
Lakewood
Mountain View
Wadsworth @ Yale
Route Origin Wadsworth and Yale

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Smart Work Zones

- Utilizing technology to inform drivers about upcoming work zone information
- Portable CMS
- Variable Speed Limit Signs
- Phone Apps

Source: Google Images

Source: Google Images

Smart Work Zones

- IH-35 Mobility Program
  - Run by TTI
- Bluetooth Sensors
- Real-time Website Data
- Portable CMS

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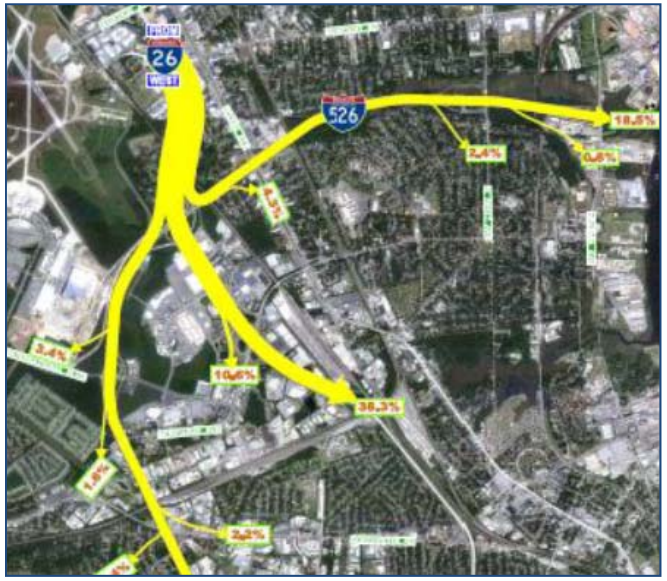
Origin-Destination

- Much lower cost than ALPR
- Useful for planners and transportation engineers
- Determine traffic patterns
- O/D Matrix Generation
- Analyze preferred routes through a network

INTERSTATE LINK ORIGIN	I-26 West of Ashley Phosphate	Aviation Avenue	Remount Road	Montague Avenue (@ I-26)	I-26 East of Montague Avenue	I-526 East of Virginia Avenue
I-26 West of Ashley Phosphate				15.9%	36.7%	15.5%
Aviation Avenue	56.4%			6.4%	17.0%	5.3%
Remount Road	56.4%			6.4%	17.0%	5.3%
Montague Avenue (@ I-26)	46.1%	4.8%	5.6%		32.3%	2.8%
I-26 East of Montague Avenue	67.0%	6.8%	7.9%			3.5%
I-526 East of Virginia Avenue	42.1%	1.2%	1.4%	3.0%	7.0%	
Virginia Avenue	42.1%	1.2%	1.4%	3.0%	7.0%	
Rhett Avenue	16.4%	0.4%	0.5%	1.8%	3.8%	59.4%



Source: Stantec

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Freeway Dynamic Message Signs (DMS)

Source: Iteris

Source: TransCore

Source: Skyline Products

Source: Google Images

Arterial DMS

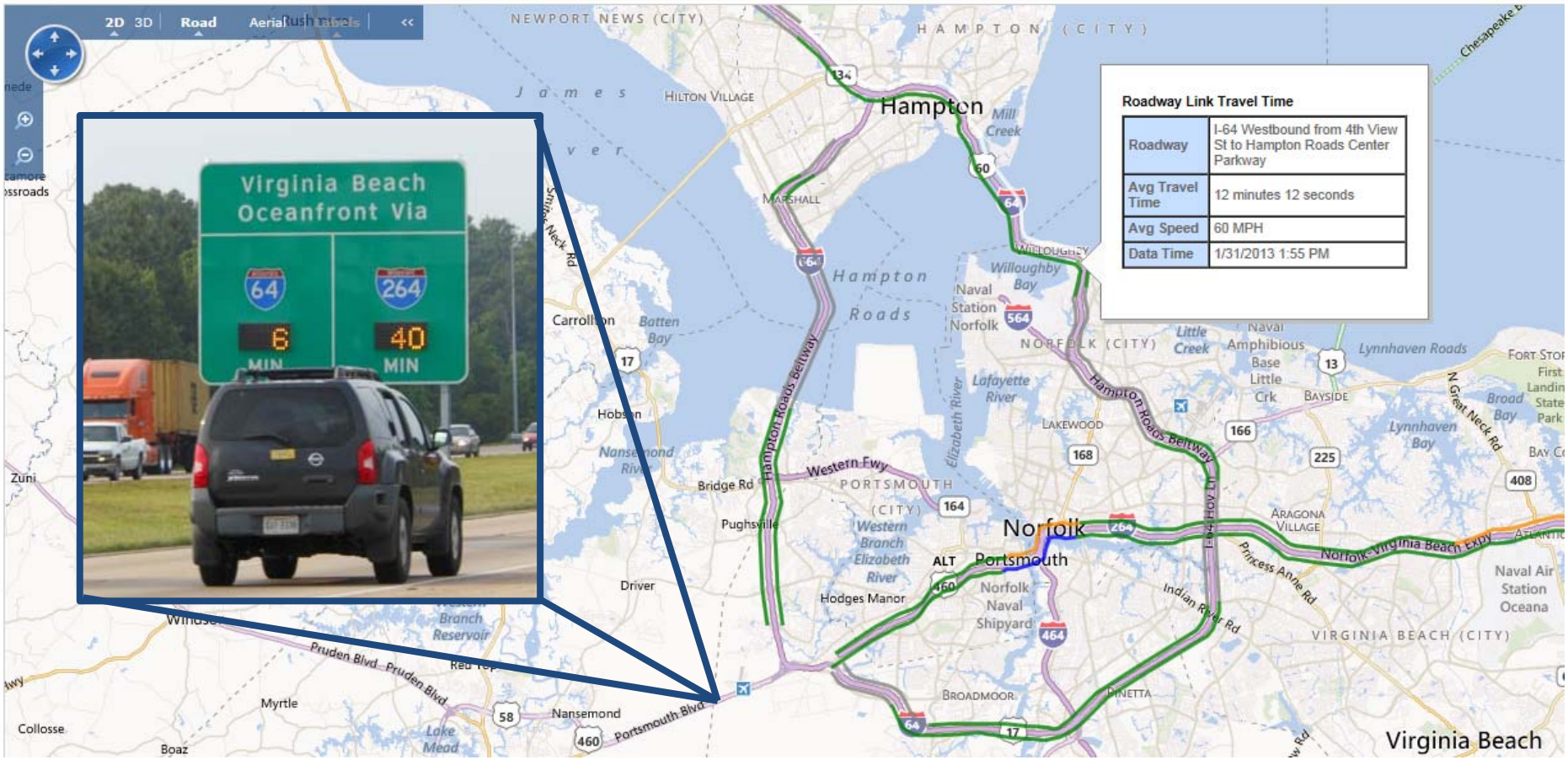
Source: Skyline Products

Source: Google Images

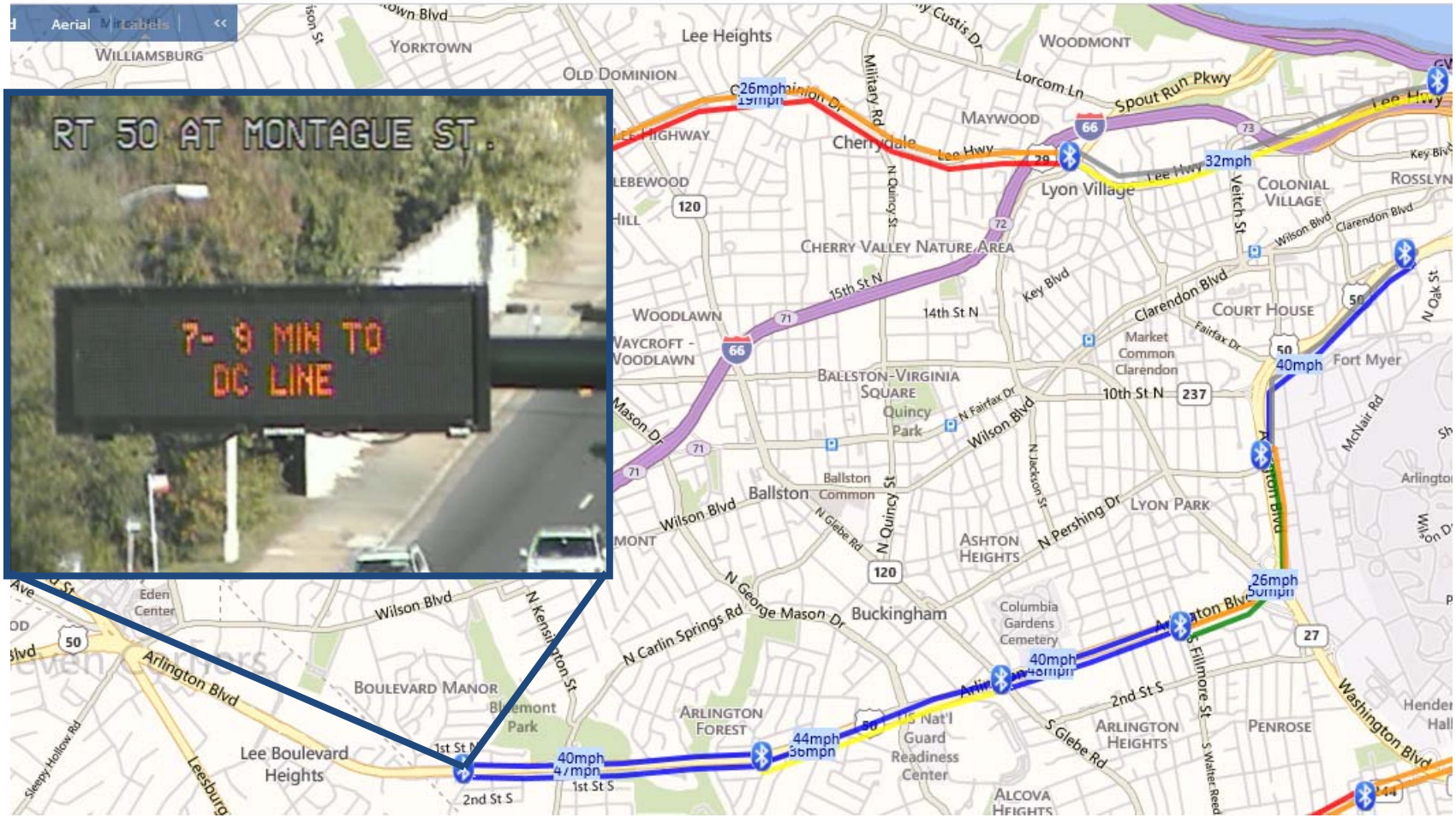
Source: Google Images

Source: Google Images

Virginia DOT Example



Arlington County, VA Example



Source: Iteris

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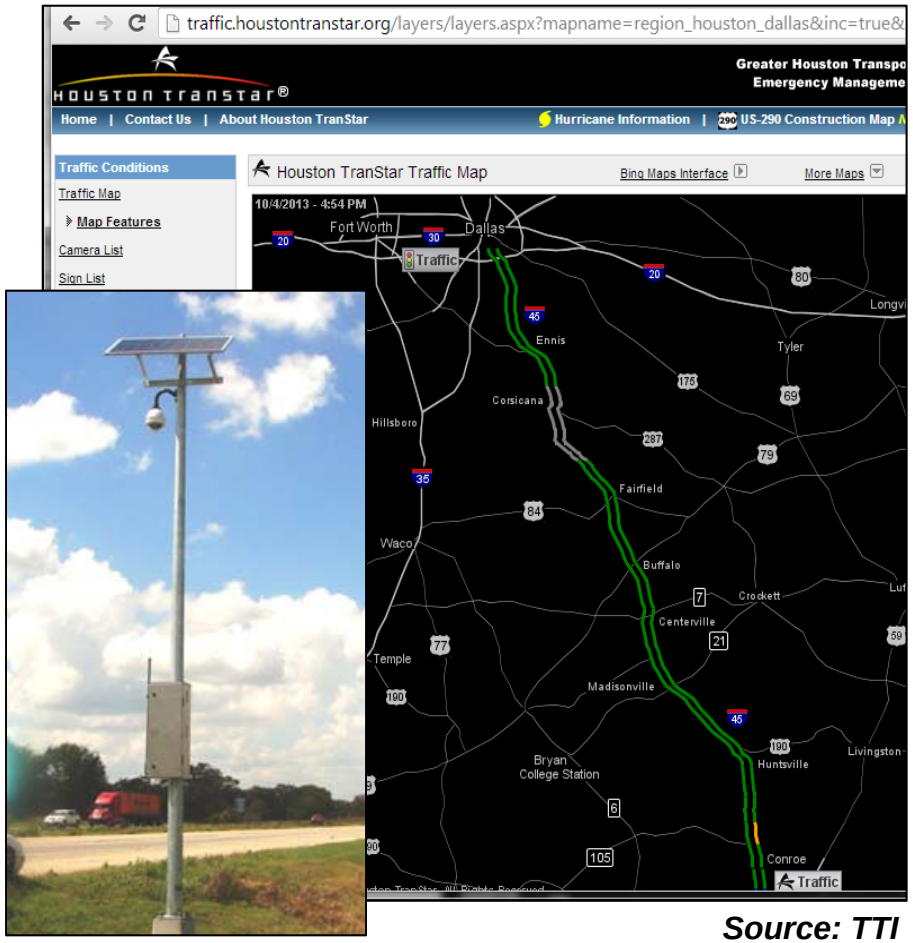
Rural Applications for Bluetooth

- Very cost effective solution for rural highways
  - Low maintenance
  - Solar powered
- Excellent capture rate, even at high speeds
- 5-10 miles spacing recommended
  - Greater spacing can be used



Source: TTI

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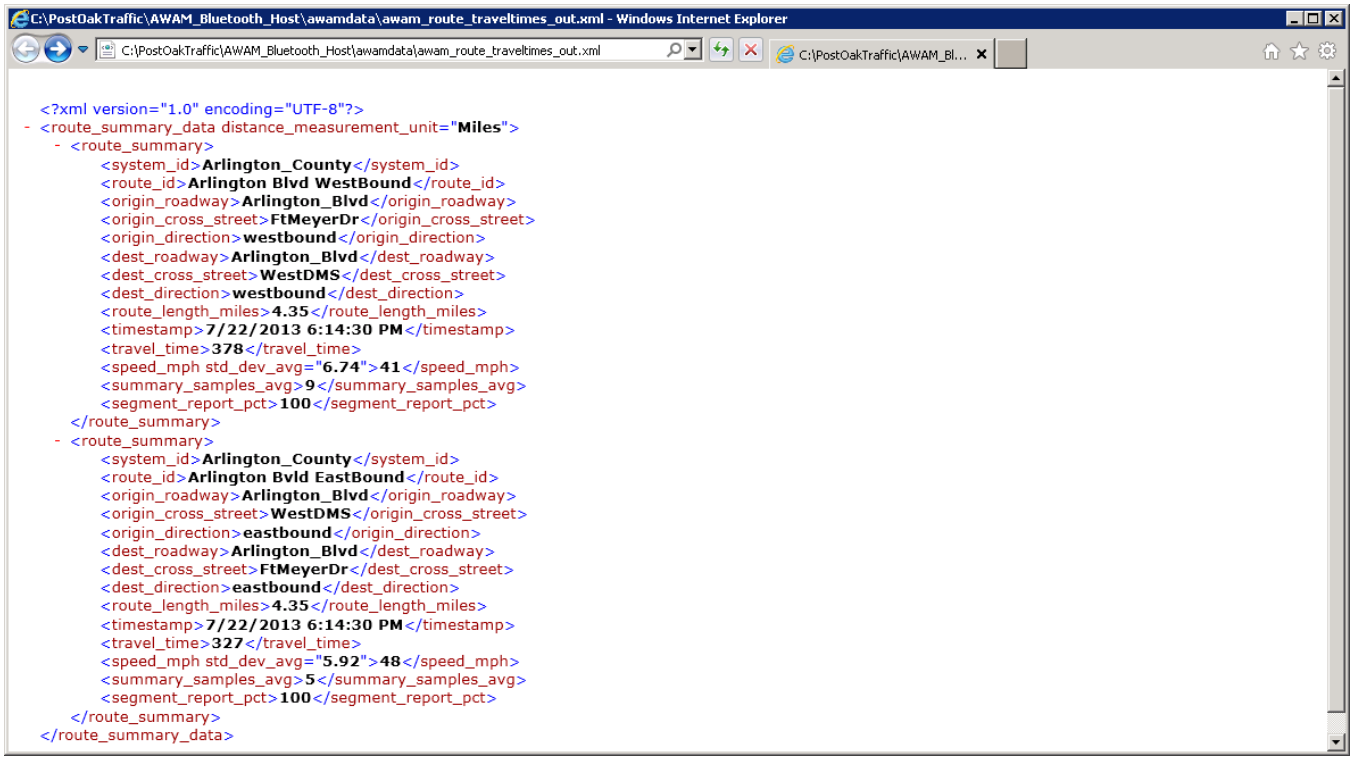
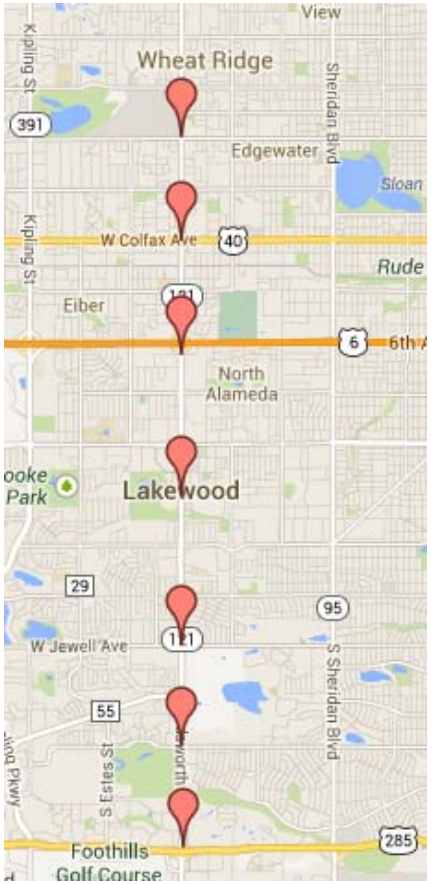
ATMS Integration

- Typically utilize an XML output that external programs can extract data sets from

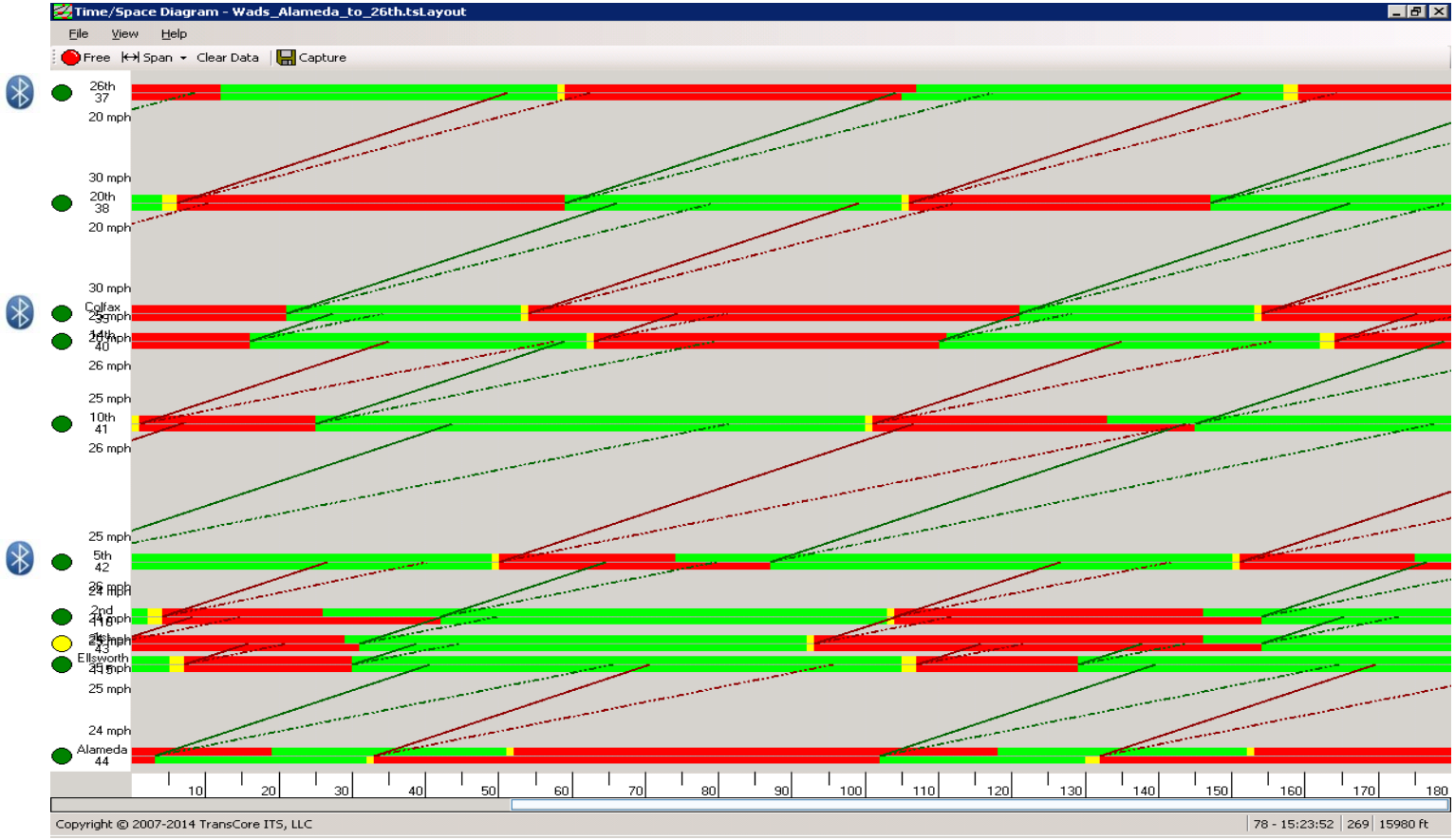


City of Lakewood, CO Example

- Data integrated into TransSuite
  - Output of travel times on congestion map
  - Incorporate into corridor travel times for distribution
  - Mobile apps for travel time and congestion data display
  - Overlaying data on time-space diagram



Time-space diagram



Solid line is design speed Dash line is actual speed from Bluetooth data

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Performance Measurement/Operations

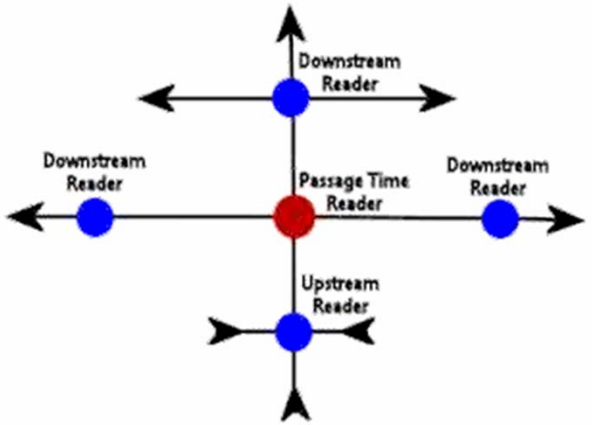
- Performance Measures
  - MAP-21
  - Travel Time Reliability
  - Aging of timing plans
  - Trigger for Adaptive signal parameter review
  - Validation of re-timing efforts
- Reviewing historical data for trends to perform before/after studies

U.S. Department of Transportation

Federal Highway Administration

Other Applications

- Intersection Delay Calculations
  - Duration Data or Passage Time
  - Analyze time that devices are moving through a particular intersection to estimate delay
  - Evaluate delay for different turning movements



Summary

- Many Operational Use Applications
- Non-Intrusive Deployments
- Low Maintenance
- High Accuracy
- Proven Technology
- Lower Cost

Questions?

Contact Information

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