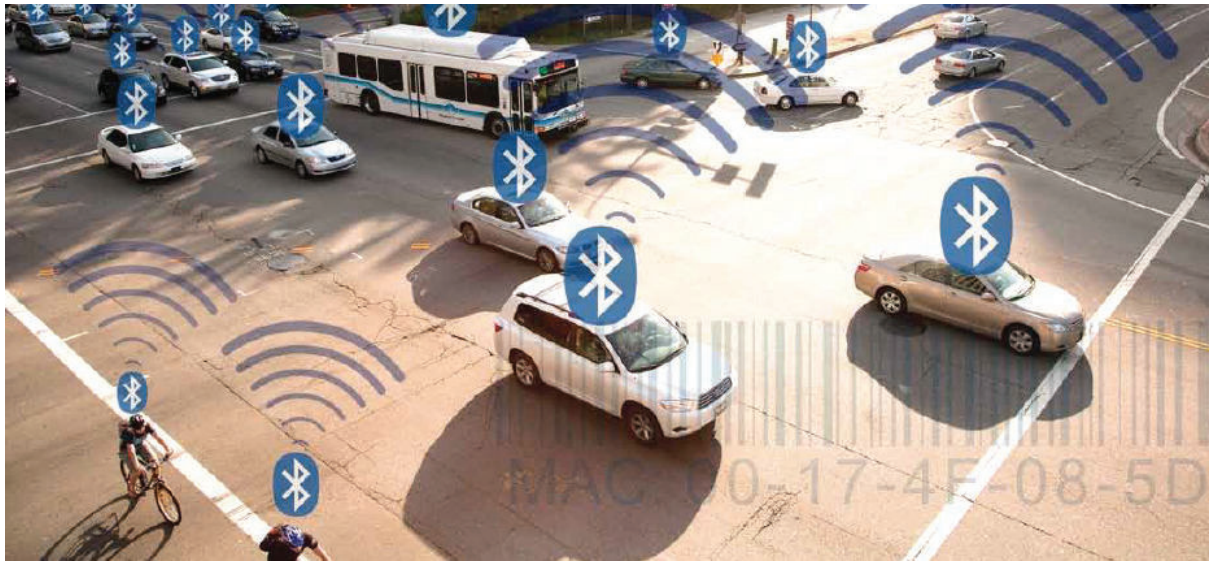

Arterial Travel Time Systems Using Bluetooth Data

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MAP-21 – Moving Ahead for Progress in the 21st Century

- July 2012
- Establishes a **performance based** program
- Program Goals
  - Improve safety
  - Maintain infrastructure conditions
  - Reduce congestion
  - Improve efficiency
- Measures of Effectiveness (MOEs)
  - **DATA!**
- Performance Measurement

U.S. Department of Transportation
Federal Highway Administration

Market for Arterial Travel Time Systems

- Major metropolitan areas are struggling with increasing traffic and a demand for information.
- 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**

Arterial T/T Estimation Issues

- Traffic signals
- Mounting or housing locations for equipment
- Smaller sample sizes
- More vehicles diverting out of study zone
- More vehicles making brief detours or stops

Current Arterial T/T 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)
  - Designed for large scale integration
- Toll tags
  - High material cost, high maintenance cost
  - Reliable for tollways, limited on arterials

Current Arterial T/T Collection Methods

- Radar
  - Spot speeds only, estimates travel time
  - Good traffic volume counter

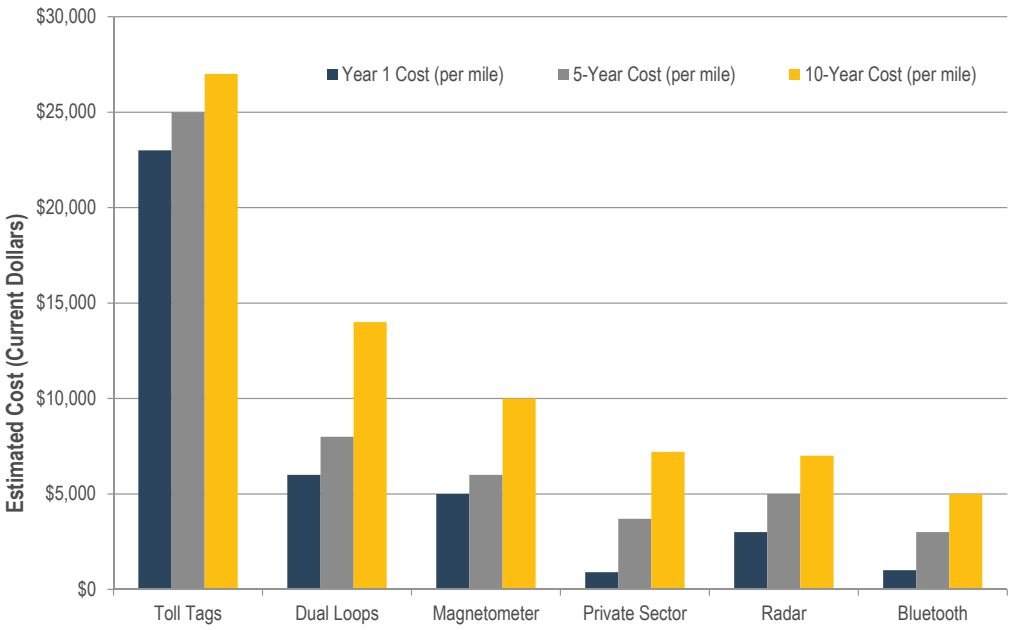
- Loops
  - Excellent traffic volume counter
  - Higher maintenance cost
  - Long-time use and experience by agencies

- Magnetometer
  - Newer technology
  - Requires in-ground sensors = higher maintenance, limited life

Bluetooth Technology

- ***Agencies want a cost-effective travel time system that delivers accurate real-time data***
- Bluetooth travel time systems can 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***

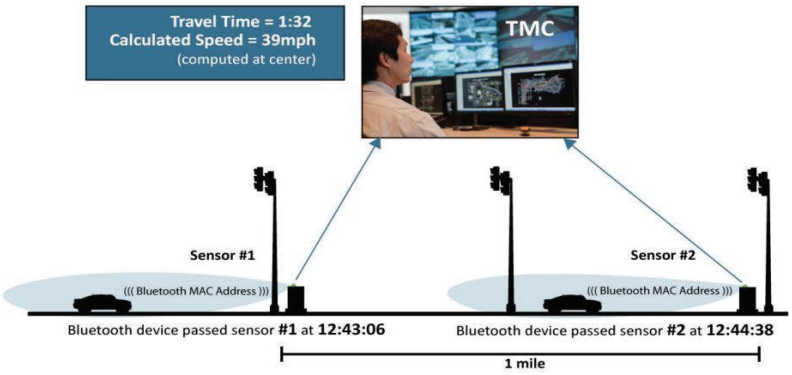
Cost Comparison



Reference: Texas Transportation Institute

How it Works

- The systems anonymously track the Bluetooth ID of passing devices (vehicles, phones, tablets, etc.) and compares the time of these ID's from one known location to another



Field Unit Deployment Considerations

- **AC Standalone Enclosure**
  - Uses local AC power from cabinet or pole
  - Additional installation costs, mounting considerations

Field Unit Deployment Considerations

- **Solar Powered**
  - Completely standalone
  - Higher cost, high maintenance
  - Mounting issues

Field Unit Deployment Considerations

- **Install in Traffic Cabinet**
  - Non-intrusive, low cost, low maintenance
  - Shelf-mount or detector card rack options

Field Unit Deployment Considerations

- **Portable Units**
  - Rental systems, popular
  - One-time use
  - Temporary Studies

Bluetooth Data – Is there enough?

- Current analysis shows 3-10% of actual volume includes Bluetooth-enabled devices
  - Urban vs. Rural
  - Day vs. Night and Rush-Hour
  - Demographics – Bay Area vs. Wichita
- General rule-of-thumb:
  - 3 matched pairs every 15 minutes is acceptable
- Well-placed sensors should provide a four-percent detection rate for roadways of 36,000 AADT or more
  - *Based on research conducted by the University of Maryland*

Data Sets

- *"From statistical theory…a two percent match rate on a roadway of 100,000 AADT would provide more than enough hits to accurately generate mean travel times in five-minute intervals; two percent of 100,000 AADT is a very large number of probes."*

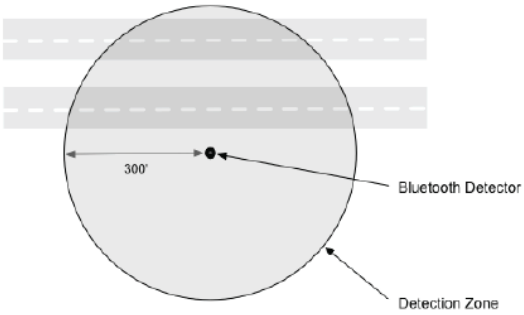
  – Stan Young, University of Maryland

Bluetooth Technology Development

- Two different methodologies of collecting MAC addresses
- Synchronous I/O
  - Limited number of reads (only 8 in a 10 sec. scan)
  - Batch scanning and batch processing – grouping reads with the same timestamp
- Asynchronous I/O
  - Real-time read of a MAC Address that is immediately time stamped and sent for processing
  - Enables more MAC Address reads
  - Enables for more MAC Address matches

Antenna

- 2.4 GHz band
- Omni-Directional
  - Circular range of detection
  - Typically 300 feet or less radius
- Uni-Directional
  - Positioned antenna for spot location
- Attachment options
  - Pole, mast arm, control cabinet



Host Software Considerations

- Host SW that uses sophisticated algorithms and filtering methods of the Bluetooth IDs 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

Host Software Output

- Typically, a web-based GUI that provides output and graphics for:
  - MAC address reads
  - Travel time matches
  - Match sample rates
  - Tabular report, by road segment and overall
  - Origin-Destination Matrix
  - Field Unit Uptime/Performance
  - Congestion Map

- Data export to CSV and XML
- Integration to ATMS systems is becoming popular

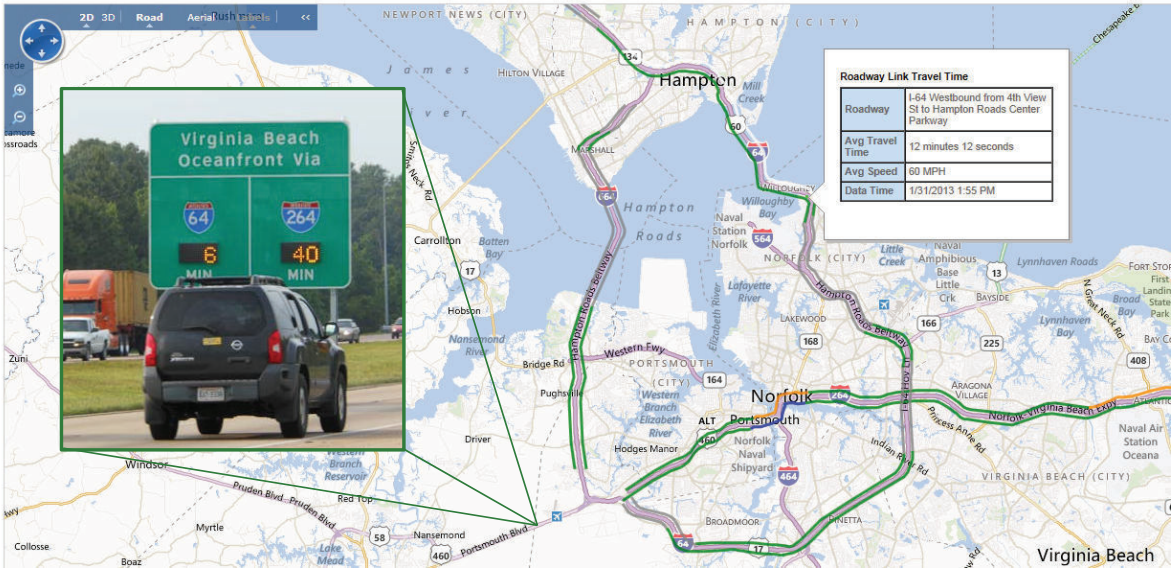
Privacy

- MAC addresses read by the field units are not directly associated with a specific user
- MAC addresses do not contain any personal data or information that could be used to identify or "track" an individual's whereabouts.
- Some agencies have required that all MAC addresses collected in the field be anonymized through **encryption** immediately upon receipt in the field process

Applications

1. Congestion Mapping
2. Providing travel times for real-time traffic information
3. Populating Dynamic Message Signs (DMS)
4. Origin-Destination Information
5. Providing alternate route information
6. Measuring the impact of construction projects
   - *Smart Work Zones*
7. Triggering or prioritizing re-timing of traffic signals
8. To update local area travel demand models

Congestion Map



Other Features to Consider

- Field Unit Uptime Performance
  - Charting the heartbeat message from a field unit to determine uptime percentage
  - Can assist with network engineering
- Automatic Field Unit Outage Notification
  - Heartbeat message from field unit to software
  - E-mail or SMS
- XML output to third-party systems for website, apps, DMS display etc.

Benefits of Bluetooth for Travel Time

- Non-Intrusive Deployments
- Low Maintenance
- High Accuracy
- Proven Technology
- Simple Integration
- Low Risk
- Lower Cost

Questions and Comments

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