Measuring Crossing Times of Passenger Vehicles Using Bluetooth Technology at U.S.-Mexico Border

CITY OF EL PASO – CIUDAD JUAREZ
CROSS BORDER MOBILITY MEETING

CITY HALL, SEPTEMBER 22 2008
Agenda

- Introduction to Bluetooth Technology.
- Compare Bluetooth Technology with Radio Frequency Identification Technology.
- Proposal for a Pilot Project to Deploy Bluetooth Readers at Ysleta Port of Entry.
Introduction to Bluetooth Technology

- Short range high frequency communication works on license free 2.4 GHz band.
- Widely used to transfer data between mobile and computing devices.
- 20% of all cars will have Bluetooth capability by 2009 and 30% by 2013.
- 2.4 billion devices will be sold by 2013 with Bluetooth capability.
- Bluetooth reader reads signals from any Bluetooth capable device in “discoverable” mode, including cars, headsets, mobile phones.
- Bluetooth reader obtains the unique identification of the signal and time stamp.
- Anybody carrying a Bluetooth enabled device crossing the border could be a “sensor”.

Texas Transportation Institute
# Compare Bluetooth Technology with Radio Frequency Identification Technology

<table>
<thead>
<tr>
<th>Description</th>
<th>RFID</th>
<th>Bluetooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage</td>
<td>Single Direction and Line of Sight</td>
<td>Omni Direction and Doesn’t Need Line of Sight</td>
</tr>
<tr>
<td>Read Distance</td>
<td>Up to 20’</td>
<td>Up to 300’</td>
</tr>
<tr>
<td>Placement</td>
<td>Above the lane</td>
<td>On the side of the road</td>
</tr>
<tr>
<td>Cost per Unit</td>
<td>$5000.00</td>
<td>$500.00 - $1500.00</td>
</tr>
<tr>
<td>Data Received</td>
<td>Small number, requires less cleaning</td>
<td>Large number, requires extensive filtering process</td>
</tr>
<tr>
<td>Market Penetration</td>
<td>As many tags distributed, so small</td>
<td>Mobile phones, head sets and vehicles with Bluetooth capability, so large</td>
</tr>
<tr>
<td>Deployment</td>
<td>Inflexible and costly</td>
<td>Flexible and cheaper</td>
</tr>
</tbody>
</table>
TTI Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time
### TTI Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

<table>
<thead>
<tr>
<th>Port of Entry</th>
<th>Date</th>
<th>Total Passenger Vehicles Entering U.S.</th>
<th>Number of Unique Bluetooth ID (In Mexican Side)</th>
<th>Number of Unique Bluetooth ID (In US Side)</th>
<th>% of Total Entering Passenger Vehicles With Matching Bluetooth ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaragoza</td>
<td>07/29</td>
<td>1184</td>
<td>185 (16%)</td>
<td>77</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>07/30</td>
<td>1219</td>
<td>157 (13%)</td>
<td>76</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>07/31</td>
<td>1086</td>
<td>252 (23%)</td>
<td>78</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>08/01</td>
<td>1154</td>
<td>213 (18%)</td>
<td>95</td>
<td>5%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>08/04</td>
<td>1064</td>
<td>408 (38%)</td>
<td>281</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>08/05</td>
<td>955</td>
<td>211 (22%)</td>
<td>265</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>08/06</td>
<td>940</td>
<td>365 (39%)</td>
<td>250</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>08/07</td>
<td>914</td>
<td>301 (33%)</td>
<td>221</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>08/08</td>
<td>917</td>
<td>386 (42%)</td>
<td>187</td>
<td>6%</td>
</tr>
<tr>
<td>BOTA</td>
<td>08/11</td>
<td>2156</td>
<td>187 (9%)</td>
<td>199</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>08/12</td>
<td>2354</td>
<td>210 (9%)</td>
<td>330</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>08/13</td>
<td>2373</td>
<td>219 (9%)</td>
<td>177</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>08/14</td>
<td>2628</td>
<td>285 (11%)</td>
<td>277</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>08/15</td>
<td>2748</td>
<td>139 (5%)</td>
<td>285</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
TTI Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

Border Crossing Time of Passenger Vehicles
Entering U.S. from Santa Fe POE

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Measured Crossing Time
CBP Reported Crossing Time
Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

Border Crossing Time of Passenger Vehicles Entering U.S. from Ysleta POE

- Measured Crossing Time
- CBP Reported Crossing Time
Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

Border Crossing Time of Passenger Vehicles
Entering U.S. from Bridge of the Americas POE

- Bluetooth Crossing Time
- CBP Reported Crossing Time
Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time
TTI Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

Note: * This sample size represents data collected at Ysleta POE only on 07/29/2008

Total Surveyed = 40

- Have Mobile Phones = 78%
- Don’t Have Mobile Phones = 22%
- Bluetooth Capable = 80%
- Bluetooth Not Capable = 10%
- Bluetooth Disabled = 60%
- Bluetooth Enabled = 40%
- Don’t Know = 10%

25% of total respondents have Bluetooth enabled mobile phones
TTI Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

<table>
<thead>
<tr>
<th>POE</th>
<th>Survey Date</th>
<th>Total Drivers Surveyed</th>
<th>Mobile Phone</th>
<th>Bluetooth Capable</th>
<th>Bluetooth Enabled</th>
<th>Market Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes  No</td>
<td>Yes  No</td>
<td>Enabled  Disabled</td>
<td></td>
</tr>
<tr>
<td>Zaragoza</td>
<td>7/29/2008</td>
<td>40</td>
<td>31  9</td>
<td>25  3</td>
<td>10  16</td>
<td>25%</td>
</tr>
<tr>
<td>Zaragoza</td>
<td>7/30/2008</td>
<td>40</td>
<td>36  4</td>
<td>23  8</td>
<td>9  14</td>
<td>23%</td>
</tr>
<tr>
<td>Zaragoza</td>
<td>7/31/2008</td>
<td>50</td>
<td>44  6</td>
<td>29  14</td>
<td>12  17</td>
<td>24%</td>
</tr>
<tr>
<td>Zaragoza</td>
<td>8/ 1/2008</td>
<td>51</td>
<td>45  6</td>
<td>34  11</td>
<td>15  19</td>
<td>29%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>8/ 4/2008</td>
<td>49</td>
<td>38  11</td>
<td>27  11</td>
<td>13  16</td>
<td>27%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>8/ 5/2008</td>
<td>40</td>
<td>33  7</td>
<td>21  11</td>
<td>12  9</td>
<td>30%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>8/ 6/2008</td>
<td>40</td>
<td>34  6</td>
<td>28  5</td>
<td>16  13</td>
<td>40%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>8/ 7/2008</td>
<td>49</td>
<td>39  10</td>
<td>26  11</td>
<td>13  13</td>
<td>27%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>8/ 8/2008</td>
<td>40</td>
<td>36  4</td>
<td>24  11</td>
<td>9  15</td>
<td>23%</td>
</tr>
<tr>
<td>BOTA</td>
<td>8/11/2008</td>
<td>47</td>
<td>39  8</td>
<td>32  7</td>
<td>12  20</td>
<td>26%</td>
</tr>
<tr>
<td>BOTA</td>
<td>8/12/2008</td>
<td>37</td>
<td>35  2</td>
<td>28  7</td>
<td>12  16</td>
<td>32%</td>
</tr>
</tbody>
</table>

Average Percentage of Respondents with Mobile Phones = 85%
Average Percent of Respondents with Bluetooth Capable Mobile Phones = 62%
Average Market Penetration (Respondents with Bluetooth Enabled Mobile Phones)= 28%
Experiment to Use Bluetooth Signal Identification to Measure Passenger Vehicle Crossing Time

**Results and Conclusion**

- Measurement of passenger vehicle crossing time at POEs in El Paso region using Bluetooth technology is feasible.
- Can be a cheaper alternative to RFID to measure passenger vehicle crossing times.
- Physical geometry and queue at POE governs the number of Bluetooth readers to be installed and the data processing algorithm.
- No private information was obtained during the testing (TAMU system reviewed the experiment before proceeding).
- **Pilot project is necessary to minimize problems that could arise during full scale deployment, because controlled experiment does not reveal such problems.**
Proposal for a Pilot Project

Goals
- Verify the capability of Bluetooth readers to adequately measure border crossing time in a bigger deployment environment than in smaller controlled experiments.
- Identify design and implementation issues, including benefits, costs, and other stakeholder constraints.
- Leverage funding for full scale deployment.
- Reduce total cost of full scale deployment.

Objectives
- Install Bluetooth readers at U.S. and Mexican side of the border (Ysleta POE) to measure passenger vehicle crossing time (north and southbound).
- Develop mechanisms to transmit, filter, and archive data from Bluetooth readers.
Proposal for a Pilot Project

Ysleta Port of Entry

Server will process raw data and archive border crossing data

Average Crossing Time

Mobile

Internet
Proposal for a Pilot Project

Current Crossing Time
- > 60 min
- 30 min – 60 min
- < 30 min
Proposal for a Pilot Project

- Functional Requirements
  - The system should provide average passenger vehicle crossing time at the interval of 15 minutes.
    » Existing RMIS website by using color coded lines.
    » Push crossing time information to mobile phones.
  - The system should archive historic average border crossing time.
    » Agencies should be able to retrieve historic border crossing time using RMIS website.
# Proposal for a Pilot Project

<table>
<thead>
<tr>
<th>Pilot Project System Deployment at Ysleta POE</th>
<th>Equipment Purchase and Installation Cost Per Site</th>
<th>Number of Reader Sites</th>
<th>One Time Development Cost</th>
<th>Pilot Project Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetooth Readers (Installed on dedicated pole with solar power, battery and wireless communication)</td>
<td>$20,000 – $25,000</td>
<td>3</td>
<td>$55,000</td>
<td>$115,000 – $130,000</td>
</tr>
<tr>
<td>Bluetooth Readers (Installed on the wall of existing building with wireless communication and without solar power)</td>
<td>$2,000 - $3,000</td>
<td>3</td>
<td>$55,000</td>
<td>$61,000 – $64,000</td>
</tr>
<tr>
<td>Radio Frequency Identification (Installed on dedicated pole with solar power, battery and wireless communication)</td>
<td>$35,000 – $40,000</td>
<td>3</td>
<td>$85,000</td>
<td>$190,000 – $205,000</td>
</tr>
</tbody>
</table>
Proposal for a Pilot Project

1. Purchase Bluetooth Readers, Components and Necessary Services
2. Develop Applications to Extract and Process Raw Data
3. Install Readers in U.S. and Mexico
4. Develop Applications to Relay Current and Archived Crossing Times
5. Test and Run the Service

Duration:
- 4 Months
- 3 Months
- 5 Months
Contact Information

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