Center for International Intelligent Transportation Research

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

CITY OF EL PASO - TRANSPORTATION LRC

CITY HALL, FEBRUARY 18, 2010

Agenda

- Introduction to Bluetooth Technology.
- Compare Bluetooth Technology with Radio Frequency Identification Technology.
- Measurement of Passenger Vehicle Crossing Times at U.S. – Canada Border Using Bluetooth Technology.
- TTI's Bluetooth Experiment at the U.S. – Mexico Border in July and August of 2008.
- Proposal for a Pilot Project to Deploy Bluetooth Readers at Ysleta Port of Entry.

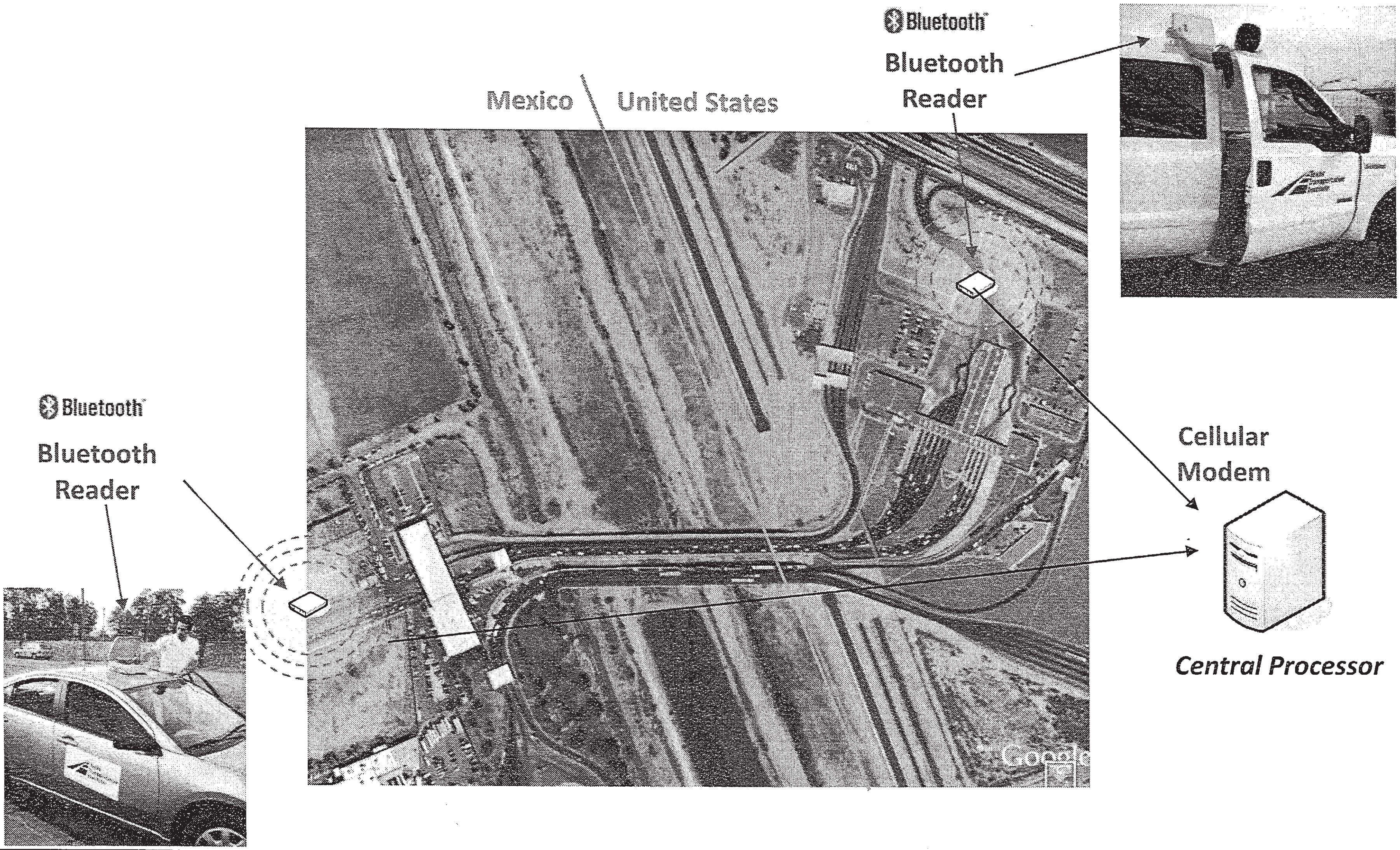
Introduction to Bluetooth Technology

- 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".

Compare Bluetooth Technology with Radio Frequency Identification Technology

Description	RFID	Bluetooth
Coverage	Single Direction and Line of Sight	Omni Direction and Doesn't Need Line of Sight
Read Distance	Up to 20'	Up to 300'
Placement	Above the lane	On the side of the road
Cost per Unit	$5000.00	$500.00 - $ 1500.00
Data Received	Small number, requires less cleaning	Large number, requires extensive filtering process
Market Penetration	As many tags distributed, so small	Mobile phones, head sets and vehicles with Bluetooth capability, so large
Deployment	Inflexible and costly	Flexible and cheaper

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

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

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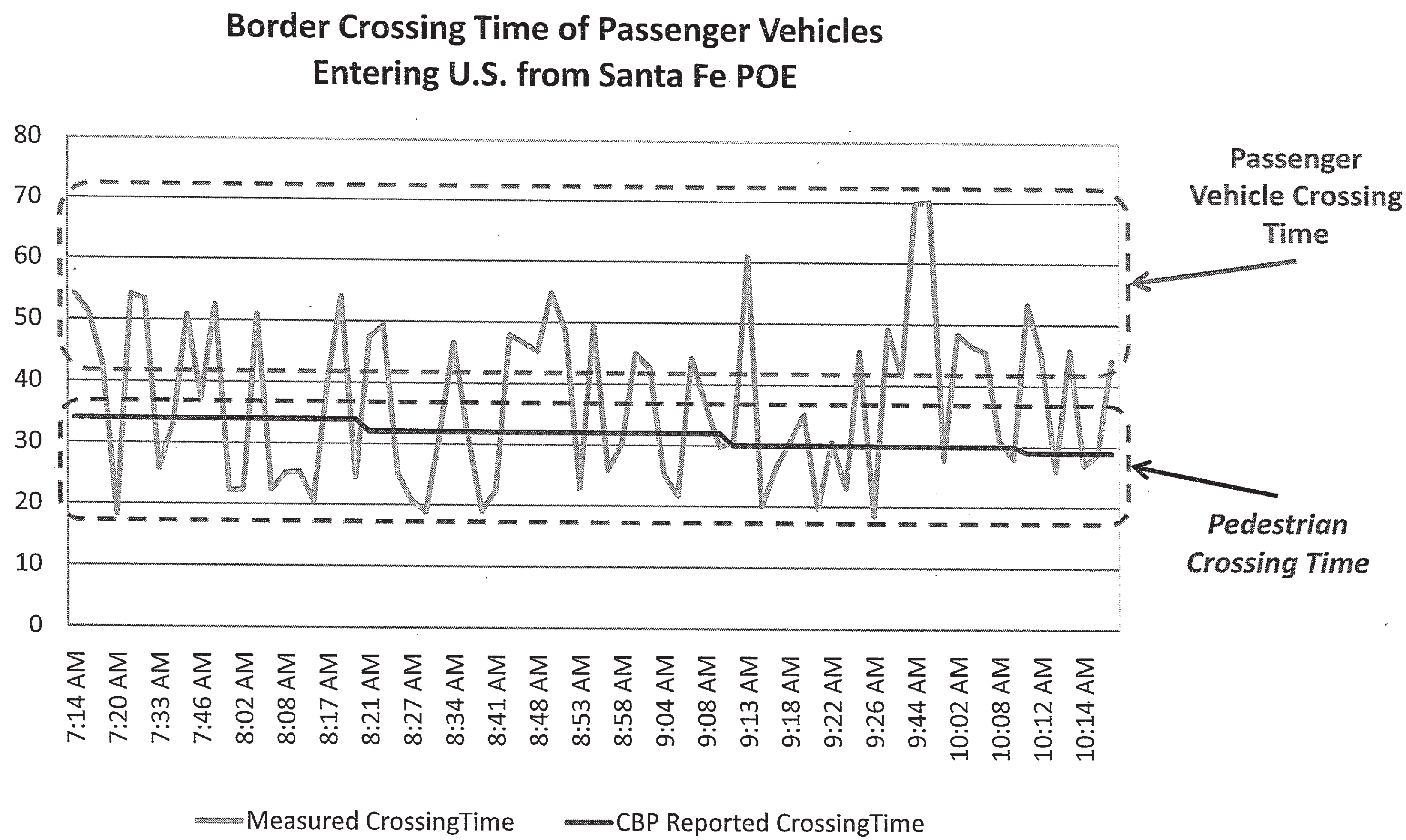

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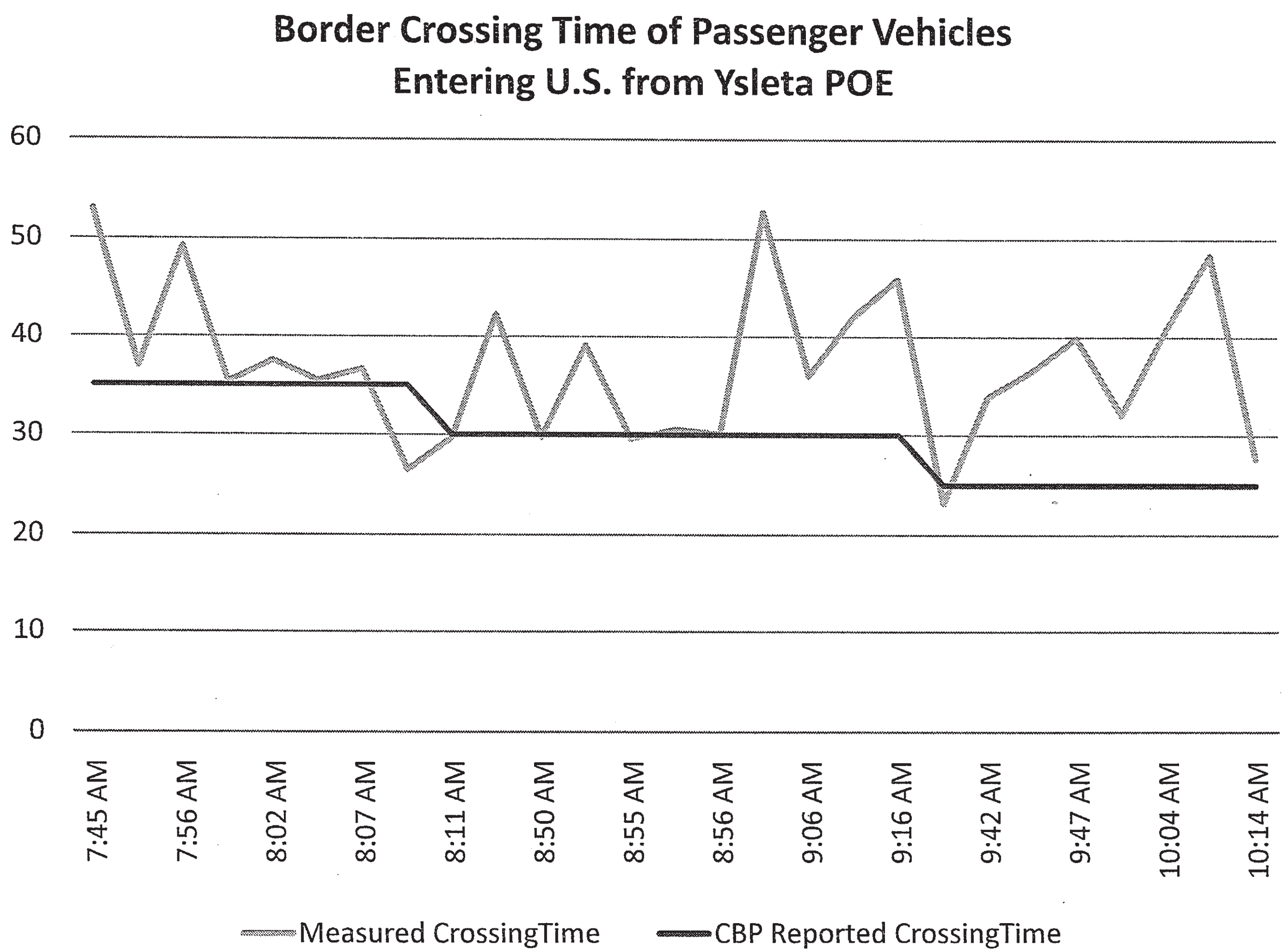

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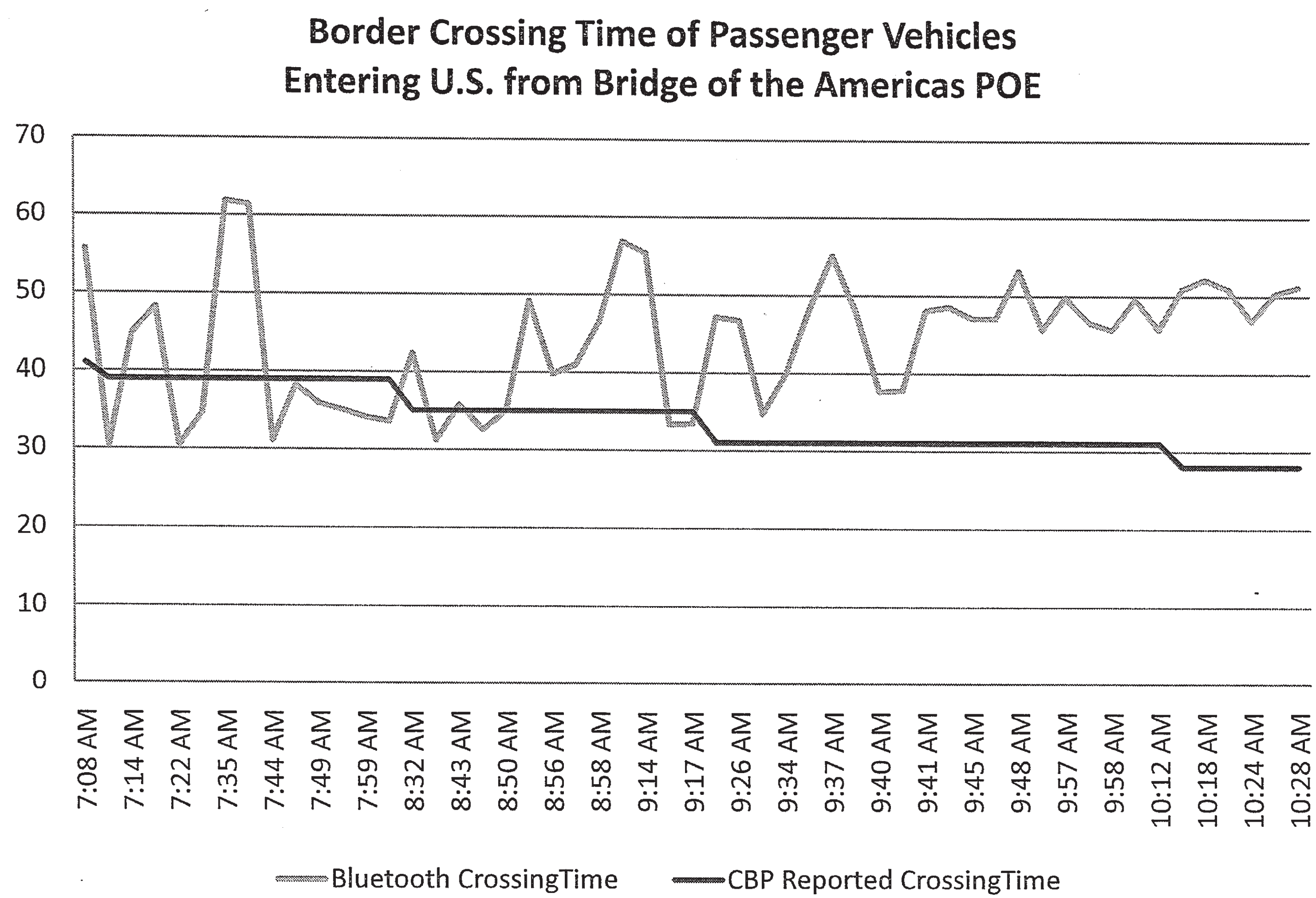

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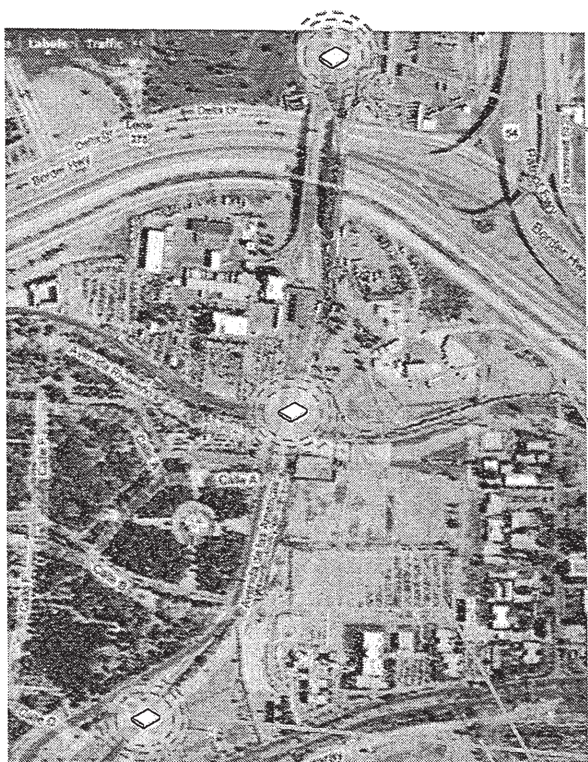
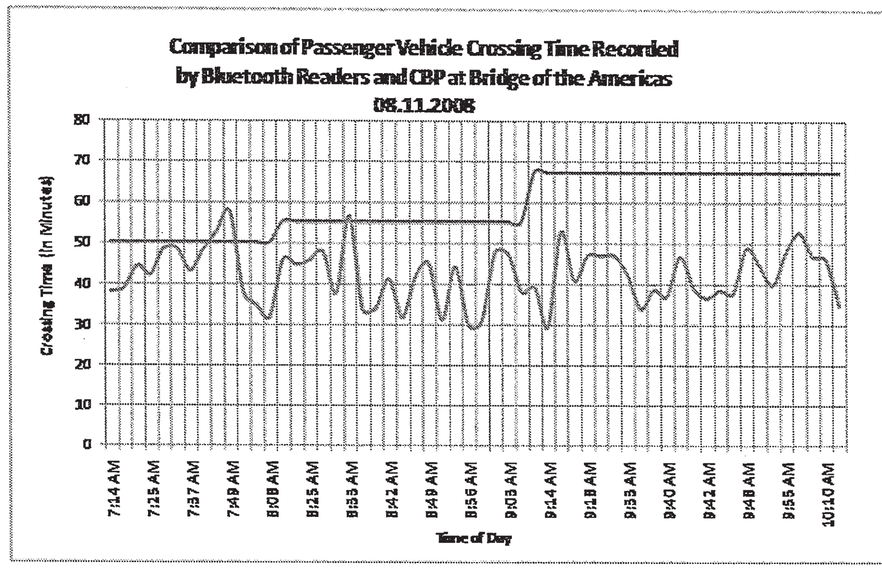
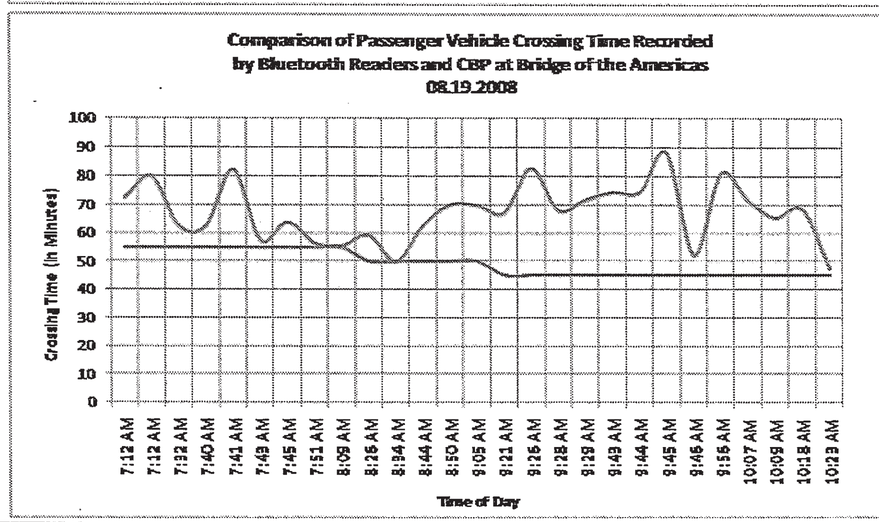




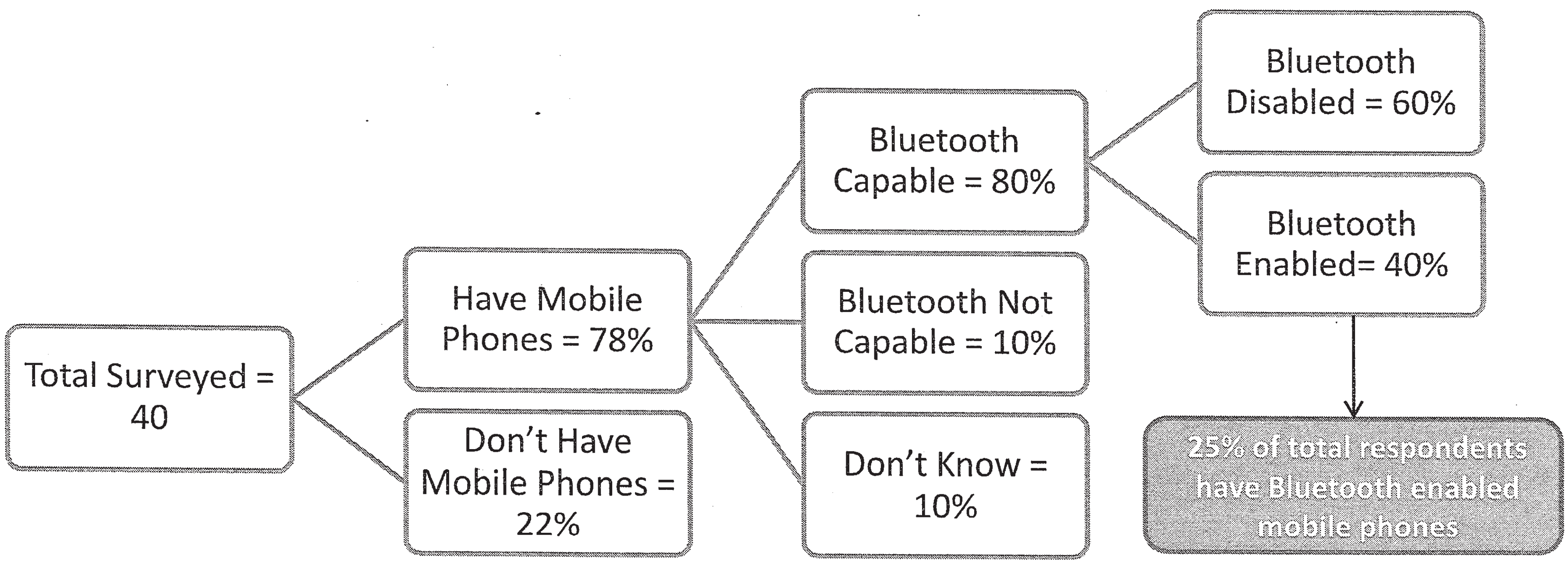


Week 1 – Position of BT Reader in MX Side

Week 2 – Position of BT Reader in MX Side

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



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

POE	Survey Date	Total Drivers Surveyed	Mobile Phone		Bluetooth Capable			Bluetooth Enabled		Market Penetration
			Yes	No	Yes	No	Do not Know	Enabled	Disabled	
Zaragoza	7/29/2008	40	31	9	25	3	3	10	16	25%
Zaragoza	7/30/2008	40	36	4	23	8	5	9	14	23%
Zaragoza	7/31/2008	50	44	6	29	14	1	12	17	24%
Zaragoza	8/1/2008	51	45	6	34	11	0	15	19	29%
Santa Fe	8/4/2008	49	38	11	27	11	0	13	16	27%
Santa Fe	8/5/2008	40	33	7	21	11	1	12	9	30%
Santa Fe	8/6/2008	40	34	6	28	5	1	16	13	40%
Santa Fe	8/7/2008	49	39	10	26	11	2	13	13	27%
Santa Fe	8/8/2008	40	36	4	24	11	1	9	15	23%
BOTA	8/11/2008	47	39	8	32	7	0	12	20	26%
BOTA	8/12/2008	37	35	2	28	7	0	12	16	32%

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.**

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Intelligent Transportation Systems Applications at the El Paso-Ciudad Juarez Border Crossings RFID and Secure Border Trade Project

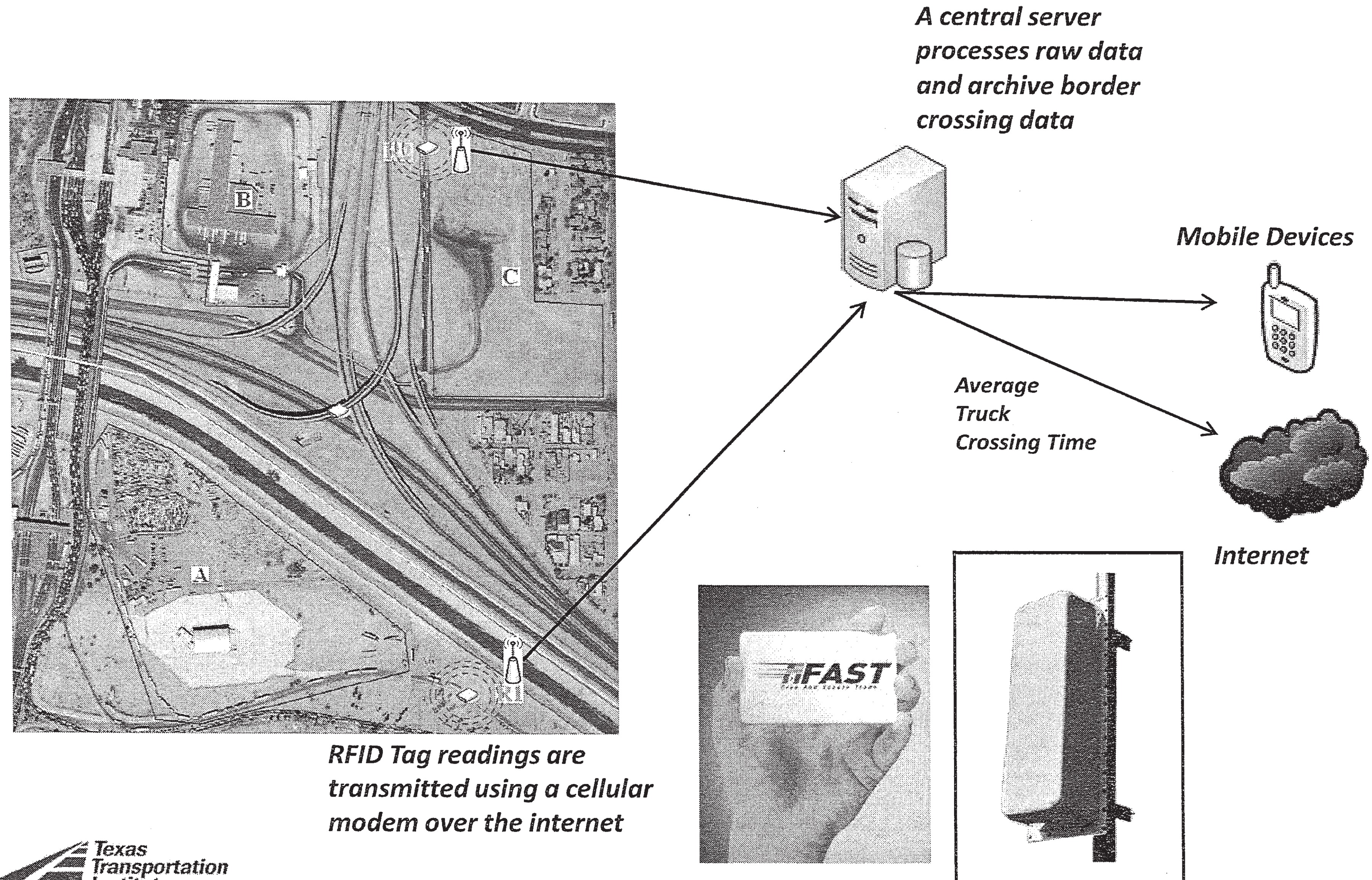
The Center for International Intelligent Transportation Research

El Paso, Texas

Faster, Smarter, Safer

February 18, 2010

Radio Frequency Identification Based System to Measure Truck Crossing Times



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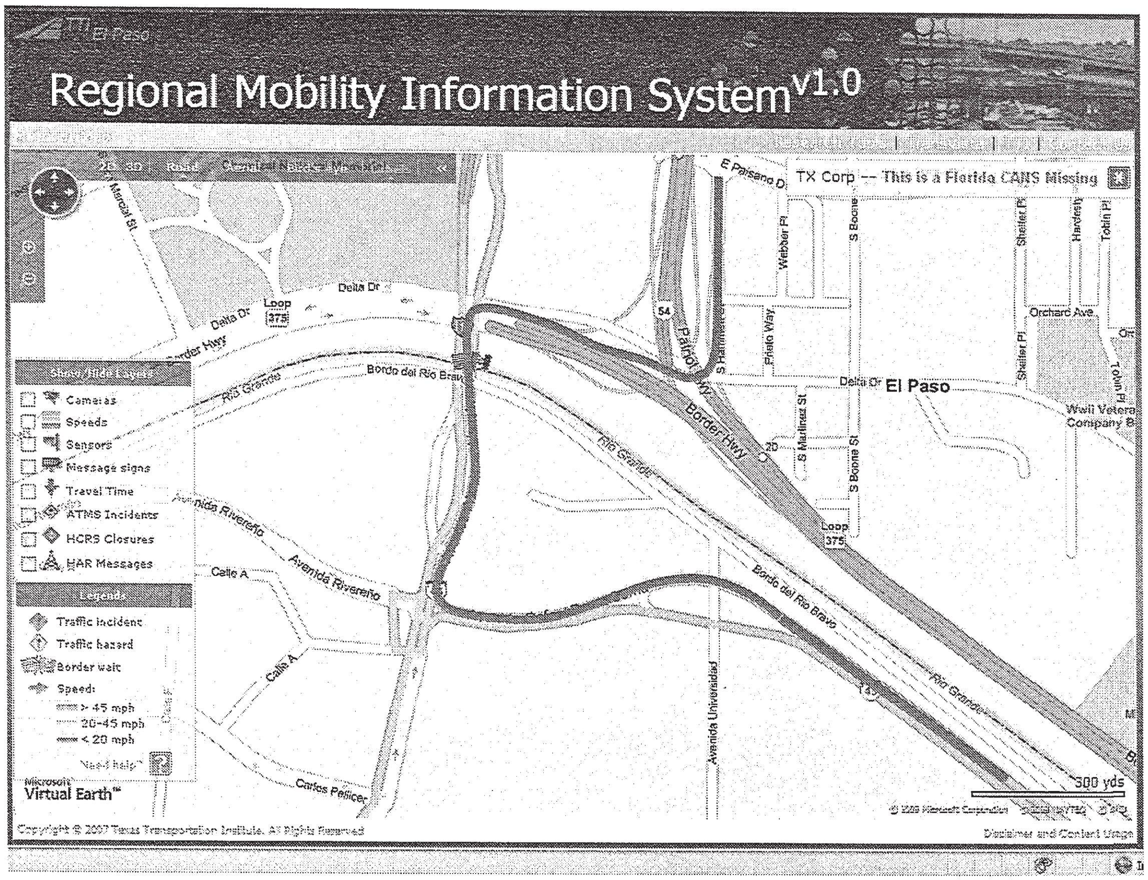
Radio Frequency Identification Based System to Measure Truck Crossing Times



Current Truck Crossing Time at BOTA

> 60 min

30 min – 60 min

< 30 min

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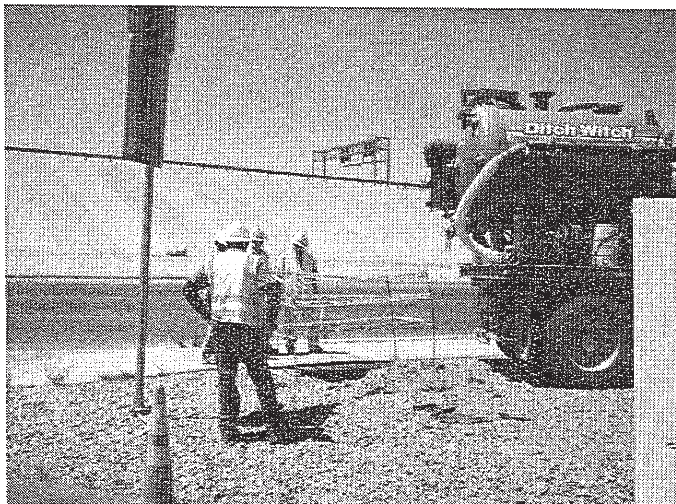
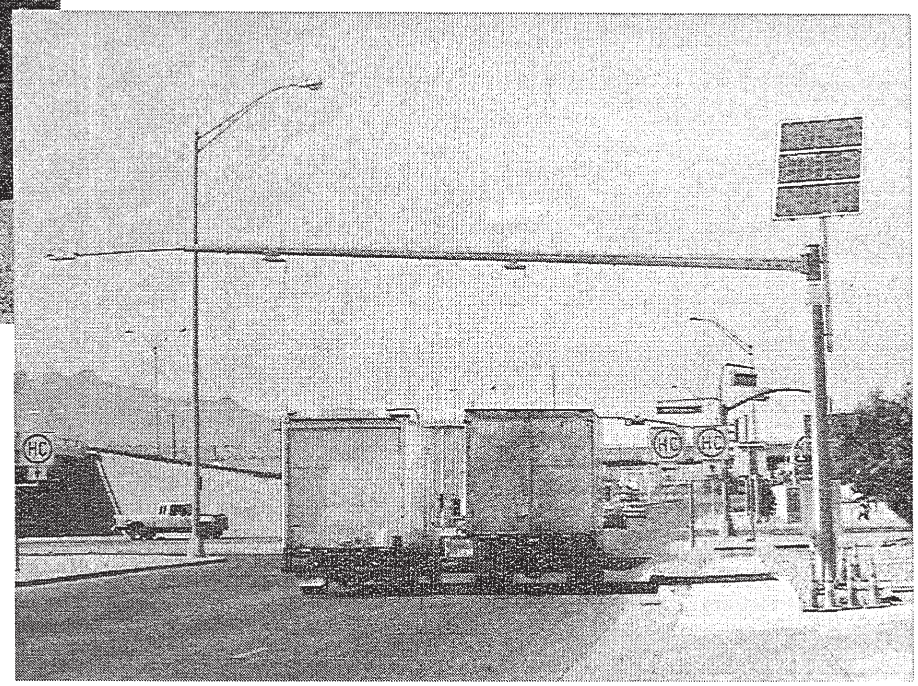
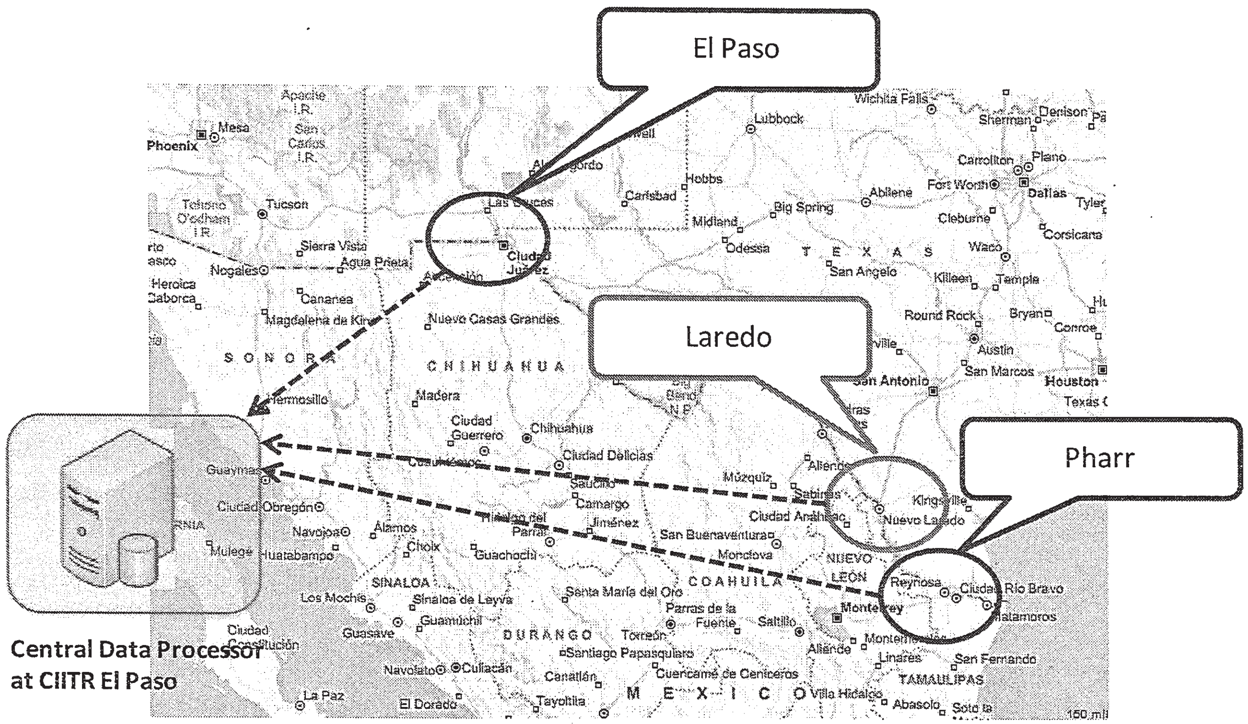
Radio Frequency Identification Based System to Measure Truck Crossing Times





Implementation of RFID Based Technology to Measure Crossing Times of Commercial Vehicles



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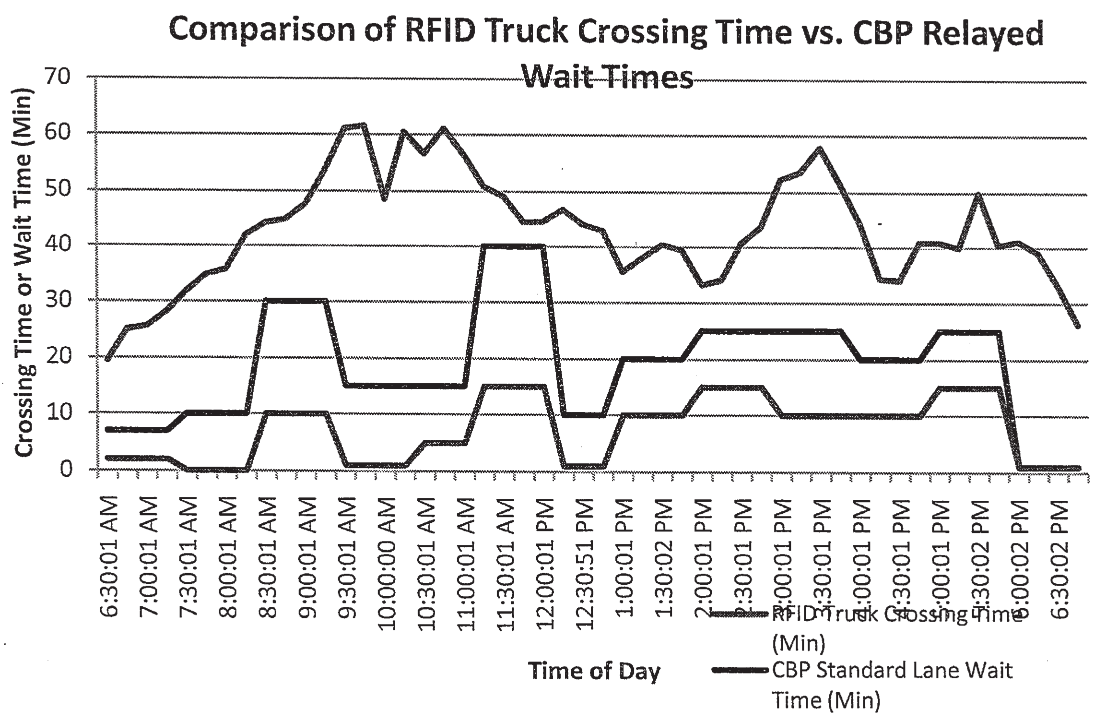
Crossing Times of Commercial Vehicles at BOTA



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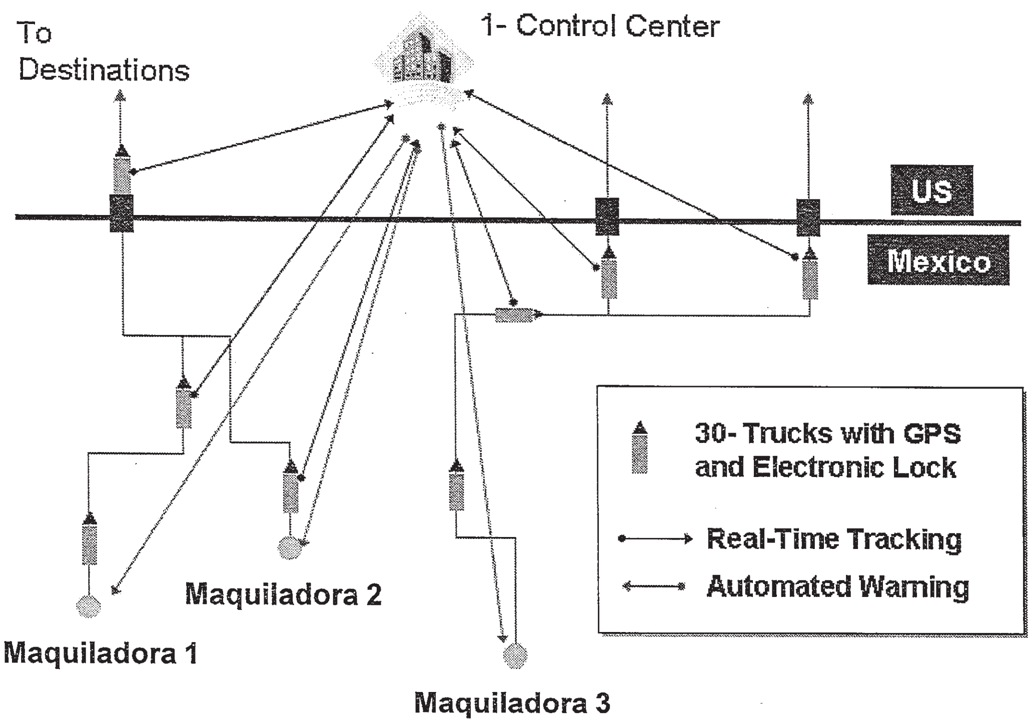
El Paso County Secure Border Trade (SBT) Demonstration Project

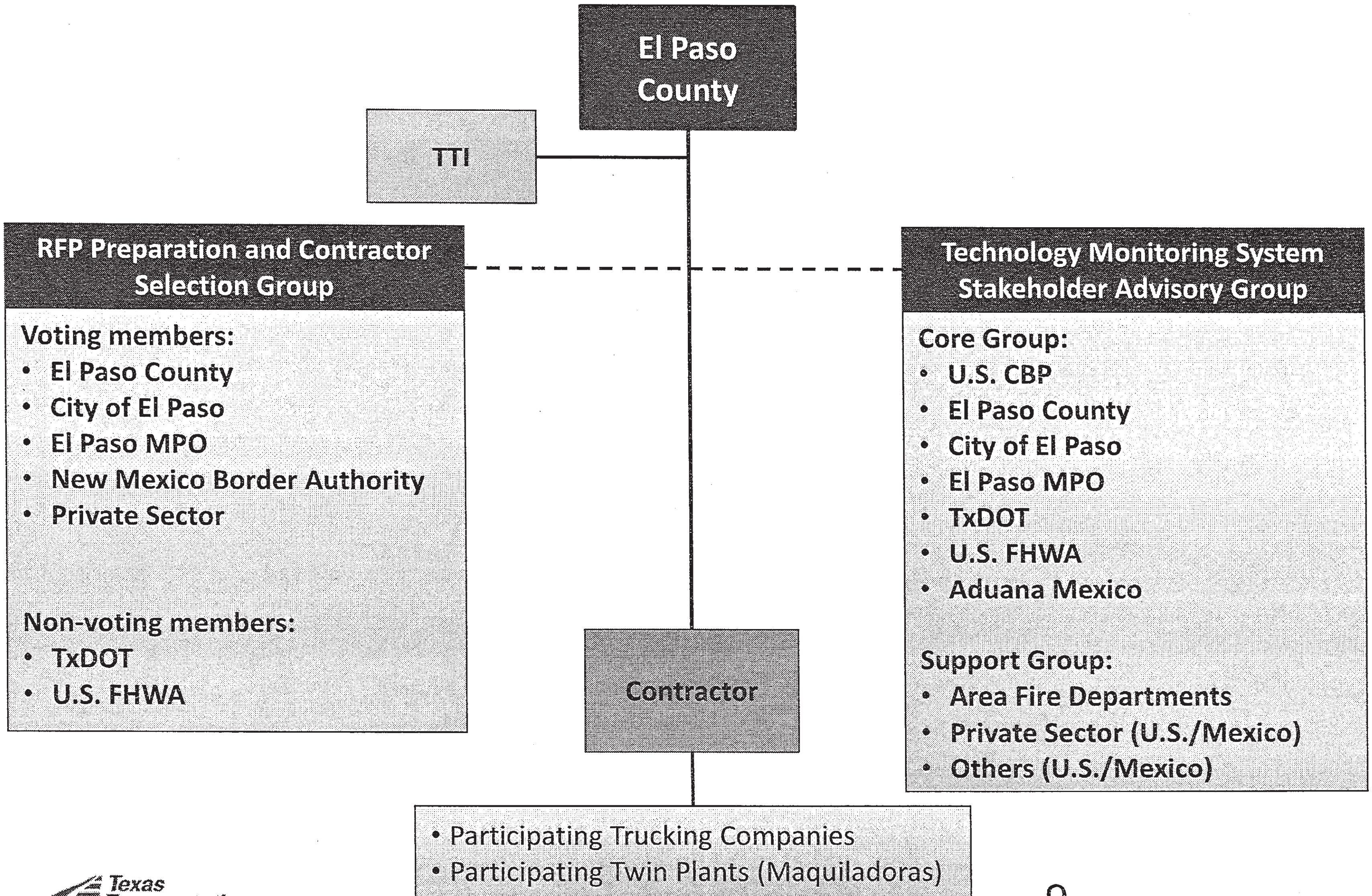
- Goal
  - Heighten security, promote economic development, and border trade efficiency through enhanced stakeholder collaboration
- Objectives
  - Introduce state-of-the-art technology to track and monitor commercial freight carriers
  - Expand the visibility of cross-border supply chain by extending monitoring of vehicles and cargo away from the border
- Project promoted and championed by the County of El Paso, funded by FHWA through Coordinated Border Infrastructure funds
- TTI is providing technology monitoring assistance and project management support to the El Paso County

El Paso County SBT Demonstration Project - Scope



- One central control facility equipped with software and hardware technology to track and monitor trucks in real-time
- Three designated "secure" maquiladora sites with surveillance devices and establish procedures for loading of goods
- 30 designated FAST-registered tractors and trailers with GPS-based electronic locking system

El Paso County SBT Project Management Plan



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El Paso County
Secure Border Trade Demonstration Project

Project Summary · February 10, 2010

Project Overview

The objective of Coordinated Border Infrastructure (CBI) funding from FHWA is to increase the security and efficiency related to the movement of goods and people at the Mexican and Canadian borders with the United States. To that end, the El Paso County Secure Border Trade Demonstration Project (SBTDP) is geared to meet these objectives and meet the unique needs of the largest concentration of Maquiladora operators in the world – those located in the El Paso/Juarez region. Specifically, this project will equip 30 heavy-duty tractors/trailers with state-of-the-art intelligent transportation system devices to secure cargo and transmit key data into a central repository where the data will be analyzed by software agents to detect anomalies which may have comprised security of the protected cargo.

At the core of the El Paso County SBTDP will be a unique software system and related network of technologies utilizing Intelligent Software Agents (ISAs). The ISAs will analyze and collaborate with each other to process vast amounts of wide ranging data which impact cargo movement. Such data is useful to truck operators and maquiladora owners and could be valuable to customs and other border officials. Utilizing an integrated hardware network that has been installed on vehicles and at predetermined load sites, the ISA software system will track cargo as it is loaded and transferred from its origin at the Maquila plant, across the border and on to its ultimate point of destination to create a Decision Support System. It is important to note that the information analyzed from the actual border crossing will be only one part of the larger integrated cargo tracking effort.

In addition to the intelligent software technology to be developed and deployed as part of this effort, there will be many other hardware, software and communications components incorporated into the project. Most of these components will be used to gather, store or transmit data to be analyzed and used by the ISA. Specifically, a Global Positioning System (GPS) will be a key component in the overall design of the El Paso County SBTDP. However GPS systems are not all the same. Every GPS is designed and sold to accomplish different missions. Many transportation companies use a very simple GPS unit to track the location of their trailers and speed of the trucks. These less sophisticated units are typically programmed to send a satellite signal at a predetermined interval - once a day, a week or a month. This is done to locate misplaced or stolen trailers, while conserving battery life. A more sophisticated GPS configuration will be used inside the tractor for this project that will gather other data such as temperature, air pressure, etc. and establish real-time communication with the driver.

The most critical data collection and communication devices used in the El Paso County SBTDP will be those used on the tractor and trailer transferring the cargo. This tractor and trailer configuration is comprised of a GPS unit with integrated data storage and communication capabilities, an intelligent locking device and other RFID and sensor collection capabilities.

For demonstration purposes, the project is proposing to use truck and trailer combinations that operate exclusively in the El Paso/Juarez region. While some transportation companies might currently have some of the hardware components needed to participate, none of them have the integrated hardware, software or communications systems to transfer and read real-time data. The data captured from the onboard components with which the trucks are to be equipped is combined with data captured about the cargo, truck, driver, weather conditions and traffic conditions before being transmitted to a central ITS center, which will monitor (and as required), track and control the movement of each vehicle. This would be an impossible task if a person were required to monitor every vehicle. The unique aspect of this system is that this function will be automated through the use of ISAs which automatically analyzes all the information collected and determines if an event, or combination of events, has occurred for which an alert should be issued. Consequently, the human operator responds only to the exceptions (alerts) rather than attempting to track each vehicle all of the time. Because of the speed at which the ISAs function all of this can be performed in real time.

Maquila operators agreeing to participate in the program will have their own designated transportation carriers for the border area. These carriers will need to agree to share data not previously used in transport efforts. Research has found that once the carriers understand the project, most will be very willing to participate. However, equipping trucks and trailers that will operate in the El Paso/Juarez region is essential to the success of the effort and will require the cooperation of both heavy-duty fleet vehicle operators and maquila owners.

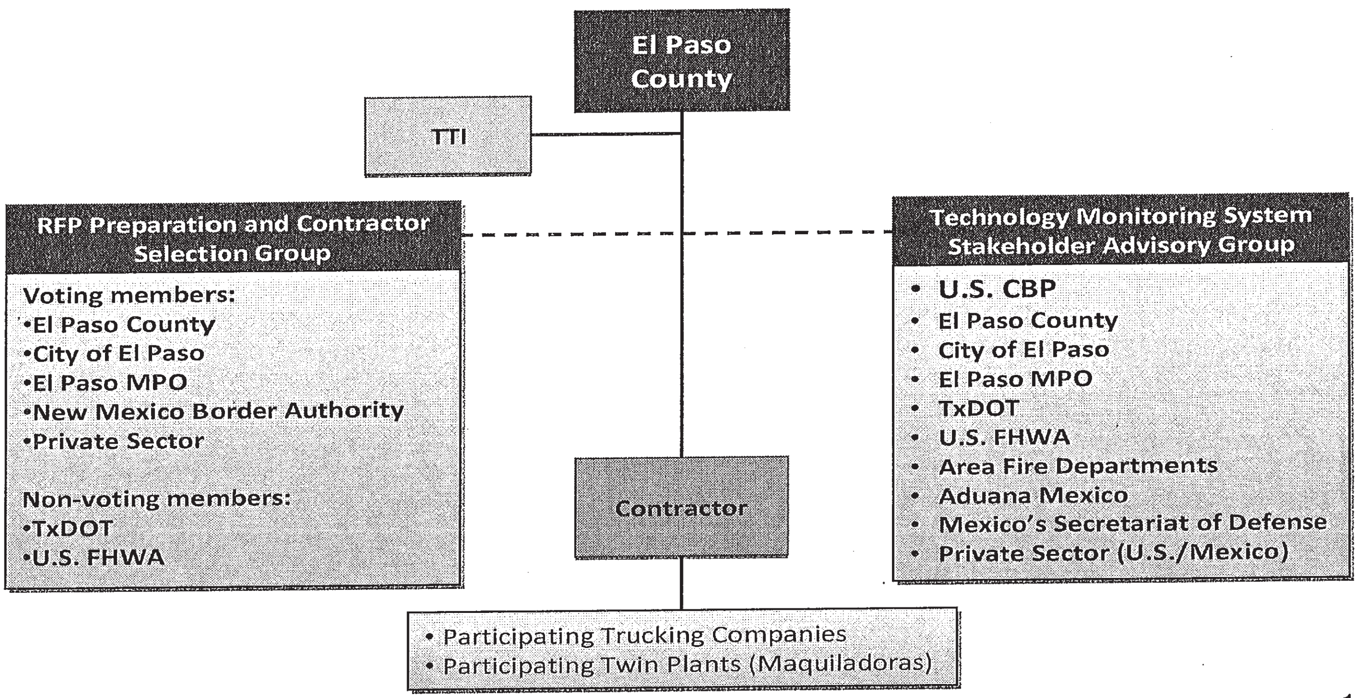
The ultimate goal of this effort is to create a national standard for maquila users and cargo transport. In that regard, data gathered regarding truck and cargo movements in San Diego or Seattle is as important to the project as data gathered in El Paso/Juarez. Analyzing data collected from multiple locations will allow project partners to verify that the software architecture modeled as part of the El Paso County SBTDP can be utilized in related efforts elsewhere.

Regardless of the possible national benefits, the El Paso County SBTDP is designed to meet the minimum needs of the maquila operators in the El Paso/Juarez region. As the largest concentration of maquila operators in the world, software and communication systems that are specifically adapted to meet the needs of our local industries will help to insure their long term viability which is essential to the economic health or our region. The El Paso County SBTDP helps assure the region's continuing leadership role in the evolving international trade landscape and is the perfect test-bed for developing and applying technologies to ensure a secure maquiladora industry here and elsewhere.

Project Budget Summary

	Federal Share	Match/In-kind	Total
El Paso County SBTDP	$2,881,521	$ 720,380	$3,601,901

Management Plan



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SBT Project Organization.

The Technology Monitoring Committee (TMC) consists of representatives from several stakeholders in the region. The TMC's role will be to systematically ensure that at every stage of project development and implementation:

- Pre-defined quality standards for each and every step of the process are met;
- Business and technical needs of ALL stakeholders are integrated; and
- Quality of end product is met.

The TMC will coordinate with the County of El Paso and TTI in developing procedures to monitor the progress of the project, identify benchmarks, set significant milestones, and engage in testing and evaluation of the project. In addition, the TMC will:

- Assist TTI in technology monitoring activities for the successful design, operation, maintenance, and retirement of the project;

- Provide technical oversight and monitor the project by assisting TTI with specific systems engineering tasks throughout the life-cycle of the project;
- Monitor major systems engineering tasks and assess risks and benefits;
- Assist in assuring and increasing participation of stakeholders throughout the life cycle of the project; and
- Participate in, and review and approve the concepts of operation, stakeholder needs and requirements, high and low level designs, testing, verification and retirement of the project.

The following agencies have agreed to be part of the TMC:

- Customs and Border Protection
- Federal Highway Administration
- City of El Paso
- Texas Department of Transportation
- El Paso Metropolitan Planning Organization
- El Paso County