TECHNICAL MEMORANDUM

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SUBJECT: AI and RFID-Based Wait Time Monitoring at Paso Del Norte: A Cost Comparison

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Introduction

This technical memorandum provides a comparative analysis of two technology platforms designed to measure border wait times for northbound passenger vehicles at the Paso Del Norte (PdN) port of entry in El Paso, Texas. It summarizes the order-of-magnitude implementation costs for each system—one based on radio-frequency identification (RFID) and the other on artificial intelligence (AI)-driven video analytics—and explores how each can be integrated with upstream Bluetooth/WiFi-based monitoring systems. The analysis draws on recent deployments and cost estimates developed by the Texas A&M Transportation Institute's Center for International Intelligent Transportation Research (CIITR) and is intended to inform future research and planning efforts focused on wait time measurement at land border crossings.

1. Cost Comparison: RFID-Based vs. AI-Based Border Wait Time Systems at Paso Del Norte

Recent efforts by CIITR have advanced and tested two technology platforms for measuring northbound passenger vehicle wait times at U.S.–Mexico border crossings: one based on radio-frequency identification (RFID) and the other on video cameras paired with AI-based image recognition.

At the Paso Del Norte (PdN) port of entry in El Paso, a full-scale implementation of an RFID-based wait time system was scoped and estimated by CIITR researchers at approximately $280,000 (Spring 2025). This estimate covers equipment procurement—including industrial RFID readers, directional antennas, enclosures, and surge protection—along with system design, labor, contractor services, integration, testing, and about 4–5 months of operation. The proposed deployment spans three key locations: the Mexican toll booth, the midpoint of the bridge, and the U.S. CBP primary inspection area.

By comparison, an AI-based system uses a smaller hardware footprint—comprising IP video cameras positioned at critical points, edge computing units, and a cloud-based analytics platform. When scaled to match the complexity and traffic volume of PdN, total implementation costs are estimated at approximately $210,000. This figure includes system design, procurement, deployment, integration, testing, and a comparable operational period.

Overall, the AI-based system offers an estimated cost savings of 25–30% compared to the RFID-based system, largely due to lower equipment and installation costs. Long-term maintenance costs are also expected to be lower for the AI-based system, which typically requires only occasional software updates and recalibration. Its hardware is modular and vendor-flexible, and installation and maintenance rarely require traffic disruptions.

In contrast, RFID systems require more specialized components, are generally tied to proprietary vendors for hardware replacement, and often necessitate lane closures for installation or repairs—adding to cost and operational disruption. These differences highlight the AI-based system's potential for cost-effective deployment and easier long-term support in complex border environments like PdN.

2. Complementary Use of Lane-Level and Upstream Wait Time Technologies

Regardless of the technology selected for within-port monitoring, pairing it with a Bluetooth/WiFi-based system upstream of the port adds significant value for the measurement of crossing time across the border. Bluetooth/WiFi systems detect anonymous signal pings from travelers' devices and estimate travel times from key approach corridors to the POE entrance.

When used in combination, these technologies provide a multi-segment view of traveler delay:

- **Bluetooth/WiFi systems** capture travel times from upstream road segments to the POE entrance, providing insight into regional congestion, queue spillback, and arrival patterns.
- **RFID or AI-based systems** measure lane-level processing times within the POE, from toll booth to primary inspection, revealing operational inefficiencies and throughput issues.

In the AI-based configuration, computer vision algorithms classify vehicles by lane designation (e.g., General, Ready, SENTRI) and track movement through the crossing. This provides operational visibility comparable to RFID, but with lower upfront costs and without requiring tagged vehicles.

Together, Bluetooth/WiFi and RFID or AI systems form a layered, complementary architecture. Bluetooth/WiFi delivers broader situational awareness upstream, while RFID or AI enables precise lane-level insights within the port—supporting improved border management, performance evaluation, and real-time traveler information.

Conclusion

AI-based video analytics represent a promising and cost-effective alternative to more hardware-intensive technologies for measuring border wait times, particularly in environments like the Paso Del Norte port of entry. While RFID remains a proven solution for lane-level precision, AI systems can deliver comparable operational insights at a lower cost and with greater deployment flexibility—especially when combined with upstream Bluetooth systems for full-segment delay

monitoring. Although AI-based approaches may still benefit from additional refinement and validation under varied field conditions, their current performance and affordability justify further investment and consideration for broader deployment. As border management strategies evolve, these AI-driven systems offer a scalable path forward for enhancing performance measurement and real-time decision support.