Wait Time Estimation Using Roadside Wi-Fi/Bluetooth Scanners

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Overview

Our goal is to measure the wait times for the Standard, Ready and Sentri vehicular lanes of San Ysidro crossing. There are two ways to estimate the wait times: the first method requires roadside infrastructure and the second does not require roadside infrastructure. Each has its pros and cons. In this document we will outline a method that requires roadside infrastructure.

When a cell phone has its Wi-Fi or Bluetooth turned on, it emits a signal with a unique ID in the signal called Mac Address. Wi-Fi and Bluetooth each have its own unique Mac address. Wi-Fi signal travels longer distance than the Bluetooth signal. Many of the commuters when they wait in line at the border will have Wi-Fi or Bluetooth turned on in their phones. In addition they will be using Bluetooth low energy devices such as FitBits, Smart Watches and ear pods. The idea is to install devices on the roadside that can read the Mac address emitted from the phones and wearable devices. The readers can be placed at critical points in Tijuana where the lines begin to form and also on the US side right after the CBP inspection booth. We can then uniquely track the commuters via their Mac address as they cross the border and hence get the wait times as well. Since we will get a large number of Mac addresses, we can run statistical filtering to throw out the outliers and obtain an aggregated wait time for each lane type. It should be noted that though commuters can be uniquely tracked across the border, it does not sacrifice their privacy. We will be unable to tie their Mac address to any personal information such as name, phone number or where they live.

We will next describe the roadside readers that need to be deployed. There are several commercial off the shelf readers that are available on the market They are self contained units that can be powered either via solar, battery pack or through direct power. Here is the spec for one such reader.

https://www.smatstraffic.com/wp-content/uploads/2018/06/TrafficXHub-Technical-Specifications.pdf

The reader comes with cellular connectivity so that all the data can be transferred to the cloud. We can run algorithms in the cloud that computes the wait time estimates from the

time stamped mac addresses. The reader is enclosed in a weatherproof container, and is typically mounted on a roadside post with access to power. It can also be powered via solar if needed.

Initial scouting reports seems to indicate that we would need 7 readers on the Mexican side (or 14 if you install two per location for redundancy) and 1 (or 2) reader on the US side.

Figure 1: A typical roadside reader mount