AI & Digital Twin Technology in Traffic Signal Timing

A Case Study of Blue Diamond Corridor in Las Vegas, Nevada

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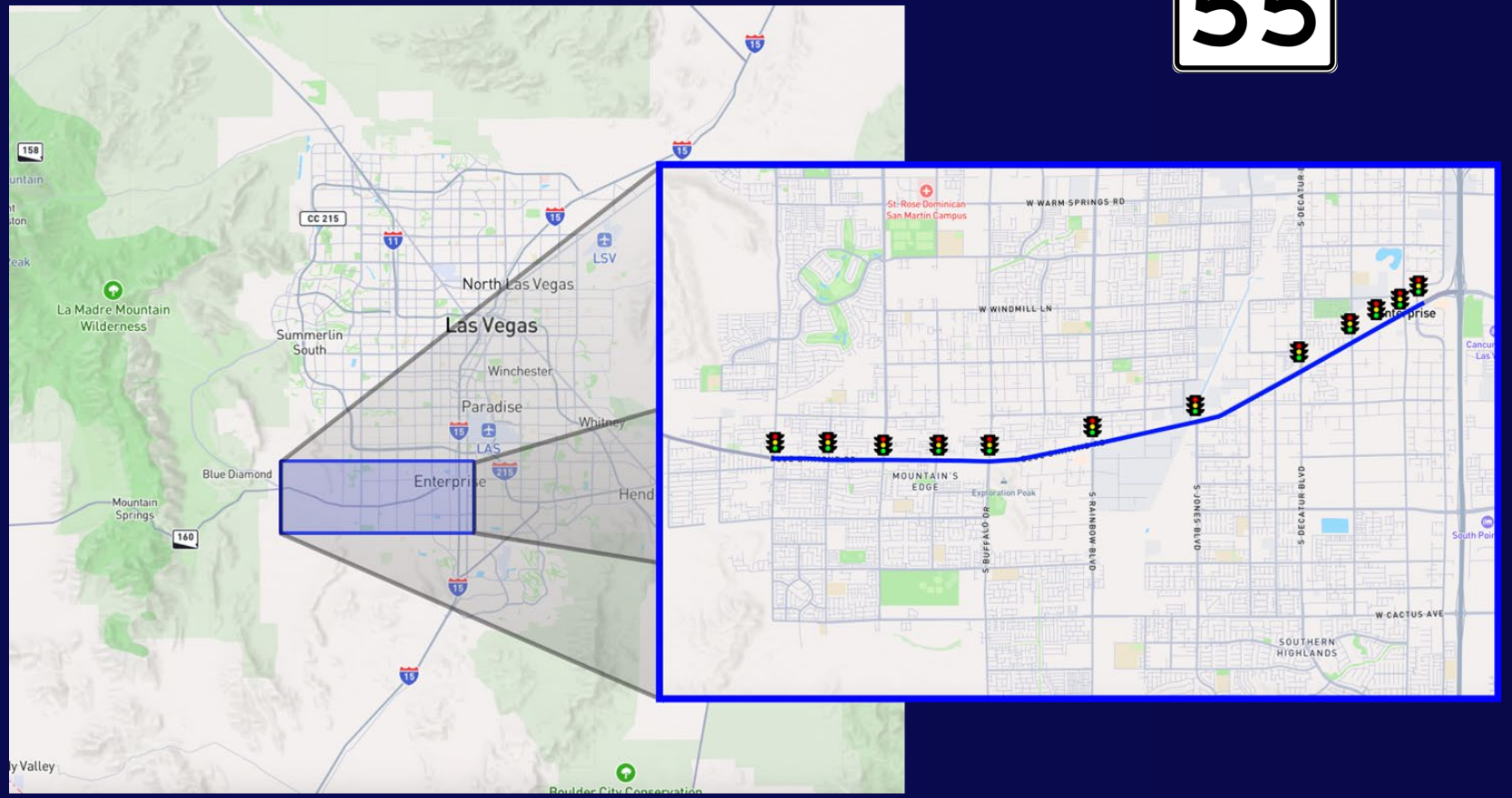
Location Overview

- 6.5 mile corridor on Blue Diamond Rd. in Las Vegas, NV
- 12 signalized intersections with a fixed timing schedule (7 TOD plans)
- 2-4 lanes in each direction



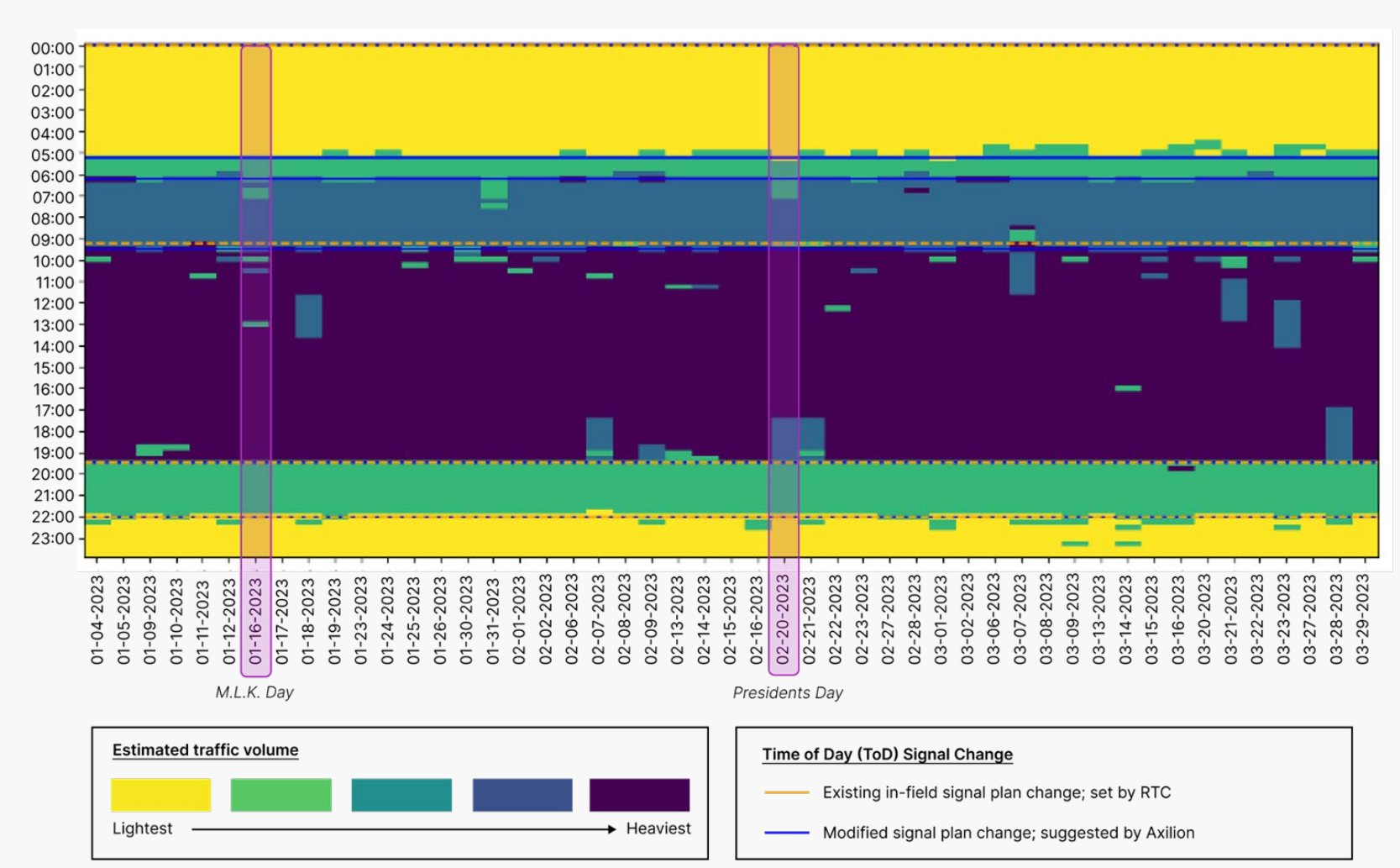
Objectives

Proof of concept - apply Axilion's X Way platform to leverage digital twin technology and AI-based reinforcement learning for traffic signal retiming

Traffic improvements - Improve travel time (weekdays only) while maintaining pedestrian safety

Cluster Analysis

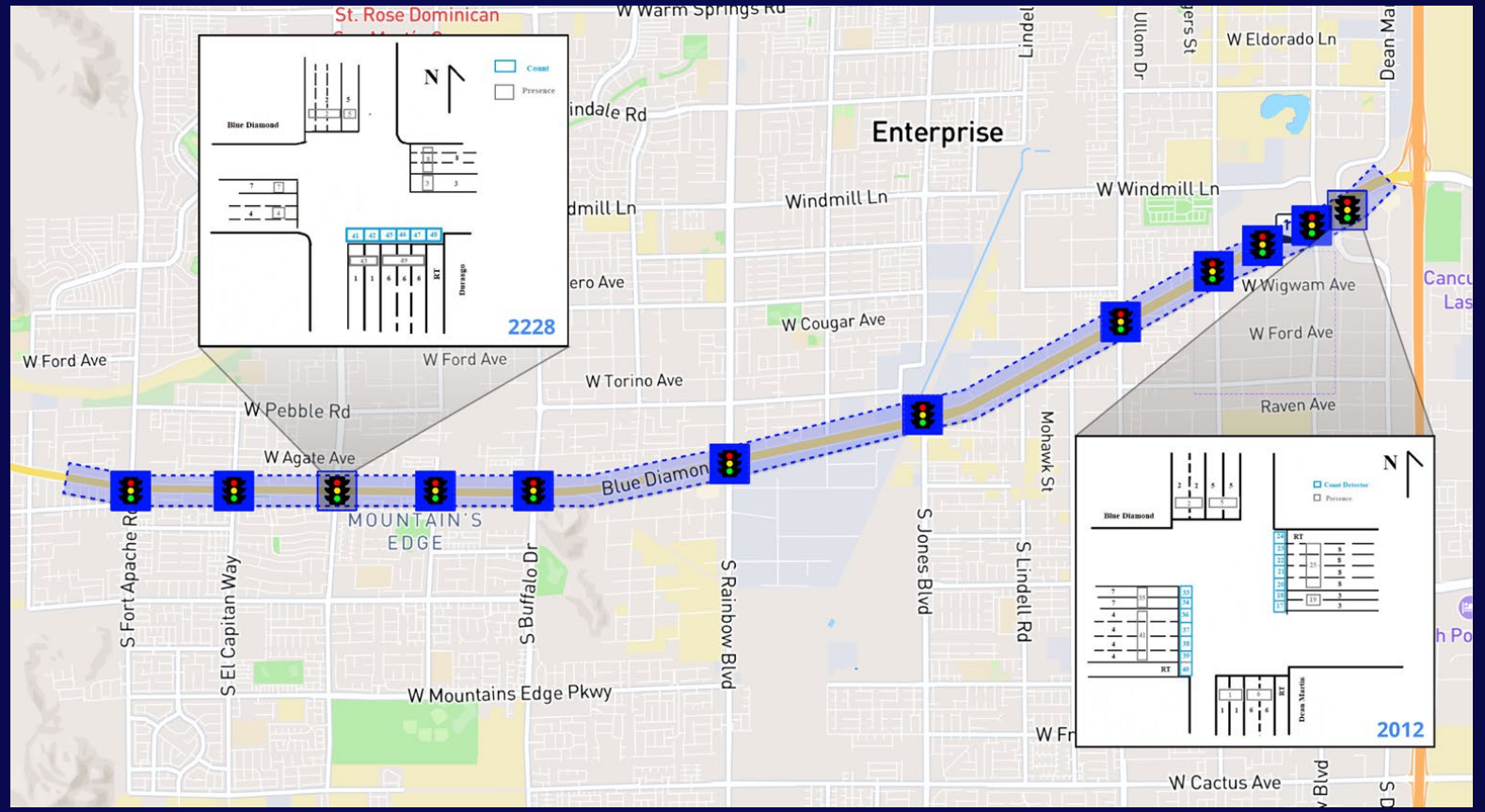
- Performed a cluster analysis to obtain initial observations of the corridor
- Includes HiRes log + probe data
- Unsupervised AI process sorts data into bins



Cluster analysis of all intersections within the Blue Diamond Corridor (M-F only)

Challenges

- Detector limitations
  - Two partial count detectors
  - Not enough to extract turning movement count

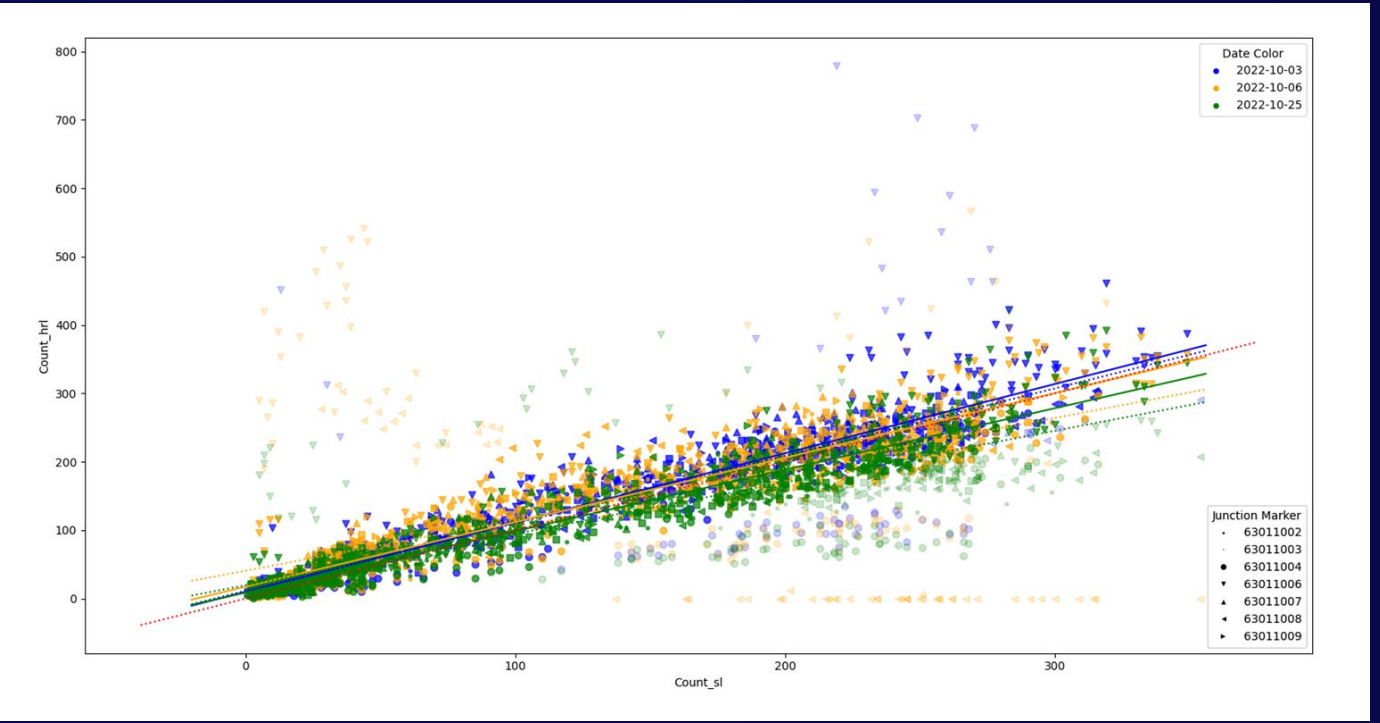


BD/ Durango Dr (#2228): NB only, all lanes

BD/ Dean Martin Dr (#2012): EB + WB, all lanes

Generation of turning movement counts

- To overcome the challenge around limited count detectors, Axilion meshed the available count detector data together with probe-based turning movement counts at a 15-minute resolution

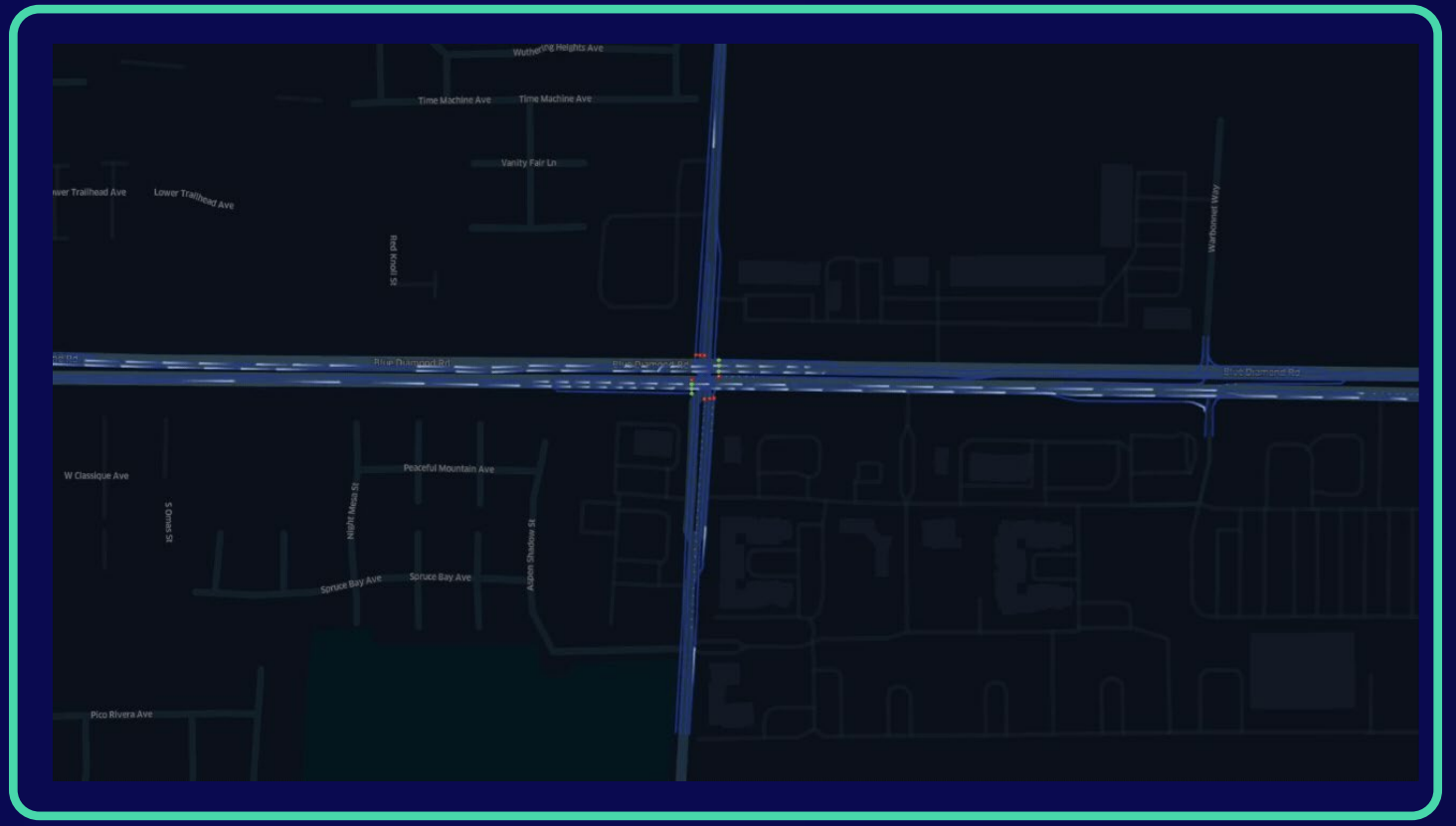


Example of Axilion's detector correlation matrix comparing high-resolution traffic log data to probe vehicle data (Skyland Blvd. located in Tuscaloosa, AL)

STREETLIGHT DATA

Digital twin build & calibration

- Set up a digital twin to match the same controller configuration and traffic movements present in the Blue Diamond corridor
- The digital twin emulated the geography of the corridor down to 6-in. exactness
- TMCs were injected into the digital twin to model driver behavior

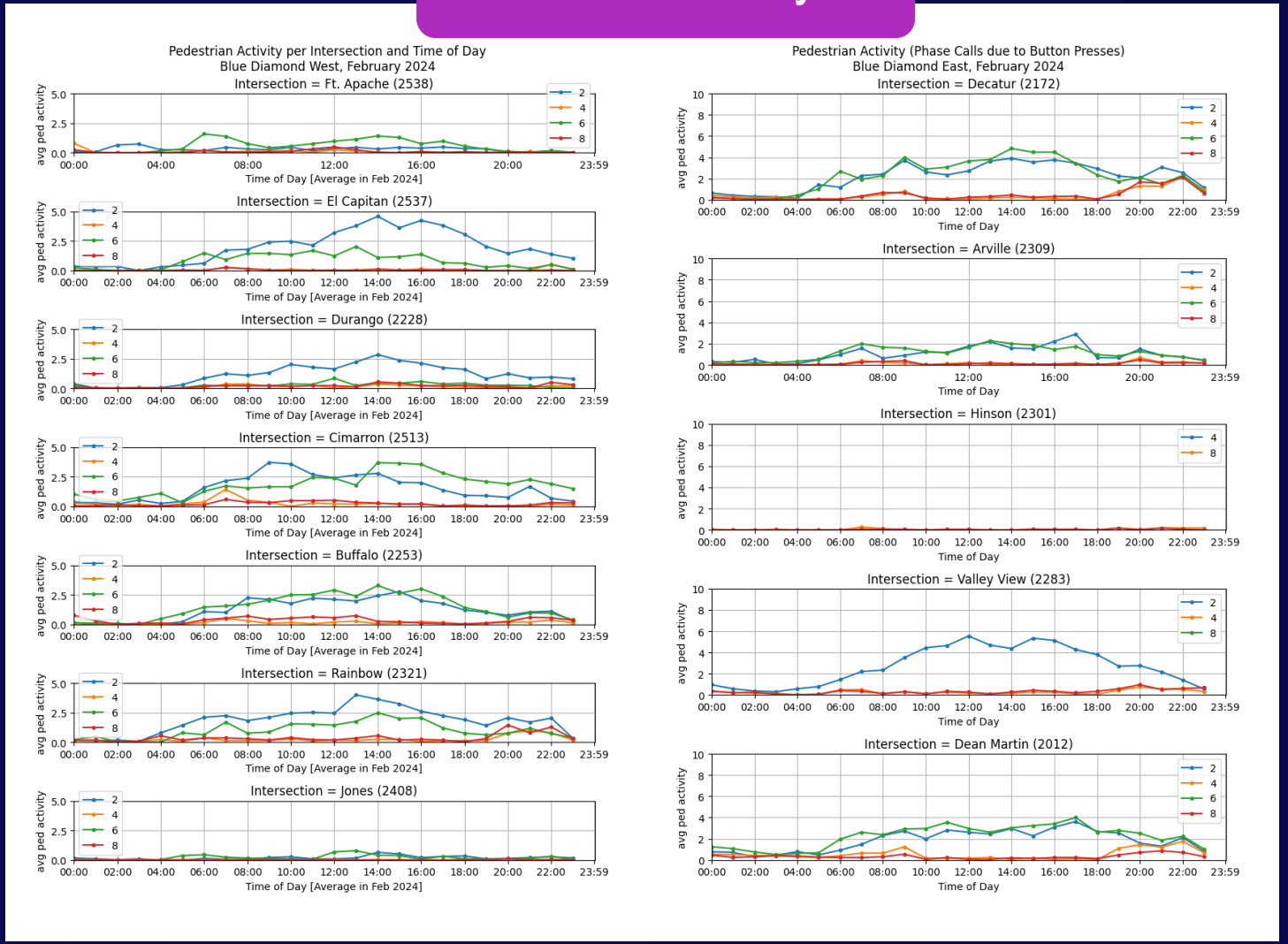


Digital twin in X Way platform (intersection of Blue Diamond Road and S Rainbow Boulevard)

X Way - Elevated Pedestrian Protection

- High-res log pedestrian activities across the corridor
- Better understanding of how the corridor should be modeled and optimized

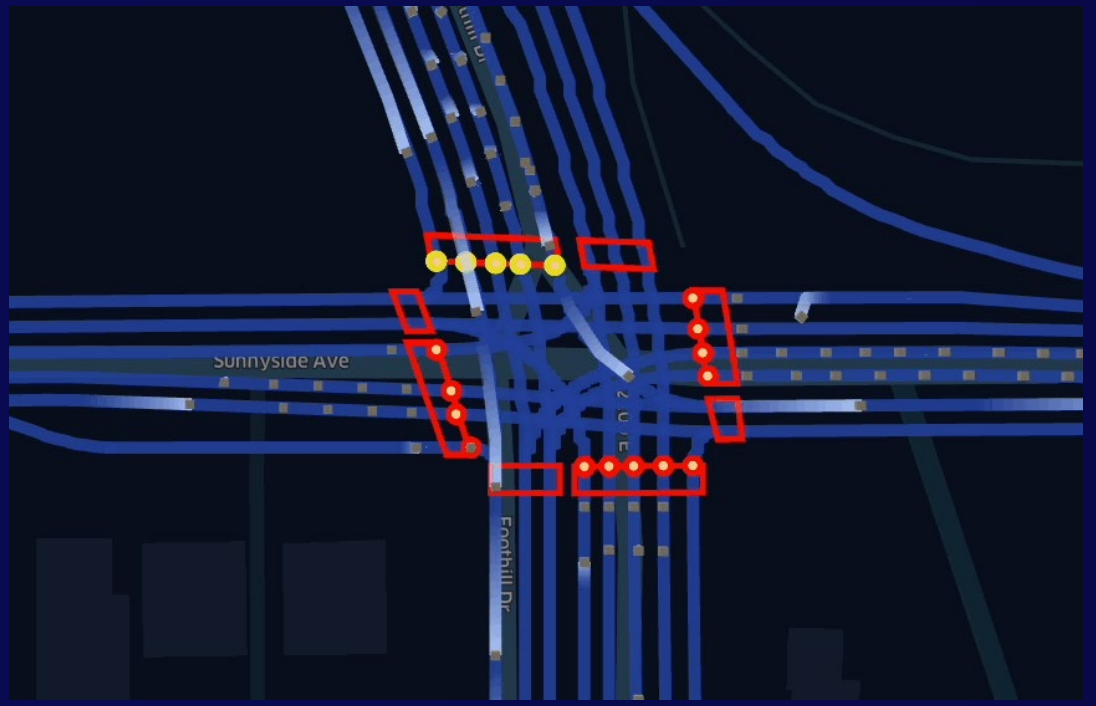
Pedestrian activity



Number of cycles per hour with a registered pedestrian call (Feb 2024 M -F)

Enhanced Pedestrian Support

- RTC directive – remove oversized ped
- X Way enhanced accordingly:
  - Added pedestrian activation to simulation, based on HighRes log detection activation
  - Added Ped crossing to visualizer



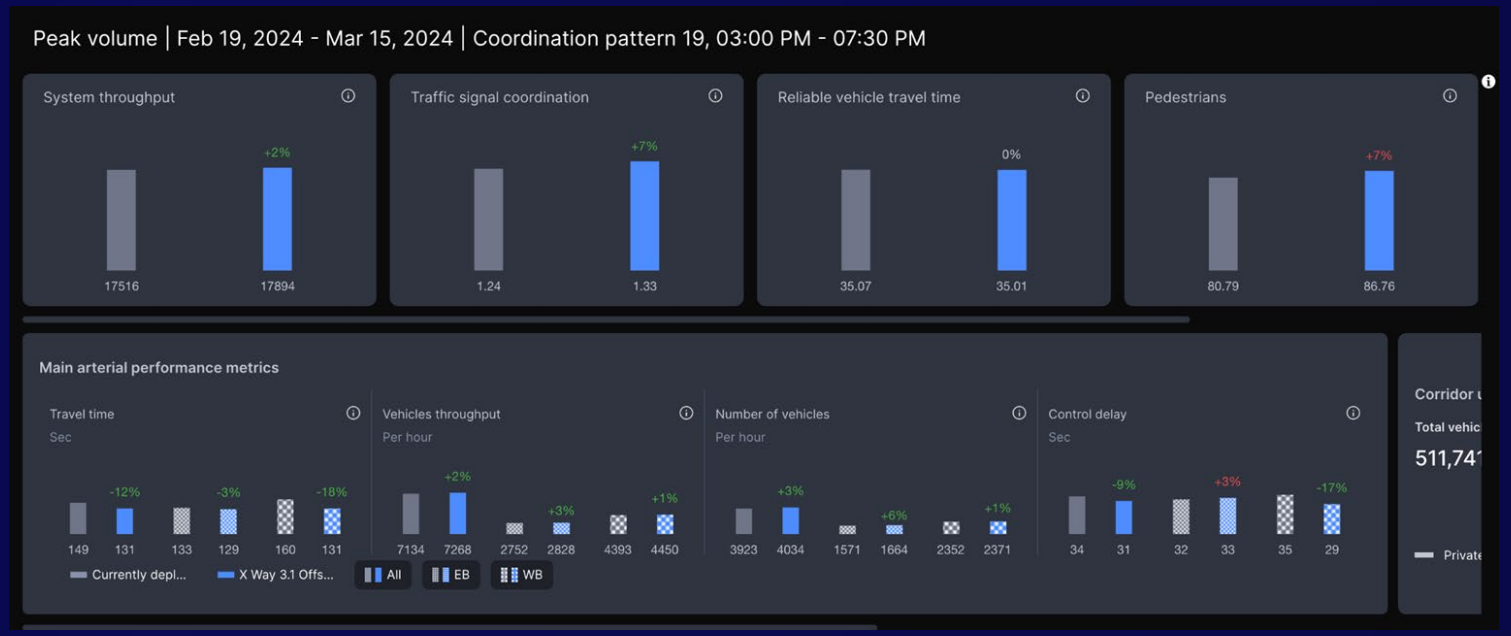
AI processing using reinforcement learning

- Automatically tested 65,930 iterations of signal timing configurations using the digital twin
- Identified the signal timing plan that yielded the most favorable results to improve main arterial time without major detriment to level of service for non-coordinated approaches

Backend of optimization in X Way

Pre-deployment analysis

- Before deploying the new plans in the field, X Way users could view the expected impact of the signal timing plan on measures such as control delay, arrivals on green, and number of stops

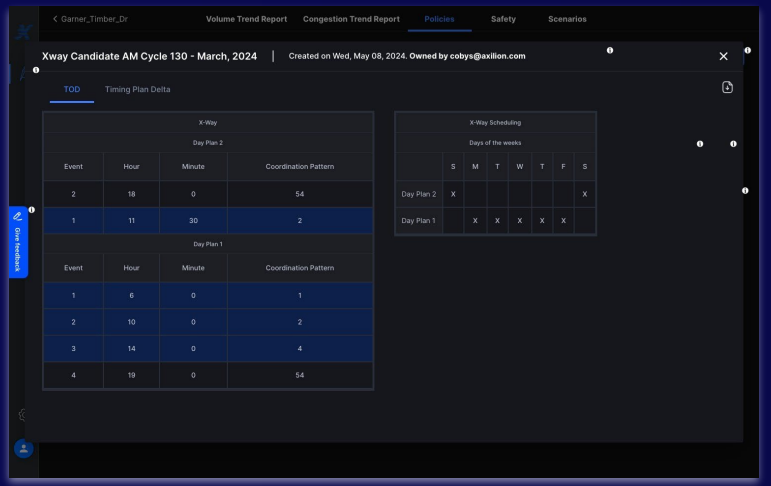


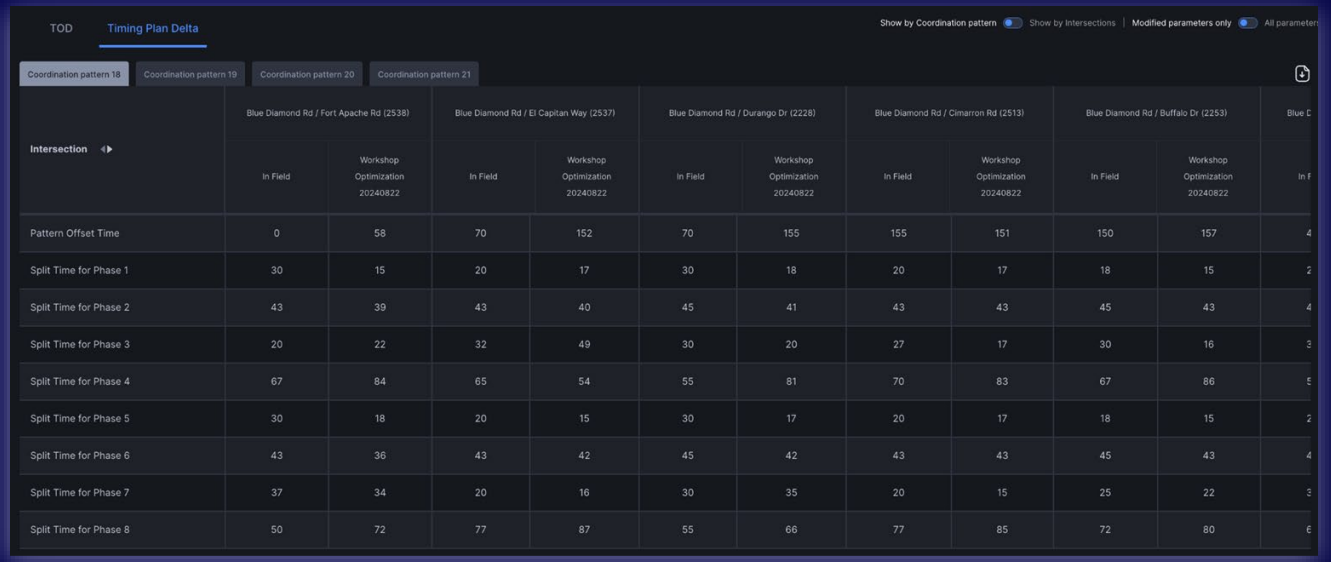
X Way analytics dashboards comparing projected outcome of signal timing plan changes

https://axilion.com/blog/measuring-traffic-signal-performance/

Optimized set of signal timing plans

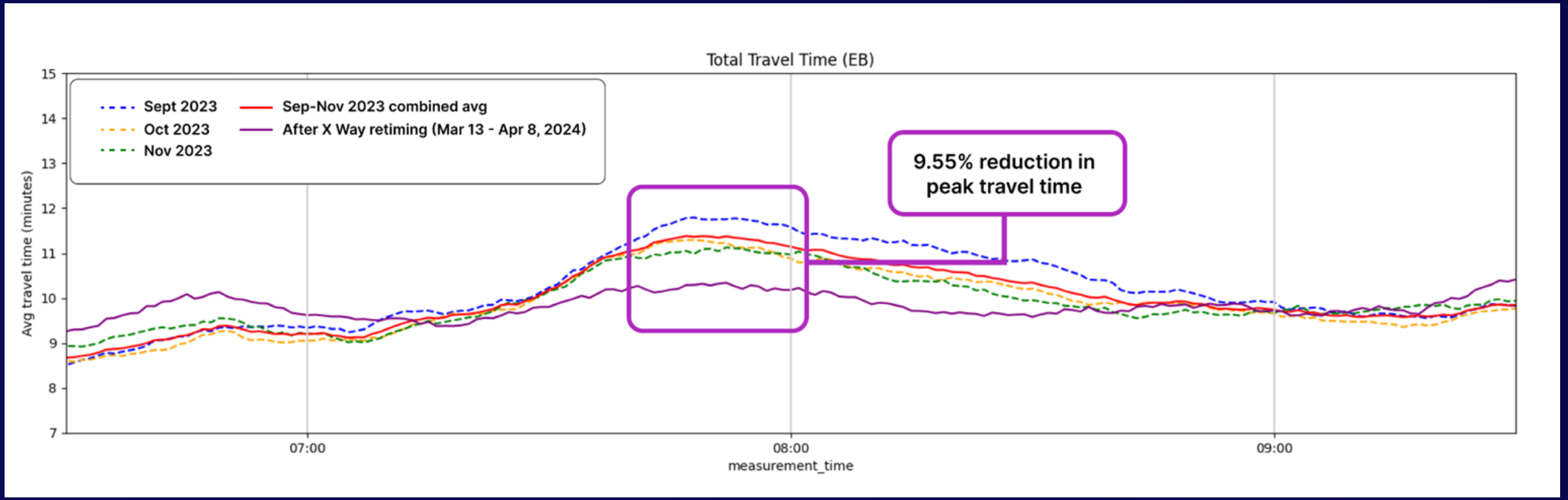
- Full set of recommended splits and offsets per each intersection and coordination pattern
- Available via the UI, or can be exported to CSV and PDF files, timing sheets databases to be downloaded directly to the controller





Results: AM Peak

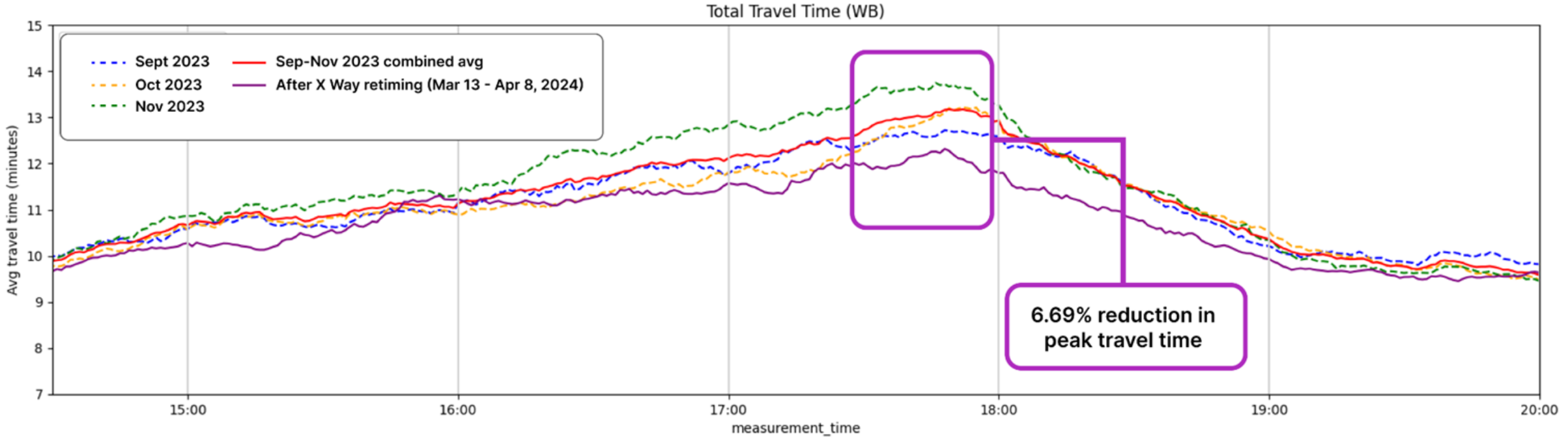
- 9.55% reduction in travel time for the eastbound traffic at the 7:47 AM peak



Morning travel times for Eastbound traffic, INRIX @1min resolution

Results: PM Peak

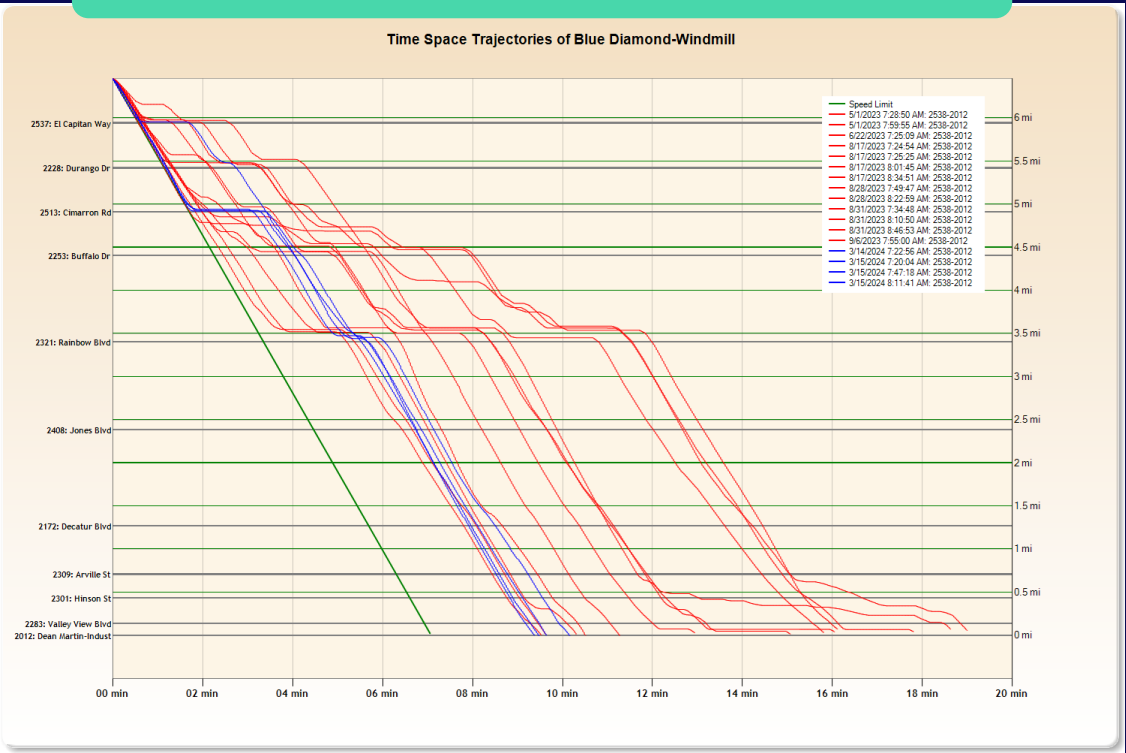
- 6.69% reduction in travel time for the westbound traffic at the 5:47 PM peak



Afternoon travel times for Westbound traffic, INRIX @1min resolution

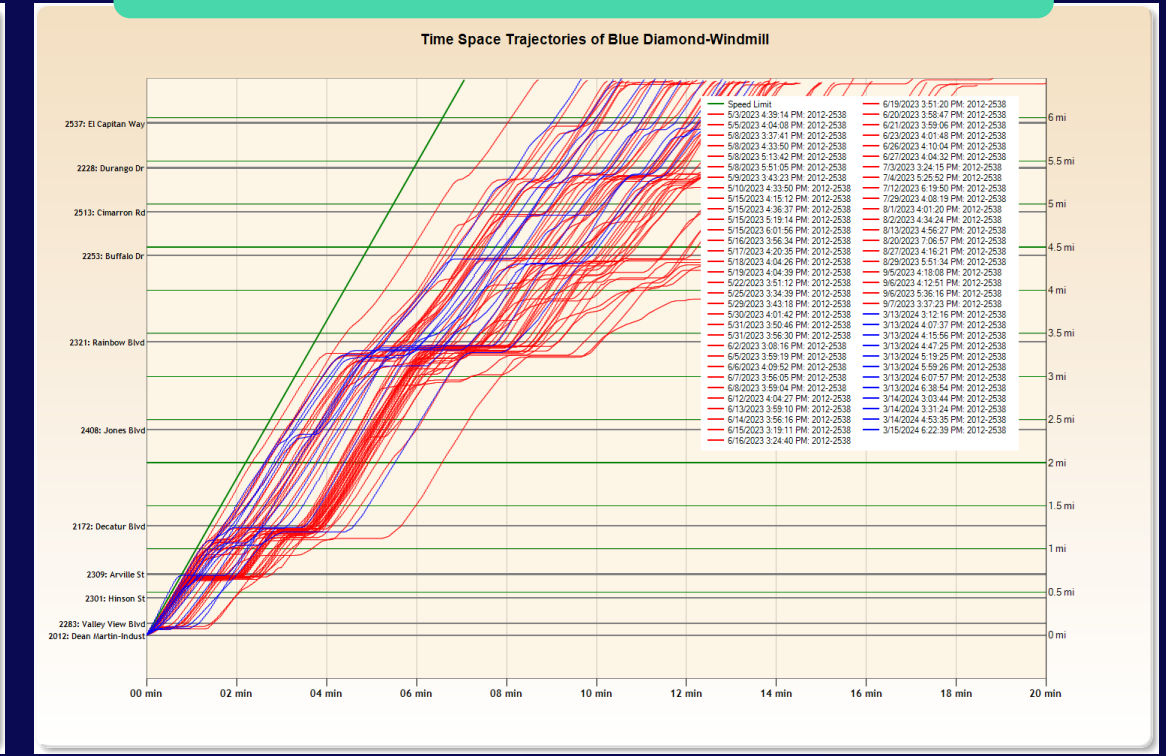
Travel time runs

Morning - Eastbound Traffic (7am-9am)



- **Samples Collected:**
  - Before deployment: 13
  - After deployment: 4
- **Findings:**
  - 31.2% reduction in travel time after deployment

Afternoon - Westbound traffic (3pm -7:30pm)



- **Samples Collected:**
  - Before deployment: 52
  - After deployment: 12
- **Findings:**
  - 13.1% reduction in travel time after deployment

Many thanks to the RTC team for their excellent support & guidance!

Questions?

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