AI Pedestrian Detection for Real-Time Safety Intervention

Real-Time Traffic Signal Safety Interventions with Bellevue Washington

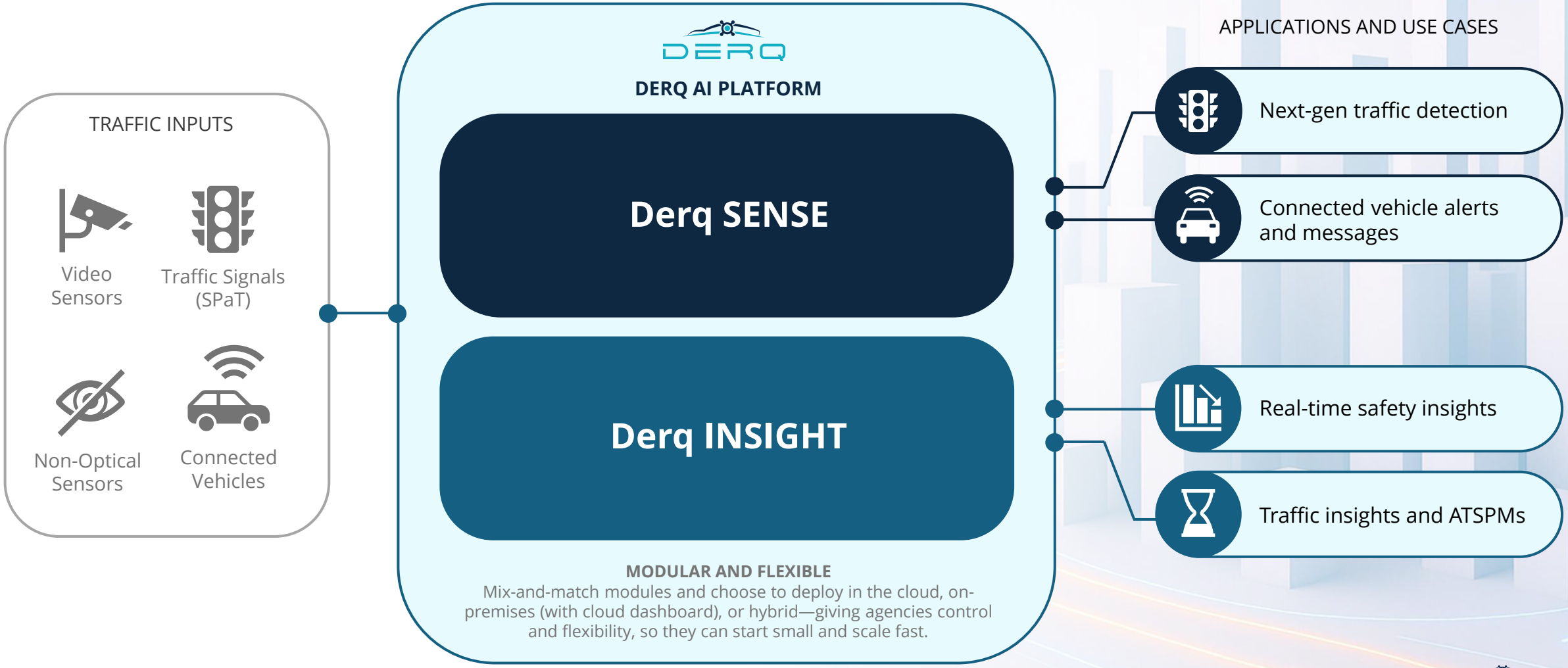
Who We Are and What We Do

Our mission is to eliminate road fatalities and power the future of safer, smarter roadways. We help cities improve safety and optimize traffic flow for all road users.

An MIT spinoff founded in 2016, our award-winning ITS technology is deployed across 17 U.S. states, Canada, and the GCC region, with 20 patents and global recognition from leaders in AI and mobility.

Our Product Portfolio

Our AI platform **detects, tracks, classifies, and predicts** to optimize traffic safety and flow for all road users



Our Technology

Our AI platform **detects, tracks, classifies, and predicts** to optimize traffic safety and flow for all road users

Next-Gen Traffic Detection

- Vehicles (trucks and cars)
- Vulnerable road users (pedestrians, bikes, and scooters)
- Inclement Weather, Nighttime, Glare, etc.

Real-Time Safety Insights

- Crashes
- Near-misses (vehicle and pedestrians)
- Violations
- Wrong ways

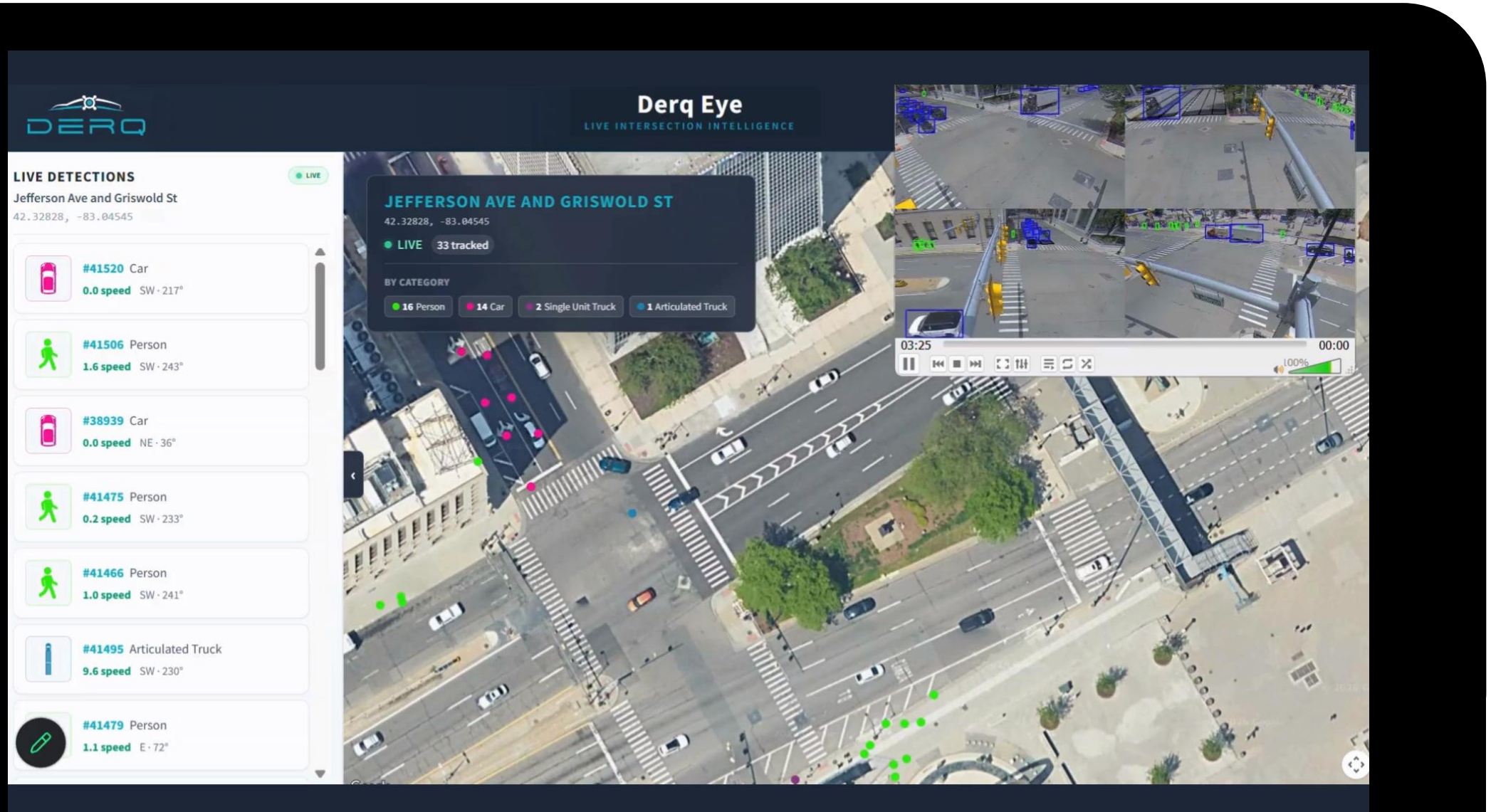
V2X Alerts

- Real-time V2X alerts and safety messages

Traffic Insights and ATSPMs

- Automated incident detection
- Counts, classification, turning movement, ATSPMs

Derq AI at Work



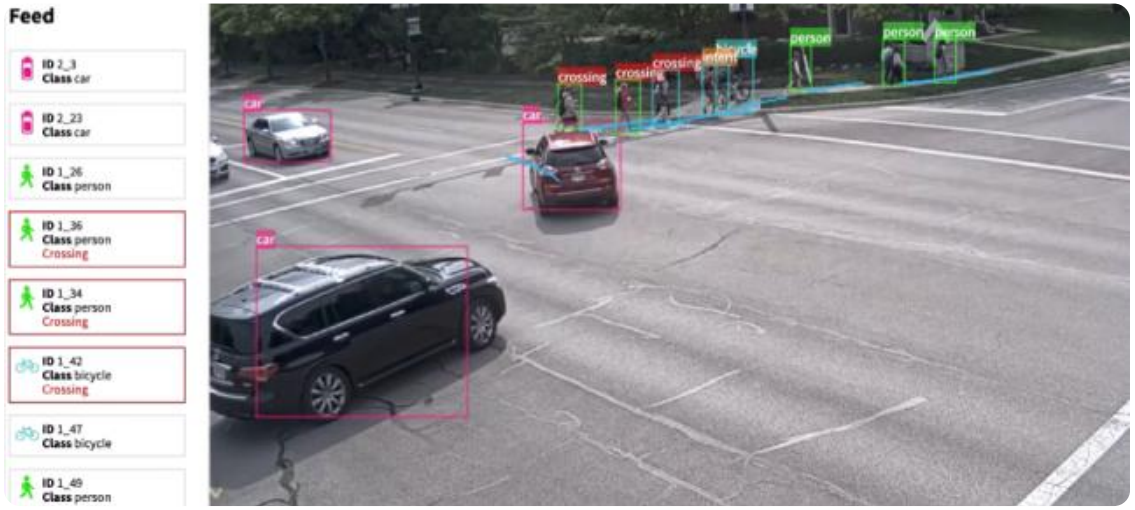
Multimodal Classification

VRU Detection

- Pedestrian
- Bicycle
- Mobility aid user
- Personal mobility device

Vehicle Detection

- Car
- Minibus van
- Pickup truck
- Bus
- Single unit truck
- Articulated truck
- Motorcycle



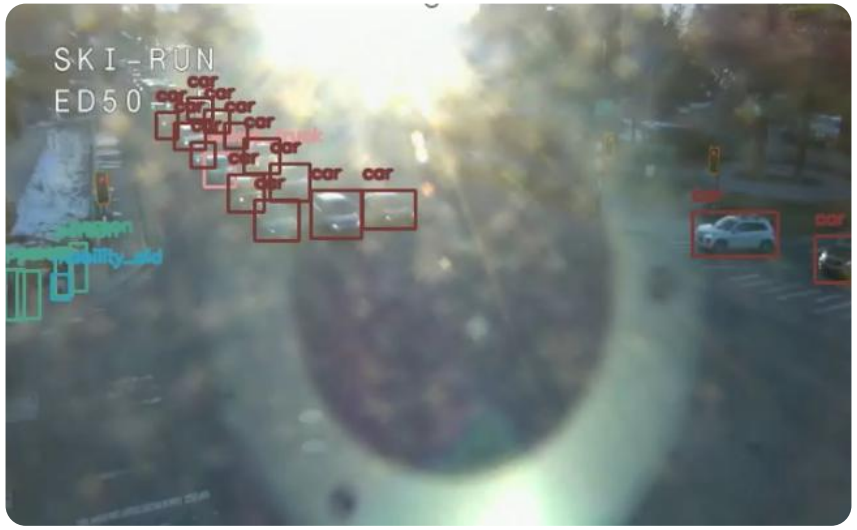
Detect in Challenging Conditions

Low Visibility

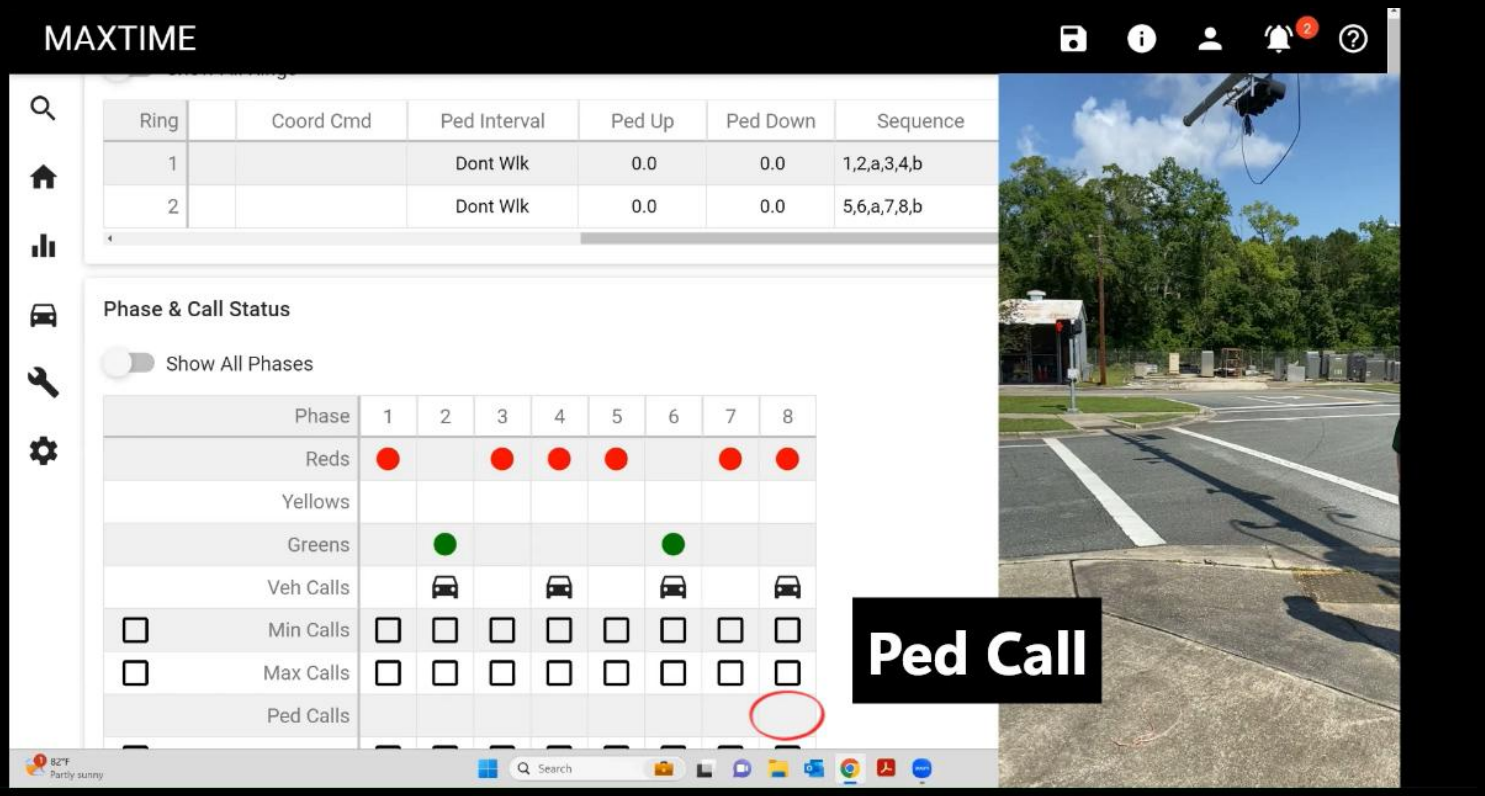
- Night
- Low light
- Smoke and haze

All Weather

- Heavy rain
- Heavy snow
- Sun glare
- Fog



Passive Ped Detection… Extension (controller agnostic)

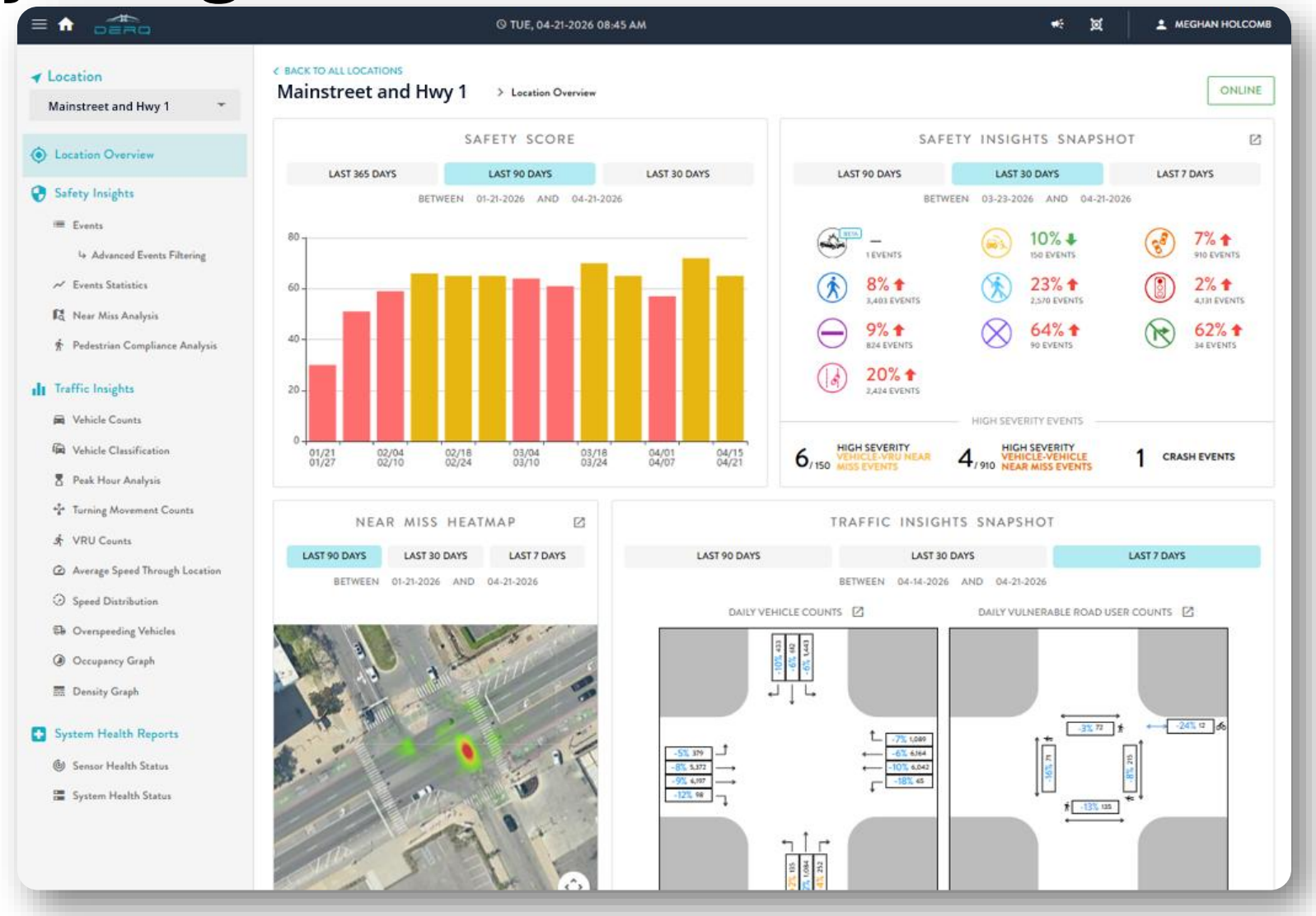


Ped Call Extension (Max)

Real-Time Safety Insights

AI Platform and Dashboard

- **Events summary**
- **Events statistics**
- **Near-miss analysis**
  - Including heatmaps and configurable severity analysis plots
- **Pedestrian compliance analysis**
  - Including heatmaps
- **Advanced filtering**
  - Day of week, time of day, detection area, related events, severity, speed, movement, type, involved parties, and more



Safety Events

Crash

Near-Miss
(Vehicle-VRU)

Near-Miss
(Vehicle-Vehicle)

Wrong Way

Illegal Crossing

Ped Signal Violation

Red Light Violation

Stopped Vehicle

Illegal Turning Movement

Lane Compliance Violation

ROW Intrusion

Animal on Road

Pedestrian Compliance Heatmap

Display concentrations of illegal pedestrian crossing events. Apply filters to see involved parties, trends, and related events.

Safety Insights—Near Miss (Veh-VRU)

Vehicle-VRU Near Miss

Event ID : 67d99d975c936c001205290a

Location
Washington Boulevard (US-301) & Main Street

Detected on
03-18-2025 12:21:40 PM

Speed
15 mph

Near Miss Type
Cutoff

Detection Area
West Leg

Road User A
Class: Pedestrian
Speed: 4 mph
Movement: TH
Direction: NB

Road User B
Class: Passenger Vehicle
Speed: 15 mph
Movement: LT
Direction: EB

Surrogate Safety Measures
PET : 3.41s
TTC : N/A
Gap Time : 0.5s
Severity : High
Max Speed : 19 mph

Safety Insights—Near Miss (Veh-VRU)

Vehicle-VRU Near Miss

Event ID : 69b1d3ef23268a0012915a77

Location
Fruitville Road & Lemon Avenue

Detected on
03-11-2026 04:43:24 PM

Speed
18 mph

Near Miss Type
Cutoff

Detection Area
Intersection Center

Road User A
Class: Bicyclist
Speed: 4 mph
Movement: TH
Direction: NEB

Road User B
Class: Passenger Vehicle
Speed: 18 mph
Movement: TH
Direction: WB

Surrogate Safety Measures
PET : N/A
TTC : 0.9s
Gap Time : 0.5s
Severity : High
Max Speed : 21 mph

Safety Insights—Near Miss (Veh-Veh)

Vehicle-Vehicle Near Miss

Event ID : 69866020dc42d500123e59cd

Location
Fruitville Road & Central Avenue

Detected on
02-06-2026 04:41:49 PM

Speed
22 mph

Near Miss Type
Cutoff

Detection Area
Intersection Center

Road User A
Class: Passenger Vehicle
Speed: 22 mph
Movement: TH
Direction: EB

Road User B
Class: Passenger Vehicle
Speed: 13 mph
Movement: TH
Direction: NB

Surrogate Safety Measures
PET : 3.21s
TTC : 0.3s
Gap Time : 0.5s
Severity : N/A
Max Speed : 24 mph

Safety Insights—Crash

Vehicle-to-vehicle crash

Crash BETA

Event ID : 67f1e4fcb2ac120012e49c36

Location
US-41 & US-301

Detected on
04-05-2025 10:19:28 PM

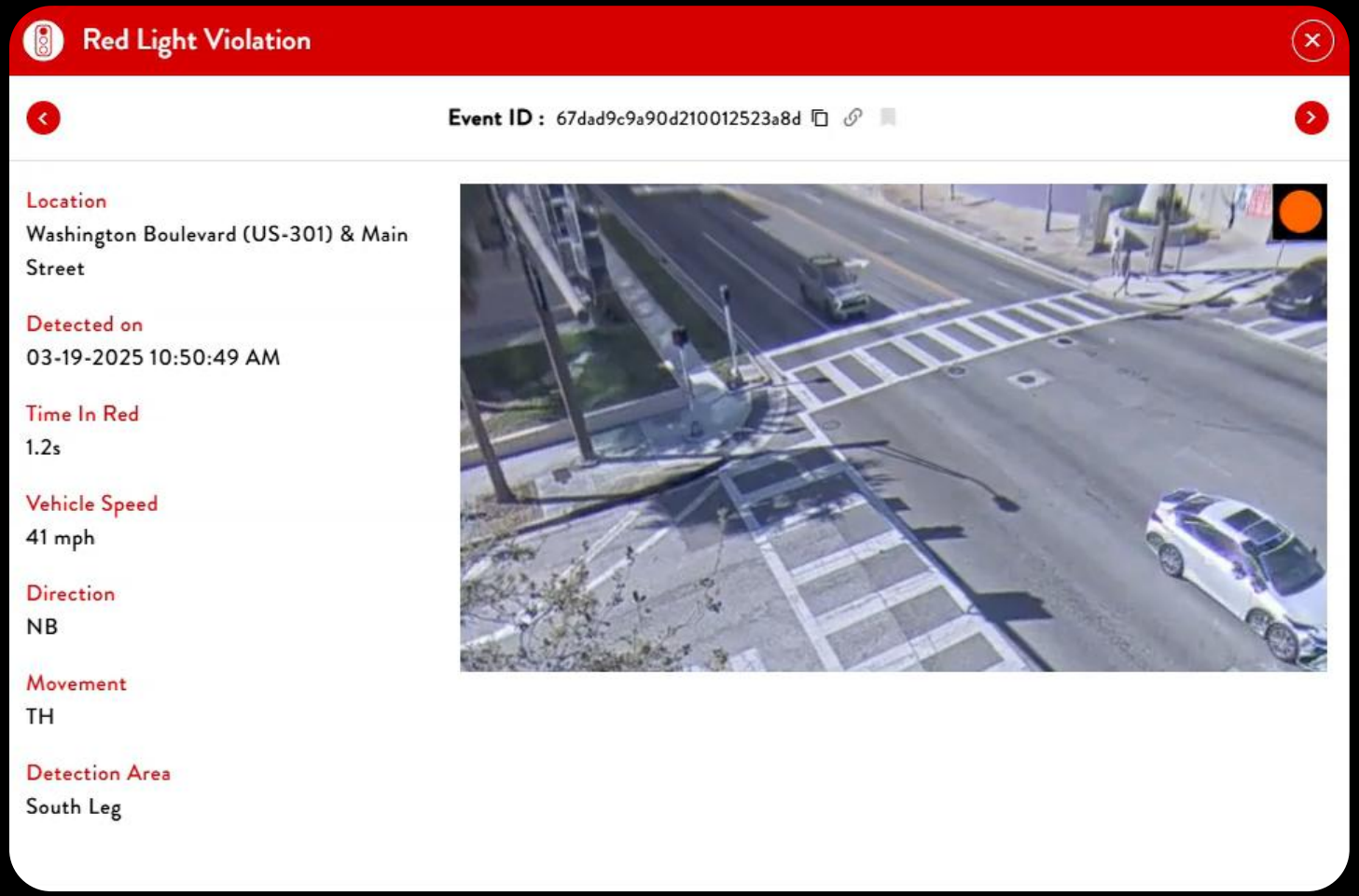
Detection Area
Intersection Center

Road User A
Class: Passenger Vehicle
Speed: 26 mph
Movement: TH
Direction: SB

Road User B
Class: Passenger Vehicle
Speed: 33 mph
Movement: TH
Direction: NWB

Safety Insights—Red Light Running

Red light violation

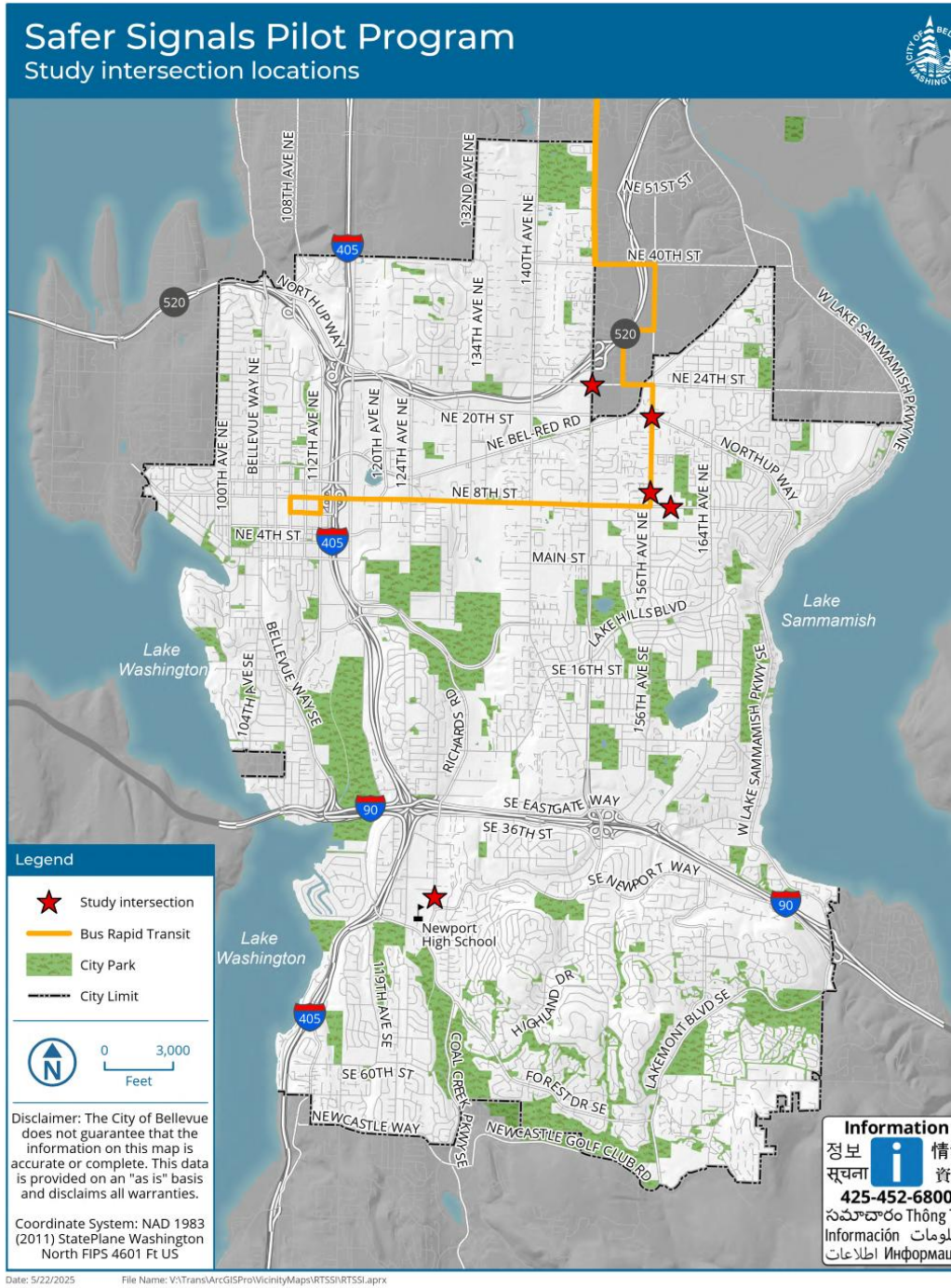


City of Bellevue RTSSI

AI Pedestrian Detection for Real-Time Safety Intervention

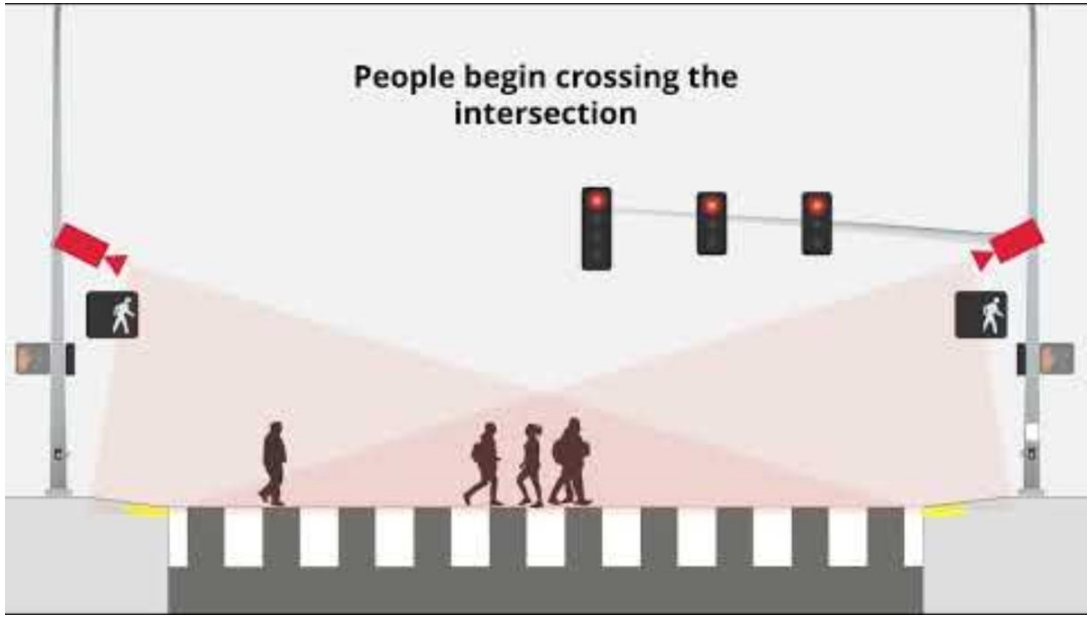
Overview

- Purpose: Use real-time signal interventions to improve intersection safety for Vulnerable road users and drivers
- Focus: Test whether signals can detect risks and automatically adjust timing/treatments at intersections
- Study Area: Five intersections in Bellevue
- Core Scenarios: Pedestrian phase extension, walk time extension, dynamic left-turn phasing, and dynamic no-turn-on-red operation
- Goal: Support Bellevue's Vision Zero effot to eliminate fatal and serious traffic crashed by 2030



Crosswalk Occupancy / Pedestrian Phase Extension

- Detects when a person walking, biking, or rolling is still in the crosswalk and needs more time.
- Uses real-time analytics to track pedestrian speed and trajectory inside the crosswalk.
- Sends an input to the signal controller to delay the start of the conflicting vehicle phase.

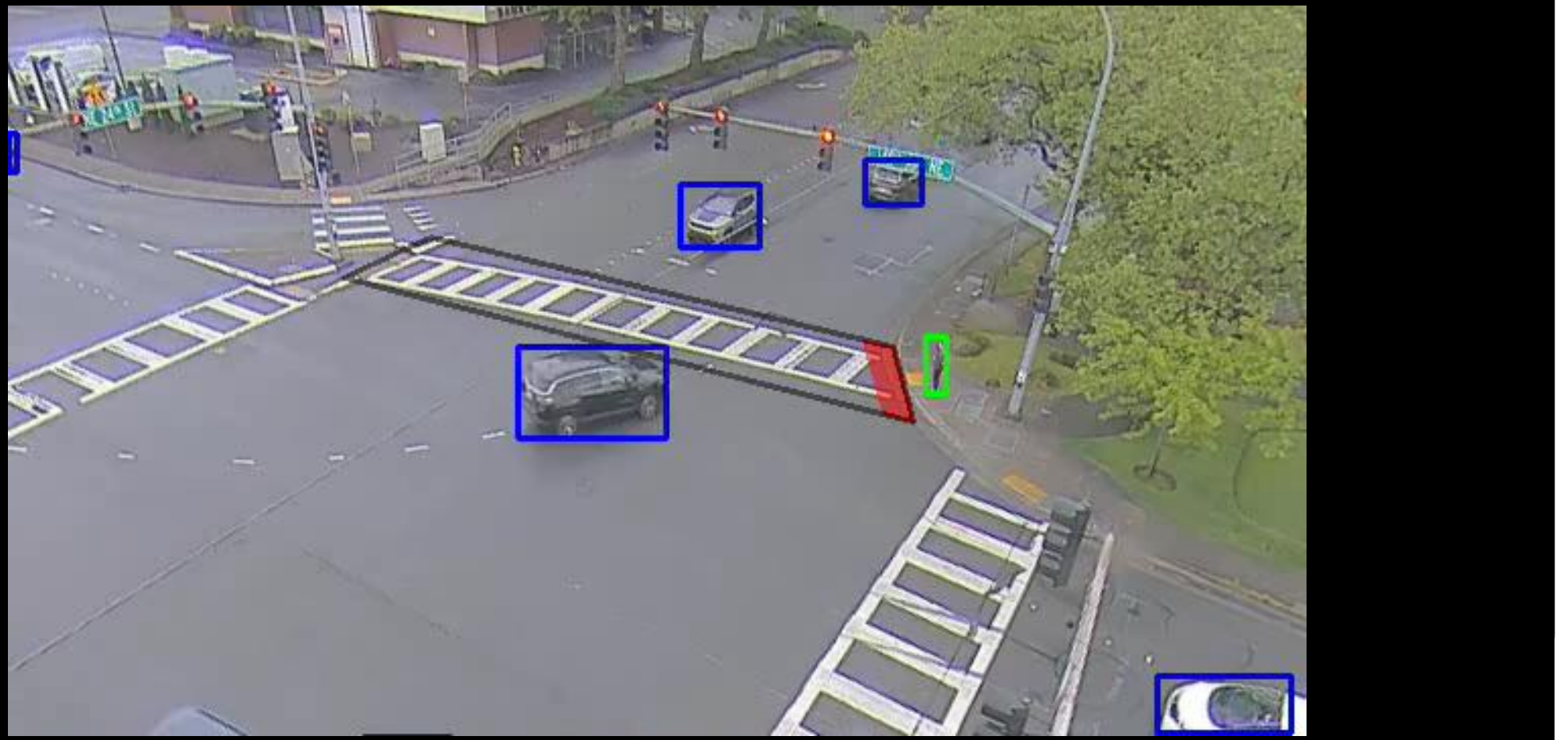


Crosswalk Occupancy / Pedestrian Phase Extension

Pedestrian Variable Conditions

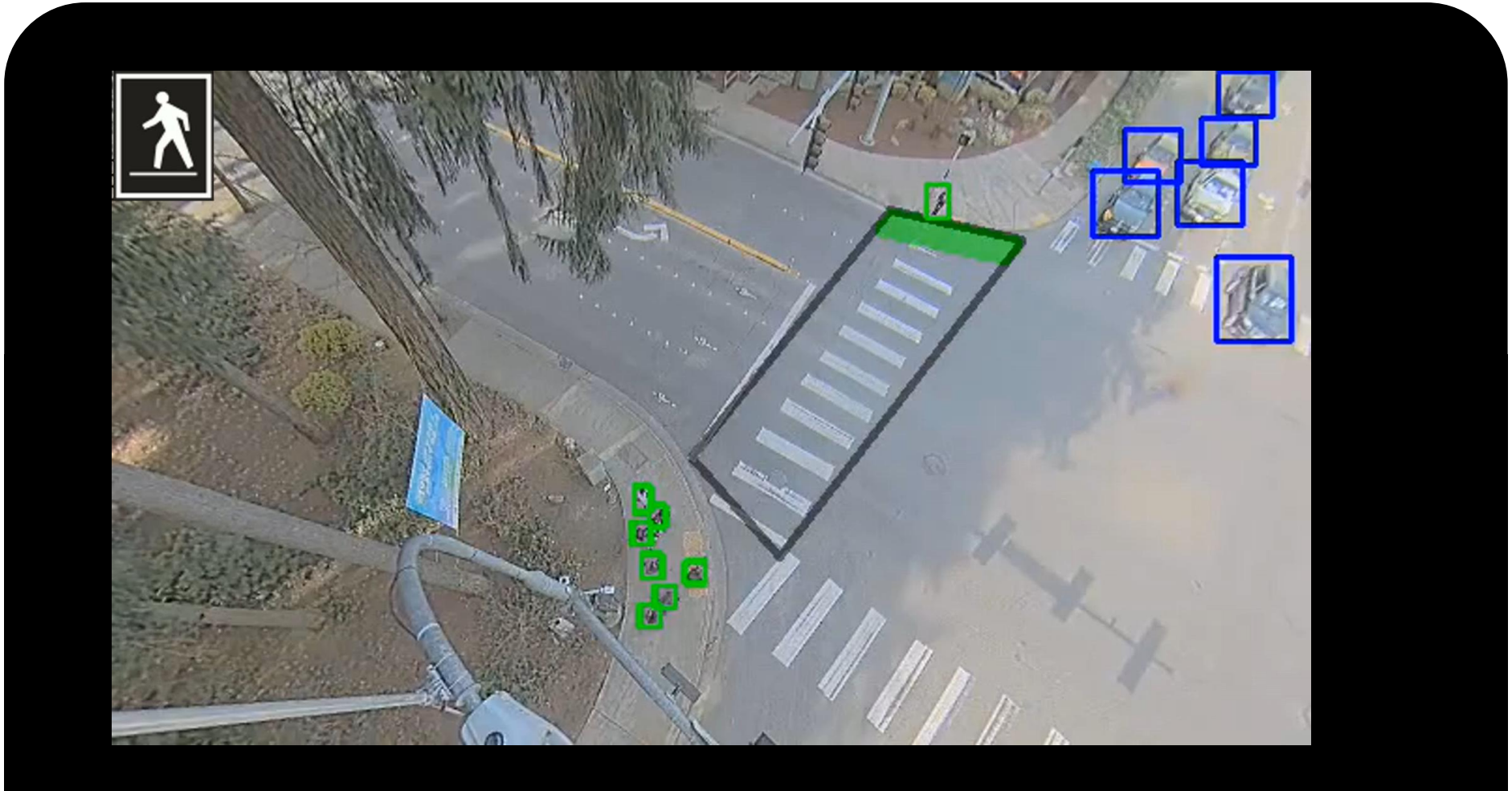
- Walk speed is not consistent
  - The first few steps off the curb can distort speed calculations
  - The system needed to ignore initial acceleration period
  - Ped speed had to be tracked continuously throughout the crossing
    - Trigger logic had to be a running average, not a single speed reading
- Directionality
  - Peds needed to be tracked bi-directionally across the same crosswalk
  - Multipole peds could be in the crosswalk at the same time, moving at different speeds
- Proactive vs Reactive
  - The system needed to determine whether a pedestrian still needed protection before the conflicting vehicle phase began

Passive Ped Detection for Extension



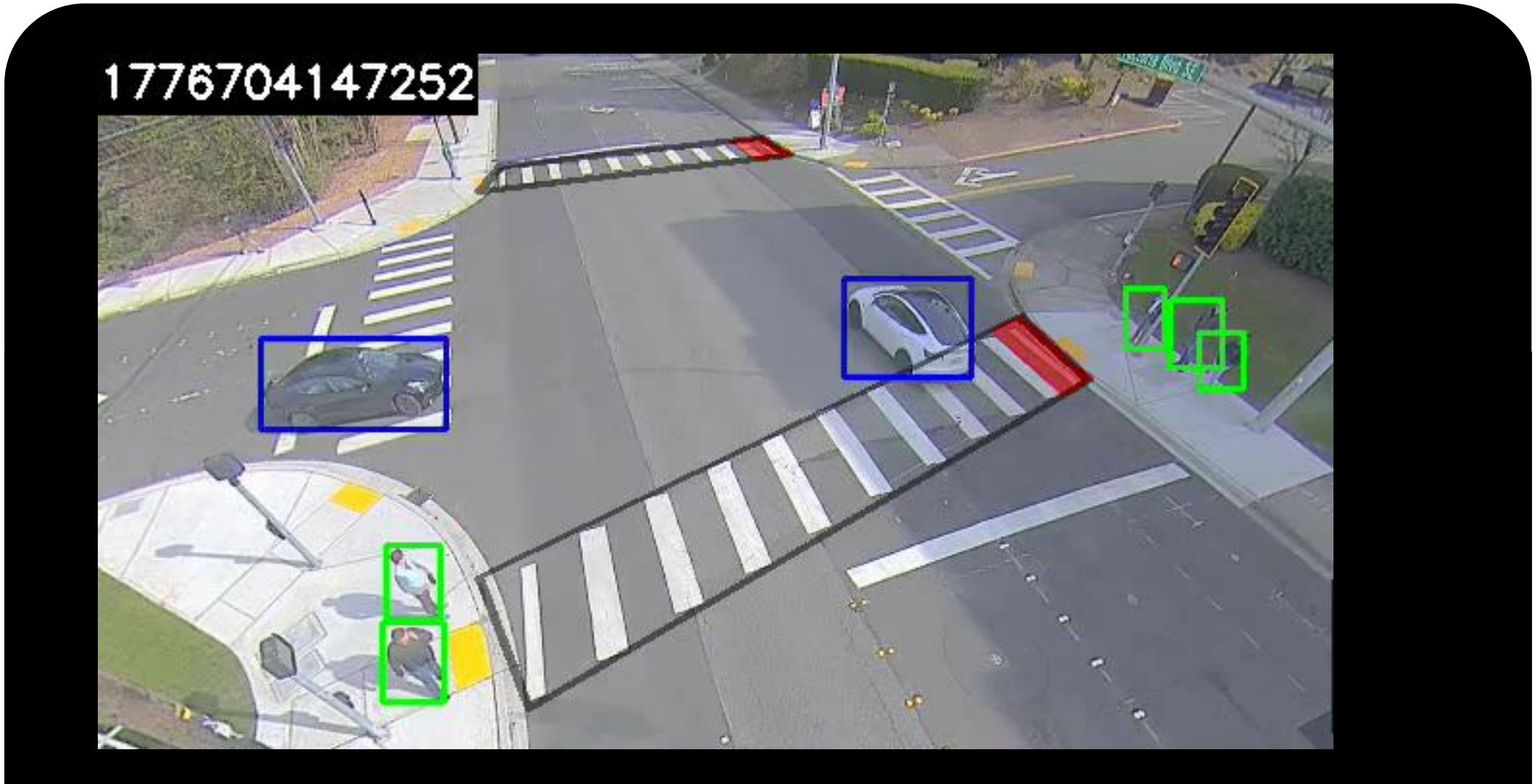
Dynamic Passive Ped Detection Based on Slow Speed

Slow Walking (Ped Extension): When 2 regular peds cross, the zone does not light up and **NO WALK CALL** was initiated . When a 3rd Ped enters and walks slowly, the zone lights up and a **WALK EXTENSION** is initiated. The **threshold** is 2.5fps for the extension during **WALK** and **NO WALK** time.



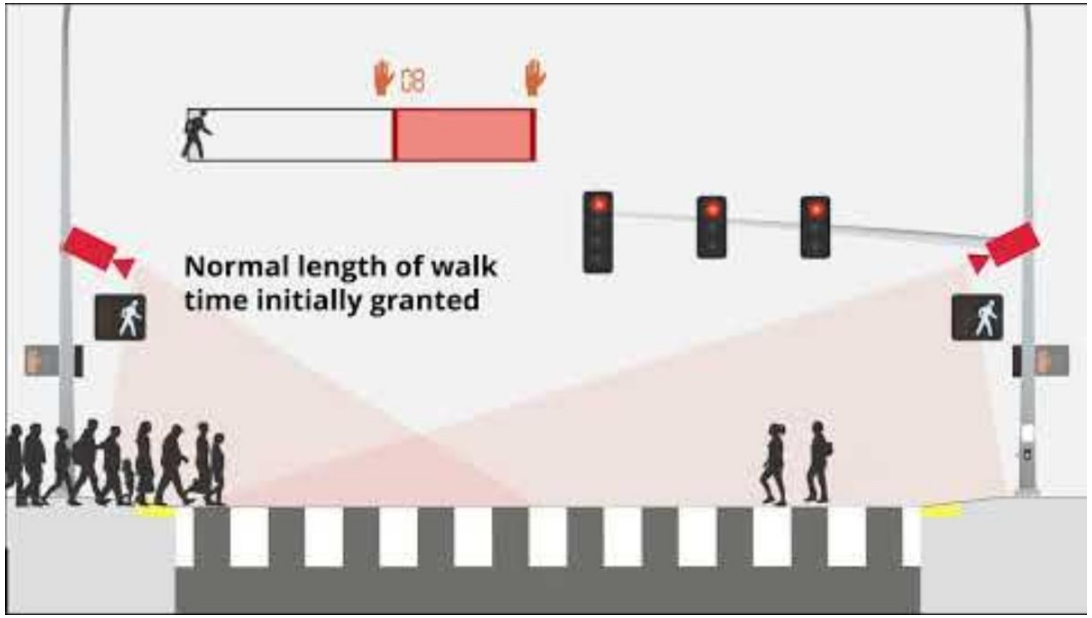
Passive Ped Detection Based on High Speed

WALK EXTENSION is not initiated because the Peds are walking **faster** than 2.5fps.



Walk Time Extension Based on Volume

- Detects the number of pedestrians entering the crosswalk at the start of WALK.
- Extends the WALK phase when pedestrian volume exceeds a defined threshold.
- Also accounts for slower-moving pedestrians based on a user-defined speed threshold.



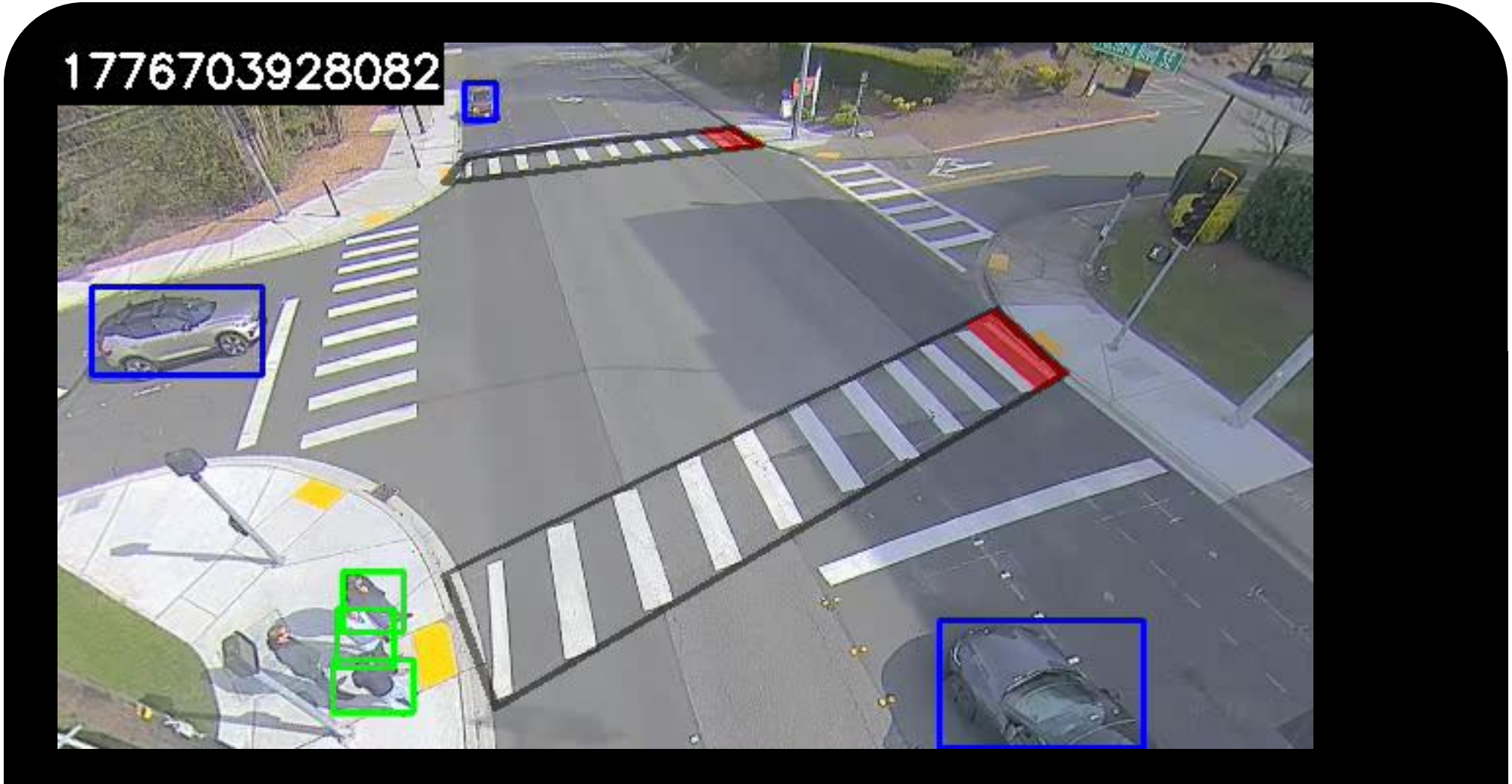
Walk Time Extension Based on Volume

Unique Conditions

- Close grouped peds
  - System needed to be able to differentiate peds, even they entered as a cluster
- Running Count
  - The system couldn’t just take a snapshot count of peds, it needed to run a continuous count of peds with that number changing as the enter and exit crosswalk at different times
  - Logic needed to avoid double-counting the same pedestrian

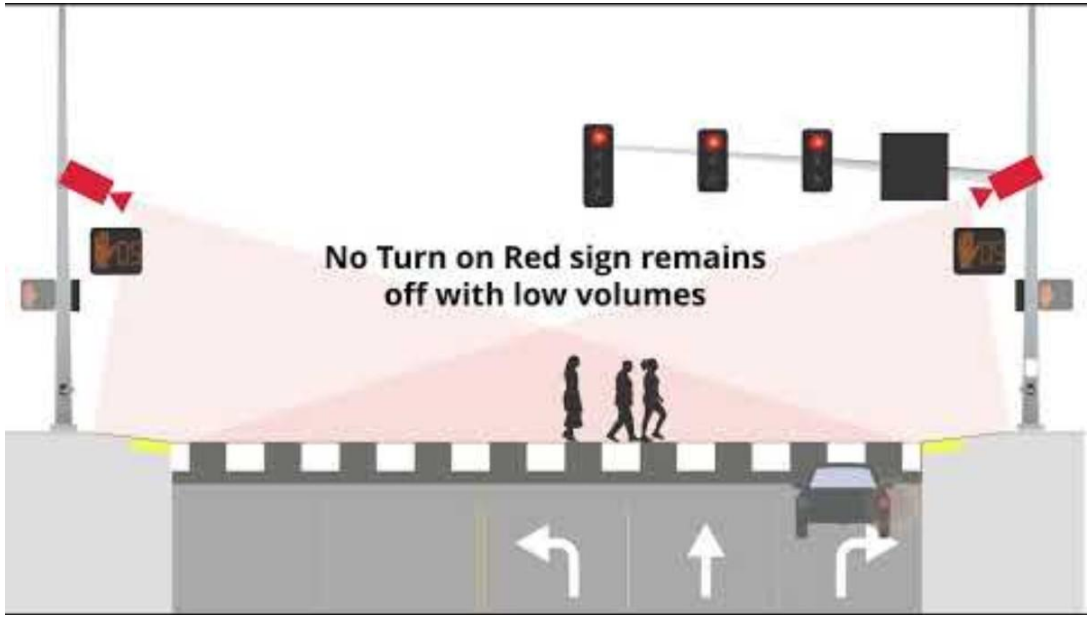
Passive Ped Surge Detection

- Any of the peds being **passively detected** are putting a **WALK CALL** in to the controller
- Once **5 members** are **passively detected** in the crossing walk, the **WALK EXTENSION** is initiated (highlighted cross walk) The **# of members** is user definable.



Dynamic No Turn on Red

- Detects active pedestrian crossing movements and right-turn vehicle demand.
- Activates a dynamic LED No Turn on Red restriction when thresholds are met.
- The traffic signal controller controls the exact sign activation, based on input from the detection system.



Dynamic No Turn on Red

How We Made It Work

- Signal phase coordination
- No direct SDLC connection in TS1 cabinet environment
- SPaT timing and latency management
- Relay-based trigger outputs to the controller
- Layered pedestrian and vehicle detection logic
- Avoiding false or unnecessary sign activations