

MALIBU



SAFETY ADAPTIVE SIGNAL SYSTEM:
Enhancing Traffic Safety on PCH

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Kimley»Horn

Expect More. Experience Better.



EXCESSIVE SPEEDING

How much does excessive speeding contribute to an unsafe corridor?

(Source: [Portland.gov - Top Contributing Factors to Traffic Deaths](https://www.portland.gov/transportation/2022/04/20/portland-top-contributing-factors-to-traffic-deaths)).

“Speed was reported to play a role in **at least 42%** of deadly crashes between 2017 and 2021, including either driving over the speed limit or driving too fast for road conditions. When serious injuries are factored in with traffic deaths, **at least 28%** of crashes involve the driver’s speed. In five years, 471 people who died or suffered life-altering injuries due to speed. The percentages above are the crashes with speed reported as a factor, however the role that speed plays in fatal and serious injury crashes is often **undercounted**. ”



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WHAT FACTORS CONTRIBUTE TO AN UNSAFE CORRIDOR?

1. Driver behavior:

1. Distracted drivers
2. Impaired drivers

2. Corridor characteristics:

1. Conditions that facilitate excessive speeding – light traffic, good signal timings, wide roadways, high speed limits, sparsely spaced intersections
2. Visibility – most pedestrian fatalities occur at night
3. Proximity to high-volume pedestrian areas (e.g. schools, malls, venues, etc.)



WHAT FACTORS CONTRIBUTE TO AN UNSAFE CORRIDOR?

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What is within our power to change within a reasonable budget and timeframe?

2. Corridor characteristics:

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Challenges

- **Perceived tradeoff between safety and mobility**
- **Some of our tools don't work across the day**
 - Rest in Red
 - Timing to reduce speeding opportunities
- **Most of our strategies are binary**



SPEED-RELATED COLLISIONS

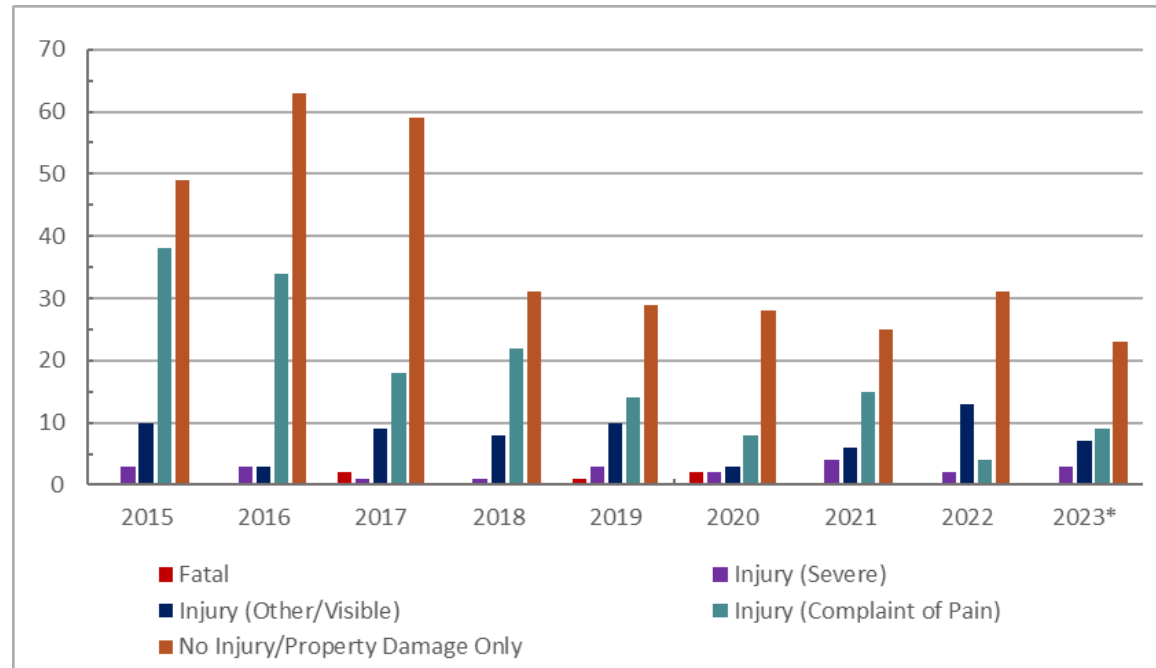




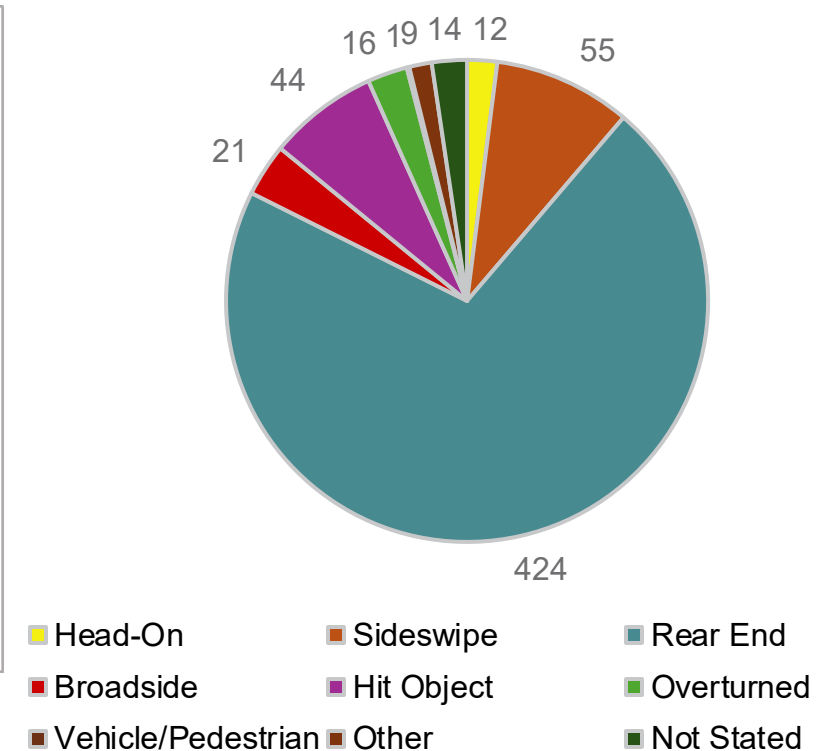
THE CITY OF MALIBU – SAFETY ASSESSMENT

Year	Number of Collisions
2015	100
2016	103
2017	89
2018	62
2019	57
2020	43
2021	50
2022	50
2023*	42
Total	596

PCH 2015-2023 Speed-Related Collisions by Type



PCH 2015-2023 Speed-Related Collisions by Cause





SAFETY ADAPTIVE APPROACH

What is “*Safety Adaptive*”?

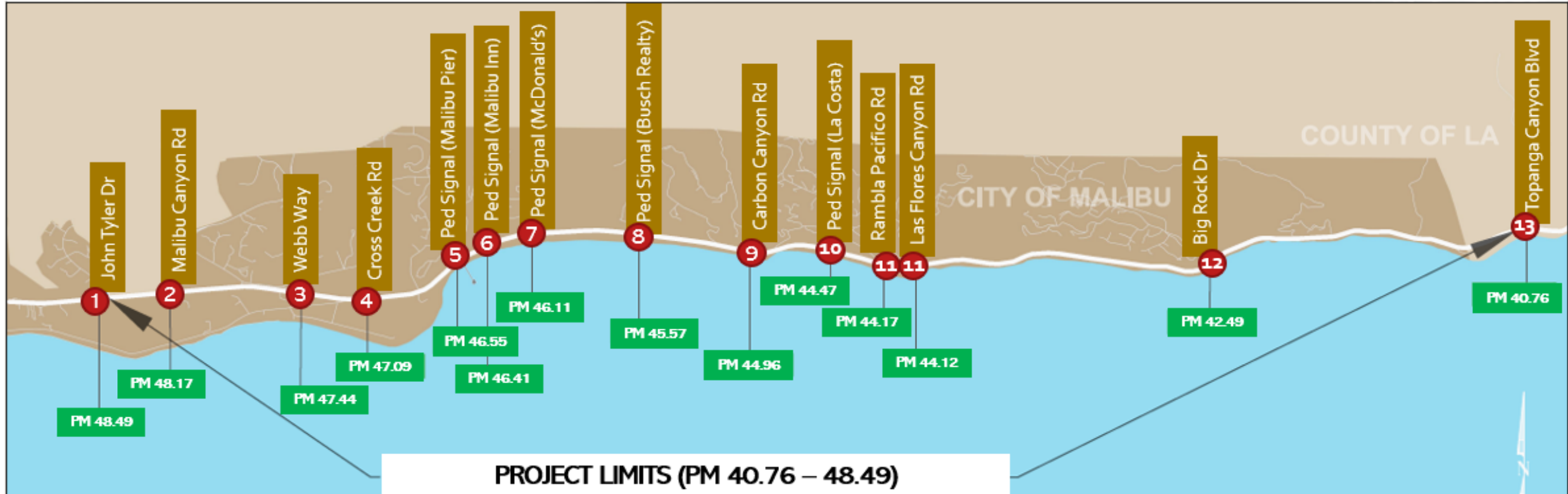
Technology designed to take real-time vehicle speeds as an input and, when unsafe driving conditions (i.e. motorists speeding) are detected, adjust the signal timings to stop motorists at more red lights until the unsafe condition is no longer detected.

This allows a “**dynamic speed bump**” on major roadways that only activates when you need it.



PROJECT OVERVIEW

- SR-1/PCH from John Tyler Dr to Topanga Canyon Blvd
- Approximately 8 miles with 13 signalized intersections



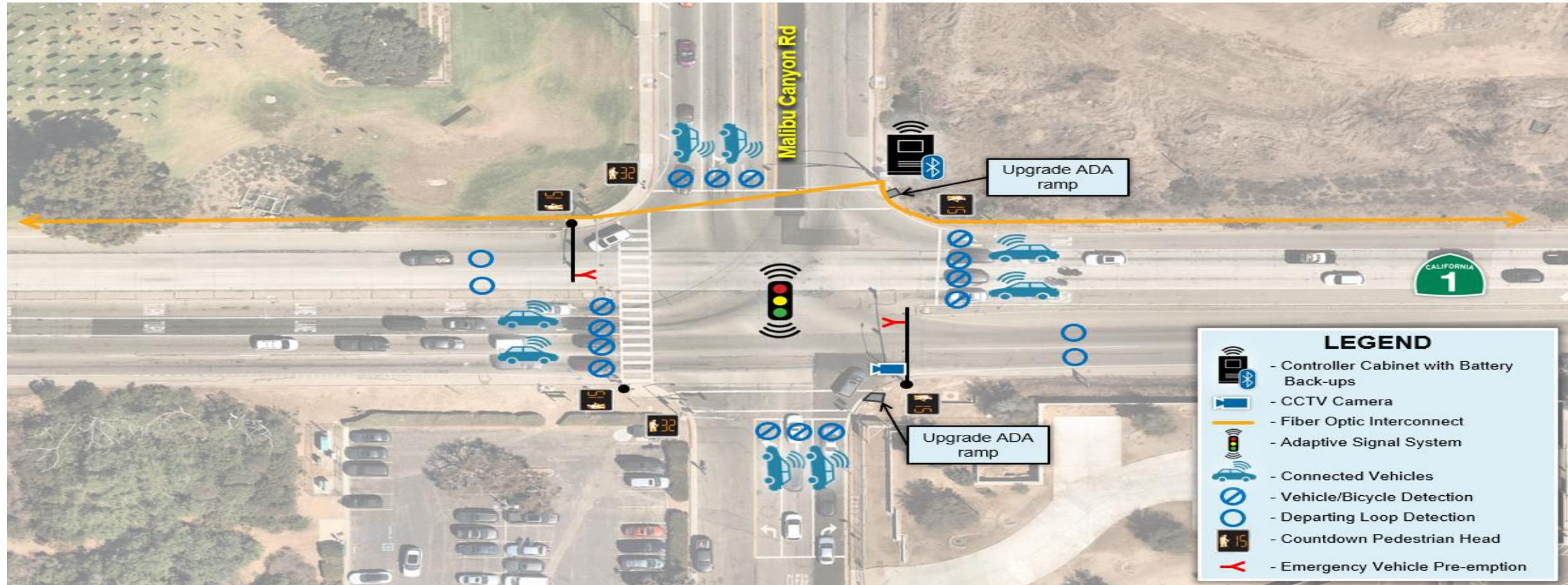


PROJECT OVERVIEW – PCH SIGNAL SYNCHRONIZATION





PROJECT OVERVIEW – INTERSECTION ENHANCEMENTS





SAFETY ADAPTIVE APPROACH

Kadence Adaptive Traffic Control System (ATCS) Software:

- Centralized adaptive traffic control
 - *No equipment in the cabinet*
- Controllers polled once per second
- Coordination parameters modified every couple cycles
- Works with all modern traffic signal controllers
- Works with all detection technologies
- Safety-based adjustments possible where speed sensing instrumentation is available



Kadence Safety Adaptive Process Flow

Malibu PCH

TMC/TOC/Central

Kadence Algorithms and GUIs

② Inputs

Outputs ③

Field Devices

① Outputs

Inputs ④

D4 Traffic Signal
Controller



Traffic Signals



Speed Trap
Loops



Iteris
Vector

Process Steps

- ① D4 traffic signal controller sends second-by-second detector and phasing info + minute-by-minute binned vehicle speeds from speed trap loops to Kadence. Iteris Vector Camera sends minute-by-minute binned vehicle speeds to Kadence.
- ② Kadence receives the phasing and detector data from field devices and the safety adaptive algorithm processes data to determine appropriate timing and safety optimizations.
- ③ Kadence safety adaptive algorithm generates timing plan optimizations designed to either improve traffic flow or, if unsafe speeding is detected, increase the occurrence of red lights. These optimizations are typically generated every 3 cycles (e.g. ~4-6 minutes).
- ④ Kadence sends the new optimized timing to the traffic signal controller and initiates a central command to make the controller run this plan.
- ① The process repeats starting again at step 1.

Prepared by:

Kimley»Horn

Aug 2025



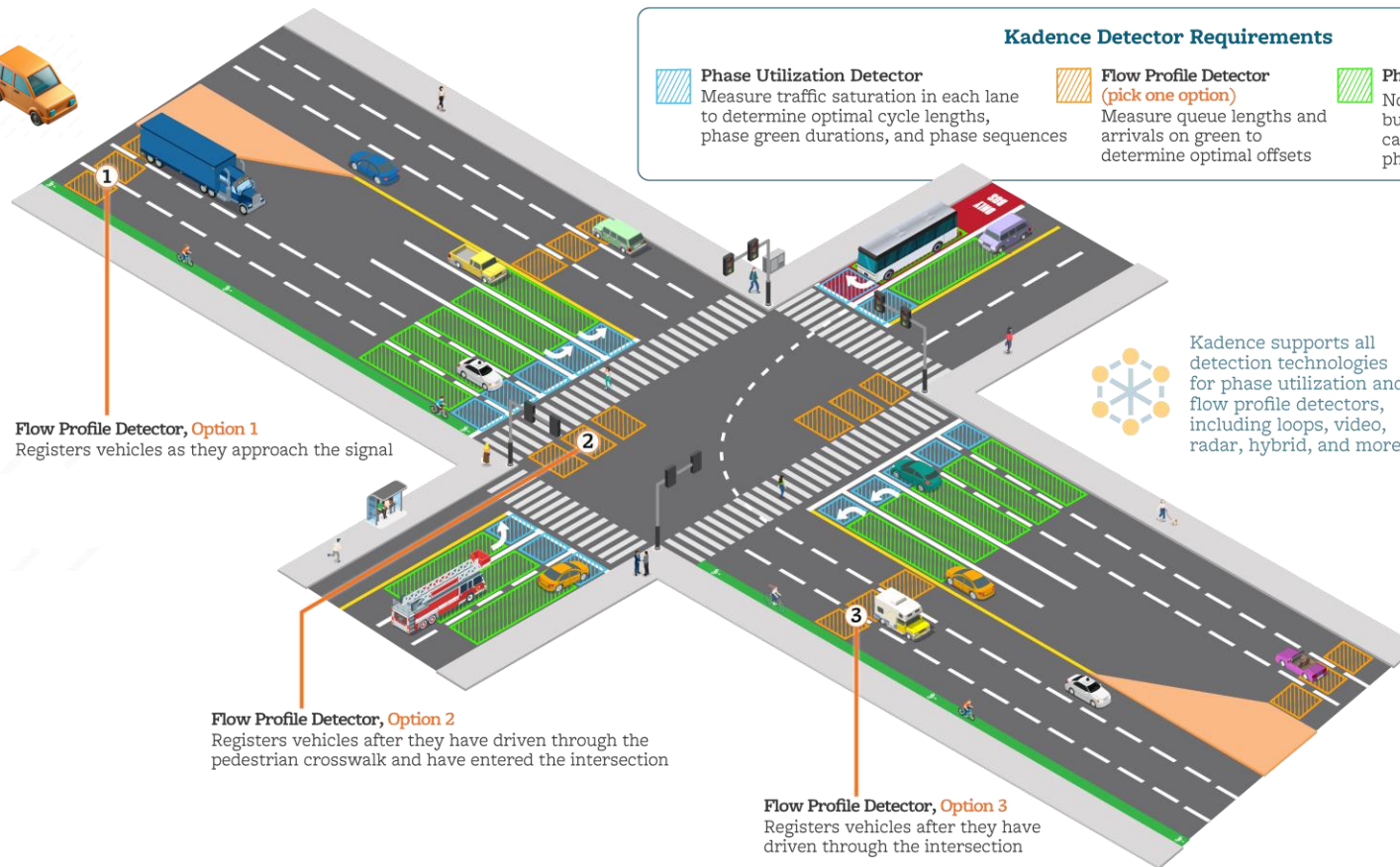
TRADITIONAL ADAPTIVE APPROACH

Kadence Detector Requirements

 **Phase Utilization Detector**
Measure traffic saturation in each lane to determine optimal cycle lengths, phase green durations, and phase sequences

 **Flow Profile Detector (pick one option)**
Measure queue lengths and arrivals on green to determine optimal offsets

 **Phase Call Detector**
Not used in Kadence calculations but necessary for ensuring vehicle calls/extensions are placed for each phase. May cover multiple lanes.





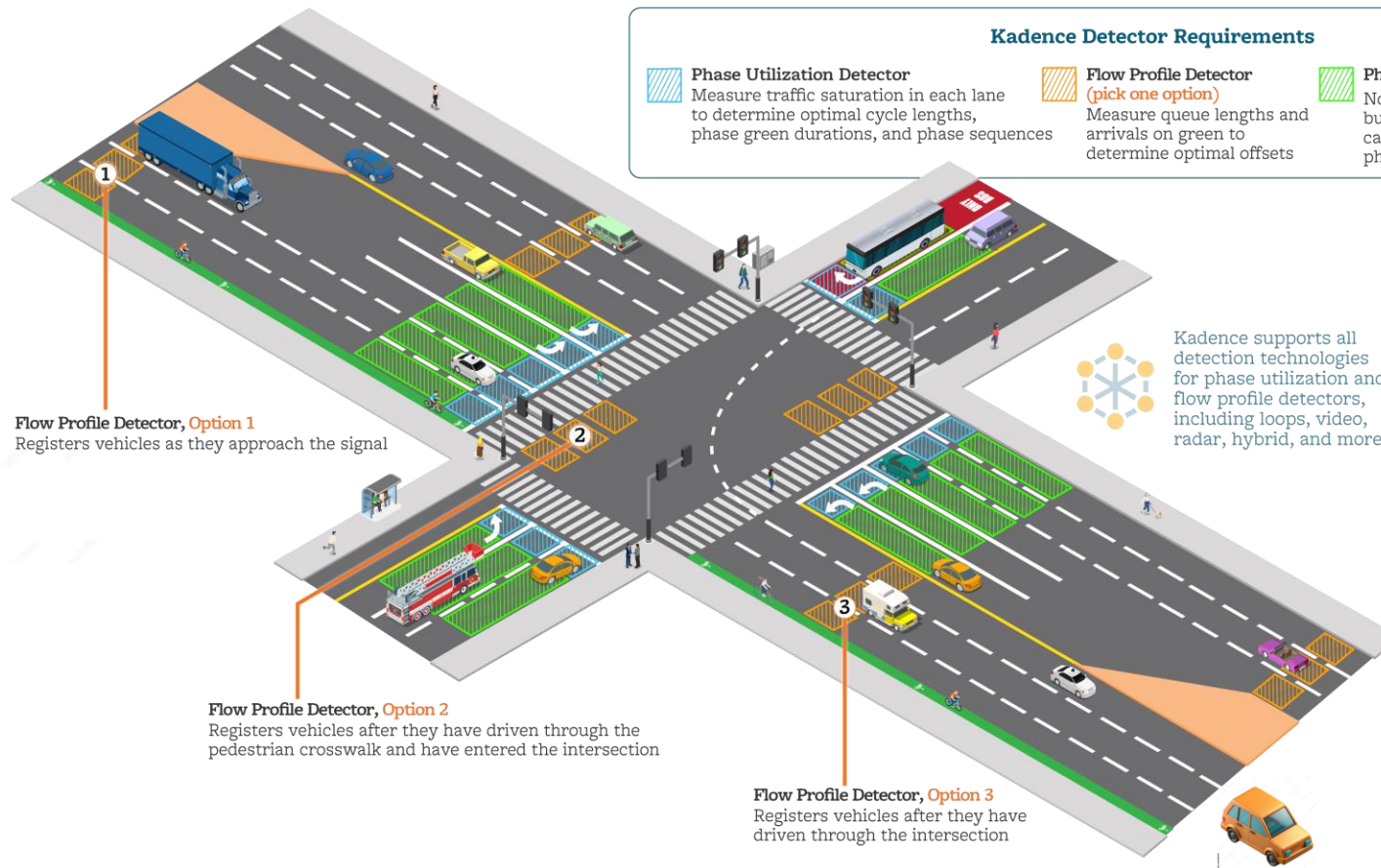
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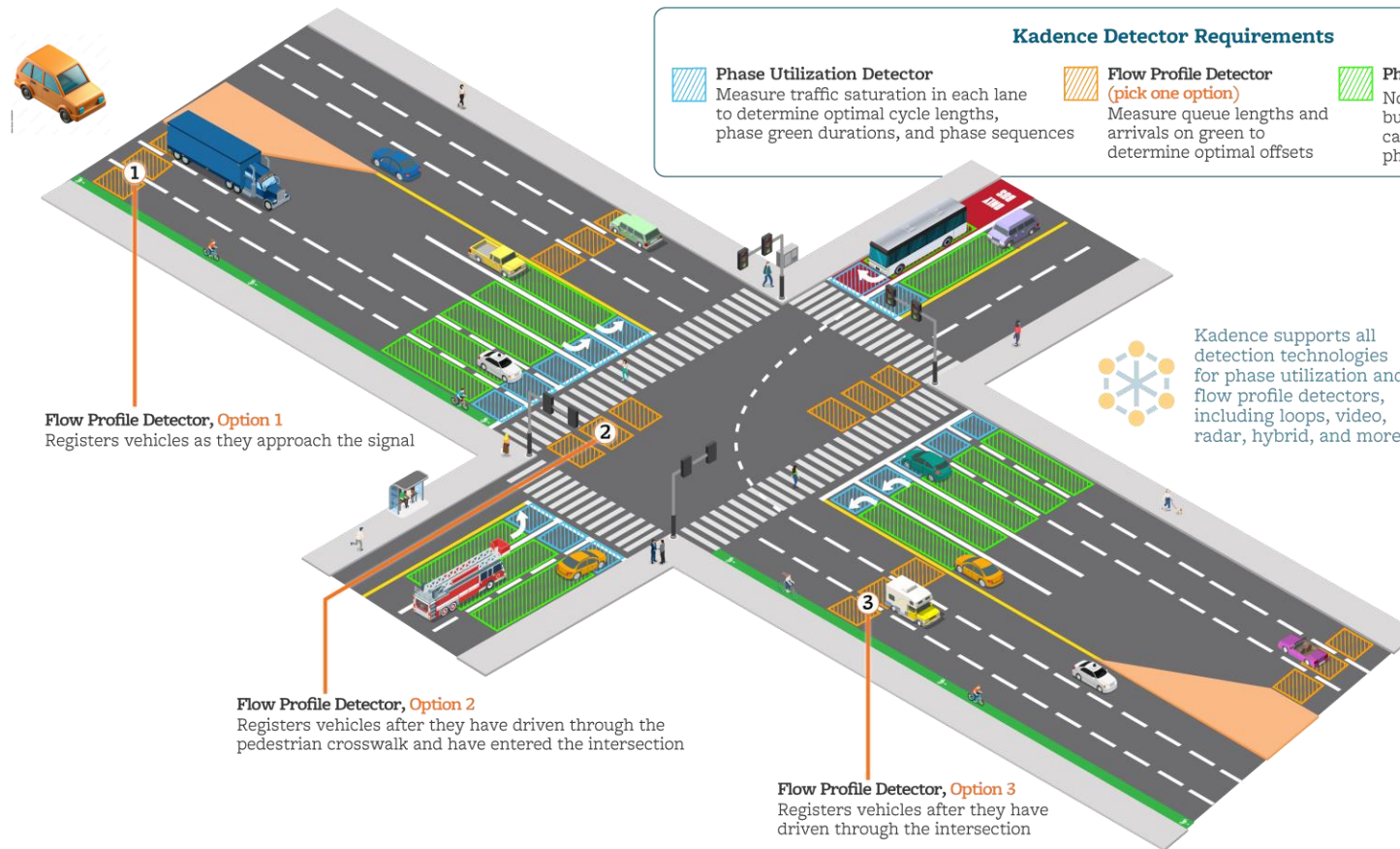
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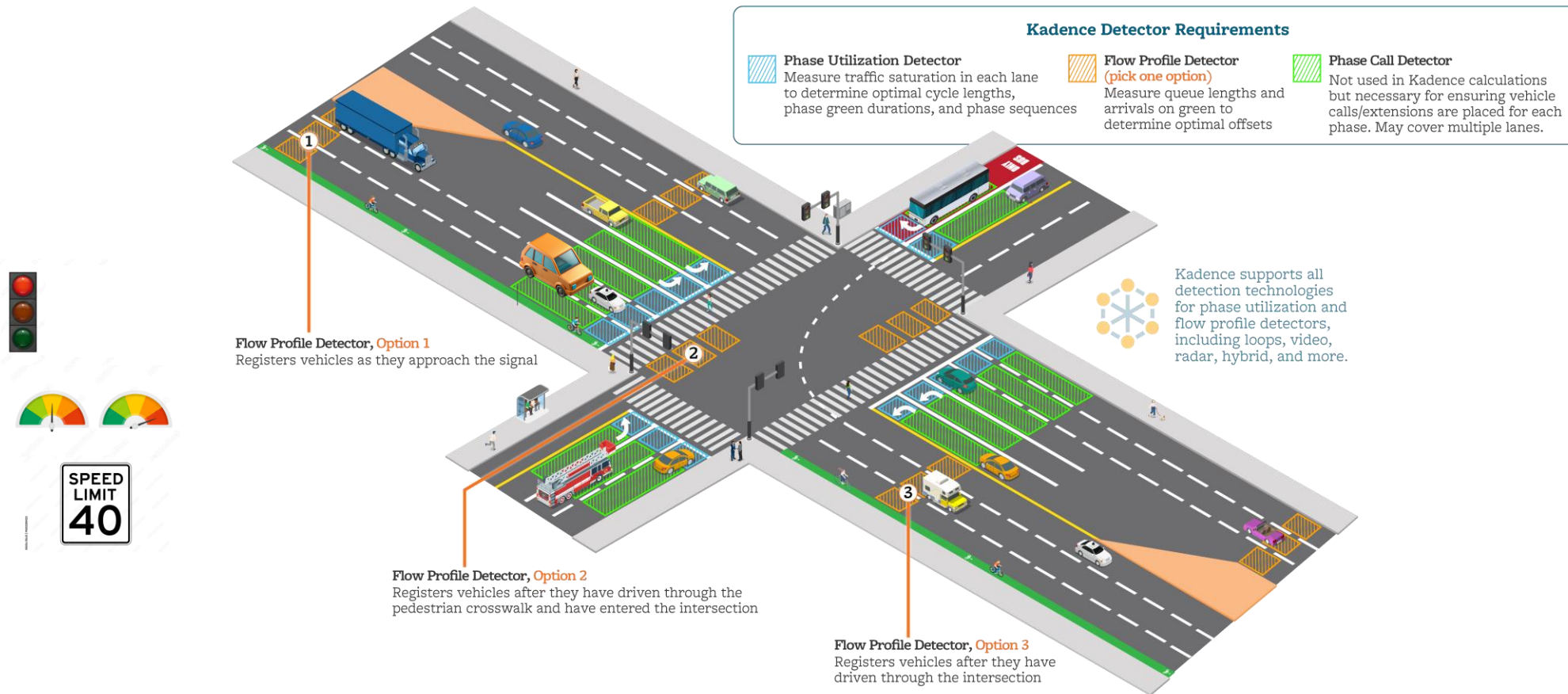
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SPEED
LIMIT
40

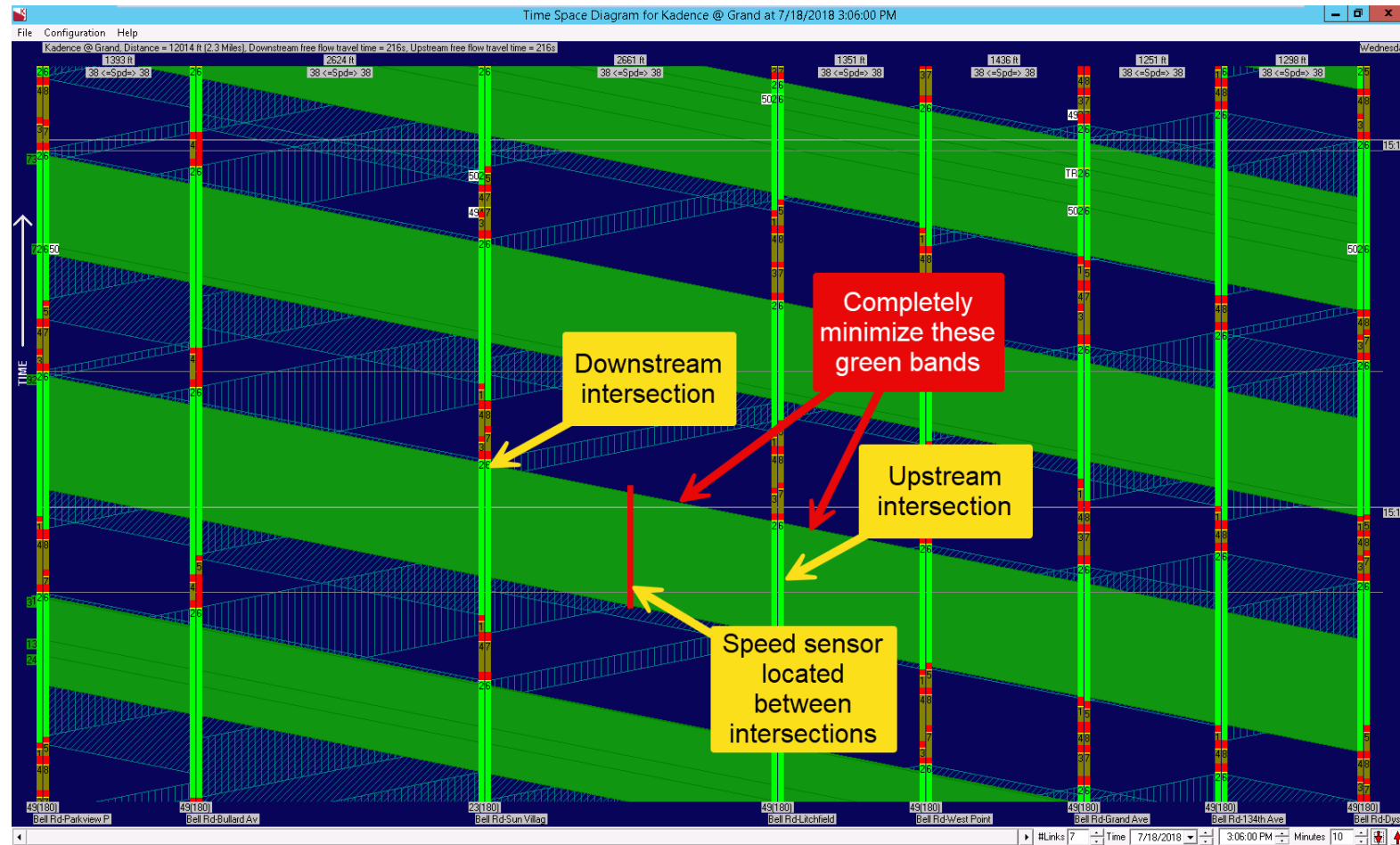


SAFETY ADAPTIVE APPROACH



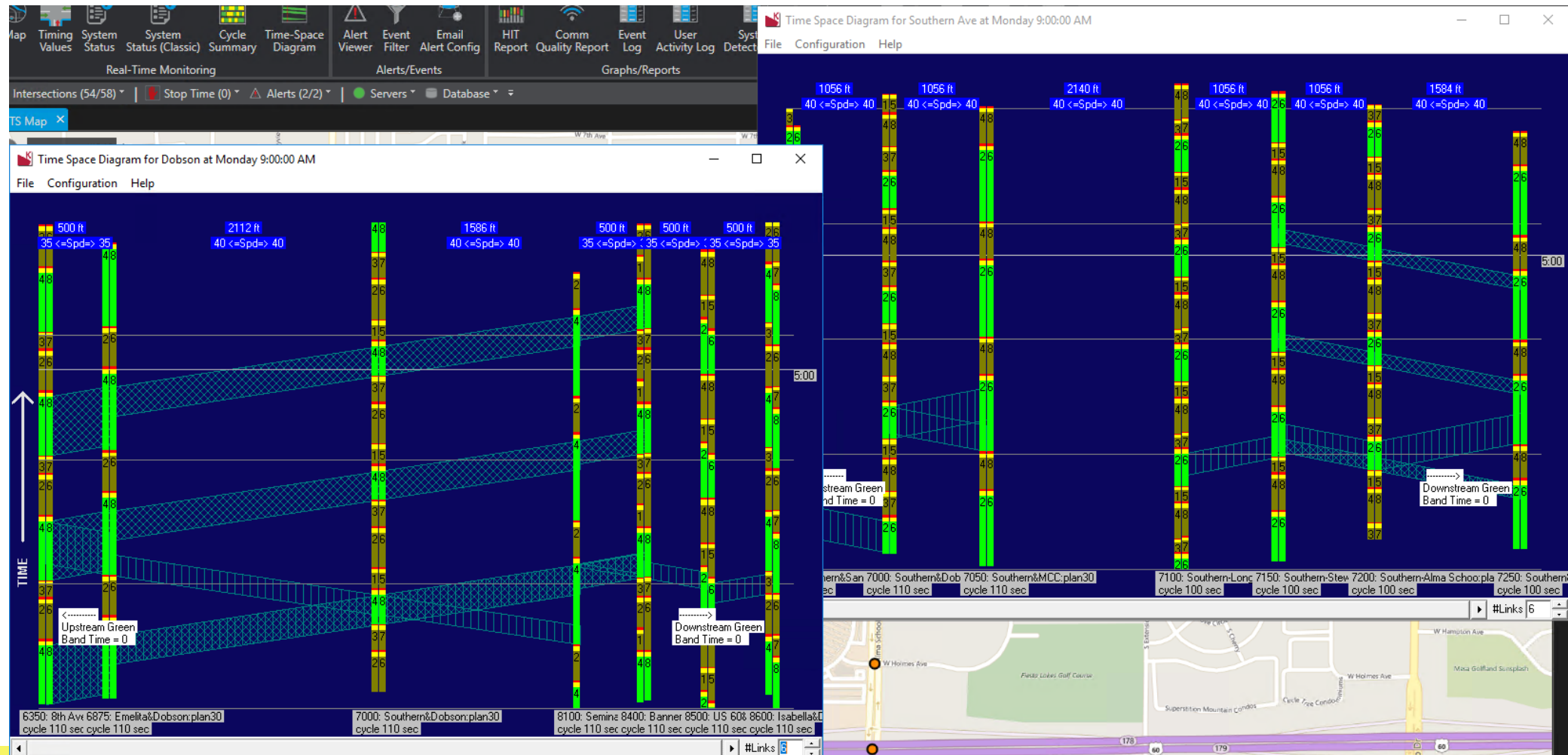


GREEN BAND DE-OPTIMIZATIONS





GREEN BAND DE-OPTIMIZATIONS





Kadence Safety Adaptive Network Diagram

Caltrans Network

Kadence Server



Kadence
Workstation



Field Device Network



Traffic Signals (D4)

Kadence - UDP : City defined port



Iteris
Vector

Kadence - HTTPS : REST API

Prepared by:

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Aug 2025

SAFETY ADAPTIVE SIGNAL SYSTEM: *Enhancing Traffic Safety on PCH*



CURRENT STATUS – TESTING AND ALGORITHM REFINEMENT

KITS Map X Section Parameters - Adaptive X

Section Name: **Adaptive** Plan: Default Plan

Cycle Adjustment Parameters

- (1) "Unsaturated" Phase Utilization: 40 (0-100)
- (2) "Saturated" Phase Utilization: 80 (0-100)
- Minimum # of Ints below (1): 1 integer
- Minimum # of Ints above (2): 1 integer
- Minimum Time Plan must be active: 15 minutes

Incremental Cycle Adjustment Parameters

- Enable Cycle Adjustment: ☒
- Cycle Increment: +/- 10 seconds
- Min Cycle Time: 60 seconds
- Max Cycle Time: 180 seconds
- Enable TOD Cycle Reset: Always

TOD Schedule Adjustment Parameters

- Enable Plan Switching Adjustment: ☐
- Earliest Start of next TOD plan: 15 minutes
- Latest End of current TOD plan: 15 minutes

Number of Cycles Per Decision: 3 integer

Phase Omit Cycle Threshold: 0 integer

Always Collect Data: ☒

Phase Sequence Parameters

- "Heavy" Phase Utilization: 85 (0-100)
- "Light" Phase Utilization: 35 (0-100)
- Comparative Difference Factor (Util1 > Util2 + factor): 15 (0-100)

Split Adjustment Parameters

- Max Split Increment: +/- 5 seconds
- Max Split Deviation: +/- 40 seconds
- Split Improvement: 1 percent
- Copy Split Deviation to all in section: Copy

Offset Parameters

- Max Offset Increment: +/- 100 seconds
- Max Offset Deviation: +/- 100 seconds
- Offset Improvement: 1 percent
- Offset Scaling Mode: Classic scaling
- Copy Offset Deviation to all in section: Copy

Safety Adaptive Parameters

- Cycle Decrease Speed Threshold: 10
- Max Cycle Deviation: 50
- Minimum # of Speed Sensors Above Threshold: 2

Plan: Default Plan

Save Cancel Clear Plan

KITS Map X Intersection Parameters - 1902: ASC3 Emulator-2 X

Intersection Name: **1902: ASC3 Emulator-2** Plan: Default Plan

Master Settings

- Adaptive: Enable Disable
- Queue Estimation: Enable Disable
- Safety Adaptive: Enable Disable

Adaptive Logic

- ☒ Reallocate Splits
- ☒ Calculate Offsets

Fail Conditions

- ☐ Comm Fail Disable Section
- ☐ Enable Fail Detector Logic

Queue Estimation

- ☐ Enable Queue Split Logic
- ☐ Enable Queue Offset Logic
- ☐ Enable Queue Sequence Logic
- ☐ Enable Queue Left Turn Adjustment

Misc Configuration

- Max Offset Deviation: 100
- Max Split Deviation: 40
- Phase Omit Cycle Threshold: 0

Phase Sequence Configuration

- Barrier Group 1
- Barrier Group 2

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iteris



PROJECT STATUS & NEXT STEPS

- Finalize Safety Adaptive System development
- Deploy and Monitor
- Addition of per vehicle actions

MALIBU



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QUESTIONS?

AUGUST 2025



FUTURE PCH SAFETY PROJECTS

- *Speed enforcement cameras*
- *Roundabouts*
- *Raised medians*
- *New pedestrian crossings*
- *Full intersection redesign for improved safety*
- *Redlight enforcement cameras*



SAFETY ADAPTIVE APPROACH

Why does excessive speeding contribute to an unsafe corridor?

Because as we move faster, we need more time to react to an object in front of us.

The average human reaction time is about 250 milliseconds.

- At 20 mph (29.3 ft/sec) – 7.3 ft travelled before a reaction can even begin
- At 40 mph (58.7 ft/sec) – 14.7 ft travelled before a reaction can even begin
- At 60 mph (88 ft/sec) – 22 ft travelled before a reaction can even begin



SAFETY ADAPTIVE APPROACH

To react, take action, and come to a complete stop (with perfect weather/roadway conditions)

- At 20 mph (29.3 ft/sec) – 40 ft to come to a complete stop
- At 40 mph (58.7 ft/sec) – 120 ft to come to a complete stop
- At 60 mph (88 ft/sec) – 240 ft to come to a complete stop



PROJECT OVERVIEW – INTERSECTION ENHANCEMENTS



