

# Cloud Based TSP: City of San Jose DOT

MTC Tech Transfer: TSP 102 | 8/13/24

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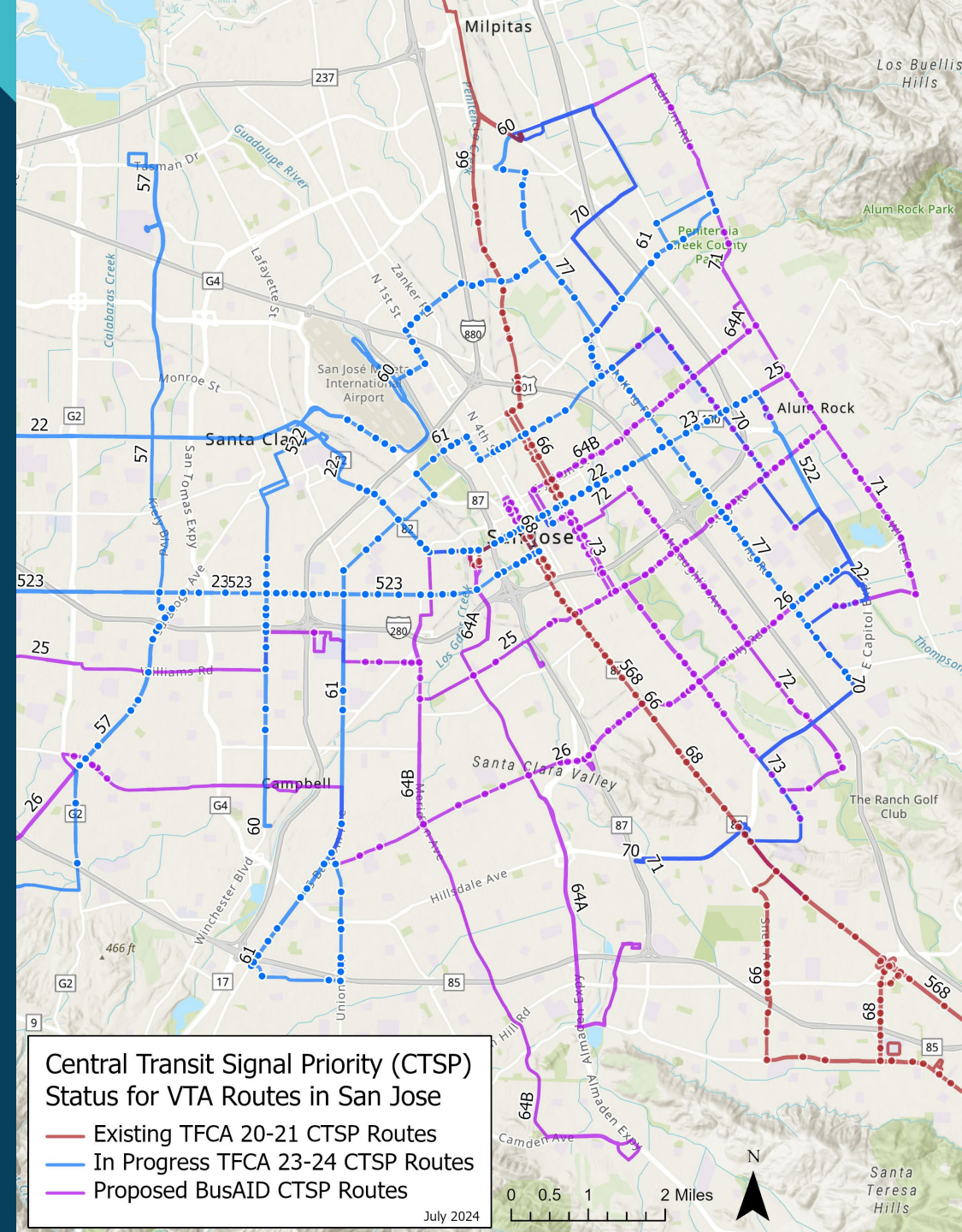
Vanessa See | Associate Engineer | Signal Operations

# Agenda

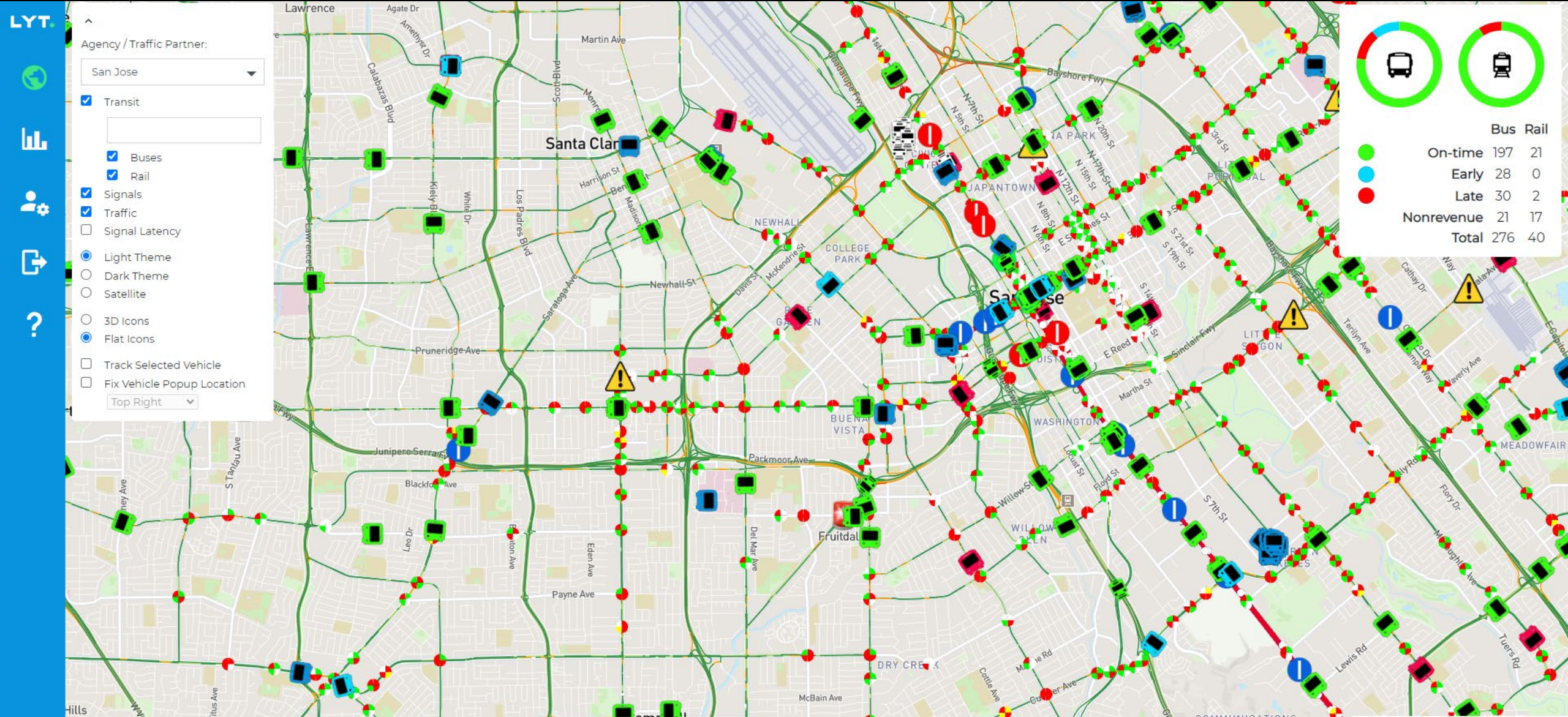
- Overview of the City of San Jose's Central TSP System
- Using Dynamic ETA's for CTSP
- Hardware Based TSP vs. Central TSP: Deployment and Maintenance Considerations
- Hardware Based TSP and Central TSP: Concurrent Operations
- Controller TSP Parameters
- Business Rules
- Performance Metrics
- Lessons Learned

# Central TSP

- Cloud-based TSP using LYT:
  - No physical equipment required in the traffic signal cabinet or signal poles.
  - Integrates with existing controller firmware D4 by Fourth Dimension.
  - Maestro box in Network Operations Center.
  - LYT obtains Computer–Aided Dispatch/Automatic Vehicle Location GPS info from VTA buses.
- As of July 2024, deployed Central TSP along VTA routes 57, 66, 68, 70, 77 & Rapid 568 (around 190 intersections).
- ~\$4,000/intersection for programming support & license/subscription for 5 years.



# LYT Interface



# LYT Interface

Agency / Traffic Partner: San Jose

Transit

Buses

Rail

Signals

Traffic

Signal Latency

Light Theme

Dark Theme

Satellite

3D Icons

Flat Icons

Track Selected Vehicle

Fix Vehicle Popup Location

Top Right

**VTA 143**  
Route: 68  
Next Stop: Monterey & Rancho  
32 secs delayed  
Speed: 27 mph

Next Priority Signal: Fehren Dr & Monterey Rd  
TSP Request Status: Active  
TSP Strategy: No Adjust  
ETA: 41 secs

	Bus	Rail
On-time	194	21
Early	30	0
Late	31	2
Nonrevenue	18	17
Total	273	40

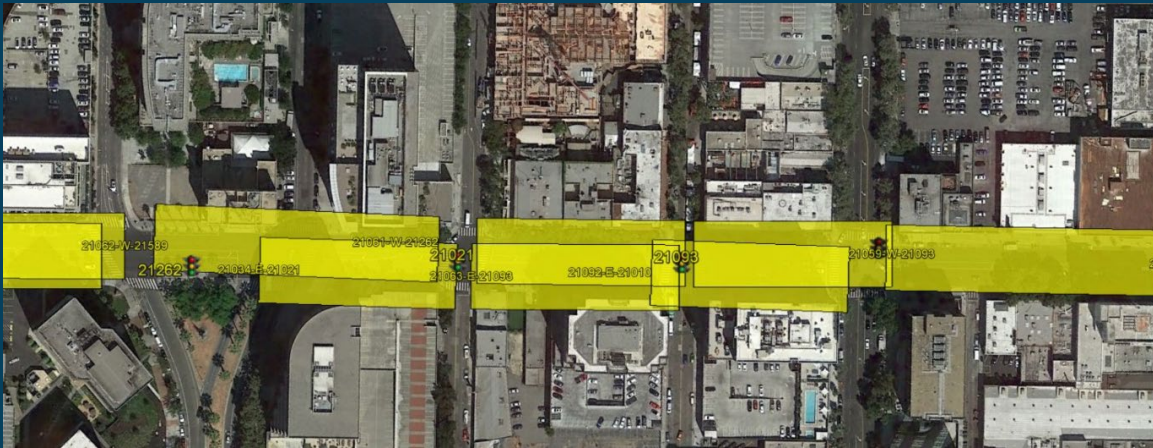
# TSP & San Jose Transit First Policy

- Adopted by San Jose City Council July 2022.
- Prioritizing transit operations and access in its plans and operational decision-making.
- Council Policy Priority #14 – Citywide Transit First Policy Framework:
  - Whenever a street where transit operates is part of a planning effort, the effort should incorporate how to make transit faster, more useful, and a more viable option.
  - Any street that operates large numbers of buses per hour or where speeds are below an ideal threshold should be considered for transit priority improvements.
- TSP aligns with Transit First Policy by prioritizing transit operations at signalized intersections to provide a better experience for transit riders. Reducing bus travel times and promoting transit.
- Grand Boulevards designated with transit as primary mode of transportation.

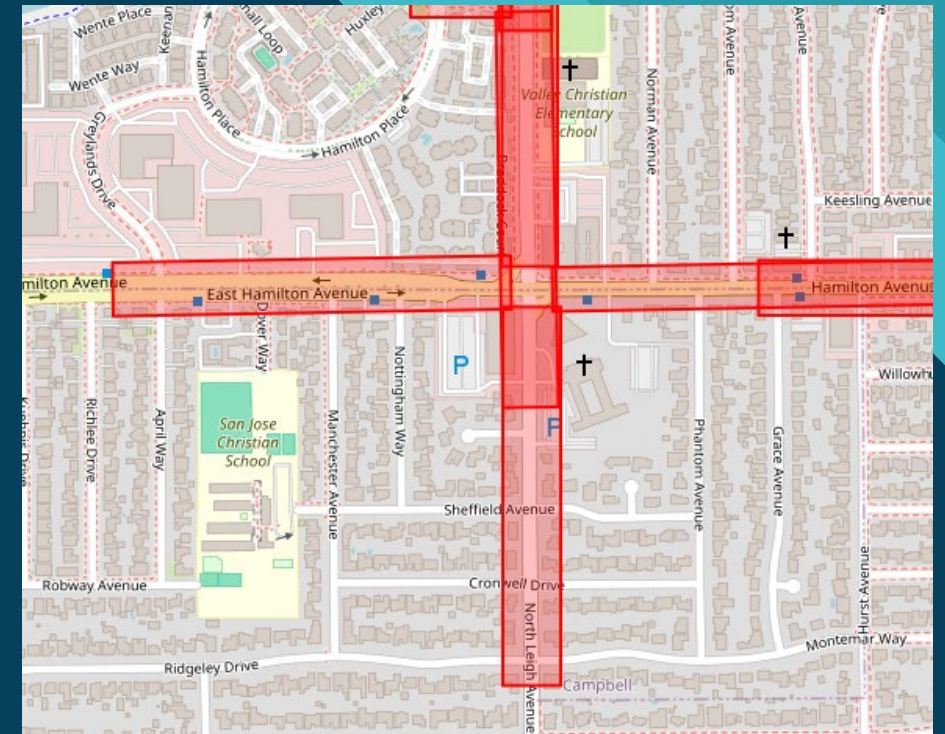
# Dynamic ETA's

# Existing Hardware Based TSP Technology

- Hardware based TSP and Central EVP use geofence zones and GPS detection.
- Emtrac zones configured to detect buses leaving the previous signalized intersection or 1,000 ft before target intersection.
- Controllers can only support a static ETA.



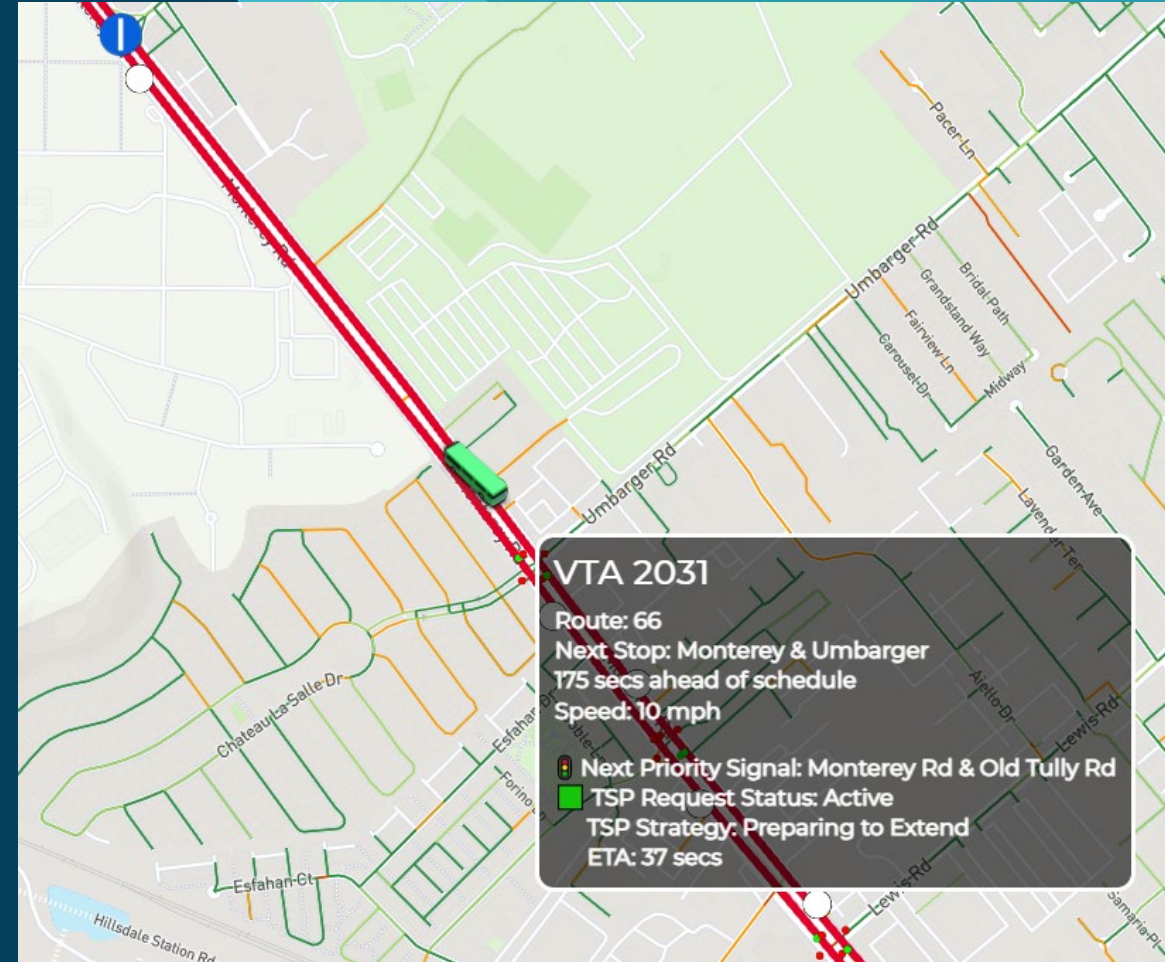
Bounding boxes for Hardware-Based TSP system on Santa Clara Street



Sample geofence zones for Central EVP

# Dynamic ETA's

- AI machine learning models generated to estimate time of arrival (ETA) to the intersection.
- Uses predictive & historical traffic trends to estimate time bus will reach intersection:
  - Daily/hourly traffic patterns
  - Bus stop wait times
  - Skipped stops
- Able to adjust ETA's in real-time:
  - Traffic congestion
  - Near side bus stop



# Dynamic ETA Demo

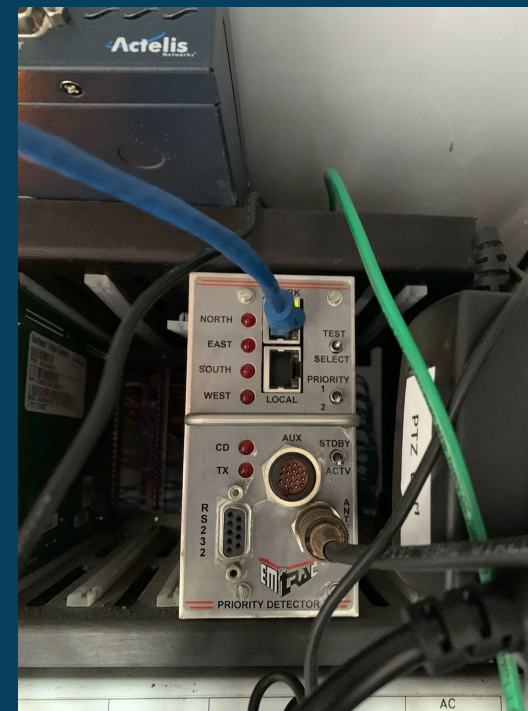


# Hardware Based TSP vs Central TSP

Deployment and Maintenance Considerations

# Hardware-Based TSP

- TSP for Light Rail Transit (LRT) using loops.
- Rapid 522 and Rapid 523 using hardware-based TSP (Emtrac).
  - Physical equipment required:
    - Antenna
    - Priority detector card in the traffic signal cabinet
    - Cabling
    - Transmitter on bus
  - Fixed point detection (geofence zones).
  - Can still provide TSP if communication to controller is down.
  - Approx. \$3,900/intersection for equipment & programming support + additional \$2,000 labor for cable pulling.



# Limitations of Hardware-Based TSP

- More equipment = more points of failure
- Staffing required to configure/troubleshoot equipment
- Bus route (intersection) realignment changes
- Buses may not have correct vehicle transmitter installed (bus swapping)
- Time-intensive to troubleshoot
- Limited adjustments for fixed point detection (Central TSP more dynamic)



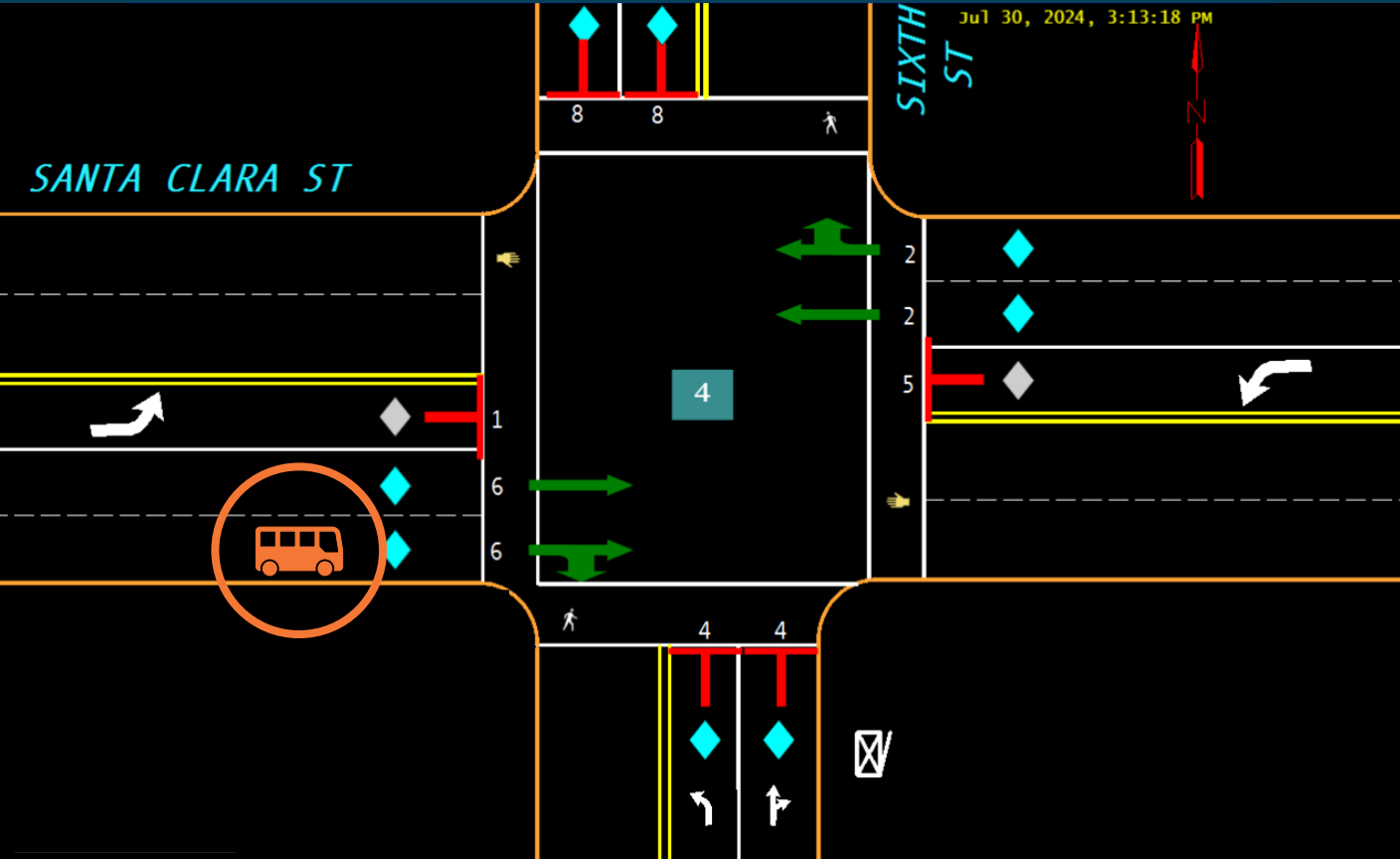
Bounding boxes for hardware-based TSP system on Santa Clara Street

# Central TSP Benefits

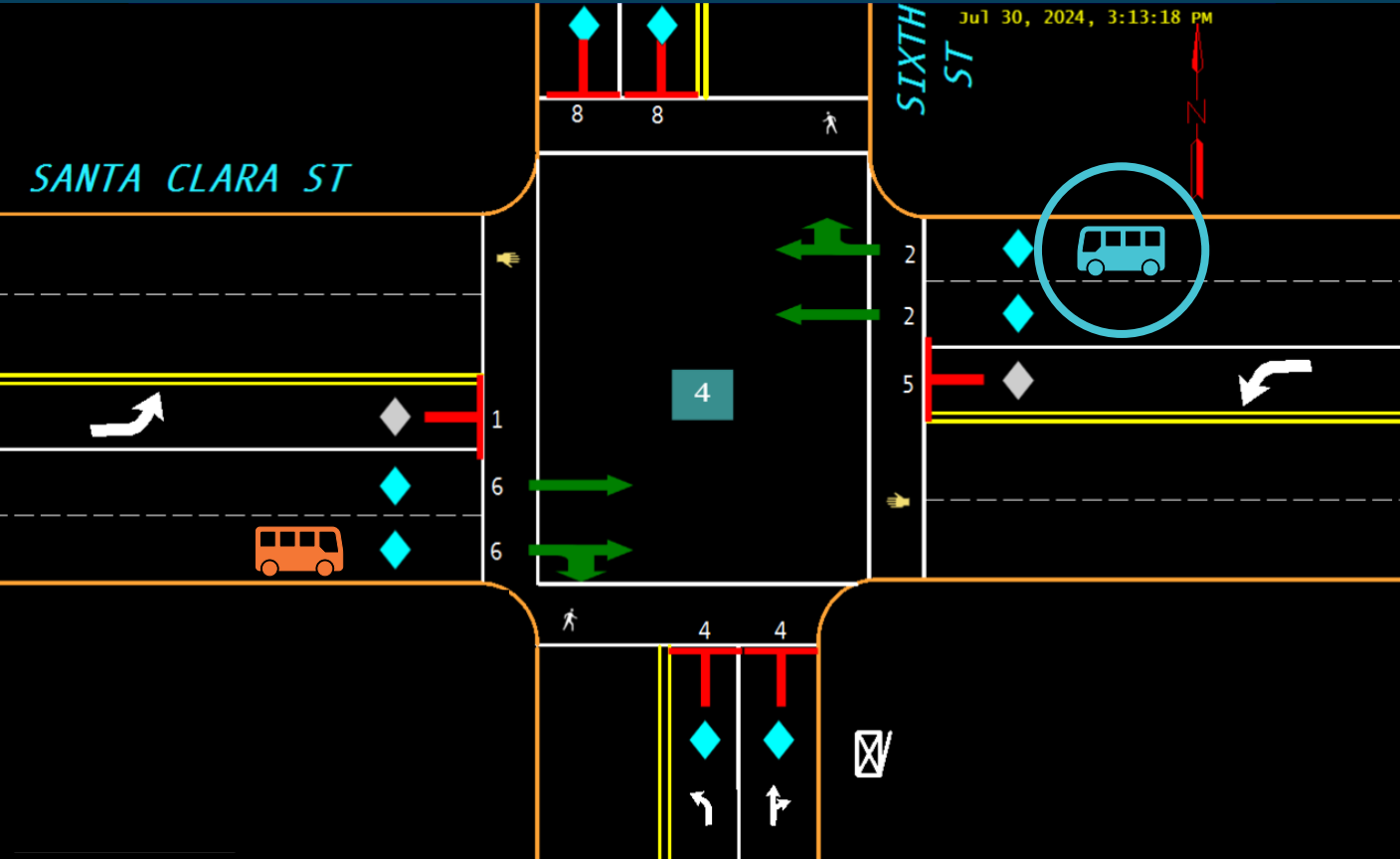
- No additional equipment in the cabinet or signal poles.
- Faster deployment time of Central TSP than Hardware Based TSP.
- Flexibility to setup TSP at specific intersections, not just route based.
- No communication workaround (install Maestro device at the intersection).

# Hardware Based TSP & Central TSP

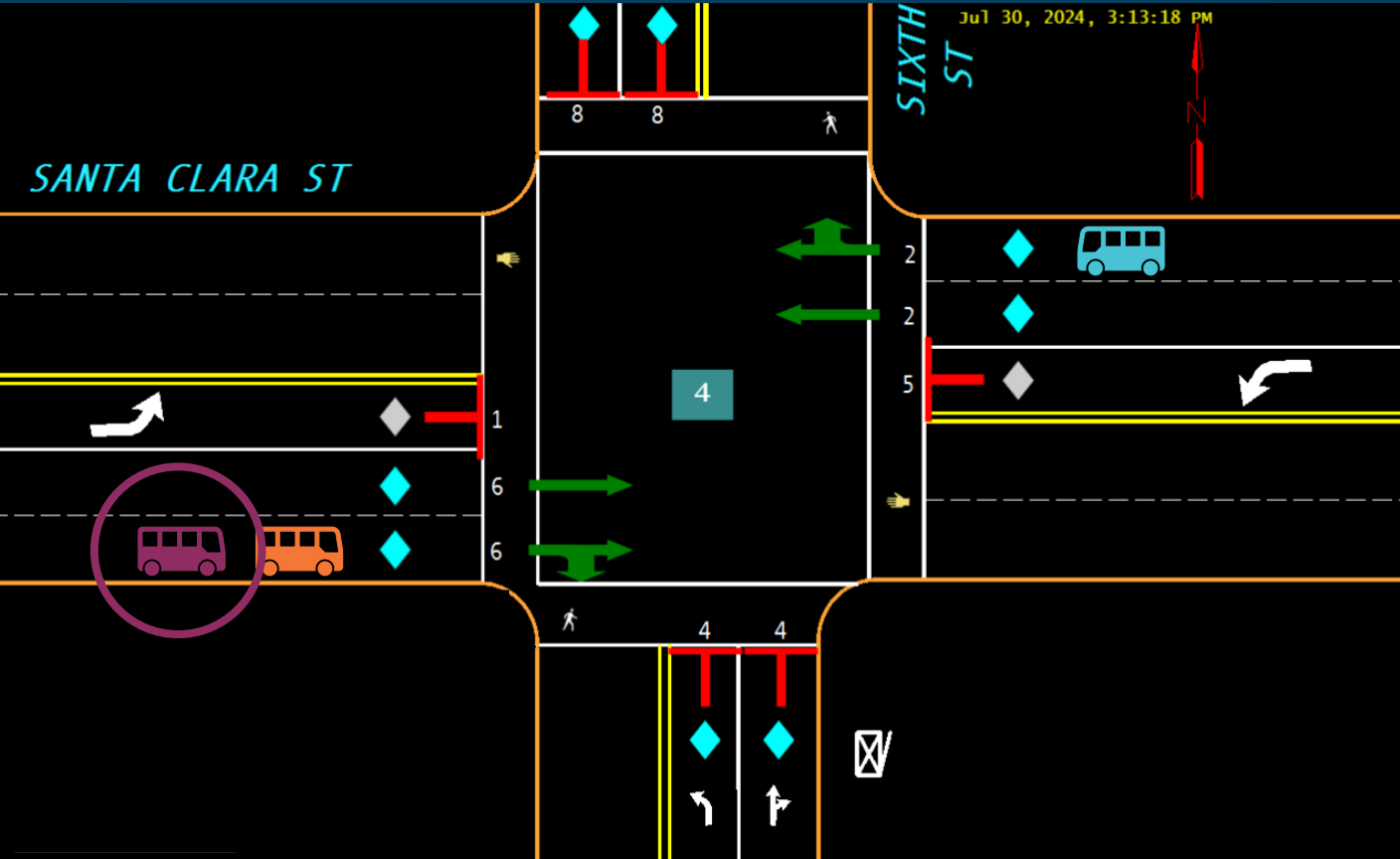
Concurrent Operations



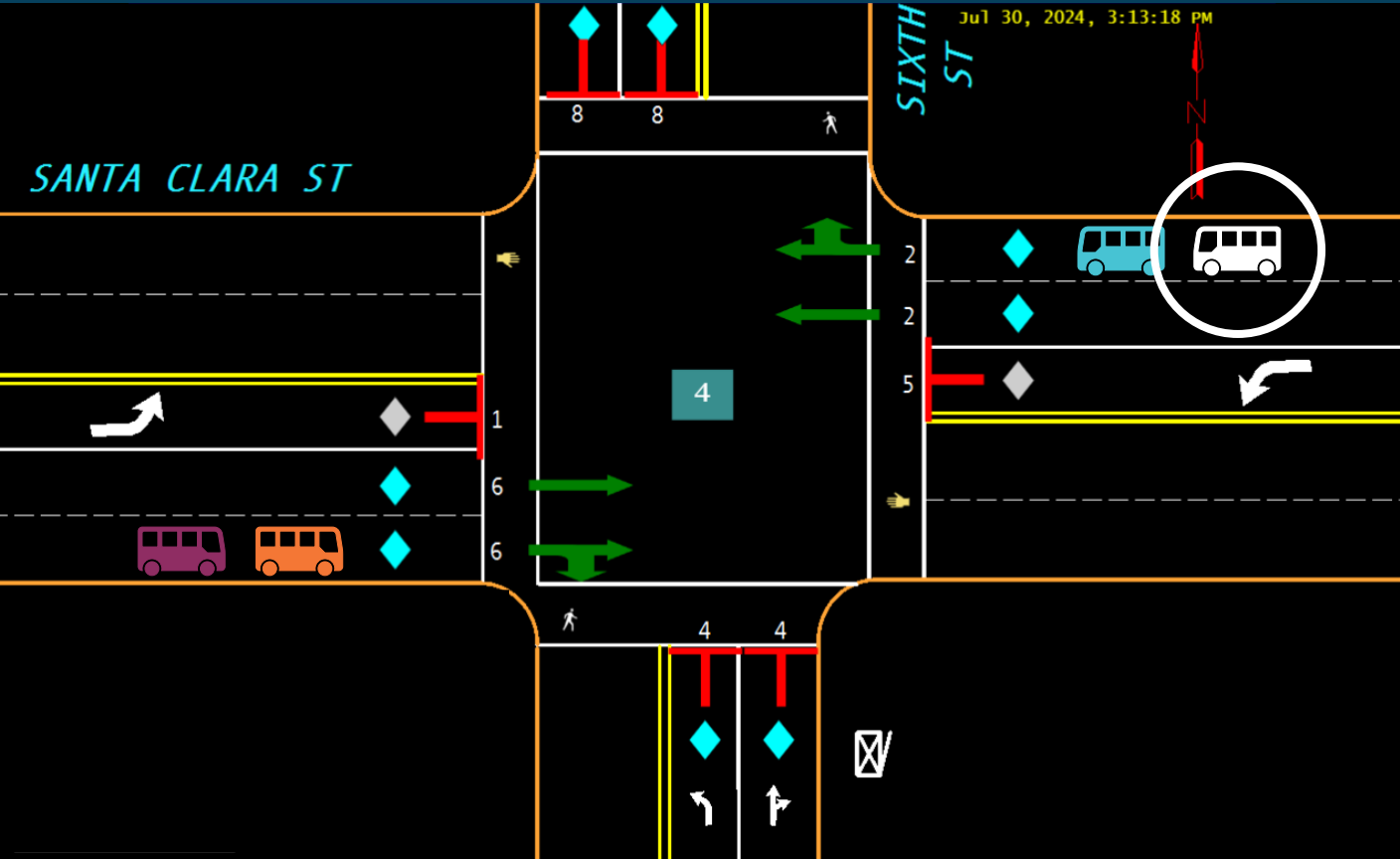
TSP Channel	Route	TSP Type
1		
2	EB Rapid 522	Emtrac (Hardware)
3		
4		
5		
6		
7		
8		



TSP Channel	Route	TSP Type
1		
2	EB Rapid 522	Emtrac (Hardware)
3		
4	WB Rapid 522	Emtrac (Hardware)
5		
6		
7		
8		

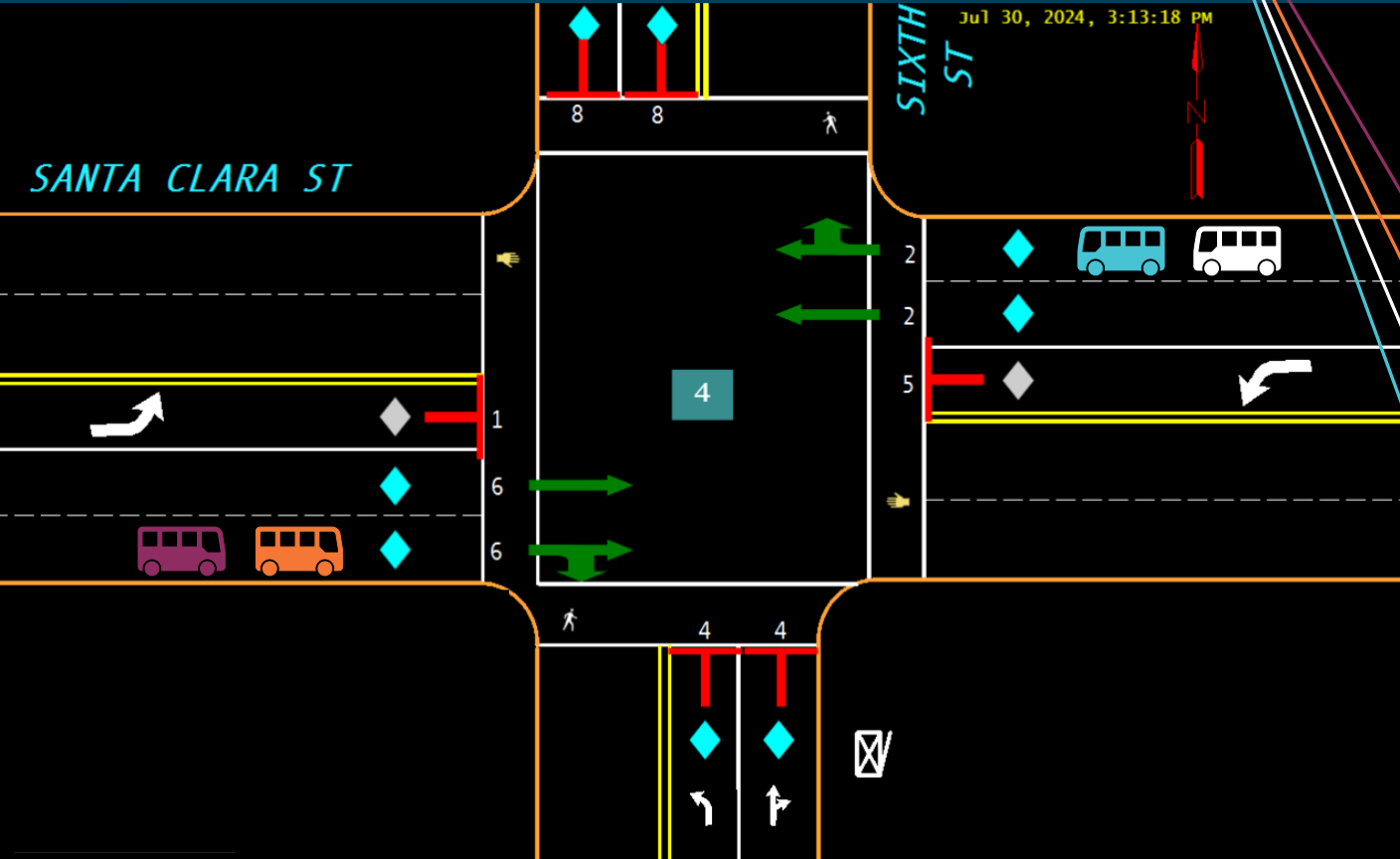


TSP Channel	Route	TSP Type
1	EB Route 66	LYT (Central)
2	EB Rapid 522	Emtrac (Hardware)
3		
4	WB Rapid 522	Emtrac (Hardware)
5		
6		
7		
8		



TSP Channel	Route	TSP Type
1	EB Route 66	LYT (Central)
2	EB Rapid 522	Emtrac (Hardware)
3	WB Route 66	LYT (Central)
4	WB Rapid 522	Emtrac (Hardware)
5		
6		
7		
8		

Bus TSP is treated first come, first served  
(bus with lowest ETA will get TSP service)



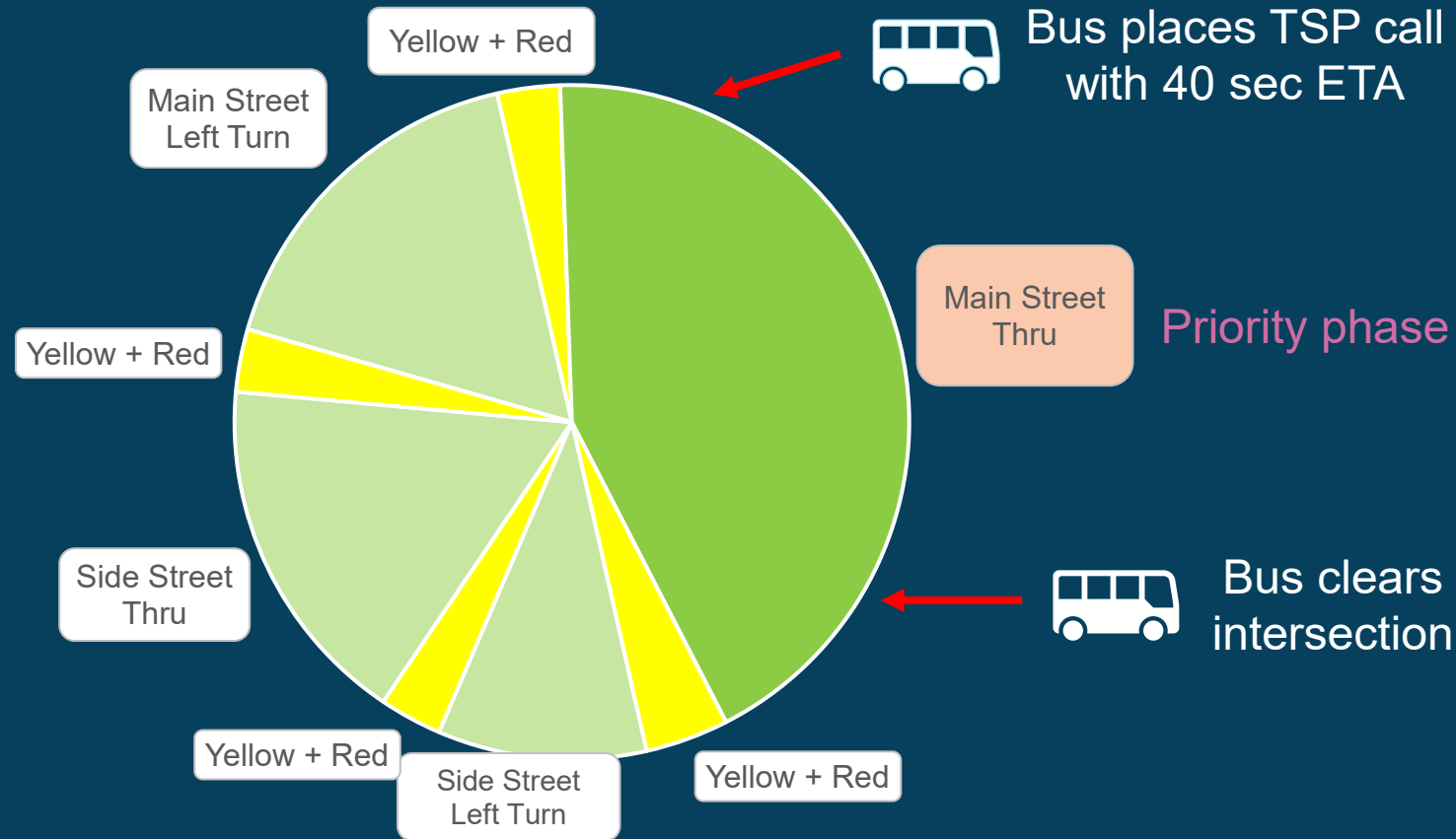
TSP Channel	Route	TSP Type
1	EB Route 66	LYT (Central)
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3	WB Route 66	LYT (Central)
4	WB Rapid 522	Emtrac (Hardware)
5		
6		
7		
8		

# Controller TSP Parameters

# TSP Strategy - Do Nothing

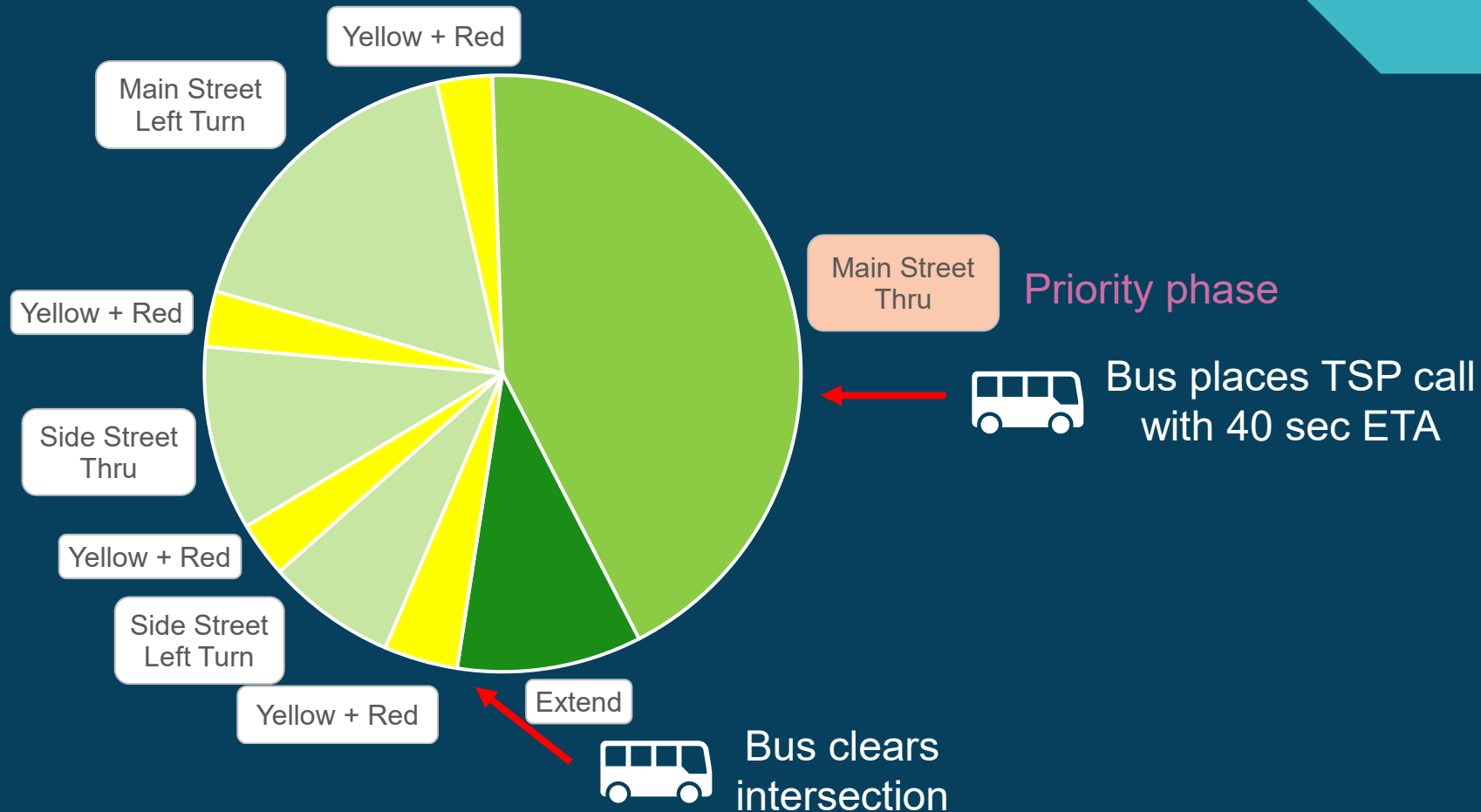
Best case scenario

- TSP call is placed before or during the priority phase, but the transit vehicle can clear the intersection during the normal green time



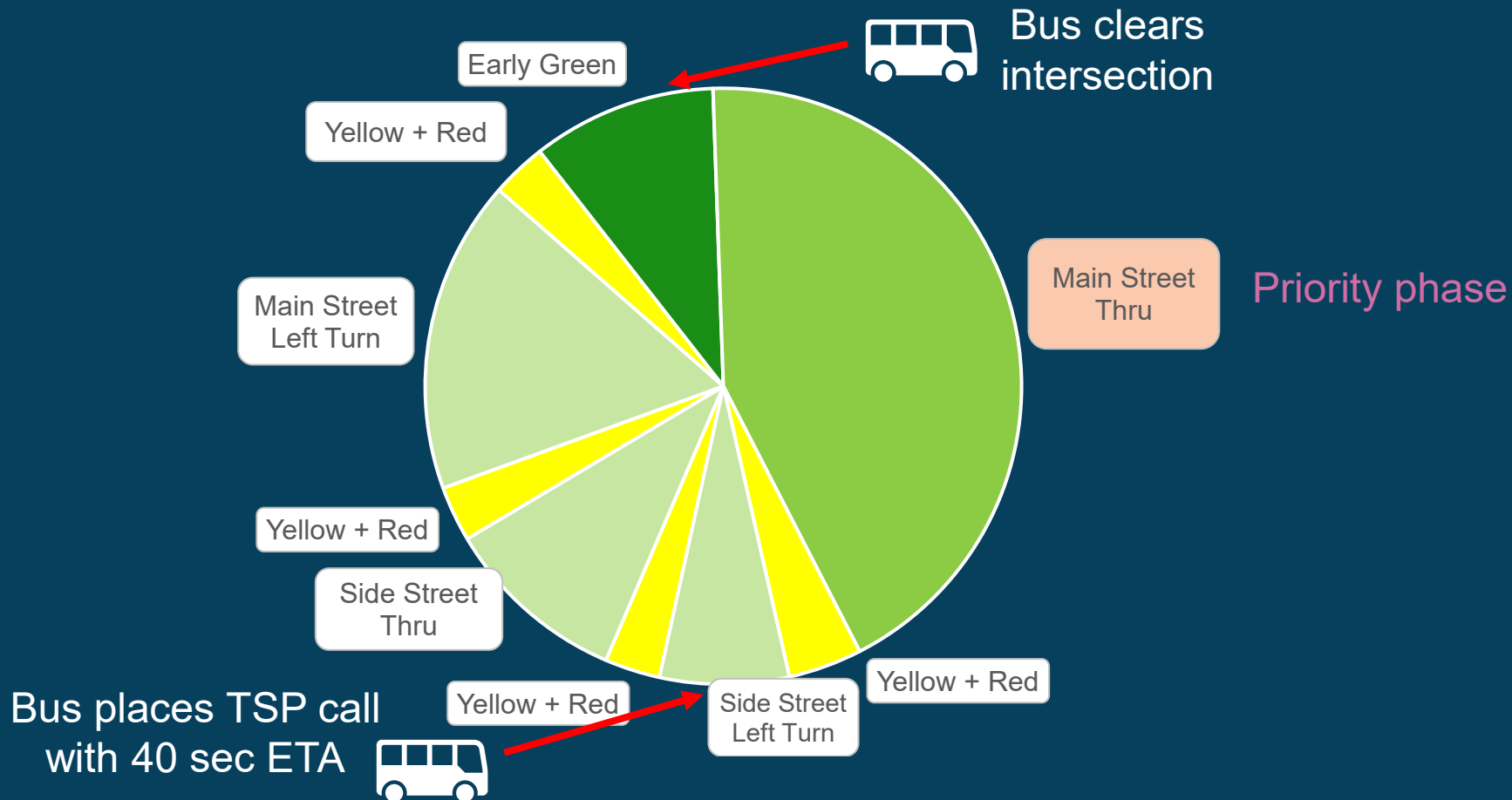
# TSP Strategy - Extended Green

- TSP call is placed before or during the priority phase, but the transit vehicle requires extended green time to clear the intersection



# TSP Strategy - Early Green

- TSP call is placed when the priority phase is not active and therefore the transit vehicle receives an early green



# TSP Parameters

## Priority Mode

- San Jose Default: Early & Extend
- Extend Only

## Extension Limit

- Max time that phases are allowed to extend beyond their normal force-off/max out points
- Prevents the controller from extending greens too long during TSP service
- San Jose Max Extension: 20 sec

## Priority Minimum Green

- If the controller needs to truncate green times for conflicting phases to provide TSP, this is the minimum green time that will be served before the conflicting phases terminate
- Prevents the green time for non-TSP movements from getting cut too short during TSP service
- San Jose Default Priority Min Greens
  - Main street thru: 20 sec
  - Other movements: 10 sec

Note: these parameters are configurable separately for coordinated and free modes

# Business Rules

## Route Priority



Light rail



Rapid bus

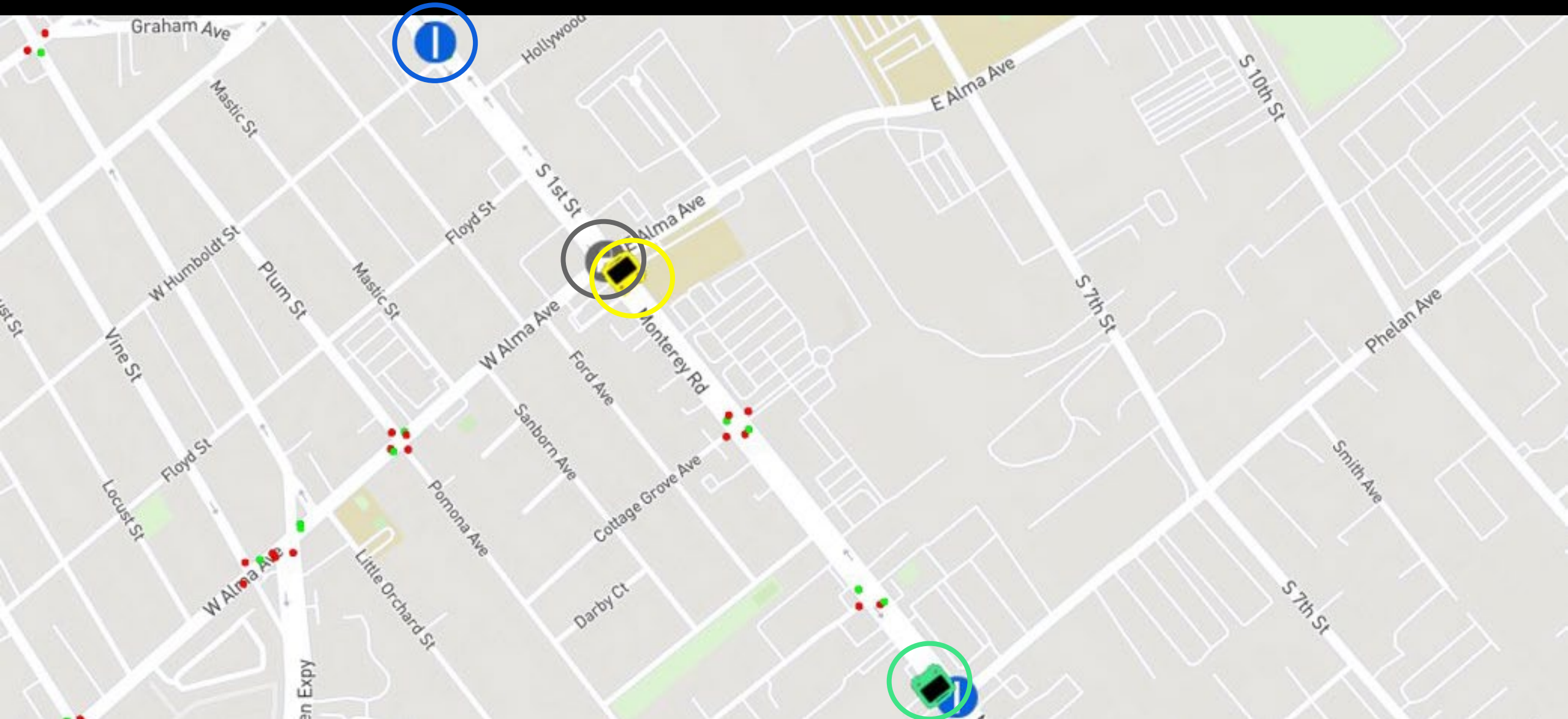


Non-rapid bus

## Reservice Inhibit

- Controller parameter that locks out TSP calls following a previous TSP service
- Prevents excessive disruption to the signal timing
- Mode
  - Intersection-wide
  - Only for the same TSP channel
- Lockout times used in San Jose
  - 60 second default
  - 170 second maximum (longest cycle length)

# Reservice Inhibit



# Business Rules Considerations



## Flexibility

Central systems offer more business rules than controllers do



## Ability to manage


Central-based business rules can be easily turned on and off systemwide, whereas controller-based business rules must be configured for individual intersections

# Performance Metrics

# Emtrac Log


Priority Detector Log...

Connected To: **Intersection ID: 21802 - (Network - 10.192.113.15)**


 Retrieve Log...


Extended Log Data


 LRV Signals  
 ETA Distances  
 TSP Confirmation  
 End Velocity/Heading


 Clear Log in EMTRAC Unit...


Index	Event Type	Zone Type	Int. ID	Zone ID	Vehicle ID	Dir	Priority	Date / Time		
								Start	Stop	Elap
999	Zone Event	Standard	21802	21015	4309	W	2	7/20/2024 3:11:33 PM	7/25/2024 2:21:37 PM	4290
54	Zone Event	Standard	21802	21015	4309	W	2	7/20/2024 3:11:33 PM	7/25/2024 7:05:35 PM	4460
996	Zone Event	Standard	21802	21015	8339	W	2	7/25/2024 1:57:24 PM	7/25/2024 1:57:42 PM	17
997	Zone Event	Standard	21802	21015	4317	W	2	7/25/2024 2:09:56 PM	7/25/2024 2:10:24 PM	28
998	Zone Event	Standard	21802	21072	4311	E	2	7/25/2024 2:15:29 PM	7/25/2024 2:15:47 PM	17
0	Zone Event	Standard	21802	21072	4308	E	2	7/25/2024 2:25:21 PM	7/25/2024 2:25:37 PM	15
1	Zone Event	Standard	21802	21015	8328	W	2	7/25/2024 2:28:14 PM	7/25/2024 2:28:26 PM	12
2	Zone Event	Standard	21802	21072	8331	E	2	7/25/2024 2:31:33 PM	7/25/2024 2:31:47 PM	14
3	Zone Event	Standard	21802	21015	4307	W	2	7/25/2024 2:37:12 PM	7/25/2024 2:37:28 PM	15
4	Zone Event	Standard	21802	21072	4325	E	2	7/25/2024 2:41:25 PM	7/25/2024 2:41:43 PM	17
5	Zone Event	Standard	21802	21072	8338	E	2	7/25/2024 2:52:03 PM	7/25/2024 2:52:21 PM	17
6	Zone Event	Standard	21802	21072	4323	E	2	7/25/2024 2:57:04 PM	7/25/2024 2:57:20 PM	15
7	Zone Event	Standard	21802	21015	8332	W	2	7/25/2024 2:58:18 PM	7/25/2024 2:58:38 PM	20
8	Zone Event	Standard	21802	21015	4315	W	2	7/25/2024 3:09:13 PM	7/25/2024 3:09:27 PM	13
9	Zone Event	Standard	21802	21015	8346	W	2	7/25/2024 3:11:56 PM	7/25/2024 3:12:12 PM	15


 Open Log...

 Save Log...

 Clear Log Table...

 Print Log...

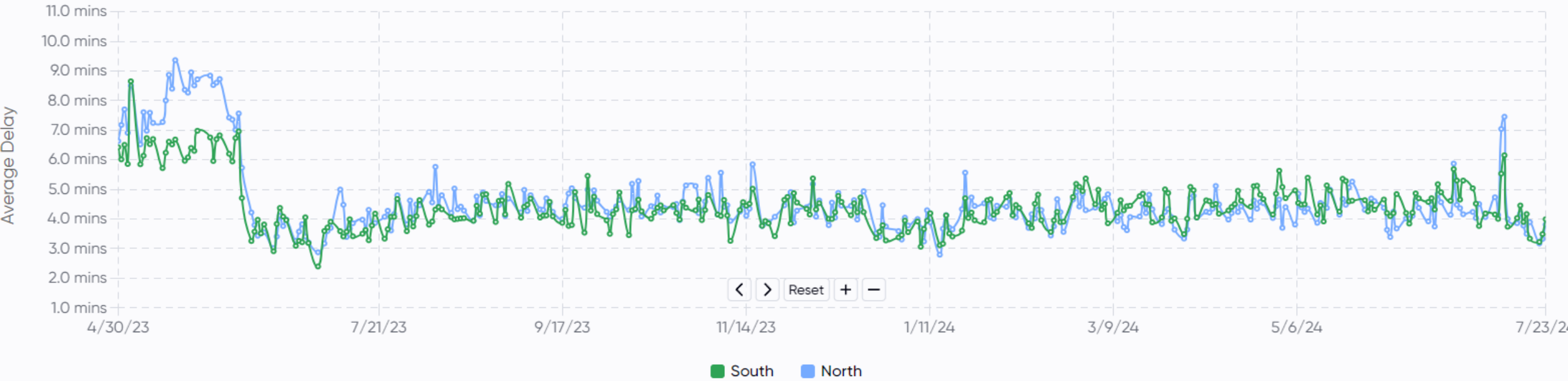
 Analysis to MS Excel Spreadsheet...

 Export to MS Excel Spreadsheet...

# LYT Performance Metrics

Average Red Light Delay Over Time ⓘ

Rapid 568 ▾ CSV ⬇️ ⓘ

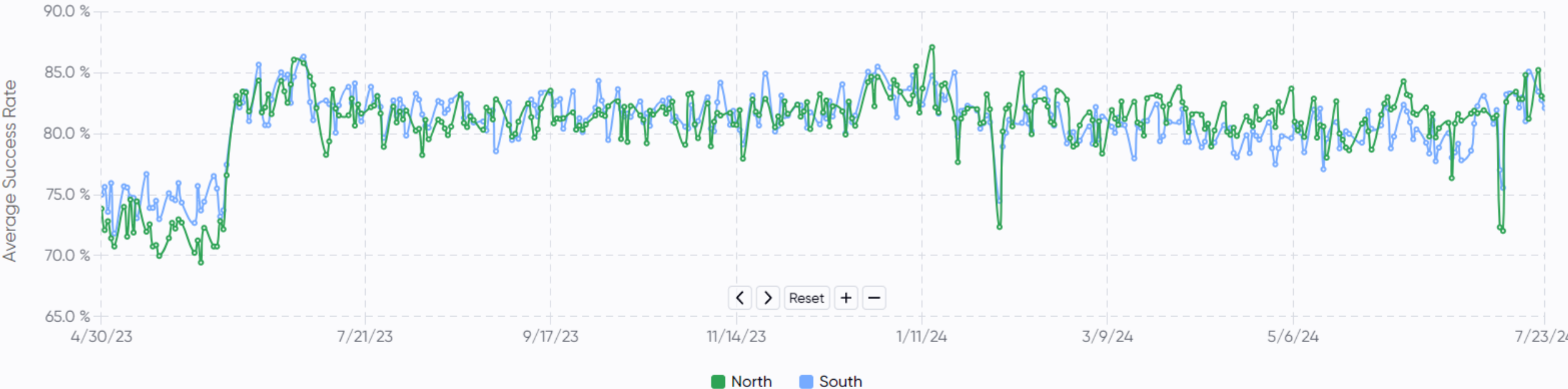


# LYT Performance Metrics

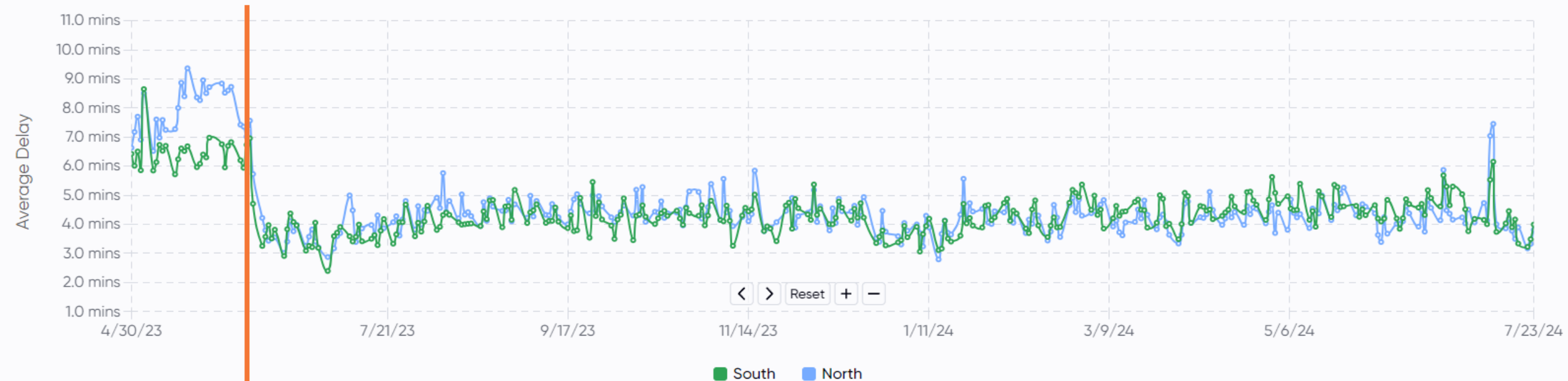
Average Green Light Success Rate Over Time ⓘ

Rapid 568 ▾

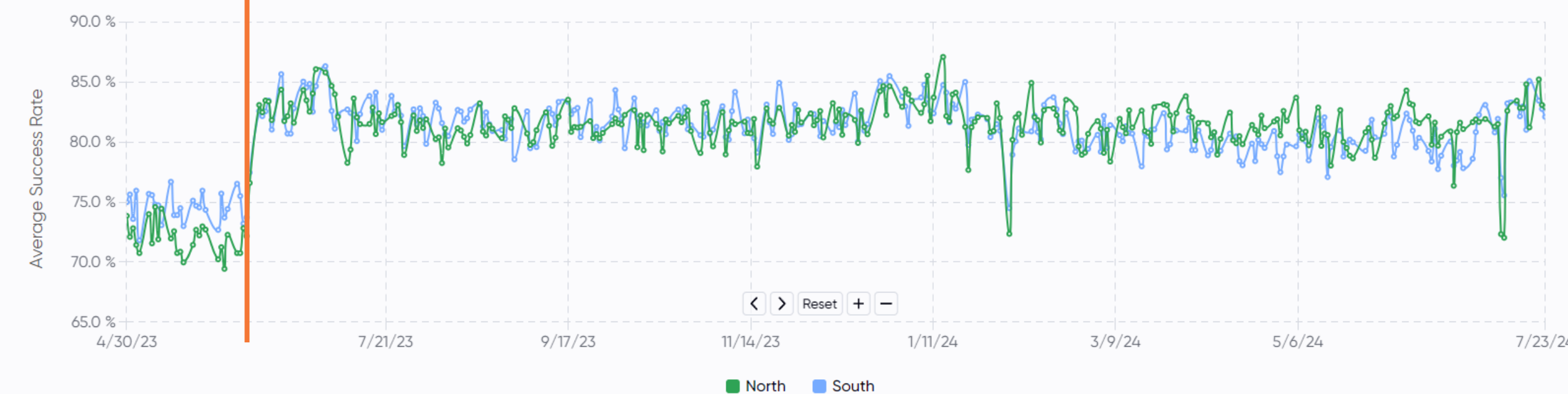
CSV ⬇



## Average Red Light Delay Over Time [i](#)



## Average Green Light Success Rate Over Time [i](#)



# Average Red Light Delay by Intersection ⓘ

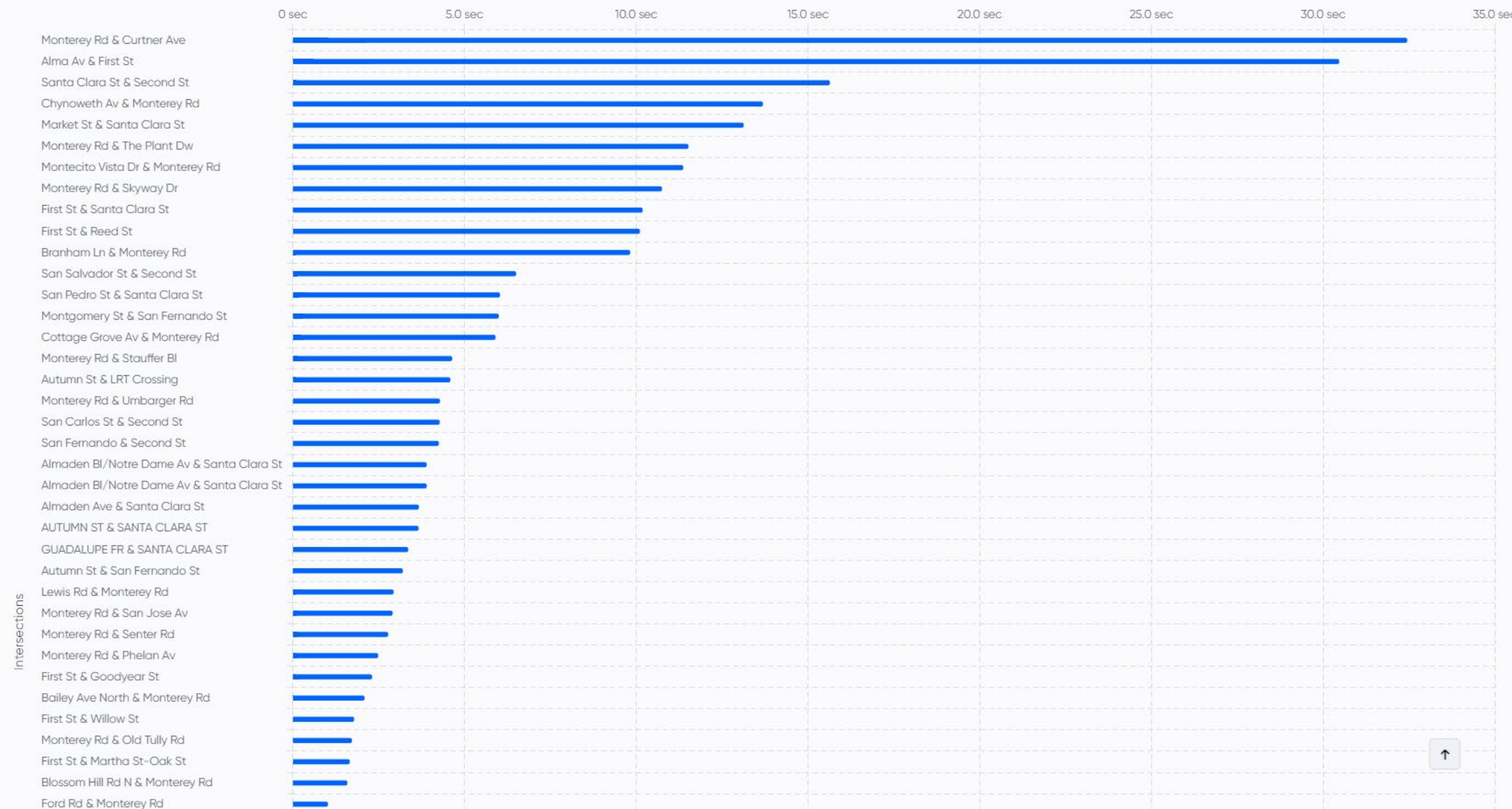
Rapid 568 ▾

South ▾

Delay (Decreasing) ▾

Last 30 days ▾

CSV ⬇



# Lessons Learned

# Operational Considerations

- Consider traffic volumes, signal spacing/timing, and modal priorities



Monterey Road

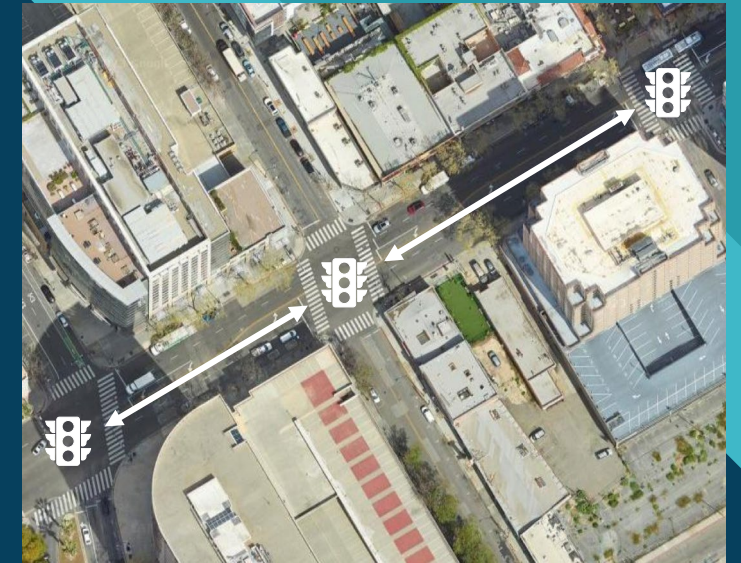
- Long signal spacing
- Relatively long signal cycles

Good candidate for TSP



Oakland Road & 101 Ramps

- Short signal spacing
- High vehicle volumes in all directions
- Off-ramp queues are a consideration



Santa Clara Street

- Short signal spacing
- Relatively short signal cycles
- Pedestrian recalls

# TSP Considerations



## Interoperability

CTSP is inherently flexible  
Hardware-based TSP  
Adaptive signal systems



## Coordination

Policies and goals for TSP  
Re-routes  
Timepoints



## Funding

Grants can cover initial  
setup/licensing costs  
After this, transit agencies  
should fund CTSP



# Thank You

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