DRAFT AMENDMENT No.2 to AGREEMENT BETWEEN CITY/COUNTY ASSOCIATION OF GOVERNMENTS OF SAN MATEO COUNTY AND SUSTAINABLE SILICON VALLEY FOR INTELLIGENT TRANSIT SIGNAL PRIORITY PROJECT

WHEREAS, the City/County Association of Governments for San Mateo County (hereinafter referred to as "C/CAG") and Sustainable Silicon Valley (hereinafter referred to as "Contractor") are parties to an Agreement dated September 13, 2018, for the Optimizing Urban Traffic (OUT) in San Mateo Pilot Project (the "Agreement"); and

WHEREAS, the original Agreement term included a completion date of June 30, 2020; and

WHEREAS, the parties executed amendment No. 1 on July 8, 2020 to extend the project completion date to June 30, 2021;

WHEREAS, due to multiple fiber breaks, the COVID-19 pandemic and subsequent lockdown, local traffic patterns were severely disrupted while many potential test drivers were quarantined, making it difficult to recruit sufficient participants for the Optimizing Urban Traffic (OUT) driver advice trials. Therefore, Contractor was unable to continue the pilot under the original scope;

WHEREAS, since the Summer of 2020, the Contractor has been working with C/CAG on alternative project concepts and decided to pursue a Transit Signal Priority project in the City of East Palo Alto (EPA);

IT IS HEREBY AGREED by C/CAG and Contractor as follows:

1. The term of the Agreement, as provided in Section 1 "Service to be provided by Contactor" and Section 5 "Contract Term," shall be extended through February 25, 2022.

2. The Contractor has chosen to substitute the specified Subcontractor "Connected Signals, Inc." (SC) with another well-qualified Subcontractor, "SinWaves, Inc." with consent from the C/CAG Executive Director. SinWaves, Inc. conducts business as LYT (hereinafter referred to as "LYT");

3. All references in this Agreement to "Connected Signals" or "CS" shall be replaced by LYT.

4. Due to changes in work activities listed in Exhibit A, *Scope of Work*, the Exhibit shall be replaced in its entirety with a revised version of Exhibit A, *Revised Scope of Work*. Additionally, the original Exhibit B shall be replaced

with an updated Exhibit B, *Revised Milestones and Payment Schedules*. Both exhibits are attached to this Amendment No. 2 and incorporated to the Agreement.

5. This amendment shall take effect on May 17, 2021.

Except as expressly amended herein, all other provisions of the Agreement shall remain in full force and effect.

City/County Association of Governments	Sustainable Silicon Valley
_____	_____
Sandy Wong C/CAG Executive Director	Jennifer Thompson Executive Director
Date:_____	Date:_____

Approved as to form:

_____
Melissa Andrikopoulos
Legal Counsel for C/CAG

EXHIBIT A

REVISED SCOPE OF WORK

Intelligent Transit Signal Priority Pilot Project in East Palo Alto

Background

Transit is a core component of community vitality. In urban environments, the communities offering affordable housing can be significantly distanced from opportunities that support upward social mobility. With car ownership often being an elusive goal to lower income communities, transit often provides the only viable mobility to education, work, food, and social services. As such, the efficiency and effectiveness of the local transit systems have a direct social impact on the communities, providing opportunity for improved quality of life. Furthermore, in a post-COVID environment, cities have the unique opportunity to transform transit and Single Occupancy Vehicle (SOV) mobility. To do this, transit must become a more competitive option to the driving alone culture.

From a transit operator's perspective, inefficient routes that are a consequence of traffic congestion become increasingly more expensive to operate, as more buses or trains are needed to maintain the same frequency of service. Slower bus speeds with more frequent stopping and starting results in a poor rider experience, causing rides to opt for other modes of transport. Loss of riders, reduction in bus speed, and frequent periods of stop and go delay causes transit fare loss, increased emissions, and increased spend for vehicle operations and maintenance. Finally, the overall efficiency of the local transit system has a direct social impact on communities with higher than average transit dependency and lower vehicle ownership.

One of the ways to counteract these inefficiencies is to implement Transit Signal Priority (TSP) for bus operations, which is simply the idea of giving special treatment to transit vehicles that have a higher occupancy of people at signalized intersections, thus increasing the throughput of an intersection. However, costs for implementing many of the solutions are often prohibitive and have yet to be optimized for larger scale deployments. As such, cities and transit operators are searching for solutions that can be easily integrated into their existing infrastructure and can prove their value in their existing operational environment.

In today's age of highly reliable large-scale communication access, there exists the opportunity to eliminate the hardware cost of transit signal priority solutions while maximizing the investment on current solutions. Many of today's signal controller firmware vendors have software functionality to facilitate the function of placing virtual priority calls. The information needed to place these virtual calls can be found at the transit agency. In order for transit agencies to manage their fleet, they typically have implemented tracking devices on each of their vehicles in order to report to their computer-aided dispatch and automatic vehicle location (CAD/AVL) software. With

vehicle locations known in near real-time, software and networking can now be used to bridge the gap between transit vehicles and city signals to facility transit priority in a more reliable, sustainable, and intelligent way. This project seeks to leverage these developments to give cities and transit operators comprehensive, system-level overview of the transit network in real time, detailed bus route information, accurate intersection bus arrival times, and a view of other traffic across the intersection and corridors all while intelligently prioritizing buses.

Intelligent TSP

SSV's technology partner, LYT, has demonstrated a cloud-based transit signal priority system, LYT.speed, which combines asset management, automation, and machine learning to produce a system capable of providing services to an entire region. Unlike hardware-based systems, LYT.speed uses preexisting equipment and leverages cloud technology to facilitate operations. This removes the need for vehicle detection hardware at the intersection because vehicle location is known through the CAD/AVL system. This enables both priority calls from greater distances away from signals and priority calls coordinated among a group of signals. LYT.speed processes live bus location information through machine learning models and makes priority calls based on estimated times of arrival. Furthermore, the system provides real-time insights on which buses are currently receiving priority along with daily reports of performance metrics.

Project Overview

The intelligent Transit Signal Priority (TSP) pilot will deliver a Cloud-based Artificial Intelligent-powered TSP system along University Avenue and selected routes in East Palo Alto. The system utilizes traffic signal controllers connected to San Mateo Smart Corridor communication networks (when available, or wireless cellular modems) to dynamically adjust the phase and timing of traffic signals to provide sufficient green clearance time while minimally impacting cross traffic. A sub-fleet of SamTrans buses that serve the selected routes will be equipped with low-cost wireless GPS devices that will provide real time location-based information to the back-end system. Efficiency is improved due to increased real-time awareness of where any and all buses are at a given time.

Project Partners

The Intelligent Traffic Signals pilot will engage and leverage a coalition of local and statewide partners, including

- SSV
- C/CAG
- LYT
- SamTrans
- City of East Palo Alto / Contractor Cal-West

SSV will be the overall project manager, contracting with the other project stakeholders through a series of contracts and MOUs.

SamTrans is an essential partner who will provide the buses to be used in the pilot. They have advised SSV from the start about which routes will be most suitable, as well as the frequency of service and bus stop locations.

Cal-West Lighting and Signals manages and maintains all City of East Palo Alto (EPA) traffic signals and will be assisting in the setup and connection of communications equipment to the traffic signal controllers. In the event that Cal-West needs to incur costs in assisting SSV for the pilot, SSV will provide contingency funds to cover such costs.

Caltrans is aware and supportive of the pilot but will have no direct role. They will provide project guidance as needed. The signals we are using for the pilot are not maintained by Caltrans and therefore we may work them.

Expected Benefits for East Palo Alto and region

Win-win for stakeholders. A successful demonstration results in a win-win for all stakeholders, as the reduced travel times improves regional productivity, while releasing transit resources to improve other routes or provide service to a larger community of riders. The City of East Palo Alto would be the first city in San Mateo County to deploy such a system and help set the direction for the region.

Mobility for disadvantaged and transit reliant residents. Slow bus speeds result in poor rider experience, often prompting residents to opt for other modes of transportation. This contributes to traffic congestion, and has a direct social impact on communities already heavily transit-dependent.

Reduced congestion and pollution. A direct benefit to EPA is reduced congestion along major arteries, and likewise the reduction in toxic pollutants that idling buses emit. This likely will contribute to the EPA 2020 Bay Road TDM Program designed to reduce overall demand for peak hour trips while also reducing trips utilizing single occupant vehicles (SOVs).

Leverage Smart Corridor. Additionally, the project leverages the San Mateo Smart Corridor capabilities, leveraging state-of-the-art technology including upgraded traffic signal controllers with remote management capability, integrated by fiber-optic cables that link 10 cities along this corridor, and overlaps many of the ITSP study streets.

Significant reduction in deployment, operations and maintenance costs. Benefits include a significant reduction in hardware costs and staff time for initial deployment. Required maintenance and operations costs are also reduced, as the cloud-based software enables remote and automated configuration of the traffic signal controller priority system. Transit operational efficiencies alone will reduce vehicle and labor resources required for operation, ultimately allowing distribution of funds for reinvestment into the transit network.

Shift perception of transit. Finally, shifting the perception of transit as an efficient mobility provider with increased throughput that provides significant value to the community will be key to driving a focus on prioritizing transit as a viable mode share. Enabling other transit agencies to replicate the deployment of cloud-based signal priority for transit will transform city/transit collaborations to focus on technology foundations crucial to next-generation traffic management.

Platform for future innovation. The TSP System will be offered as a proof-of-concept (PoC) pilot for a future SamTrans project, which builds on these to-be proven capabilities. During the pilot phase, SSV will oversee the execution of agreements between and among the project partners. It is expected that this implementation can be readily expanded to a variety of other applications, including emergency service vehicle preemption, bicycle detection and/or prioritization, and the creation of virtual High Occupancy Vehicle (HOV) lanes which give HOVs preference at signalized intersections.

ITSP Investment Model

The original funding agreement that C/CAG and Sustainable Silicon Valley entered into for the Optimizing Urban Traffic (OUT) project in City of Menlo Park has a not to exceed amount of $236,700. Sustainable Silicon Valley committed $246,000 of in-kind contribution to the project, bringing the total project value to $482,700.

To date, Sustainable Silicon Valley has expended $58,669 of the $236,700 under the original project. An amount of $178,031 remains in the funding agreement. Due to the COVID 19 pandemic, the OUT project in Menlo Park is no longer feasible. Sustainable Silicon Valley is requesting to direct the remaining $178,031 to the intelligent transit signal priority pilot project in East Palo Alto.

An approximate accounting of time SSV invested in the project is as follows, beginning in September of 2018 until November 2020.

SSV Person	Role	In-kind Work Performed (Summary)	Person Hours Contributed/time period	Internal SSV Rate $	Total $
Jose Iglesias	Lead Project Advisor	Develop OUT idea into executable project; develop concept of driver trials; develop privacy and data security models; work with technology providers to	804 / 20 weeks	$100/hr	$80,400

		develop OUT technology framework			
Bruce Naegel	Project Manager	Manage initial project definition, work plan, and manage initial KH data gateway work; manage relationships with technology partners	680 / 17 weeks	$30/hr	$20,400
Jennifer Thompson	Executive Director	Oversee OUT project and manage relationships with key stakeholders including C/CAG, City of Menlo Park	700 / 20 weeks	$36/hr	$25,200
Andrew Clark	Project Director	Identify relevant technology partners; develop SOW, work plans, schedules and contracts Develop new TSP project, SOW, plan	1200 / 33 weeks	$100/hr	$120,000
Total SSV In-Kind Through Nov. 2020					$246,000

The Pilot

This proof-of-concept pilot opportunity presented by C/CAG, Caltrans, the City of East Palo Alto, SamTrans, SSV and LYT will use a sub-fleet of the District's vehicles to collect about 5 weeks of historic data and then test cloud-based TSP for a total of 6 months in the City of East Palo Alto. The Cloud-based iTSP will provide the same priority scheme as in a traditional TSP system but doesn't require installation of any physical devices at intersections. The pilot will provide real-time data and mapping capabilities that are currently not offered with the more traditional TSP systems.

The pilot system will be deployed using a software interface (LYT/Maestro) and is only functional when both connected to intersections and wirelessly connected buses. Given that the SamTrans fleet is not yet fully connected via cellular, the Pilot will include installation of temporary tracking devices, procured, installed and maintained by SSV, onboard a sub-fleet of SamTrans buses. At the end of the pilot, SSV will manage the removal of all hardware from the SamTrans buses and City of East Palo Alto network.

Pilot Location

SamTrans has advised that Routes 296 and 280/281, major transit connectors for those traveling across EPA, Menlo Park up to Redwood City (Figures 1 and 2) are the most suitable for our pilot. The main artery, University Avenue, is a heavily used and highly-congested corridor. Feeding University is the Dumbarton Corridor, also heavily utilized by tech workers headed to/from the East Bay. For this pilot the team will be focusing in on the EPA section of the route. Figure 3 shows the traffic signals that will take part in the study, overlayed with SamTrans Routes 296 and 280/281.

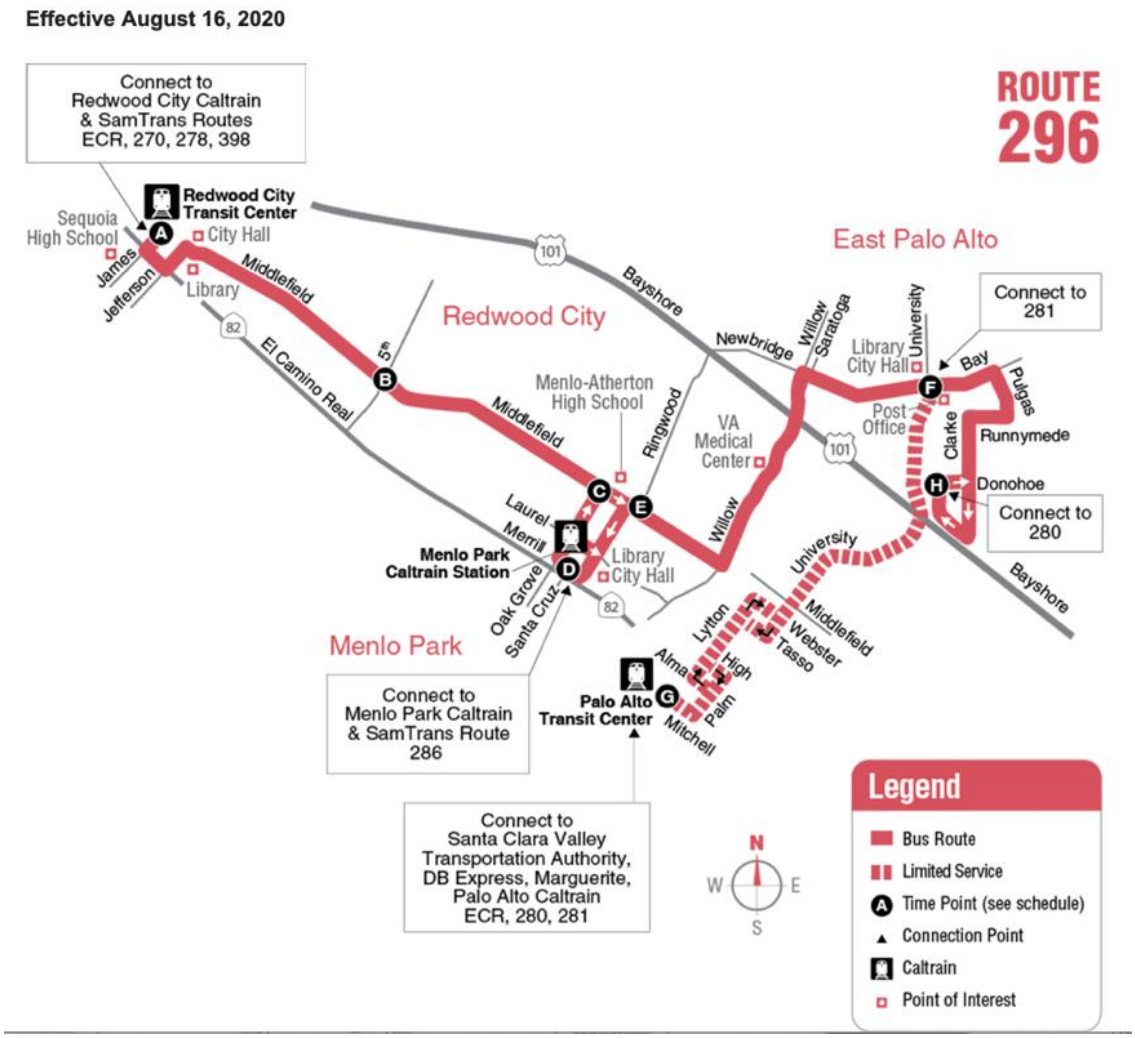

Figure 1: SamTrans Route 296 in East Palo Alto

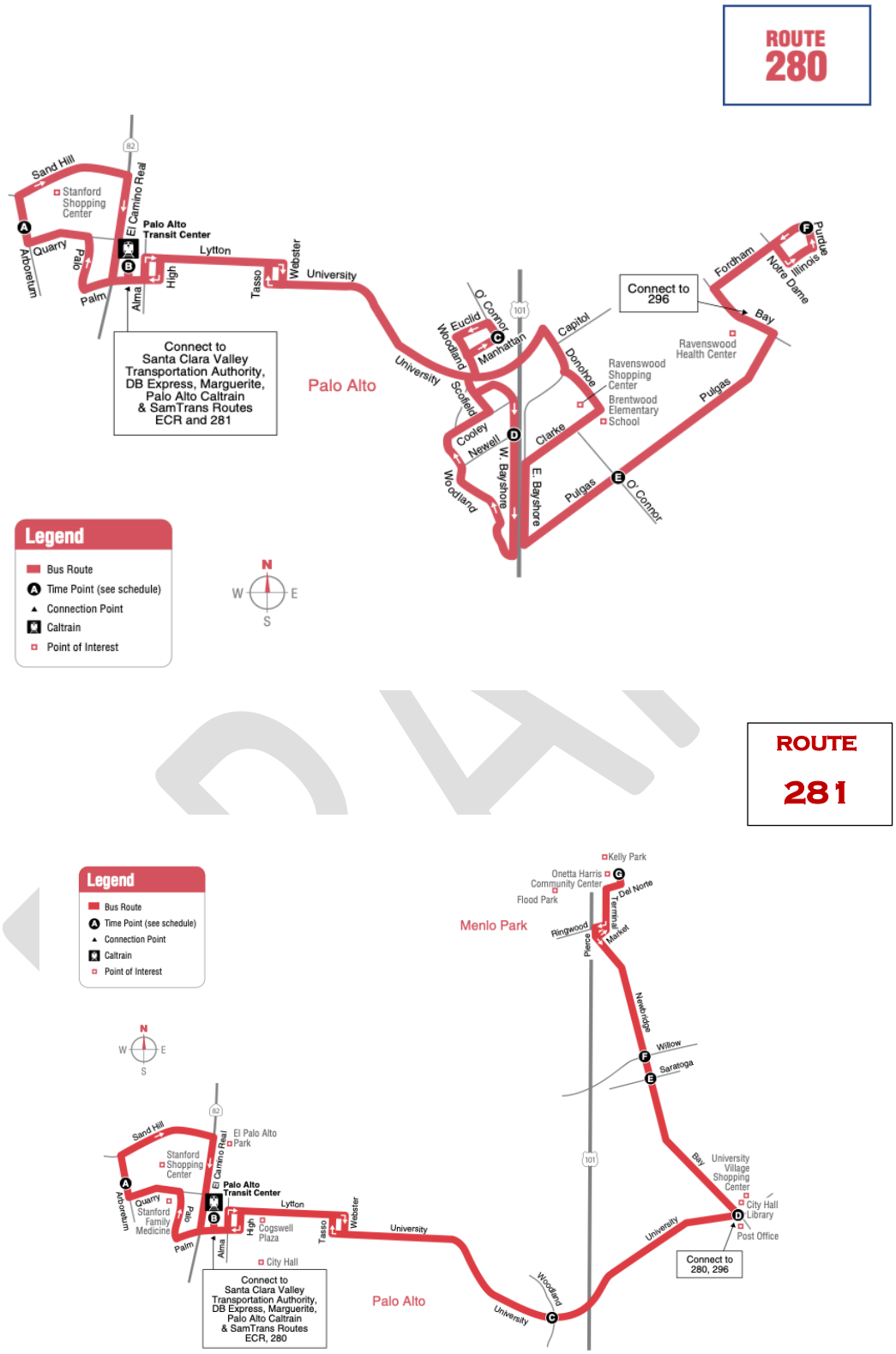

Figure 2. SamTrans Routes 280/281 in East Palo Alto and Palo Alto

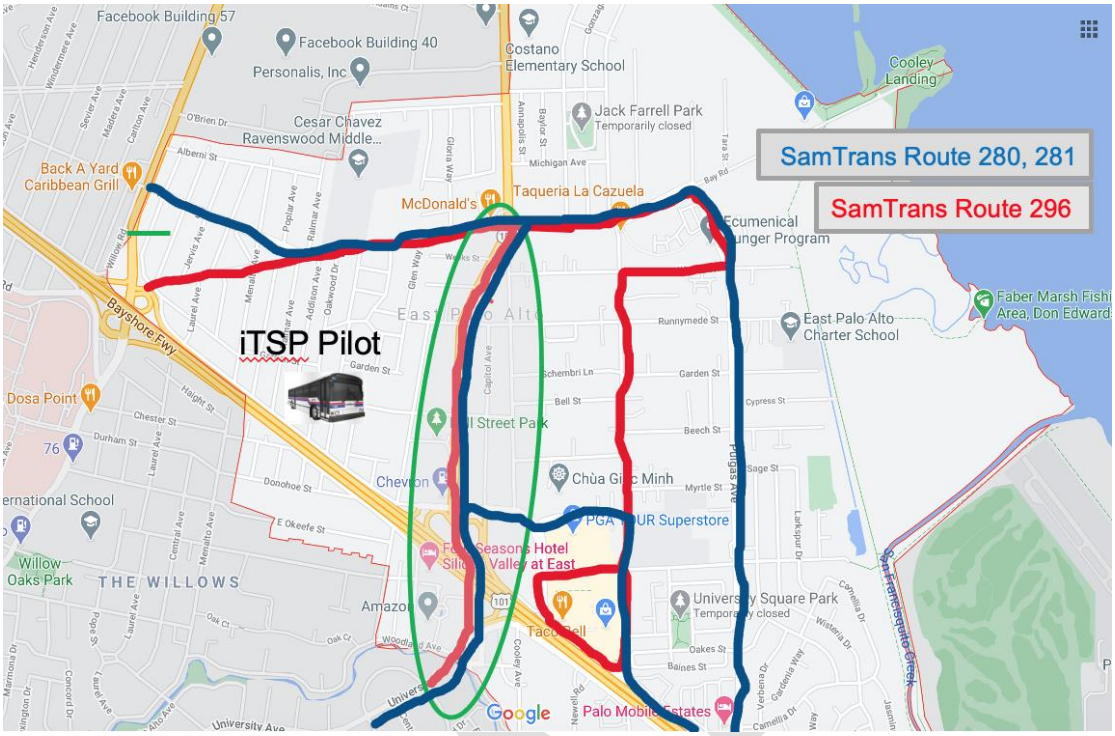

Figure 3: EPA Alto Traffic Signals Overlayed With Routes 296 and 280/281

Required Equipment

Based on the actual number of SamTrans buses dispatched along the pilot routes, SSV will purchase up to 45 GPS tracking units at approximately $8,000, which will provide a temporary tracking/location capability for the pilot. An example of the device is shown in Figure 4.

Figure 4: Temporary Vehicle Tracking Device “Particle Tracker One”

Additionally, up to 6 4G/LTE wireless modems will be purchased by SSV and deployed at selected intersections along the Pilot routes, and will be used to securely communicate with the traffic signals at those locations.

Other equipment required includes Maestro (a small computer, Figure 5) to be supplied by LYT. It contains software that enables secure communication between the LYT cloud platform and city traffic lights. To enable safe and secure connections with traffic signals, each city requires just one device, called Maestro. It is a computer that resides at the network "edge" and serves as the protective link between city traffic signals and the LYT platform. It is designed to securely manage the information exchange between traffic lights and LYT's cloud platform.

Figure 5: Maestro

System Setup

The temporary vehicle tracking devices attached to the SamTrans sub-fleet will be configured to send location updates to the LYT cloud platform. Software will collect and process transit bus location updates in real-time. Once approximately 5 weeks of transit bus location information has been saved, LYT will begin training machine learning models capable of predicting the buses arrive time to the piloted traffic signals.

The City of East Palo Alto will provide LYT with traffic signal phase diagrams according to the NEMA standard. EPA and Cal-West IT will work with LYT to implement secure communication between traffic signals, Maestro, and the cloud platform.

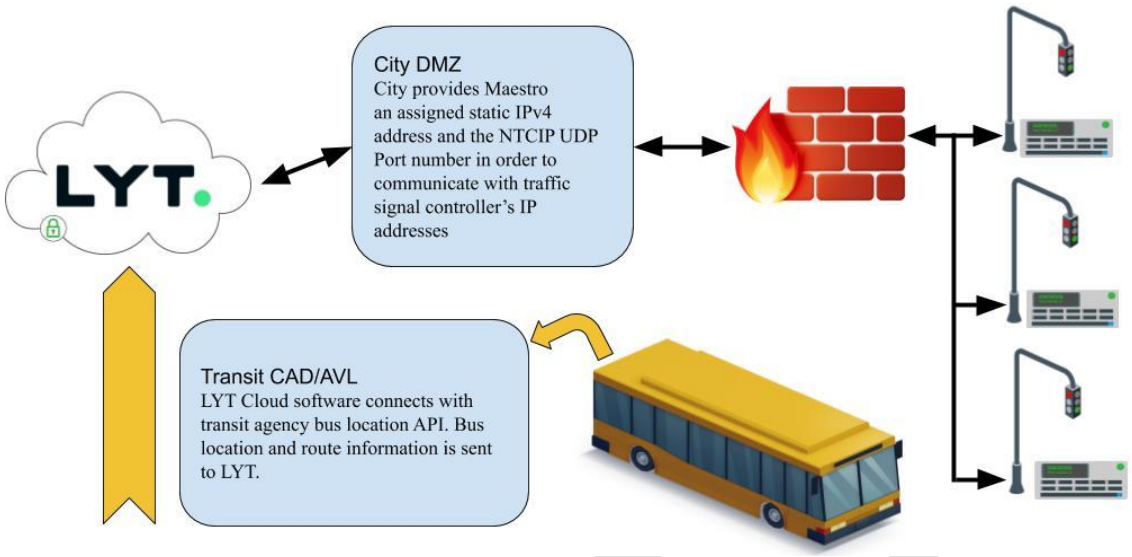

Figure 6: LYT.speed Network Architecture Diagram

System Software, Data Collection, & Monitoring

The LYT system includes a web portal for EPA, C/CAG and transit staff to login and view how the transit system is performing at each of the piloted traffic signals. Features include:

- Secure login with additional One Time Password (OTP) at each login
- View entire city, multiple cities, a particular signal or a particular transit vehicle
- Troubleshoot issues in real-time at the intersection level with signal performance metrics
- Review charts of daily priority calls and their impact on transit performance

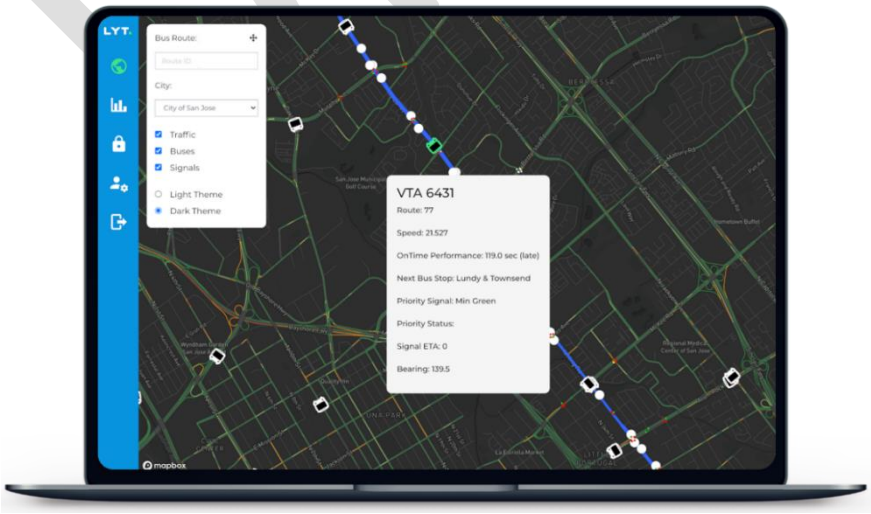

Figure 7: LYT's Live Map

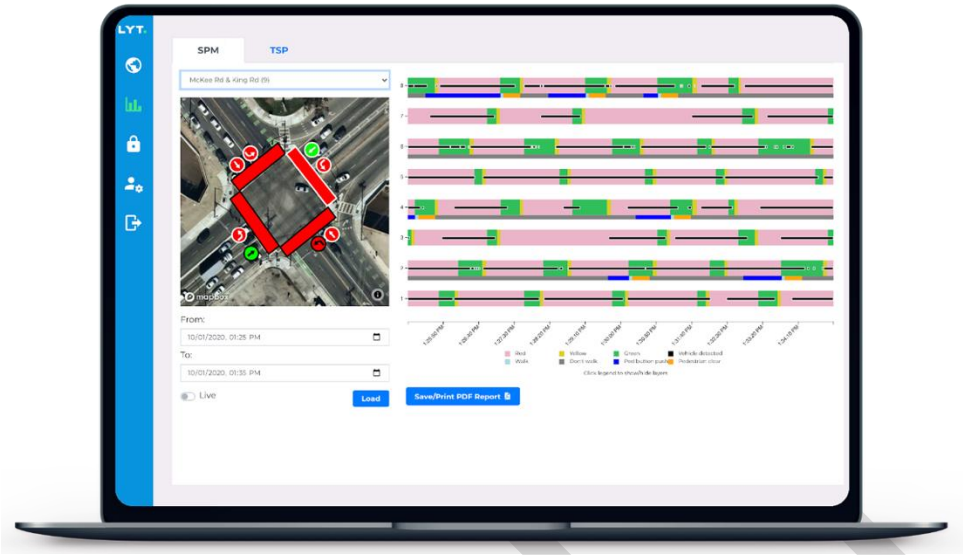

Figure 8: LYT's Signal Performance Records

Deliverables and Schedule

Summarized in the table below, a number of significant metrics will be collected during the pilot time to evaluate the level of success, including, but not limited to:

- Setup and installation time
- Traffic light delay
- Bus speed
- Traffic signal network performance

Using this information SSV and LYT will provide to all stakeholders a comprehensive report which will include, but is not limited to, the analysis and documentation of:

- The security & reliability of the traffic signal communication network
- The before and after effects of traffic light delay on average bus speed
- Report will document the project challenges
- Recommendations on next steps
- Potential to add other project evaluation elements into the report

Other project-related data and metrics may be added to the report, based on evolving requests from stakeholders and participants. SSV shall submit a report outline to C/CAG for approval prior to drafting the report. SSV will also submit a draft project report to all the partners for comments. With comments from the stakeholders, SSV will then prepare a final project report for submittal to C/CAG.

ITEM #	TASKS AND DELIVERABLES	ANTICIPATED SCHEDULE
1	LYT and Cal-West to verify traffic signal interconnect possible using 4G wireless modem connections. SSV and LYT to identify a temporary bus tracking unit (1st unit purchased and tested) Note: LYT has tested an all-wireless connection solution utilizing 4G cellular modems which we'll use in this pilot.	Done
2	Kick off meeting	Target 5/20/21
3	SSV to acquire required number of specified 4G cellular modems to support pilot. LYT and Cal-West to configure the selected traffic controllers with 4G cellular modems to enable LYT.speed's communication with EPA traffic signals. SSV to acquire temporary tracking units for SamTrans subfleet.	5/17/21 – 6/04/21
4	EPA to provide LYT with intersection diagrams, NEMA phase and ring configuration, EVP controller channel configuration, phase overlap configurations, list of traffic signal controller types with firmware version numbers, and traffic signal controller manuals (PDF format).	5/17/21-6/04/21
5	SamTrans to provide LYT with GeoJSON shape files of routes, schedules, and bus stop GeoJSON file consisting of stop coordinates and IDs.	6/11/21
6	LYT to review and verify traffic agency intersection documents, SamTrans route and stop files, and complete digital system mappings on LYT's platform	6/18/21
7	LYT and SSV to coordinate the communication connection between LYT's cloud (CloudConductor) and SamTrans Buses (Tracker One devices)	6/23/21
8	LYT to validate communications with selected EPA traffic signals.	6/23/21
9	LYT to validate that transit signal priority is functioning along the corridor by supervised field observations.	6/25/21
10	Begin training Maestro AI component against live TSP data	6/28/21-7/30/21
11	Live TSP Pilot Operation in East Palo Alto	8/01/21-2/4/22
12	Live Operation Completion Date	2/4/22

ITEM #	TASKS AND DELIVERABLES	ANTICIPATED SCHEDULE
13	SSV and LYT will remove Maestro, provided firewall, and external communication connection from EPA signal controllers SSV will remove tracking devices from SamTrans buses	2/7/22
14	SSV will develop final Report to C/CAG. SSV will make presentation to C/CAG Committees and Board of Directors on project findings. SSV will develop slide presentation with revisions by C/CAG staff and project stakeholders.	2/25/22

Responsibilities of Project Stakeholder

C/CAG:

- Grant limited access to the Safe and Smart Corridor to SSV and LYT

Caltrans:

- As needed provide advice and guidance to the pilot

SSV:

- Perform all project management responsibilities
    - Build, manage overall project plan
    - Host bi-weekly calls with C/CAG, SamTrans, East Palo Alto, and LYT
    - Develop bi-weekly meeting agendas, facilitate meetings and document action items
    - Review project progress and discuss upcoming needs and deliverables
    - Communicate with stakeholders
    - Submit monthly invoices with progress reports summarizing work completed in each billing period
    - Define success criteria, prepare and deliver final report
- Manage sub-contractors and stakeholders
- Define project and convene stakeholders, partners
    - C/CAG
    - SamTrans
    - City of East Palo Alto
    - LYT
- Purchase temporary bus trackers, 4G/LTE modems; coordinate and fund installation and removal of devices based on schedule approved by SamTrans

LYT:

- Work with all stakeholders to develop evaluation criteria
- Work with all stakeholders to collect data for evaluation
- Work with all stakeholders to analyze data
- Receive from SamTrans a shapefile or GeoJSON file of transit routes and bus stops; receive bus route schedule files
- Digitally map bus route and bus stops into CloudConnect
- Digitally Map Signalized intersections (match phase to lane) and validate
- Provide EPA's IT department LYT's secure communication requirements (firewall and Internet connection and/or 4G/LTE modems)
- Provide 1 Maestro to EPA configured to their IT guidelines
- Confirm Maestro is successfully pulling signal status at 1 Hz from all authorized traffic signals
- Confirm city connection to AWS for Maestro software updates
- Use vehicle data and traffic engineering principles to configure signal controller priority settings
- Grant stakeholders access to LYT's web portal
- Attend bi-weekly calls with C/CAG, SamTrans, EPA, and SSV

City of East Palo Alto

- No direct cost to EPA to participate in the pilot
- Provide LYT communication access to traffic signals via city network or 4G cell modems
- Provide LYT with traffic signal phase-to-lane documentation
- Help facilitate working with traffic contractor Cal-West Lighting
- Traffic signals may require firmware updates from the vendor
- Attend Bi-weekly meeting with SamTrans, C/CAG, SSV, and LYT
- Communicate to LYT any system issues or concerns

SamTrans:

- Agree to participate
- No direct cost to SamTrans to participate in the pilot
- Provide vehicle information and specs for temporary trackers
- Allow access to buses for installation and removal of temporary trackers
    - Approximately 45 buses would need the trackers installed; this would include all vehicles that could be assigned to Routes 296 and 280
- Participate in weekly meetings
- Contribute to evaluation metrics development
- Allow for removal of trackers at end of TSP operation
- Share data

EXHIBIT B

MILESTONES AND PAYMENT SCHEDULE

Assumptions

- Maestro, LYT's data gateway is able to consume real-time traffic light and sensor data, can communicate with traffic lights and is accessible through the East Palo Alto city network and/or supplied 4G cellular modems
- SamTrans will provide sufficient buses to be dispatched within the City of East Palo Alto and allow installation of temporary GPS location devices
- LYT will provide, as a service, all necessary software and service infrastructure to perform the following activities.
- SSV will purchase necessary communications equipment for secure connection to City of East Palo Alto network and/or traffic controllers, up to 8 traffic lights along University Avenue and other selected intersections
- SSV to host monthly status meetings among all of the principal project partners
- SSV and LYT to remove all installed hardware and software upon completion of pilot

Milestones and Payment Schedule

Project Phases	**Responsible Party(ies)**	**Completion Date & Milestone Payment**
Phase 1: Integration with SamTrans		5/17/21 –6/04/21
SSV and LYT will locate a vehicle tracking solution that will meet SamTrans and LYT system requirements for performance and security.	SSV	$8,000
Procured system will be *temporarily placed on the buses, requiring minimal driver interaction.		
Test vehicle connectivity and verify correct data is sent to LYT cloud platform	LYT	$10,000
Cover cost of GPS tracker cell service for 7 months (45 buses * $6.45/month * 1 month training + 6 months operation)	SSV	$ 2,031
Project Management	SSV	$21,500

Phase 2: Integration with City of East Palo Alto		6/04/21 – 6/21/21
LYT to work with EPA IT, and CalWest to securely connect traffic signals with Maestro and the cloud software	LYT	$30,000
Review EPA and SamTrans traffic signal documentation and proper mapping to LYT's Maestro platform		
Install secure connection at EPA City Hall and/or procure 6 4G/LTE modems and validate connectivity to Maestro	SSV	$1,000
Prepare street network and configuration of traffic lights (controller and geo-spatial data)		
Validate traffic signal priority is properly functioning		
Cover cost of 4G/LTE modems for 7 months (6 signals * $10/month * 1 month training + 6 months operation)	SSV	$500
Project Management	SSV	$21,500
Phase 3		6/21/21 – 7/30/21
Begin training on live TSP data collected from traffic signals	LYT	$20,000
Project Management	SSV	$21,500
Phase 4: Pilot Operation		8/01/21 - 2/4/22
Turn on LYT.speed. buses servicing routes 296 and 280 will now get transit signal priority	LYT	$10,000
Monitor Service and perform changes were needed, technical customer support, bug fixes		
Remove all tracking hardware, firewalls, connections to EPA City, 4G/LTE modems and LYT software	SSV	
Project Management		$5,500

Phase 5: Evaluation & Reporting: Write comprehensive report. Disseminate findings. LYT will provide technical authoring of parts of the report. Project Management Presentation to C/CAG Committees and Board of Directors on project findings. SSV will develop slide presentation with revisions by C/CAG staff and project stakeholders.	 LYT SSV	2/7/22 - 2/25/22 $5,000 $21,500
Amendment No. 2 Cost **Total SSV** **Total LYT** **Total Amendment No. 2 Cost** **Previously Paid to SSV for Project Management** **Previously Paid to subcontract Through SSV** **Previous expenditure total** **Total Amendment No 2 Cost (incl. Previous Spend)** **In-Kind SSV Investment to Date (see above section "OUT Investment Model")** **Total Project Value (incl. SSV in-kind investment)**		 **$ 103,031** **$ 75,000** **$ 178,031** **$ 18,669** **$ 40,000** **$ 58,669** **$ 236,700** **$ 246,000** **$ 482,700**