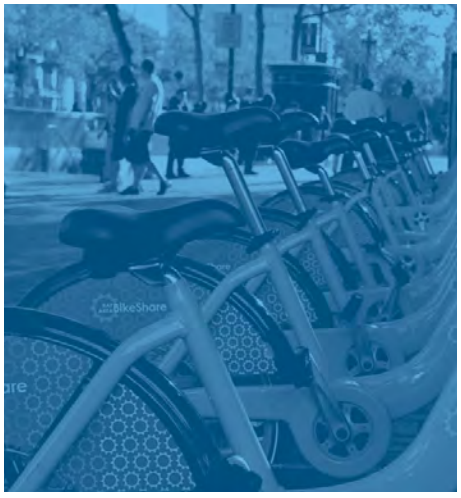
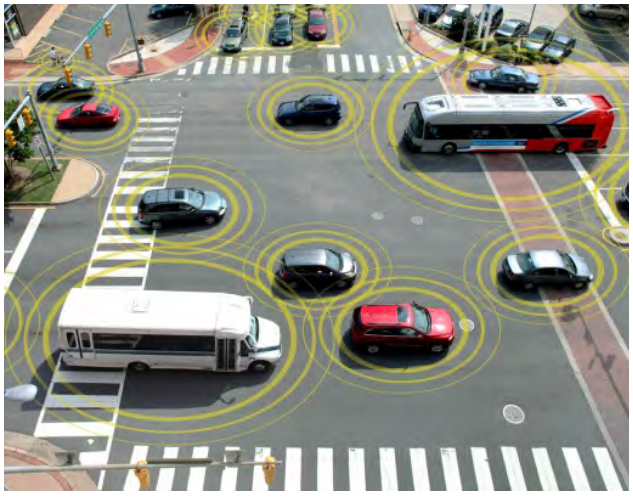
City of San Francisco

Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD)





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Notice of Funding Opportunity
#DTFH6116RA00012

SFMTA
Municipal
Transportation
Agency

Project Name:

City of San Francisco
Advanced Transportation and Congestion Management Technologies Deployment Initiative

Previously Incurred Project Cost	$100,000
Future Eligible Project Cost	$32,507,775
Total Project Cost	$32,607,775
ATCMTD Request	$11,997,760
Total Federal Funding (including ATCMTD)	$12,097,760
Are matching funds restricted to a specific project component? If so, which one?	Yes. Some private commitments (letters included in the Appendix) are specific to certain project components.
State(s) in which the project is located	California
Is the project currently programmed in the: • Transportation Improvement Program (TIP) • Statewide Transportation Improvement Program (STIP) • MPO Long Range Transportation Plan • State Long Range Transportation Plan	Yes. MTC Plan Bay Area, which is the MPO Long Range Transportation Plan.

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1 Executive Summary

San Francisco is already a global leader in smart cities. Our culture is vibrant and technology-infused, breeding innovation and leveraging city-led initiatives to incubate and disseminate knowledge while pointing paths to the future. Responding to the Smart City Challenge started San Francisco down the path of smart technology to achieve our vision for a more advanced and innovative transportation system that provides greater mobility and a better quality of life to all San Franciscans. Our willingness to engage with ambitious and advanced transportation technologies is a reflection of the innovative atmosphere within San Francisco, which makes the City the ideal place where new solutions for our transportation issues can be rolled out.

With the Advanced Transportation and Congestion Management Technologies (ATCMTD) program, we hope to transform this ambitious vision into practical and replicable solutions that can be immediately deployable, readily scalable and easily shared with other cities. In particular, we would like to use advanced transportation technology to implement near-term improvements to our street network to make it safer and smarter, providing greater mobility for all of its users. Our vision is of shared mobility, i.e., the shared use of a vehicle, public transit, bicycle, or other mode that enables travelers short-term access to transportation modes on an as-needed basis.

- **Shared** to reduce the fleet size and travel costs, and improve mobility and access for all users;
- **Connected** to minimize fatalities and collisions and to maximize operating efficiency; and
- **Automated** to minimize congestion, parking demand, and operating costs.

Transportation is the lifeblood of our communities. It connects us to opportunity, to one another, to the things that make life meaningful. And, to that end, San Francisco needs to be a pioneer in the most innovative transportation options available: the region's population and jobs will grow by 25 percent by 2040. Without innovation to meet housing and transportation inequities, the region risks its economic competitive advantage.

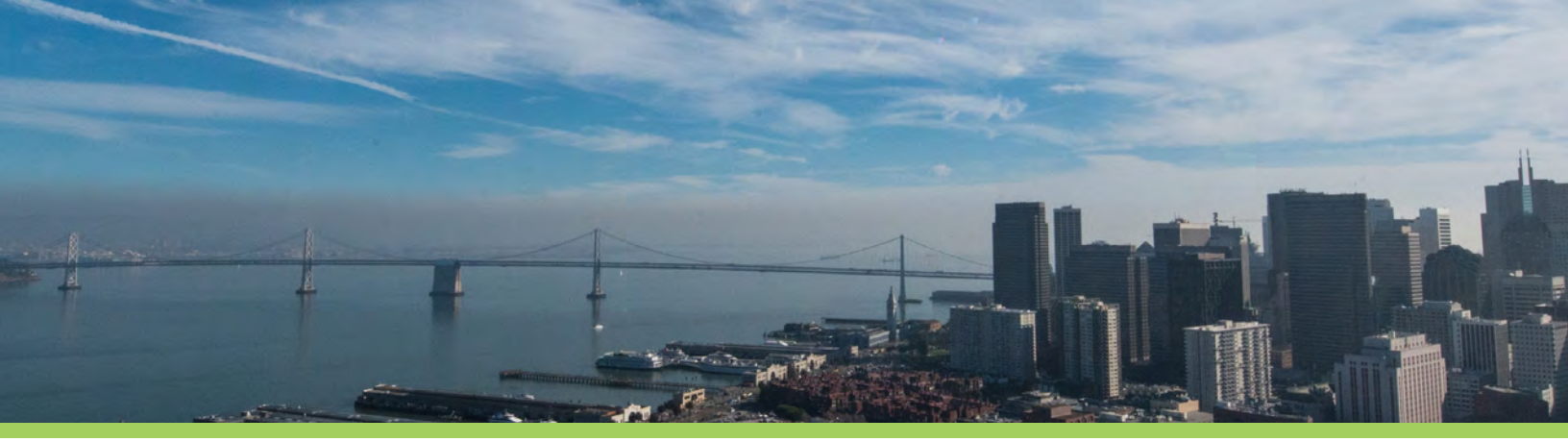
Transportation comprises 43% of San Francisco's greenhouse gas (GHG) pollution, hindering our pursuit of carbon-neutrality. Moreover, while we have made great strides in walking, public transit, bicycling and shared modes, these networks are fragmented and are not meeting the needs of the other half that drive. Therefore, **we aim for smarter and more efficient use of our street infrastructure.** We want to encourage ride sharing and carpooling by creating dynamic pickup curbs for carpooling and ridesharing vehicles, and create a regional carpool lane system that can speed up and incentivize these trips.

In 2015, 30 residents lost their lives in San Francisco due to traffic fatalities. We do not accept that a certain number of fatalities are just "the cost of doing business." We must get to zero. To this end, **we aim to roll out smart traffic signals as part of our Vision Zero plan to eliminate traffic fatalities.** With our smart signals, we aim not only to make intersections safer and more accessible for pedestrians and cyclists in the City's neediest communities, we also seek to improve their overall efficiency by providing signal preference to priority vehicles, such as emergency vehicles and public transit vehicles.

Moreover, we want to push the envelope of innovation by investing in advanced technologies that better position the City for future growth and opportunities. We propose to pilot a connected tolling system that implements congestion pricing to allow us to better manage traffic as well as encourage high-occupancy vehicles and public transit through pricing incentives. Furthermore, we would like to pilot automated vehicles for potential wide-scale rollout throughout the City, which would present a rich array of new mobility options for all.

Our pursuit of forward-thinking solutions to San Francisco's transportation doesn't stop with carpooling, ridesharing, tolling, safety advancements and automated vehicles. The projects we deploy as part of this proposal will only be a start. Rather, they will set the stage for a much larger effort to roll out even more advanced, integrated and innovative technologies in the coming years to create a smarter and more mobile city for all San Franciscans.

San Francisco is uniquely fit to implement these projects because of its location, massive network, unprecedented



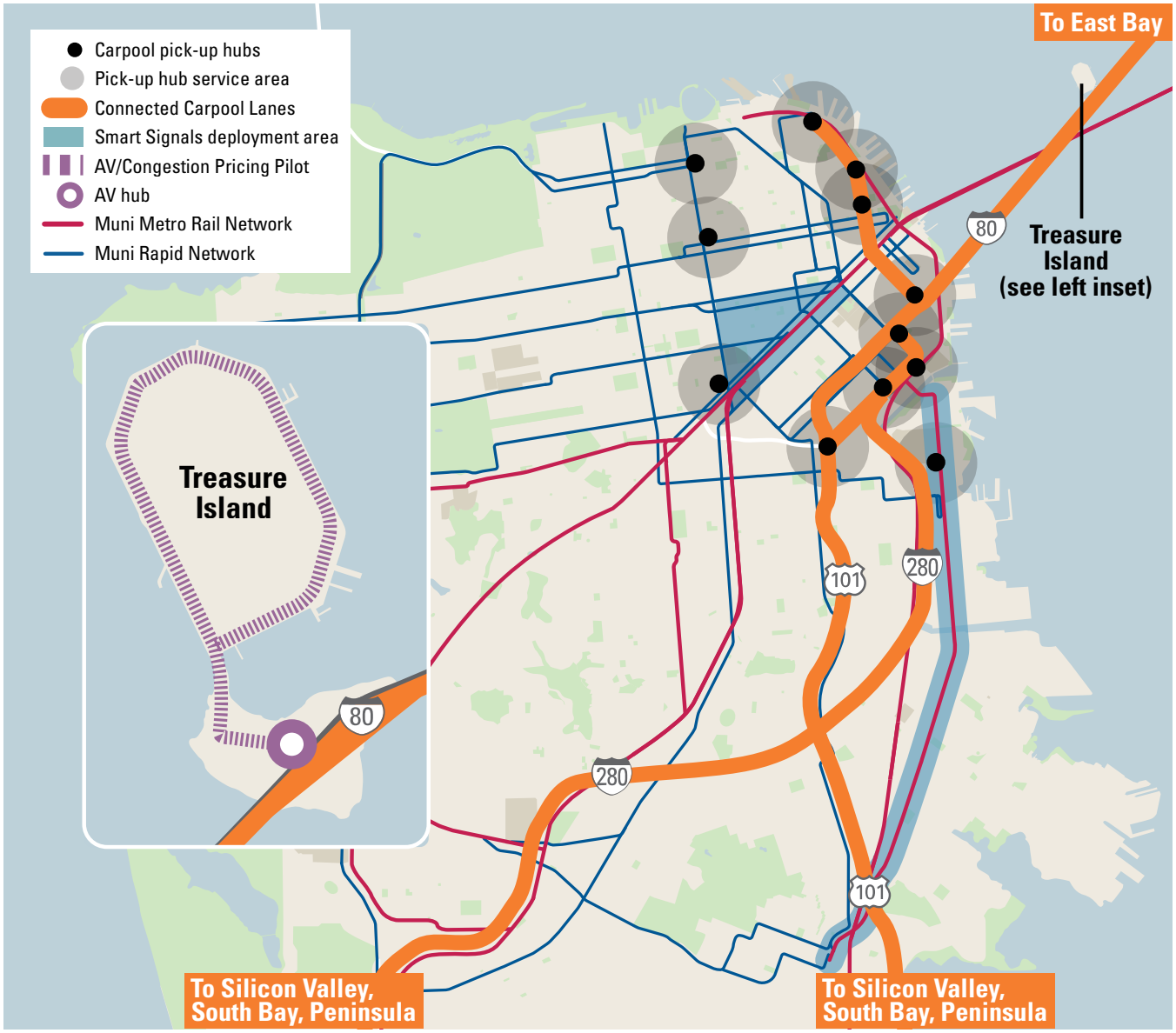
and unparalleled access to technology partners, and its interdisciplinary research alliance with the University of California, Berkeley. We offer:

1. **Unrivaled mobility innovation:** The San Francisco region is the nation's premier test bed for groundbreaking discoveries and trendsetting policies. Our pace of transportation innovations in shared mobility, electrification, and automated vehicles occurs nowhere else on earth.
2. **Proven track record of success through SFpark:** SFpark, a dynamic parking management system that achieved behavioral change through pricing experimentation (funded by the USDOT Urban Partnership Program), serves as a model across the U.S. and 12 nations around the world.
3. **Strong project partnerships:** Our proposed projects are being implemented with the San Francisco County Transportation Authority (SFCTA); a research alliance with world-class researchers at the University of California, Berkeley, one of the finest public institutions in the world; and a wide array of technology partners. Our approach to policies, innovation, and research puts us in a position to lead the world.
4. **The Smart Cities Institute or "Superpublic":** We have created "Superpublic," which is our Smart City Institute to provide a physical space adjacent to City Hall to bring together our partners – public, private and academia – under one roof to work together to solve complex transportation and other municipal challenges.
5. **Perfect combination of urgency and early adoption culture:** Our residents are eager for innovative mobility solutions.
6. **Confidence in data and risk management:** Our track record and reputation shows we know how to collect, warehouse, and protect critical data from both a privacy/security and proprietary (business competition) perspective. Our decades of experience and robust institutional frameworks ensure that we can provide a low-risk location that provides the highest impact for deployment and scalability.
7. **A guaranteed return on investment for the nation:** Investing in our vision and approach will produce outcomes that will prove replicable, scalable, and sustainable over the long term.
8. **An ideal urban laboratory for the nation:** San Francisco offers varied topography, urban form, and micro-climates that match the majority of cities across the nation within its city limits, except for snow. This, and its open and inclusive trend-setting culture, groundbreaking transport and land use policies, and our proximity to Silicon Valley, is why 13 automated vehicle companies are already here.

Furthermore, San Francisco—unlike all U.S. cities and most others across the globe—manages all of its rights-of-way, parking, public transit, and taxi operations under a single roof: the San Francisco Municipal Transportation Agency (SFMTA). This enables a supportive and integrated policy environment essential to realize such an ambitious vision.

In order to achieve our vision, SFMTA will be the lead agency and implement an array of innovative projects in partnership with the San Francisco Country Transportation Authority (SFCTA), which will contract with SFMTA on implementation through the Treasure Island Mobility Management Agency (TIMMA). Working in synergy, these solutions will maximize the potential of our street infrastructure, providing safer, more mobile streets for all San Franciscans. However, they are also scalable projects that uses San Francisco as a laboratory for pioneering transportation technologies, with their successes being able to be replicated on a large scale, not just in our City and region, but in the entire country.

2 The Projects



Connected Carpool Lane

Deploy new highway HOV lanes for transit/carpools

Desired Outcomes:

- Increased ride sharing, mobility (especially job access) and public transit ridership
- Reduced commute travel times, regional rail crowding, congestion, VMT, and GHG emissions

Smart Traffic Signals

Deploy Multi-Modal Intelligent Traffic Signal Systems in the form of Transit Signal Priority and Emergency Vehicle Preemption

Desired Outcomes:

- Increased safety and public transit speeds
- Reduced truck signal delays

Autonomous Shuttles

Deploy and test electronic, autonomous shuttles that serve intra-island trips

Desired Outcomes:

- Provide clean, reliable last-mile transportation to Treasure Island
- Deployable throughout City, region, and nation

Dynamic Carpool Pick Up Curbs

Dedicated curb space for pick-up/drop-off by carpools and ridesourcing services

Desired Outcomes:

- Incentives for sharing rides
- Improved safety
- Reduced congestion, double parking, modal conflicts, idling, and travel times

Connected Vision Zero Corridor

Deploy multi-Modal Intelligent Traffic Signal Systems located roadside and in-vehicle

Desired Outcomes:

- Reduced public transit travel times, idling and GHG emissions
- Improved safety and satisfaction for pedestrians and cyclists

Congestion Toll System

Deploy a connected, electronic toll system for the congestion pricing program

Desired Outcomes:

- Curb vehicle demand on the heavily congested Bay Bridge
- Fund and increase the competiveness and attractiveness of transit for commute trips

Solutions: Addressing San Francisco's Challenges

San Francisco is proud to have overcome many challenges through pioneering policies and innovations and an equity-focused lens. However, many more challenges lie ahead that are seemingly beyond the City's control. We are seizing this grant opportunity to help catalyze a series of breakthrough solutions that address the following challenges:

1. **Affordability crisis:** The City and Bay Area's burgeoning economy has outpaced affordable housing and transportation options causing displacement for some and longer commutes for all. A private vehicle costs an average of $10,000 per year. For many this is unsustainable with 18% of household income on average going to mobility. *We can reduce travel costs and increase ladders of opportunity for residents by providing them with viable ridesharing options. In the short-term, it means providing them with safer, more efficient streets as well as improved ridesharing and carpooling experiences that give them more alternatives to private automobiles; in the long-term, we aim to implement our AV and congestion pricing projects throughout the City to not only offer vastly improved mobility, but also use space previously taken up by private automobiles (such as parking garages) for affordable housing.*

2. **Traffic safety crisis:** 30 residents lost their lives in 2015 in preventable traffic fatalities. Historically most fatalities occur on less than 12% of the City's streets and disproportionately in low-income areas. *Consistent with the City's Vision Zero goal of reducing traffic fatalities to zero by 2024, we do not accept that a certain number of fatalities are just "the cost of doing business." The technology-driven tools we propose can dramatically reduce fatalities and increase safety for our vulnerable users, and they are being rolled out first in impacted communities like the Tenderloin that need them most.*

3. **Accessibility matters:** While we have experienced a great proliferation of on-demand transportation options, they are inaccessible, unavailable, and priced out of range for most residents. We need universal design principles in current scheduled/on-demand and future automated mobility options especially for the aging, disabled, and low income. *The improvements we make to ridesharing and carpooling will make these options more convenient, accessible, and viable, and the AV technologies we are piloting will go even further in reducing costs and improving performance of these options.*

4. **Fragmented and disconnected transportation system encourage auto reliance:** With the assistance of local and federal active transportation programs responding to public demand, the City and the nation have made great strides in walking, public transit, bicycling and shared modes. However, San Francisco's transportation networks are still fragmented for all and are not meeting the needs of the other half that drives. Reliable and available transportation for all trip purposes, all times of the day, everywhere across the City is what residents need to switch to from driving their own vehicle. Moreover, the cost of re-creating an urban landscape is prohibitive. *Rather than pouring billions into a reinvention of the City, we can strategically spend millions to achieve a fuller integration of our City's transportation system through new technologies. Our smart signals will make walking and cycling safer and more attractive. Our investment in ridesharing and carpooling will bolster its use and reduce VMT and, consequently, congestion. Finally, the AV technologies we pilot will one day be able to fill the gaps in our transportation system by creating convenient and affordable first/last mile connections.*

5. **Climate change:** Our transportation system still comprises nearly half of San Francisco's GHG pollution, and that is simply unacceptable. *Our projects go a long way to change that. Our connected carpool lane project alone would reduce regional commute travel times by over 30,000 hours per day, reduce VMT by 350,000 miles per day, and generate total value to the region of $200 million per year, including driver and company revenues accrued, GHG emissions precluded, and time saved.*

Working in concert, our projects use advanced technology to address the challenges our City currently faces. Moreover, it builds the foundation for further advancements in transportation technology that will firmly establish San Francisco as a smart, mobile, and transportation-rich city of forward-looking vision.

A Bold Answer to the Goals of the ATCMTD

	1	2	3	4	5	6	7	8	9	10	11
Regional connected carpool (HOV) lanes	●	●			●		●		●	●	●
Dynamic carpool pick up curbs	●	●			●		●				●
Smart traffic signals (Vision Zero)	●	●	●	●	●	●	●		●	●	●
Connected vehicle vision zero corridors	●	●	●	●	●	●	●		●	●	●
Congestion toll system	●	●		●		●	●		●	●	●
Connected autonomous electric shuttles	●	●	●	●	●	●	●	●	●	●	●

Key of Goals

1. Environmental benefits from congestion management and streamlined traffic flow
2. Measurement and improvement of transportation networks operations
3. Reduction of traffic crashes and increase in personal safety
4. Real time information to improve mobility, reduce congestion and provide for more efficient and accessible transportation
5. Access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services;
6. Monitoring transportation assets to improve infrastructure management, reduce maintenance costs, prioritize investment decisions, and ensure a state of good repair
7. Economic benefits from reduced delays, improved system performance, and throughput, and the efficient and reliable movement of people, goods, and services;
8. Accelerated deployment of V2V, V2I, and automated vehicle applications, and autonomous vehicles;
9. Advanced technologies integrated into transportation system management and operations;
10. Demonstration, quantification, and evaluation of the impact of advanced technologies
11. Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges.

Connected Carpool/HOV Lane Pilot

This project will combine innovative carpool matching services (e.g., ridesourcing apps such as Uber and Lyft, and carpool matching apps, such as Carma, Waze, and Scoop) with the re-striping of existing traffic lanes into high occupancy vehicle (HOV) lanes to quickly and inexpensively expand regional commuter carpooling and provide public transit access to these lanes.

This will capitalize on the Bay Area's existing casual carpooling culture, which boasts up to 9,000 daily users. The pilot will partner with industry partners to identify and implement viable HOV lanes based on aggregated user data, crowdsourcing, travel demand modeling, and simulations. Initial locations include:

- First, Battery, and Bryant Street to I-80
- I-280 Northbound off-ramp HOV queue jump to the Transbay Transit Center, via Third Street
- HOV queue jump lanes from Treasure Island on to I-80 / SFOBB, planned for deployment as part of the Treasure Island Mobility Management

HOV lane infrastructure (e.g., vehicle occupancy detectors, connected vehicle occupancy sensors) will be installed and monitored. Initial corridors for HOV lanes include major arterials in San Francisco (e.g., Battery St, First St, Third Street to Transbay Transit Center, Bryant St, 19th Ave, Van Ness Ave, Lombard St) and freeways in the City (e.g., I-80, I-280, US 101).The I-280 NB queue jump and surface HOV lane component would include:

- A seamless connection between I-280 priority lanes and the surface street network, including details like proposed bus stop locations, signal timing changes, evaluation of multimodal impacts, along King Street, eastbound between the I-280 off-ramp and 3rd Street, including the left turn from King to 3rd, and westbound between 4th Street and I-280 on-ramp, including the right turn from 4th to King.
- Redesign of 3rd Street between King and Market streets with left-side public transit-only lane and transit boarding islands. The existing public transit-only lane on 3rd Street between Townsend and Market Street suffers from congestion, particularly south of Folsom.
- Benefits to public transit include travel time savings and operating cost savings associated with reroutes.

Desired Outcome

Increased regional commute carpooling will expand mobility and jobs access, shorten travel times, reduce vehicle miles traveled (VMT), increase public transit ridership, relieve crowding on regional transit, and generate revenue for drivers and carpooling matching service providers. Initial modeling by SFMTA demonstrates that the connected carpool lanes would reduce regional commute travel times by over 30,000 hours per day, reduce VMT by 350,000 miles per day, raise $30 million in revenue for carpool matching companies and $75 million for carpool drivers per year, and generate total value to the region of $200 million per year, including driver and company revenues accrued, GHG emissions avoided, and time saved.

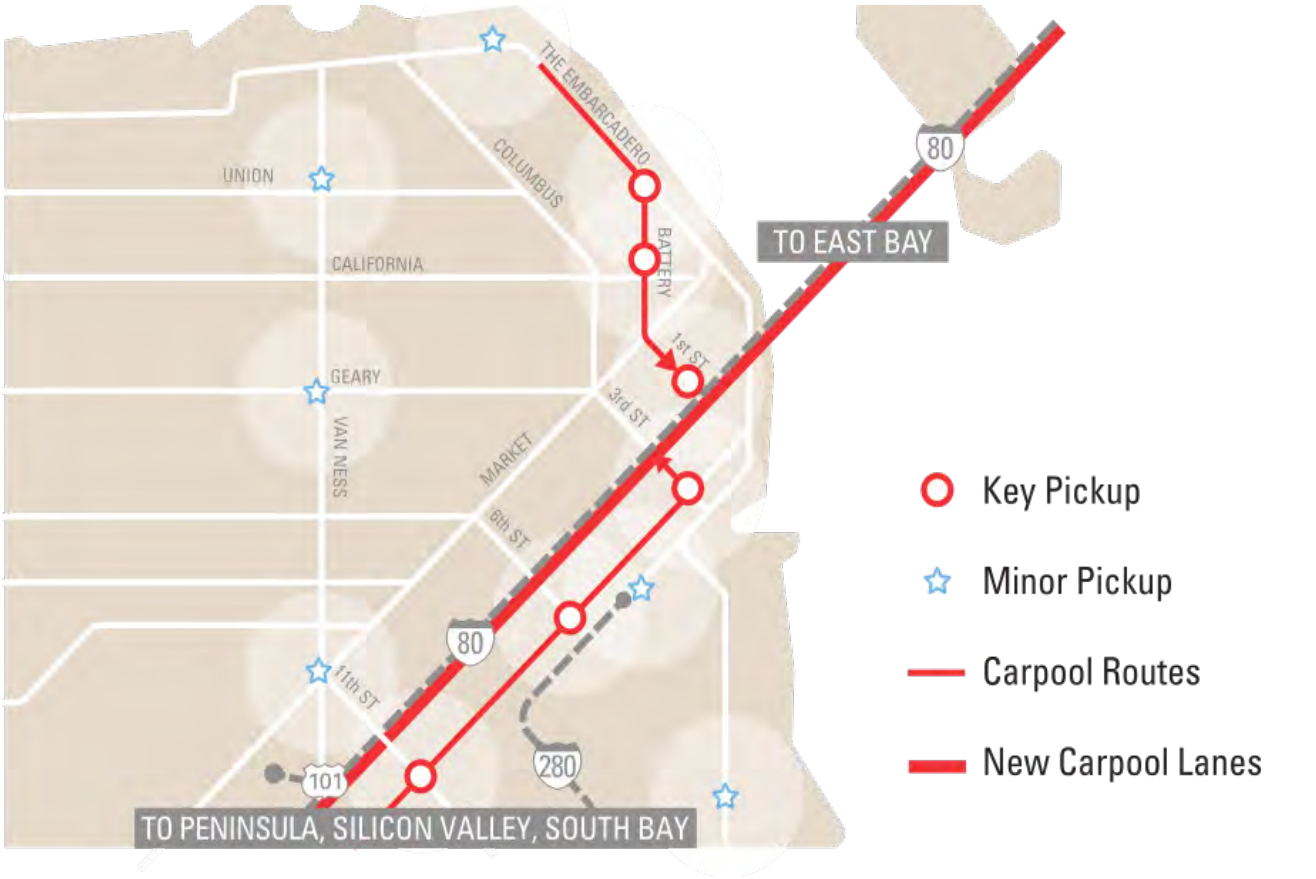
Timeline

In **Year 1**, environmental clearance, right-of way coordination with Caltrans and FHWA, and detailed design will be completed. In **Year 2**, First, Battery, and Bryant Streets will have HOV lanes installed, including lane striping, queue jumps to Bay Bridge onramps, designated carpool pickup zones at public plazas at Filbert, Sacramento, and Howard streets, driver and passenger marketing by carpool matching partners, and roadside automated enforcement infrastructure at First and Harrison Streets. **Year 3** will expand the HOV lanes to the Sterling onramp, US 101, and I-80. In **Year 4**, adaptations will continue, as appropriate, based on research feedback.

Lead

The City will lead the implementation of surface HOV lanes in partnership with California Partners for Advanced Transportation Technology (PATH) at UC Berkeley. The City will provide HOV-lane infrastructure assistance. Potential partners for carpool matching services and marketing include Carma, Lyft, Scoop, Uber, etc. Potential partners for carpool lane enforcement technology include Kapsch, Transcore, Xerox, etc. The SFCTA, through the Treasure Island Mobility Management Agency (TIMMA), will lead the implementation of the I-280 queue jump in partnership with Caltrans; and the Treasure Island queue jump in partnership with the City, TIDA, and Caltrans.

Figure 1 Connected Carpool Lanes



Dynamic Carpool Pick Up Curbs

Carpooling and ridesourcing services (e.g., Uber, Lyft) are growing in popularity. While pooled ridesourcing vehicles require little parking infrastructure, they need curb space for picking up and dropping off passengers. In the City, such curb space is limited, so drivers often use bus stops, loading zones, and parking spots reserved for persons with disabilities. This project component will reserve curb space for picking up and dropping off passengers of carpooling and pooled ridesourcing services. At present, several on-street parking spaces are reserved for passenger drop off for participants of casual carpooling near the Bay Bridge off-ramp in the Financial District. This project will be similar to this casual carpooling site, reserving spaces is dependent on a common origin/destination in the City and popular times of day.

Desired Outcome

Carpool pickup curbs will provide safe and convenient locations for carpoolers to pick up and pick passengers, reducing travel times, idling, and conflicts with public transit, pedestrians, and cyclists.

Timeline

In **Year 1**, environmental clearance, right-of way coordination within the City and with other cities, identification of key locations and detailed design will be completed. In **Year 2**, the key locations will be installed for pickup/dropoff curb space in popular neighborhoods (e.g., Financial District, SoMa, Mission, Marina). In **Years 3 and 4**, more intersections and destinations will be selected and curb spaces will be expanded. Year 2 data and analysis will guide this expansion.

Lead

The City will lead the implementation of this project, identifying curb space and industry partners.

Vision Zero Corridors: Smart Traffic Signals

Our smart traffic signals proposal will deploy and evaluate Multi-Modal Intelligent Traffic Signal Systems (MMITSS), including Dedicated Short Range Communication (DSRC) technology, across two distinct San Francisco contexts that

are both within underserved communities with frequent public transit service, have significant pedestrian crossings, and have occasional construction trucks along with heavy traffic volume to provide priority to public transit, heavy construction vehicles, and applications for pedestrian and bicycles including travelers with mobility limitations.

Tenderloin

Within the Tenderloin neighborhood upgrade, approximately 40 signalized intersections have been identified as high-priority Vision Zero (VZ) pedestrian collision locations, which experience high public transit and emergency vehicle volumes and currently lack MMITSS technology. Pedestrian signal enhancements include traditional treatments such as Leading Pedestrian Intervals [LPIs], Accessible Pedestrian Signals [APS], exclusive pedestrian phases ("scrambles" and/or protected phasing), and potentially Mobile Accessible Pedestrian Signals (MAPS). Public transit and emergency vehicle signal enhancements include Transit Signal Priority (TSP) and Emergency Vehicle Preemption (EVP) via DSRC technology, enabling a performance comparison against nearby intersections that currently use GPS technology for these functions where "urban canyon" and intersecting public transit route effects can be challenging to overcome. These signals will be interconnected into San Francisco's Transportation Management Center (TMC) via new wireless infrastructure.

T-Third Corridor

Along the T-Third light rail corridor, approximately 60 signalized intersections have been identified as high-priority VZ traffic collision locations, especially for vehicle collisions with trains. This route serves industrial zones that are transitioning into dense mixed-use communities via multiple major land use projects currently under construction. High-frequency trains run in semi-exclusive public transit lanes, while multiple electric and hybrid bus routes intersect the alignment. At present, TSP is provided for the light-rail vehicles (LRVs) via wayside detectors but not for the intersecting bus routes or emergency vehicles. Truck volumes for existing industrial uses are high, and construction vehicle traffic is growing as nearby development intensifies. Similar to the Tenderloin pilot, signal enhancements will include the use of DSRC technology for TSP and EVP functions. Also, construction trucks will be outfitted with DSRC units to evaluate the potential for Freight Signal Priority (FSP) at these intersections to reduce truck signal delay and reduce truck speeding through sensitive residential neighborhoods. For the LRVs, performance of TSP using DSRC will be tested against the current wayside detector technology. Signal enhancements will also include saturation deployment of next-generation Flashing Train Coming (FTC) roadside warning signs, as well as the use of a Connected Vehicle dashboard and smartphone augmentation of FTCs to reduce vehicle/train collisions. Finally, pedestrian signal improvements will include LPIs, pedestrian recalls, and the testing of MAPS. These signals are already interconnected into the TMC via SFMTA's fiber network.

Figure 2 Smart Traffic Signals

Desired Outcome

Smart traffic signals aim to increase public transit speeds, reduce pedestrian collisions, decrease emergency vehicle response times, reduce truck signal delay, and lower truck speeds through sensitive neighborhoods.

Timeline

In **Year 1**, environmental clearance and detailed design will be completed and the City team will begin procurement (including DSRCs) and will begin to deploy traffic signal enhancements and outfit buses and trucks with DSRC units. In **Year 2**, procurement and construction will be finalized. In **Years 3 and 4**, signal timing will be adjusted on an ongoing basis.

Lead

SFMTA will lead this pilot implementation.

Connected Vision Zero Corridors

Connected Vision Zero corridors will have connected, signalized intersections with MMITSS priority. MMITSS will reduce idling and offer safety enhancements for pedestrians and cyclists. This will be deployed by installing DSRC roadside equipment and integrating with signal controllers along the corridor. DSRC radios will be installed on public transit vehicles serving that corridor as well.

Desired Outcome

Our goal in connecting the corridor intersections is to garner travel time savings for public transit vehicles, increase satisfaction and safety for pedestrians and cyclists (to achieve Vision Zero objectives), and reduce energy use and GHG emissions.

Timeline

In Year 1, environmental clearance and detailed design will be completed and the City team will begin procurement of TSP equipment, controllers, etc., wIn Year 1, the City will select the study corridor, install roadside, and in-vehicle equipment, and refine the software. In YYear 2, construction will be completed and pilot testing will begin to verify functionality. In Years 3 and 4, implementation will continue and be adapted, as appropriate.

Lead

The City will lead the implementation.

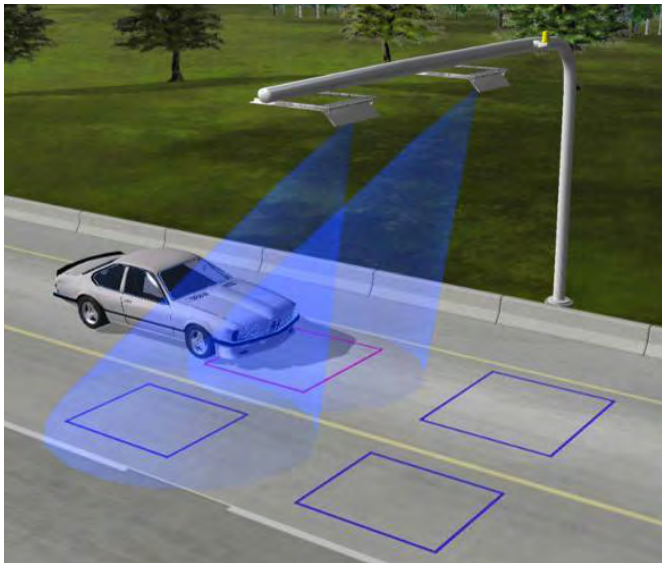


Figure 3 Congestion pricing infrastructure

Treasure Island Mobility Management Program (TIMM) Congestion Toll System

The TIMM Program will design and construct a connected toll system that will serve as the backbone for the congestion pricing program. The toll system will use electronic toll collection to identify vehicles entering and exiting the island and apply a toll. The toll system will be designed to be configurable so that the toll rates can be adjusted. The toll rate will be higher during peak periods to discourage vehicle travel during congested times and lower rates will be charged during off-peak periods. To incentivize HOV travel, public transit and vanpool vehicles will not be charged a toll. The revenue from the congestion pricing program will pay for the transportation demand management (TDM) programs and expanded bus, shuttle, and ferry transit systems that residents and visitors will be encouraged to use.

Desired Outcome

The congestion pricing program is intended to curb vehicle demand on the heavily congested Bay Bridge, particularly in the peak periods when the bridge regularly operates at or near capacity. The pricing program will create a disincentive for residents and visitors to the Island to use their cars for commute trips and will increase the competiveness and attractiveness of transit for commute trips. Revenue generated from the tolls will help to offset the cost of the increased transit services for the Island and will fund the other TDM programs that will be implemented.

Timeline

A Concept of Operations document and a Systems Engineering Management Plan have been developed for the tolling system. Final system design is anticipated to start in Year 2 and will be completed in Year 3. System installation, testing and integration will be completed in Year 4, and the system will be operational the same year.

Lead

SFCTA, in its role as the Treasure Island Mobility Management Agency (TIMMA) will lead the implementation.

The Connected Autonomous Electric Vehicles Shuttles Program will procure, test and deploy three electric Autonomous Vehicle shuttles to serve intra-island trips. The shuttles will allow for easy circulation around the Island and will serve as last-mile connections for those accessing the Island using transit. Specifically, the shuttles will serve as a connection between the residential, recreational and commercial areas of the Island and the Intermodal Hub where transfers can be made for bus service to the East Bay, bus and ferry connections to San Francisco, the Muni stop on Treasure Island, and the touchdown of the SFOBB East Span bike and pedestrian path on Yerba Buena Island. The Island provides an ideal environment for the deployment of Autonomous Vehicle technologies given its closed roadway network and moderate weather conditions and provides a highly visible setting for the demonstration of a technology that can bring numerous benefits throughout the region.

Desired Outcome

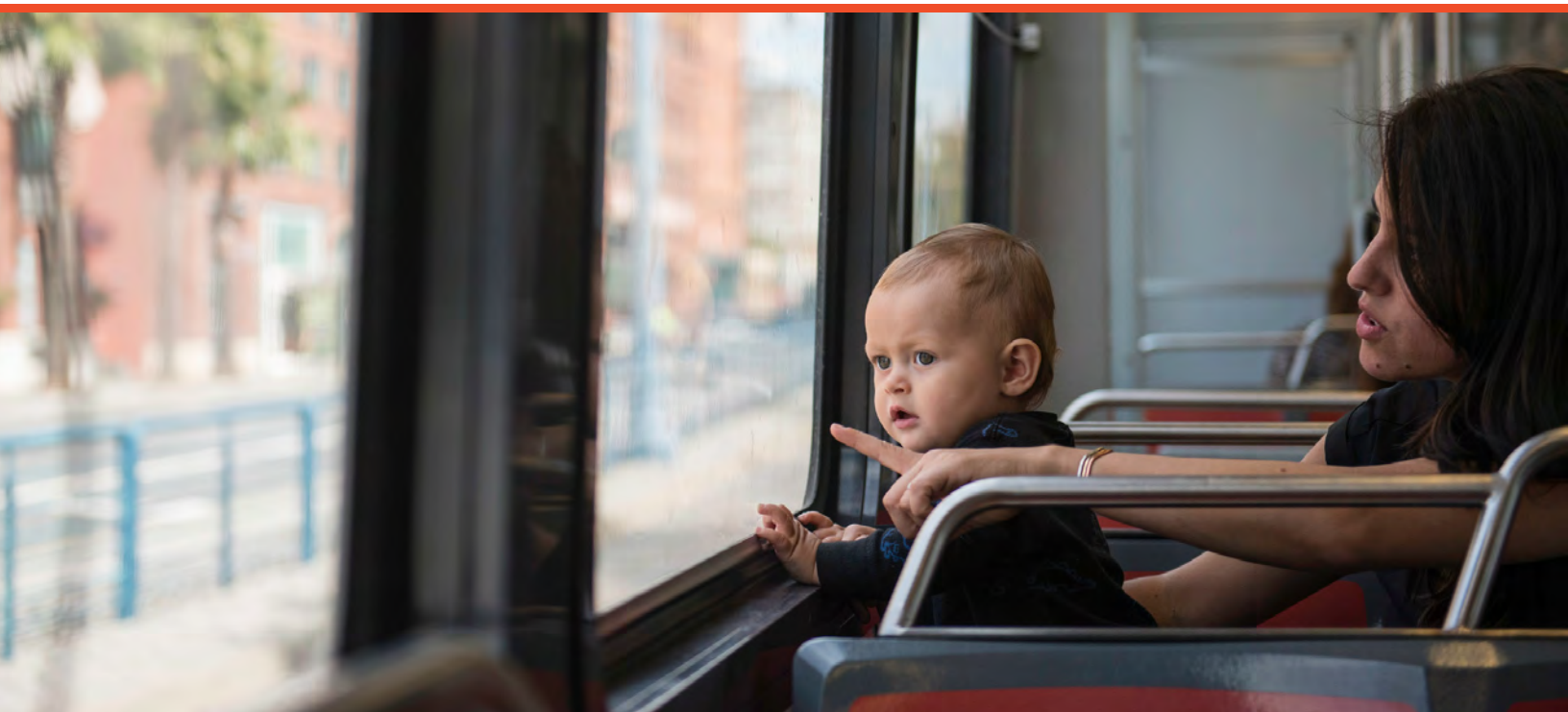
The goal of the program is to provide a reliable, clean technology, on-demand last mile transit connection between the Treasure Island Intermodal Hub and key destinations on Treasure Island including recreational areas, commercial centers and residential housing. While the full Treasure Island buildout in 2032 will have 8,000 housing units, a hotel and commercial offices, only 1,000 residential units will be occupied for the initial 2019 deployment of the AV shuttles. This setting provides the ideal environment for the testing of the on demand AV system within a small residential area and will allow streamlined customization of the system to adapt to changing needs of the users base. Lessons learned from the Treasure Island program will be applied to future deployments in San Francisco and throughout the region.

Timeline

The Treasure Island Autonomous Shuttle program will build on testing that will be initiated later this year in Contra Costa County. The GoMentum station anticipates initiating testing on 12 passenger autonomous vehicles in **Year 1**. This testing will be expanded to a public business park (Bishop Ranch in San Ramon, CA) later in the year. Building on this work, the Treasure Island shuttle program anticipates executing partner agreements in **Year 2** to begin procurement of vehicles for delivery by the end of the year for on-Island testing in advance of the planned public service that will start in **Year 4.**

Lead

SFCTA, in its role as the Treasure Island Mobility Management Agency (TIMMA) will lead the implementation



An Overarching Approach: The Superpublic

Figure 4 Rendering of the interior space

Figure 5 Exterior of 50 UN Plaza

Our vision offers bold and innovative ideas to demonstrate and evaluate the benefits of the various solutions we deploy. This level of effort requires the contributions of the City, academia, community, and technology companies. The City has created the Smart City Institute, or Superpublic, to facilitate these interactions and our smart city incubator. Superpublic, housed at 50 UN Plaza, a block from City Hall, is an optimal, neutral space for city, community, business and academic staff to meet and work together to solve city problems including transportation. Superpublic will be the meeting place, organizer and advisor to the ATCMTD Program. An impressive set of carefully chosen partners representing the City's government agencies, infrastructure network operators, and service providers will work together to meet the ATCMTD's program goals. Its transportation lens will focus on empowering vulnerable populations, making more efficient use of existing infrastructure through innovation for moving people and goods, fostering the sharing economy, reducing collisions and fatalities, and improving resilience to climate events.

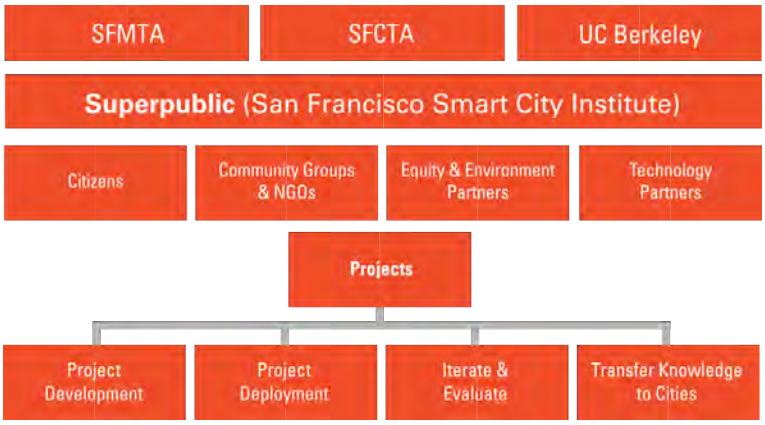


Figure 6 Smart City Institute organization chart

Strengthening Our Vision Through Partnerships

San Francisco is already working with technology partners for its current vision. Indeed, the City has also been engaging potential partners to better understand various technologies and solutions currently available and in development. The City has worked to vet potential partners based on their expertise, experience, and what they can provide to the City's vision and goals.

Our implementation strategy will incorporate multiple entities ranging from startup companies to local businesses. Local and small businesses will be able to benefit by using or adding to City data (e.g., promoting business through ads on kiosks, or using City data to track the travel patterns of potential customers). As part of our Communication Plan, the team will develop and implement an engagement approach. We will develop a comprehensive list of business types that will have different uses for our technologies. The comprehensive list will be the foundation for developing protocols when interacting with a particular type of

business. As engagements progress and business interactions increase, the approach will be reevaluated through surveys and feedback sessions to understand the needs of businesses and to ensure the approach is effective and can continue to accommodate all types of businesses. Consistent and regular communications throughout the project will ensure that we maintain strong relationships that will create a more connected community.

For startups, there are two ways to engage. First, as members of Superpublic. Second, as participants in our federally-funded Startup in Residence program. Superpublic will be a space for industry, academic, and government collaboration on policies, architecture and standards, projects, and demonstrations. Startups are not required to make direct contributions to become members but are encouraged to make in-kind contributions. We expect a large number of startups to become members of Superpublic. A large number of the 100 partnership proposals received were from startups. Startups can also apply to participate in the 16-week Startup in Residence program, which pairs technology companies with City departments to tackle specific challenges that can be addressed by technology. The program allows departments and startups to co-create solutions so that both parties can enter into a commercial contract without going through an additional procurement step.

On Treasure Island, the partnerships we've built for the successful implementation of our projects are especially strong. We have existing partnerships with public and private sector stakeholders including transit agencies, local and regional planning agencies and the Island Developer. The Treasure Island Development Authority (TIDA) is the non-profit, public benefit agency responsible for the oversight of the Treasure Island development. TIDA has worked cooperatively with TIMMA to plan and implement the Treasure Island transportation improvements and will contribute in excess of $5 million to support program development and match the federal grant funds.

As the master developer for the Island, Treasure Island Community Development (TICD) has been an active partner in the planning and program development for the congestion pricing program and the AV shuttle program and will provide financial support for the Program. TICD and TIMMA share planning and financial responsibilities for much of the Treasure Island Transportation Improvements including, new bus service, improvements to support new ferry service and implementation of the AV Shuttle program. TICD has committed $1 million to match this federal funding request.

The Shared AV Shuttle program will expand on existing public/private partnerships in place in the Bay Area to advance AV Shuttles. The GoMentum Station in Concord is a collaborative effort with the Contra Costa Transportation Authority to provide testing, research and development of AV and CV technologies. The 5,000 acre former navy weapons station has 20 miles of paved roadway and is the largest secured AV test facility in the world. The GoMentum Station is currently partnering with EasyMile, (a joint venture between vehicle manufacture Ligier Group and robotics company Robosoft) to test and deploy AV shuttles in the Bay Area over the next several years. The GoMentum Station and EasyMile have committed to provide $1 million in-kind matching services for testing, procurement and deployment of AV Shuttles on Treasure Island.

San Francisco has a long history of engaging our community and we have been leaders in working with local technologists to create community-driven solutions. We have led a number of government sponsored hackathons starting in 2009 when we launched our open data initiative. Data have been a new medium for engaging local technologists and we have been a leader in creating data standards, instituting robust data sharing policies, and creating the infrastructure to make a sustainable impact. We also have a number of partnerships with Code for America's Brigade, civic accelerators like Tumml, 1776, Y Combinator and many others where we share civic and social needs from government to the technology community. Our work will continue building on our history of open data, partnerships and civic tech experience.

Data Analysis: Integrated Research, Development, and Deployment

Our vision for research and development is to provide critical feedback and a deep understanding about how our projects will systematically inform our assessment of performance, the benefits and impacts of these projects, and documentation for technology transfer. Ultimately, this research can provide a clear framework that will allow other areas in the region and other cities across the nation to easily deploy similar technologies. We have enlisted a team of multidisciplinary scientists to lead this evaluation. The proposed research includes the evaluation of the projects into four key sections:

1. An impact analysis of dynamic carpool pickup curbs and Treasure Island congestion toll and HOV queue jump;
2. Implementation of a network of connected carpool lanes;
3. Deployment of a multi-modal intelligent traffic signal system and connected corridors;
4. Data analytics for urban mobility management and demand management.

Dynamic Carpool Pickup Curbs and Treasure Island Congestion Toll and HOV Queue Jump

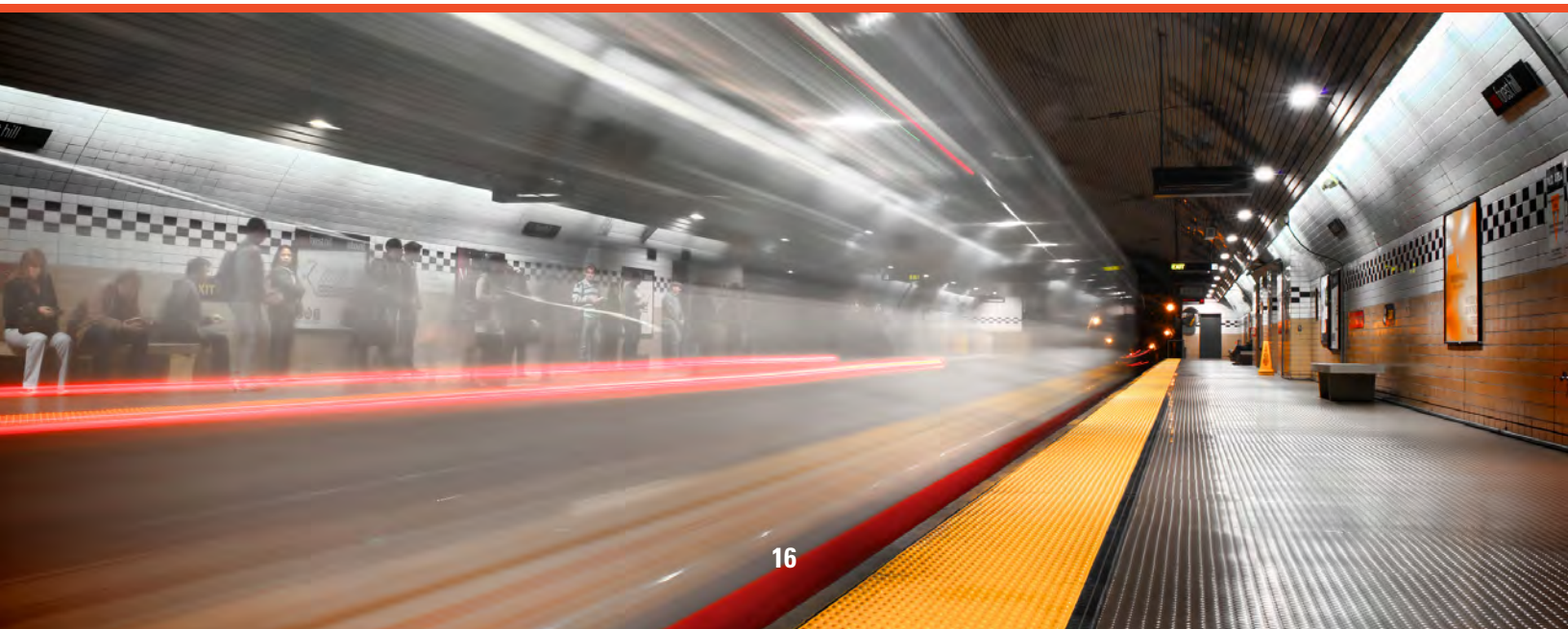
The Transportation Sustainability Research Center (TSRC) researchers at UC Berkeley will lead the evaluation of the Dynamic Carpool Pickup Curbs and Treasure Island Congestion Toll and HOV Queue Jump, as part of SFMTA's Congestion Mitigation Carpooling project efforts (i.e., carpool pickup curbs and Treasure Island toll/HOV queue jump). Researchers will assess these two projects on a number of dimensions including impacts on travel, the environment (e.g., emissions), and equity/accessibility. The research will also collect socio-demographic and attitudinal data, as appropriate.

Regional Connected Carpool Lanes

This proposed research will provide a technical evaluation of the implementation of a network of Connected Carpool Lanes along key arterials and freeways within the city of San Francisco to evaluate their effectiveness. The effectiveness of the proposed carpool lanes will be evaluated based on several metrics for the travelers (travel time, delay, travel time reliability); system (i.e., VMT, vehicle hours traveled, person miles traveled); and environment (i.e., impacts on fuel use and emissions). Travel time data on the selected corridors will be obtained from commercial data providers. HOV specific travel times will be obtained from the casual carpool travel providers, such as Lyft, Carma, etc. VMT estimates will require information on the quantity of travel that would be obtained by selective detection at key points in the corridor.

Smart Traffic Signals (Vision Zero) and Connected Vehicle Vision Zero Corridors

This proposed study, led by PATH, will evaluate and provide design guidance for the implementation of the Smart Traffic Signal System (MMITSS) at signalized intersections as part of the connected vision zero corridors



project. As MMITSS has the ability to accommodate multiple priority levels for various traveler types while minimizing delays to traffic flow, the PATH research team will work closely with SFMTA to design specific MMITSS strategies through a systems engineering process employed in the design phase. As part of the design, data type and collection methods for before-and-after evaluation will be specified. The assessment of the system effectiveness will be conducted using field data, such as travel times and delays per vehicle class and pedestrian delays and conflicts. Data on travel times will be collected from the public transit onboard devices and data providers. Signal status data obtained in real time from the controller conflict monitor will provide data on the frequency and the amount of additional green time for pedestrians and various vehicle types.

Data Analytics

In alignment with the work to be done in San Francisco on multiple potential sites (i.e., Treasure Island congestion toll and HOV queue jump, as discussed above), we will focus on two main problems, discussed below. Professors Alex Bayen and Alexei Pozdnukhov of UC Berkeley will lead this research effort.

Large-Scale Inference of Urban Mobility and Demand Management

This project will create a suite of analytical tools illustrated with a data platform capable of visualizing data sets at the corridor and city scales. Using these tools, we can use novel large data sets (for example, cell tower records from AT&T) to infer urban mobility patterns at the scales of interest in the case of Treasure Island (in which demand will radically change over the years to come) or in our proposed new carpool lanes, all while taking into account influences from a myriad of extraordinary external occurrences such as accidents or widely-attended sporting events. Using convex optimization techniques, our analysis will be able to find ideal transportation arrangements that maximize efficiency for all across different populations with all kinds of different travel patterns – from those who drive to those who ride transit, those who use routing guidance apps such as Waze to those who rely on their own knowledge of the city, etc. The proposed methods will provide unprecedented information for freeway and arterial loading, useful both for planning and operations, for the City to accommodate large-scale variations of demand, from daily fluctuations to weekly and seasonal changes or even long-term shifts that come as a result of demographics changes.

Local Scale Control of Urban Mobility Infrastructure

This project step is focused on the operation of large-scale traffic control infrastructure, such as connected automated adaptive traffic lights in the presence of uncertain traffic flows. The primary goal of optimal and robust traffic flow control is to be able to absorb the effects created by a variety of sources in urban environments, in particular:

- Routing apps, which usually do not coordinate with local traffic control and can create excess traffic in areas not designed to handle it,
- Special events such as sporting events, altered traffic patterns due to disturbances in other parts of the network, or even simple fluctuations in demand that can drastically alter demand on the freeway-arterial system,
- Innovative mobility services like Transportation as a Service (TaaS) companies and delivery companies that potentially change VMT in urban environments as mobility evolves from a car-ownership model to a service.

Using this analysis, we can better understand the City's transportation needs and patterns, and to tailor our dynamic solutions to those needs.

Regulatory, Legislative and Institutional Obstacles

The proposed projects in SFMTA's Advanced Transportation and Congestion Management Technologies grant are at both the City and regional scale. As such, each project faces various existing and potential obstacles to implementation depending on the jurisdiction wherein it is deployed. In order to address existing and future regulatory, legislative and institutional obstacles, the SFMTA will work with partners to create a Policy Advisory Board (PAB) that will meet throughout the duration of the project to provide any needed support and recommendations. The PAB will consist of the San Francisco Mayor's Office representative, the UC Berkeley Chancellor's Office representative, and SFTMA representative. Below is a brief discussion of each project and the potential obstacles therein.

Connected Carpool Lane Pilot

Portions of the carpool lane would be on I-80 and US-101, which are controlled and operated by CalTrans. As such, coordination and approval would be required. Further review from FHWA might be needed as well. Since the creation of the carpool lane would not require roadway construction or widening, the approval process is not expected to be burdensome. The lane would be created using signage and re-striping on the existing roadway.

Dynamic Carpool Pickup Curbs

Curb space used for pickups in San Francisco are regulated by the SFMTA and would not create obstacles to deployment. Similar curb space in other jurisdictions along the route would be managed by those government entities, and the SMFTA would coordinate with other Cities as needed to ensure that necessary approvals were granted.

VZ Corridors: Smart Traffic Signals

The streets and signals involved in this project are regulated and operated by the SFMTA, therefore no obstacles to deployment are expected.

Connected VZ Corridors

The streets and signals involved in this project are regulated and operated by the SFMTA, therefore no obstacles to deployment are expected.

Treasure Island Congestion Toll

The Congestion Toll on Treasure Island has already overcome what is typically the biggest hurdle in implementation: Legislative Authority – AB 981, authorizing congestion pricing on Treasure Island, was signed into law in 2008. TIMMA has also developed preliminary toll policies that have undergone extensive public review and are anticipated to be adopted by the TIMMA Board in July 2016.

Treasure Island Autonomous Shuttles

A major hurdle in the deployment of autonomous shuttles is that current California law does not allow operations of an autonomous vehicle on public roads unless a driver is seated in the driver's seat and is capable of taking immediate control of the vehicle if necessary. Assembly Bill 1592, allowing a pilot project for autonomous vehicles to proceed in Contra Costa County as part of the GoMentum Station project, has been passed by the California State Senate and Assembly and will likely be signed into law in July. This legislation will pave the way for other pilot projects throughout the state. The Treasure Island Autonomous Shuttle project will be closely coordinated with the AV program at the GoMentum Station, allowing the Treasure Island shuttles to benefit from the early vehicle testing authorized by AB 1592. The Treasure Island work plan assumes initial testing of the AV shuttles at the GoMentum site and TIMMA is actively pursuing a testing and procurement agreement with GoMentum Station.

Figure 7 An autonomous shuttle

3 Staffing and Management

Key Staff

Provided below is a brief summary for key staff and resumes for each key staff member are included in the Appendix. In addition, we will also select a Program Manager immediately after the award.

Timothy Papandreou is the director of the SFMTA's Office of Innovation. With more than 15 years of experience, Tim is a recognized leader in transportation and land-use planning, design, project management and operations. He is a trusted adviser to non-government organizations, companies, cities and state/federal governments on public-private partnerships and emerging transportation trends.

Joel Goldberg is the SFMTA's Manager of Capital Procurement and Management. Having worked with the SFMTA for over 8 years, and having 24 years of experience in public sector transportation funding, he is well qualified to serve as Grants Manager for the ATCMTD Program. Joel was Grants Manager during the launch and implementation of SFpark, a project funded through the USDOT's Urban Partnership Program. Joel and his team of six apply for, receive, and manage on the order of $400 million of transportation grants annually from a multitude of sources, with federal support coming from FTA, FHWA, and FEMA.

Greg Riessen has ten years of experience in planning, designing and implementing transportation projects. As a member of SFMTA's Transit Engineering Team, Greg specializes in the deployment and optimization of advanced transit signal priority systems. Greg has worked for the San Francisco Planning Department and Fehr & Peers Transportation Consultants. His work has included coordinating streetscape projects with City agencies and private developers and managing the environmental and design review of major land use projects.

Carli Paine manages the SFMTA's Land Use Development and Transportation Integration work, shaping the transportation programs for major new development projects. She is an expert in Transportation Demand Management and is one of the primary architects of San Francisco's proposed TDM Ordinance and the SFMTA's Commuter Shuttle Program. Carli holds a Bachelor's in Environmental Science from Columbia University and a Master's in City Planning from MIT.

Lisa Walton is the SFMTA's Chief Technology Officer. She has more than 25 years of technology experience including five as the Senior Director for IT Global Operations at Bare Escentuals Beauty where she managed the business's infrastructure, including the server environment, network, storage, IT security, and data base administration. Prior to that, Lisa served as the Director of IT Delivery for biotechnology firm Xoma, where she was responsible for application development, managing enterprise applications, and developing a Project Management Office to lead IT initiatives.

Rachel Hiatt has thirteen years of experience in transportation planning. As a Principal Planner with SFCTA / TIMMA, Rachel leads transportation planning efforts in support of the Treasure Island Mobility Management Program. Rachel's work has included long-range, countywide planning as well as neighborhood-scale multimodal transportation planning.

Frank Furger has more than 35 years of experience in delivering public sector transportation projects. As the Chief Deputy Director for the Alameda County Congestion Management Agency, Frank was responsible for the transportation planning, programming and project delivery functions for the Agency. Frank is well versed in delivering ITS projects; managing the delivery of the first Express Lane in Northern California on I-680 as well as the development of the first ICM Project in California on I-80.

Dr. Susan Shaheen is Co-Director of the Transportation Sustainability Research Center (TSRC) of the Institute of Transportation Studies at UC Berkeley. She will serve as the Principal Investigator for the project for UC Berkeley. She is an adjunct professor in the Civil and Environmental Engineering Department at UC Berkeley and is a full research engineer with the Institute of

Transportation Studies. She has been the Principal Investigator on approximately 60 projects at UC Berkeley on travel behavior, shared mobility, ITS, and alternative fuels. She was the first Honda Distinguished Scholar in Transportation at the Institute of Transportation Studies at UC Davis from 2000 to 2012. In May 2016, Professor Shaheen was named one of the top 10 thought leaders in academia by the Eno Transportation Foundation.

Dr. Alexandre Bayen is the Liao-Cho Professor of Engineering at UC Berkeley. He is a Professor of Electrical Engineering and Computer Science, and Civil and Environmental Engineering. He is currently the Director of the Institute of Transportation Studies (ITS). He is also a Faculty Scientist in Mechanical Engineering at the Lawrence Berkeley National Laboratory (LBNL), where he is the Director of the Transportation Research Group.

Dr. Alex Skabardonis is an internationally recognized expert in traffic flow theory and models, traffic management and control systems, design, operation and analysis of transportation facilities, intelligent transportation systems (ITS), energy and environmental impacts of transportation. He is a Professor in the Department of Civil Engineering at UC Berkeley and Leader in the Traffic Management Program of California PATH, a statewide ITS research center.

Contingency Plan

We will retain the same Program Manager and Project Leads throughout the performance period of the grant as much as practically possible. However, if changes occur due to uncontrollable events, we will follow a prescribed contingency approach documented in the Project Management Plan for staff replacement. As we finalize the team post-award, we will ensure that we have strong replacement candidates for all of the key positions should the need arise. If replacement of the Program Manager is needed, we will work closely with USDOT and offer the resumes of several candidates for review and concurrence.

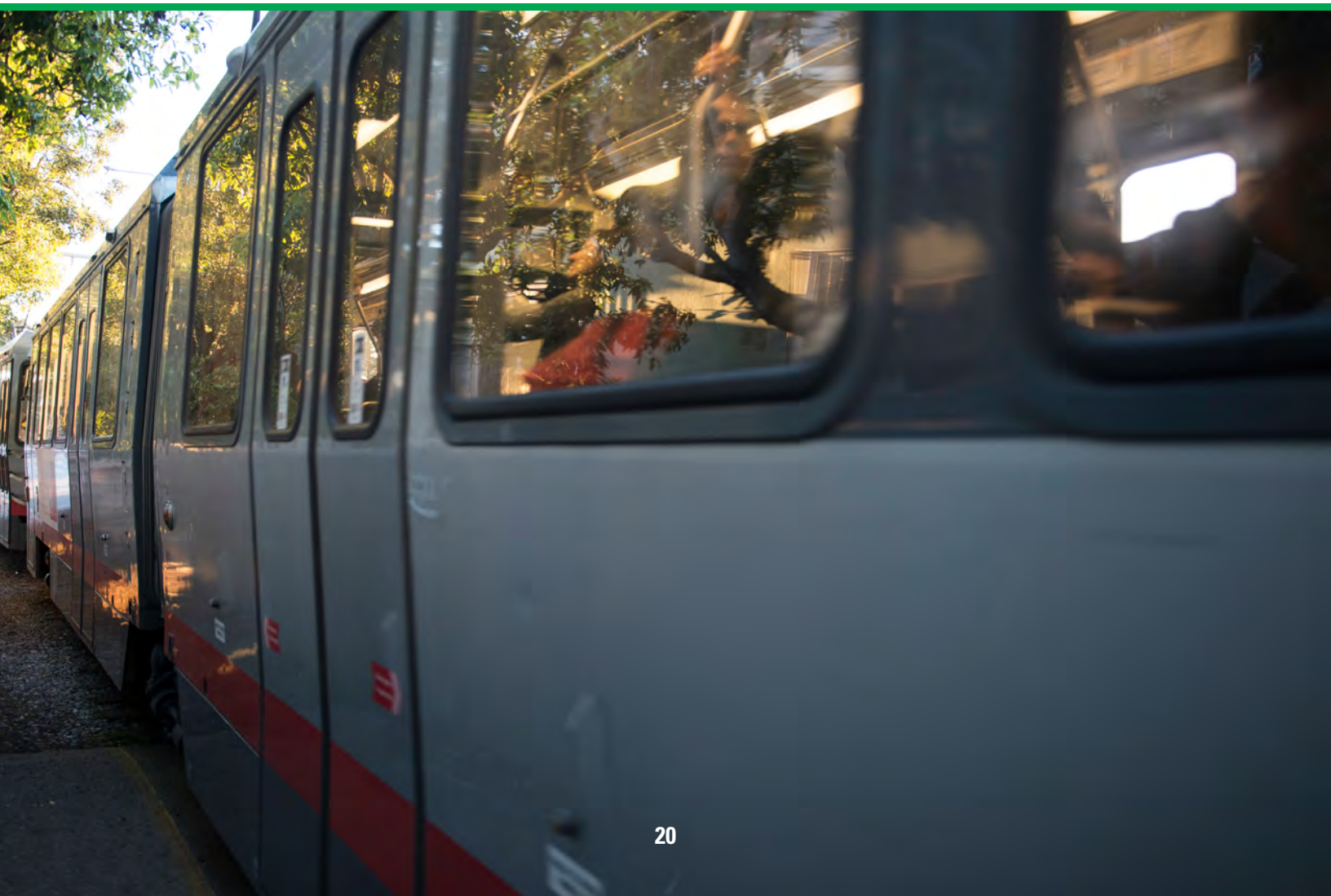
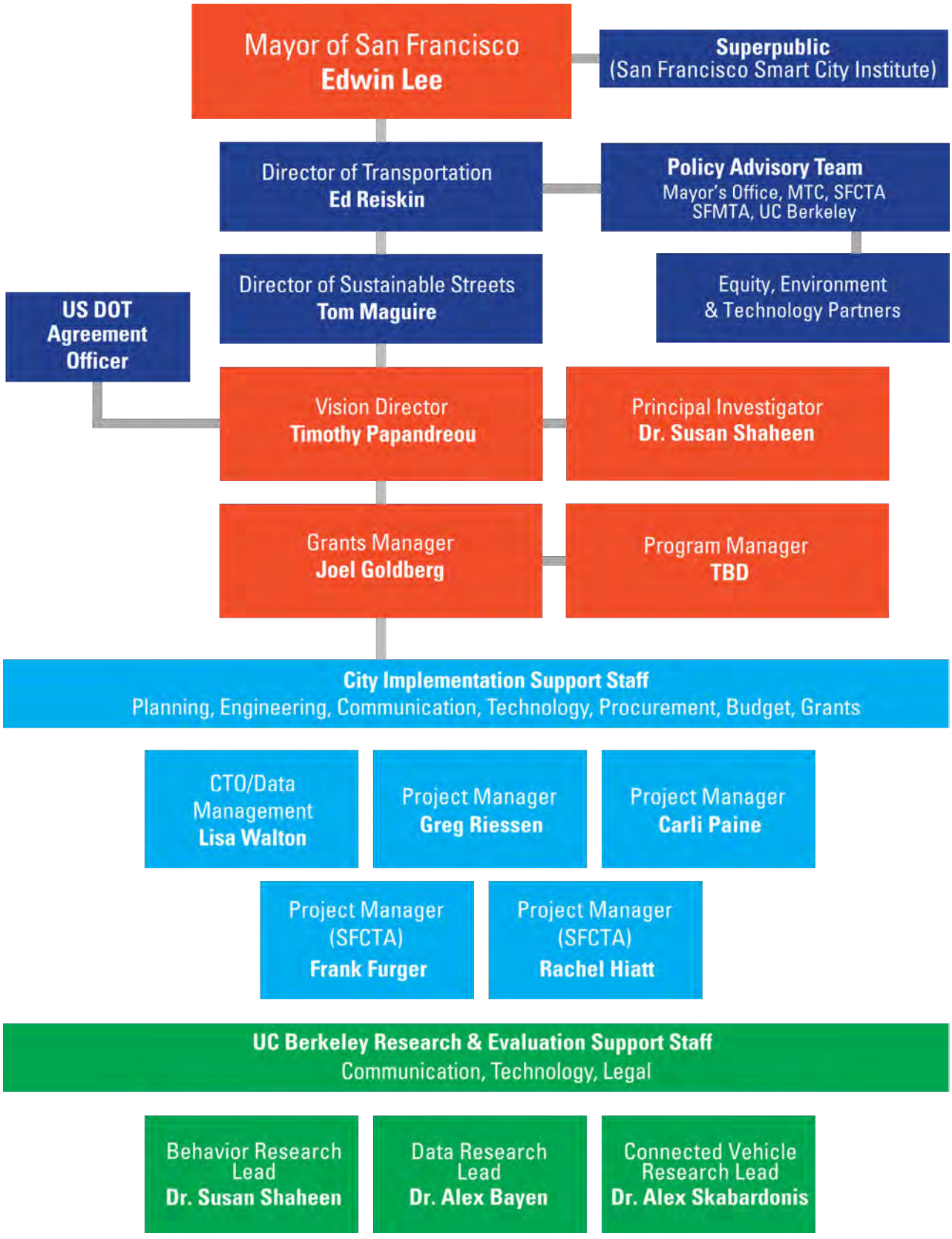


Figure 8 Staffing Organization Chart



Management Approach

The ATCMTD will be implemented through an organization administered by the SFMTA, in partnership with UC Berkeley and SFCTA through TIMMA, and a program manager to be determined.

Program Management and Team Organization

Our management and staffing approach, represented in Figure 3.1, will establish and maintain clear communication with the USDOT and all project participants. The SFMTA will work in close collaboration with UC Berkeley, SFCTA and other partners to ensure timely and accurate completion of all project tasks and delivery of all required deliverables and reports. A primary tenet of our approach is a flat organizational structure with clearly established roles.

Many administrative, fiscal, and contracting responsibilities will be centered at SFMTA, as the Consortium's Operating Agent and prime awardee, with sub-awards to UC Berkeley and other partners for various roles. SFMTA and UC Berkeley each have an extensive track record in organizing, leading, and managing large, complex transportation projects with many participants.

As shown in the organizational chart, the team will be led by SFMTA's Tim Papandreou, who will serve as the Vision Director, and Professor Susan Shaheen, who will serve as the Principal Investigator. Mr. Papandreou will work closely with the SFMTA Grant Manager (Mr. Joel Goldberg) and a "to be selected" Smart City Program Manager from a General Management/Consultant firm (within two weeks after the grant award). Provided below is a brief description of the key roles.

Vision Director: Mr. Papandreou of SFMTA will serve as the Smart City Vision Director and provide strategic vision for the execution of the grant. Specifically, he will work closely with the technical and management teams to ensure that deployment projects are designed and deployed in an integrated way to meet the ATCMTD's safety, mobility, climate change, equity, and the ladders of opportunity goals. He will also lead the external Technology Partner's engagement and will work closely with the Mayor's office to commit the resources needed for the successful execution of the project activities. Mr. Papandreou will provide thought leadership in shared mobility, complete street pilots, and integrating connected and automated vehicles into City transportation networks. He will also play a lead role in Superpublic on behalf of SFMTA. He will also coordinate with the communication and public outreach team that will be led by the City's Director of Communications and will include representatives from the Mayor's Office, Office of Innovation, and supporting contractors and nonprofits as they are integrated into the program.

Grant Manager: As the Grant Manager, Mr. Goldberg will lead all the procurement activities (including capital procurement) and subcontractor management. He and the SFMTA Capital Finance Section will be responsible for reviewing and sending invoices to USDOT and submitting the monthly and annual progress reports. He will work closely with USDOT on all contractual issues in a proactive manner and resolve them quickly. He will identify and commit the internal resources needed to execute the grant. Mr. Goldberg will be directly accessible to USDOT to provide any updates, as needed. He will work closely with the Smart City Program Manager (see below) to monitor project risks and to support the overall management and execution of the grant. The Grant Manager will work closely with San Francisco Public Works and the Mayor's Office of Innovation and manage the grant funds through the City Manager's office.

Program Manager: The City will appoint a single Program Manager (PM) with strong project management credentials (e.g., PMP certified) from an outside firm to be responsible for executing day-to-day activities of the deployment. The PM will work very closely with the Grant Manager to manage resources. The PM will ensure that tasks are completed on time, will be responsible for oversight, and will have the authority to make changes to the pilot project activities in consultation with SFMTA, UC Berkeley and other partners. The PM will also have decision-making authority over major operational and administrative issues. The PM will work closely with the Smart City Vision Director to provide formal updates at monthly Smart City Policy Advisory Board meetings. The PM will work closely with the technical leads to assess,

identify, assign, and mitigate the project risks. The PM will be also responsible to maintain quality control, using a Quality Control Plan to be integral to the Project Management Plan.

Principal Investigator: Professor Susan Shaheen will serve as the Technical Lead/Principal Investigator and provide overall technical guidance for the project. Overall UC Berkeley project oversight, contract management, reporting requirements, invoicing, and cost management will be conducted by Professor Shaheen's team at the Transportation Sustainability Research Center (TSRC). The behavioral impacts design and evaluation will be conducted and managed by her. She will work closely with the PM to ensure quality control for all the deliverables, as well as the Vision Director. She will also play a lead role in the Superpublic on behalf of UC Berkeley, as a founding partner in the laboratory. The Smart City Institute will manage the technology partners that have committed support for the pilot projects.

Technical Leads: Professors Susan Shaheen will be supported by a strong group of technical leads. The connected vehicle design and analysis will be managed by Dr. Alex Skabardonis of California Partners for Advanced Transit and Highways (PATH). Dr. Alex Bayen will oversee the data analytics components across all of the five pilot projects. Numerous postdoctoral researchers, graduate student researchers (GSR) and undergraduate students will provide support throughout the project.

Project Leads: Project Leads from SFMTA and SFCTA through TIMMA will be appointed to oversee the implementation of the projects. The Project Leads' primary role will be to manage the pilot deployments using an integrated portfolio management approach, so that the synergies among the different pilot projects are maximized and schedules are properly managed. In addition to the Project leads, the team will be led by industry experts for each of the key technical areas including: 1) Data Management (Lisa Walton); 2) Behavioral Analysis (Professor Susan Shaheen); 3) Data Research (Professor Alex Bayen); and 4) Connected Vehicle Research (Professor Alex Skabardonis). Project and Technical leads will ensure that work in their respective projects is progressing at a sufficient pace to meet or exceed the management plan. They will be expected to challenge their teams as they report the results of the ATCMTD projects.

Policy Advisory Board (PAB): A Policy Advisory Board (PAB) will meet throughout the duration of the project to provide any needed support and recommendations related to policy and regulations to execute and deploy our proposed vision. This board will consist of the San Francisco Mayor's Office representative, the UC Berkeley Chancellor's Office representative, the SFTMA representative and SFCTA/TIMMA representative. The function of the PAB is to review and make recommendations to the Director of Superpublic, research leaders at UC Berkeley, and the USDOT. The primary duties of the PAB are to provide policy and regulatory guidance to the PMO Lead, Vision Director, and the technical team, as necessary.

Project Management Processes

San Francisco's management approach is based on the Project Management Institutes' Project Management Body of Knowledge. This approach enables us to provide the USDOT team with timely delivery of innovative, flexible and compliant services. Most importantly, our approach allows the Agreement Officer Representative (AOR) to easily work with the San Francisco team to modify the statement of work, resources, budget and schedule at any time.

The overall management of the project involves several key functions: monitoring daily progress, conducting interim performance reviews, and reviewing deliverables. The Smart City Program manager and other technical leads will interact periodically with staff to ensure proper and timely execution of tasks and review all deliverables. Best practices and procedures will be applied to efficiently monitor and evaluate work deliverables.

After execution of the cooperative agreement, the program manager and key technical team will conduct a kickoff meeting with the USDOT's AOR to ensure that all parties have a common understanding of the AOR's requirements and expectations. By the kickoff meeting, we will have obtained consensus on our proposed work plan and detailed approach to accomplishing the key project deliverables. Our proposed work plan will include project scope and task descriptions, deliverables and schedule, management and staffing plan, and other relevant information. We will submit the meeting minutes within a week of the kickoff meeting.

The program manager and the team partners will prepare a Program Management Plan that describes the activities required to perform the work, per current guidance. The purpose of this plan is to detail the management and technical approaches to executing the project.

The Program Management Plan is the primary planning document for the project. It establishes the structure and controls for making management and technical decisions in the project, prioritizing project resources to meet project goals and objectives, and maximizing stakeholder buy-in for project deliverables. The plan will also describe in detail the objectives and methods to execute the scope of work on schedule. Specifically, this plan will contain sections describing a Scope Management Plan, a Schedule Management Plan, a Communications Management Plan, a Cost Management Plan, a Quality Management Plan, Configuration Management Plan, and a Risk Management Plan.

Scope Management: To make sure all required actives are fulfilled, the project plan will be shared, reviewed with, and approved by the AOR regularly to obtain concurrence on the scope of all scheduled project activities. Changes to the project will be brought to the regularly scheduled meetings with the project team and AOR, to confirm and achieve consensus on any impact to the project scope.

Schedule Management: The Program Management Plan organizes project activities, milestones and deliverables into a comprehensive plan and detailed schedule. There may be several challenges in executing this project. Thus, as the plan is finalized, specific key dependences within the plan and critical paths will be identified. Those elements will be discussed with the AOR and the technical staff to ensure they are aware of these dependences and that they are on track to meet key milestones. A delivery schedule will guide project execution. The schedule will be refined in consultation with the USDOT and submitted with the final Program Management Plan. Upon finalizing the schedule, the final schedule will be provided in Microsoft Project and PDF format.

Project expenses will be tracked at a task level and the actual expenses will be constantly checked against the planned expenses for that task. Any significant variation will be discussed with the AOR and a corrective action will be implemented in a proactive manner.

Microsoft Project will be used to plan the project schedule, and Microsoft Excel to plan project budget allocation. The team has the tools for tracking project schedule, technical progress, and spending. These tools include formal, automated program manager reports that itemize all labor and costs by subtask; program manager access to monitor electronic time sheets at any time; and formal, required, bi-weekly project reviews that include the program manager, principal and contracts staff. These reviews require program managers to discuss project progress, deliverables, schedule, and cost in an organized manner that reduces the chance to overlook anything.

Communications Management: Transparent communication mechanisms will be used to openly communicate and monitor integrated cost, schedule, and technical performance, and to detect and proactively address any issues. Daily communication and formal weekly meetings will ensure that technical leads are fully aware of progress, potential risks and technical issues. Similarly, regular communication between the program

manager and partners' contracts and financial leads ensures all contractual requirements are followed while periodic contacts with partner organizations' leadership ensure their continuing commitment.

The San Francisco team will submit progress reports to the USDOT, summarizing the team's progress toward completing each task within the task order, and which include the following components:

- Updated task progress summary, for each project task, including the status of each task deliverable, along with the major accomplishments completed and upcoming activities and milestones for the task. The summary includes any identified variance from the current work plan and planned corrective actions.
- Concise list of outstanding issues requiring USDOT attention and issues resolved.

Each Progress Report will be accompanied by the following:

- Updated version of the Project Schedule, tracking the progress of each of the six major tasks and subtasks against the baseline, clearly identifying actual start and end dates for all activities that have been initiated and/or completed.
- Updated Risk Log containing a comprehensive list of identified and assessed risks to the successful completion of this task order. Each newly identified risk is recorded into the Risk Log, with the action to develop a mitigation strategy by the next scheduled Progress Meeting.

Cost Management: The San Francisco team will take a proactive approach to identify hours charged and dollars spent supporting projects to ensure we stay within budget. The team will submit the reports where the cost and remaining budget are documented to ensure a controlled budget for the Smart City demonstration and spot any issues before cost overruns can occur. Project management costs will be kept low, while still providing the strong and effective leadership required for the highly complex set of proposed activities.

- **Quality Management:** The San Francisco team will provide quality assurance and reviews for our work products under the scope of the task order. The team will perform quality planning, control and assurance activities across all areas and tasks as follows:
- Monitoring internal process compliance using established processes.
- Regularly monitoring and objectively evaluating performed processes, work products, and services against applicable process descriptions, standards, and procedures
- Identifying and documenting non-compliance issues and recording and reporting the issues to applicable stakeholders to ensure that noncompliance issues are addressed
- Providing feedback to project staff and management on the results of quality assurance and control activities
- Maintaining quality records and lessons learned

All contract deliverables will have version control, with unique version numbers assigned to each document. Approved final versions of each deliverable (including the Project Schedule) will be placed under configuration control.

Configuration Management: This includes managing how items will be placed under configuration control are identified, when they are identified, and when they are placed into a configuration control process or system. Configuration management may include establishing a Configuration Control Board and include procedures for handling proposed changes to items under configuration control, and the role of the USDOT in configuration control.

Staff/SME Assignment: Successful project execution will depend on a strong team that meets the key needs for quality on this project. It will also require the participation of technical staff with a solid understanding of the technical areas and technologies relevant to this project. The staff members already on the team meet these criteria based on their many years of relevant experience.

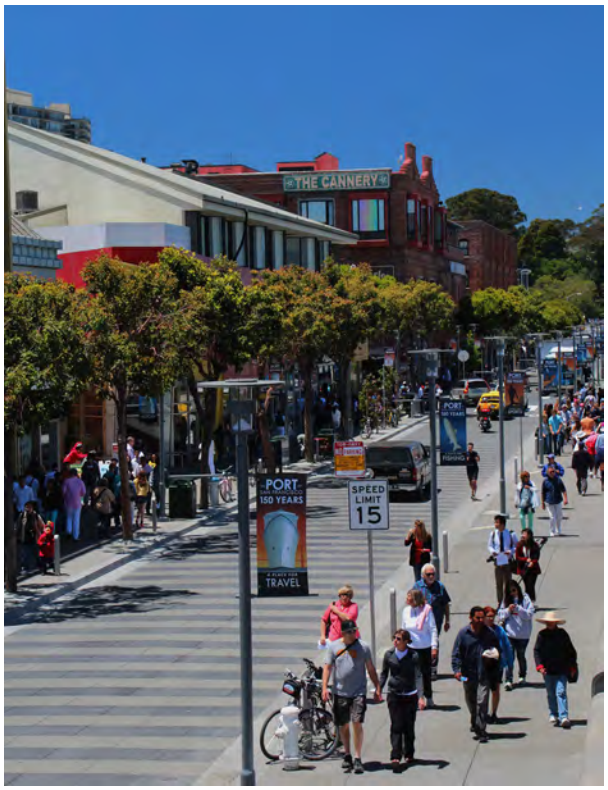
Organizational Conflict of Interest Avoidance: Although there are no known issues at this time, we will proactively work with USDOT to identify any potential issues and take the necessary steps to ensure an independent evaluation and impact estimation. If necessary, we will introduce additional staff or subcontractors to validate this independence.

4 Budget

Funding Sources

Funding Source	Amount	Description (In-Kind/Cash)
Federal		
ATCMTD	$11,997,760	Cash
Non-Federal		
Ford	$50,000,000	In-Kind
Zoox	$30,000,000	In-Kind
TIDA	$5,000,000	Cash
BMW	$3,200,000	In-Kind
Carma	$2,000,000	In-Kind
Connecthings	$1,500,000	In-Kind
Streetline	$1,400,000	In-Kind
Volta	$1,200,000	In-Kind
Gomentum	$1,000,000	In-Kind
Here	$1,000,000	In-Kind
Next	$1,000,000	In-Kind
RideLeads	$1,000,000	In-Kind
RTI	$1,000,000	In-Kind
TICD	$1,000,000	Cash
Smarking	$820,000	In-Kind
Evercharge	$500,000	In-Kind
Local Motors	$400,000	In-Kind
Gridsmart	$280,000	In-Kind
Arcimoto	$250,000	In-Kind
Moovel	$250,000	In-Kind
Streetlight	$250,000	In-Kind
QGC	$200,000	In-Kind
Silver Spring	$200,000	In-Kind
Getaround	$100,000	In-Kind
Motionloft	$100,000	In-Kind
Federal Total	$11,997,760	
Non-Federal Total	$103,650,000	
Total	**$115,647,760**	

***Committed specifically to the ATCMTD Program. SFMTA has also secured additional support (not shown here) from various parties through the Smart Cities initiative. Letters of commitment documenting this support is included in the Appendix.*



Funding Plan by Component, Source and Year*

Component	Funding Period Year One (FY 16/17)	Year Two (FY 17/18)	Year Three (FY 18/19)	Year Four (FY 19/20)	Total
Projects					
Connected Carpool Lane Pilot					
ATCMTD	$294,585	$2,037,351	$312,391	$321,763	$2,966,089
In-Kind Contribution	$116,428	$805,221	$123,466	$127,170	$1,172,285
Total	$411,013	$2,842,571	$435,857	$448,933	$4,138,374
Dynamic Carpool Pick Up Curbs					
ATCMTD	$145,150	$290,301	$294,150	$298,114	$1,027,715
In-Kind Contribution	$145,150	$290,301	$294,150	$298,114	$1,027,715
Total	$290,301	$580,601	$588,299	$596,228	$2,055,430
Smart Traffic Signals					
ATCMTD	$120,162	$352,691	$37,002	$38,112	$547,967
In-Kind Contribution	$738,139	$2,166,533	$227,297	$234,116	$3,366,085
Total	$858,301	$2,519,225	$264,299	$272,228	$3,914,053
Connected Vision Zero Corridors					
ATCMTD	$583,785	$121,562	$122,639	$38,112	$866,098
In-Kind Contribution	$3,586,110	$746,736	$753,356	$234,116	$5,320,319
Total	$4,169,896	$868,298	$875,996	$272,228	$6,186,418
Congestion Toll System					
ATCMTD	$125,000	$2,000,000	$2,750,000	$125,000	$5,000,000
In-Kind Contribution	$125,000	$2,000,000	$2,750,000	$125,000	$5,000,000
Total	$250,000	$4,000,000	$5,500,000	$250,000	$10,000,000
Connected Autonomous Electric Vehicle Shuttles					
ATCMTD	$225,000	$537,500	$137,500	$100,000	$1,000,000
In-Kind Contribution	$225,000	$537,500	$137,500	$100,000	$1,000,000
Total	$450,000	$1,075,000	$275,000	$200,000	$2,000,000
Research and Data					
Research and Development for Deployment					
ATCMTD	$82,868	$175,402	$178,751	$82,868	$519,890
In-Kind Contribution	$509,049	$1,077,469	$1,098,044	$509,049	$3,193,611
Total	$591,918	$1,252,870	$1,276,795	$591,918	$3,713,501
Data Analytics					
ATCMTD	$12,123	$19,501	$26,253	$12,123	$70,000
In-Kind Contribution	$74,471	$119,790	$161,268	$74,471	$430,000
Total	$86,594	$139,291	$187,521	$86,594	$500,000
ATCMTD Total	$1,588,674	$5,534,307	$3,858,686	$1,016,092	$11,997,760
In-Kind Contribution Total	$5,519,348	$7,743,549	$5,545,081	$1,702,037	$20,510,015
Total	**$7,108,022**	**$13,277,856**	**$9,403,767**	**$2,718,129**	**$32,507,775**

*Funding breakdowns subject to change

Project Timeline

Work Activity	Responsible Party	Start Date*	End Date*	FY 2016	FY 2017	FY 2018	FY 2019	Deliverables
Grant Agreements and Approvals								
SFMTA/FHWA Grant Agreement & Authorization to proceed	J. Goldberg (SFMTA)	Sep-16	Jan-17					Grant agreement, E-76
Development of Concept of Operations								
Institute Partnership	T. Papandreou (SFMTA) S. Shaheen (UCB) Program Mgr (SFCTA)	Sep-16	Jan-17					SFMTA/SFCTA/UCB Memorandum of Understanding (MOU)
Launch Tech Partners Portal	Program Mgr (SFMTA)	Sep-16	Jan-17					Online portal
Identify Contributors	Program Mgr (SFMTA)	Sep-16	Jan-17					List of local project contributors
Develop Memoranda of Understanding	J. Goldberg (SFMTA)	Sep-16	Jan-17					Execute MOUs with local project contributors
Bid and Award	Program Mgr (SFMTA)	Jan-17	Feb-18					Contracts with vendors
Deployment - Year One								
Institute Projects	Program Mgr (SFMTA)	Jan-17	Oct-17					Begin implementation
-Connected Carpool Lane	G. Riessen (SFMTA)	Jan-17	Oct-17					Env, Legislation, Design, ROW, Proc (epoxy, thermoplastic etc.)
-Dynamic Carpool Pick Up Curbs	G. Riessen (SFMTA)	Jan-17	Oct-17					Env, Legislation, Design, begin construction of pickup curbs
-Smart Traffic Signals	C. Paine (SFMTA)	Jan-17	Oct-17					Env, Design, Procurement of DSRCs, begin construction
-Connected Vision Zero Corridors	C. Paine (SFMTA)	Jan-17	Oct-17					Env, Design, Proc (TSP equip, controllers, etc.), begin construction
-Congestion Toll System	Program Mgr (SFCTA)	Jan-17	Jun-17					Procurement of Toll System Integrator
-Connected Autonomous Electric Vehicle Shuttles	Program Mgr (SFCTA)	Jan-17	Jun-17					Program Refinement and Agreements
Deployment - Year Two								
Continue to Institute Projects	G. Riessen, C. Paine (SFMTA) Program Mgr (SFCTA)	Jul-17	Jun-18					Continue implementation
-Connected Carpool Lane	G. Riessen (SFMTA)	Jul-17	Jun-18					HOV lanes, striping, queue jumps, pickup zones, enforcement infrastruct design, construction
-Dynamic Carpool Pick Up Curbs	G. Riessen (SFMTA)	Jul-17	Jun-18					Carpool pick-up curb design, constru to provide safe pick up and drop off
-Smart Traffic Signals	C. Paine (SFMTA)	Jul-17	Jun-18					Smart traffic signal design, construction to increase public transit speed, reduce ped collisions
-Connected Vision Zero Corridors	C. Paine (SFMTA)	Jul-17	Jun-18					Design, construct connected, signalized intersections
-Congestion Toll System	Program Mgr (SFCTA)	Jul-17	Jun-18					Toll system draft design, start construction
-Connected Autonomous Electric Vehicle Shuttles	Program Mgr (SFCTA)	Jul-17	Jun-18					Interoperability test plan, vehicle procurement, infrastructure improvements, on-Island testing
Deployment - Year Three								
Evaluate Year Two Deployment	Program Mgr (SFMTA)	Jul-18	Jul-18					Data and Metrics
Refine Year Two	Program Mgr (SFMTA)	Jul-18	Jul-18					Modify and bolster completed projects based on analysis/feedback
Institute Refined Year Three Projects	G. Riessen, C. Paine (SFMTA),Program Mgr (SFCTA)	Jul-18	Jun-19					Year three applications and continue deployment
-Connected Carpool Lane	G. Riessen (SFMTA)	Jul-18	Jun-19					HOV lanes go live
-Dynamic Carpool Pick Up Curbs	G. Riessen (SFMTA)	Jul-18	Jun-19					Pick-up curbs go live
-Smart Traffic Signals	C. Paine (SFMTA)	Jul-18	Jun-19					Test smart traffic signals, go live
-Connected Vision Zero Corridors	C. Paine (SFMTA)	Jul-18	Jun-19					Test connected signals, go live
-Congestion Toll System	Program Mgr (SFCTA)	Jul-18	Jun-19					Toll installation, integration, test & go live
-Connected Autonomous Electric Vehicle Shuttles	Program Mgr (SFCTA)	Jul-18	Jun-19					On-Island Testing
Deployment - Year Four								
Evaluate Year Two Deployment	Program Mgr (SFMTA)	Jul-19	Jul-19					Data and Metrics
Refine Year Three	Program Mgr (SFMTA)	Jul-19	Jul-19					Modify and bolster completed projects based on analysis/feedback
Institute Refined Year Four Projects	G. Riessen, C. Paine (SFMTA), Program Mgr (SFCTA)	Jul-19	Jun-20					Year three applications and continue deployment
-Connected Carpool Lane	G. Riessen (SFMTA)	Jul-19	Jun-20					HOV lanes go live
-Dynamic Carpool Pick Up Curbs	G. Riessen (SFMTA)	Jul-19	Jun-20					Pick-up curb go live
-Smart Traffic Signals	C. Paine (SFMTA)	Jul-19	Jun-20					Smart traffic signals go live
-Connected Vision Zero Corridors	C. Paine (SFMTA)	Jul-19	Jun-20					Connected signals go live
-Congestion Toll System	Program Mgr (SFCTA)	Jul-19	Jun-20					Toll installation, integration, test & go live
-Connected Autonomous Electric Vehicle Shuttles	Program Mgr (SFCTA)	Jul-19	Jun-20					On-Island Testing
Evaluation								
Evaluate Replicability	Program Mgr (SFMTA)	Apr-20	Jun-20					
Implement Long-Range Changes	Program Mgr (SFMTA)	Apr-20	Jun-20					
Administration								
Kick-Off Meeting	T. Papandreou (SFMTA)	Oct-16	Oct-16					
Invoicing	J. Goldberg (SFMTA)	Quarterly	Quarterly					Invoice Packages
Monthly Progress Reports	J. Goldberg (SFMTA)	Monthly	Monthly					Monthly Reports
Report to Secretary (Annual)	J. Goldberg (SFMTA)	Sep-17	Sep-19					Annual Reports
Final Report	J. Goldberg (SFMTA)	Jun-20	Jun-20					Final Report

*Dates are subject to change