City of San Francisco

Advanced Transportation & Congestion Management Technologies Deployment Initiative (ATCMTD)

2017

SFMTA
Municipal Transportation Agency

TABLE OF CONTENTS

VOLUME I

SECTION I :: PROJECT NARRATIVE

SECTION II :: PROJECT

SECTION III :: STAFFING & RESUMES

SECTION I

PROJECT NARRATIVE

VOLUME I

What is the Next Generation Transit Customer Information System?

The San Francisco Municipal Transportation Agency (SFMTA) is developing a new real-time vehicle arrival and service update system for the Muni public transportation network which it operates. Known formally as the Next Generation Transit Customer Information System, the project is designed to increase public confidence in Muni so that customers can take transit to their destinations quickly and reliably. By retaining and growing transit ridership, the system would contribute to the city and region's mobility, accessibility and economic health.

As the United States looks to an increasingly urbanized future, public transportation will become more important than ever to the nation's economic well-being. By attracting more ridership to space-efficient and environmentally-friendly transit, this Next Generation Transit Customer Information System is essential to building a more sustainable San Francisco. With support from the US Department of Transportation's Advanced Transportation and Congestion Management Technologies (ATCMTD) program, the innovations developed under this project will provide a blueprint for other cities looking to strengthen their transit systems.

Guided by public feedback, the system will employ the latest technology to make transit easier and more convenient to ride in an environment of increasing transportation choices.

Examples of innovations include:

- **Developing a more sophisticated and accurate vehicle arrival prediction algorithm**
- **Communicating service delays and disruptions on-board vehicles**
- **Implementing solar-powered signage to expand access to information at selected unpowered shelters and stops**
- **Strengthening network connectivity by showing transfer connection times on-board vehicles**
- **Reducing travel times by showing nearby alternative routes with shorter waits on digital signage at stops**
- **Providing stop accessibility information and elevator/escalator outage alerts for seniors and people with disabilities**
- **Balancing capacity by providing crowding alerts and suggesting parallel services with space available**
- **Using data from mobile technologies to understand customer preferences and improve service and operational planning**

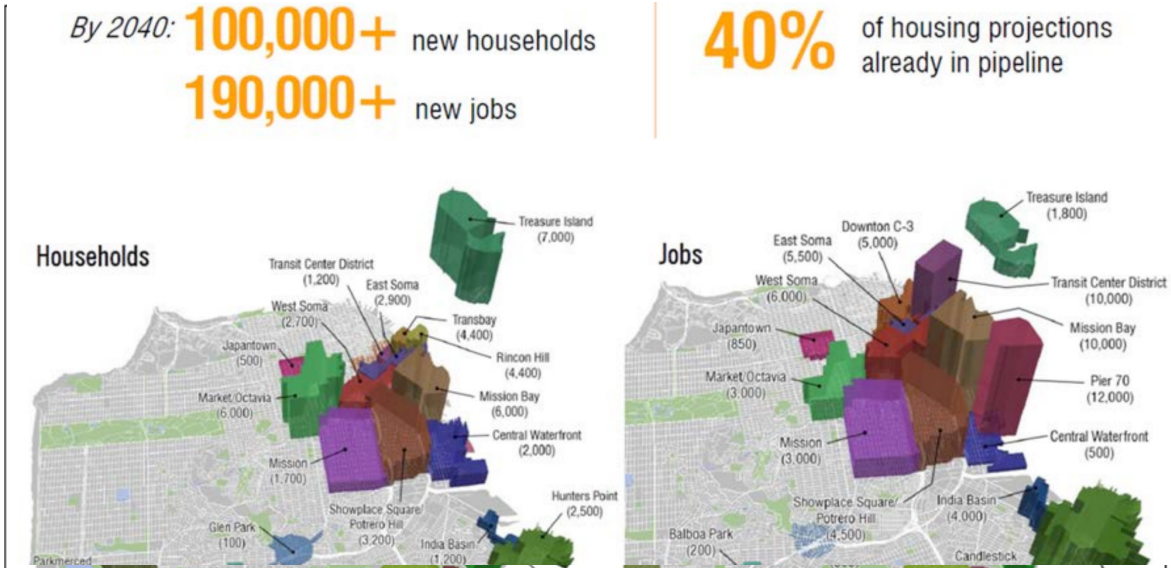


Figure _____: San Francisco's Projected Growth by 2040 (Source: San Francisco Planning Department)

The Context

Public transportation in the United States is at a crossroads. More than 50 years after the federal government officially became involved in funding transit, national ridership has surpassed 10 billion annual trips. Ridership is up by nearly 60 percent since the all-time low in 1972, led primarily by more than a doubling of ridership on rail modes as dozens of American cities have opened or expanded their heavy rail, commuter rail and light rail systems.

Recently, however, transit has struggled to hold onto these gains. In 2016, for example, national ridership fell by 2.3 percent from the previous year. More alarmingly, ridership on buses - which operate primarily in mixed traffic along with low-occupancy automobiles and ride-sharing vehicles - plunged 4.1 percent at a time when the economy and transportation demand grew. This is not sustainable. With space at a premium, America's metropolitan areas increasingly must depend on high-capacity public transportation in order to accommodate long-term population and employment growth and remain economically strong.

Nowhere is this fact more evident than in San Francisco, the second-densest major city in the United States that is constrained on three sides by water and on the remaining side by mountains. Between 2010 and 2016 alone, U.S. Census Bureau data indicate that the residential population increased from 805,235 to 870,887 (8.1 percent growth). According to the Bureau of Labor Statistics, City employment surged from 544,963 to 701,520 (26.4 percent growth) during the same period. Looking into the future, the San Francisco Planning Department projects that the city could have 100,000 new households and 190,000 new jobs by 2040. With limited space for road capacity and parking, there is simply not enough room to design a transportation system centered around low-occupancy vehicles.

Rather, San Francisco and the Bay Area's livability and economic prosperity will depend on more people walking, biking and riding transit.

Many reasons have been posited for recent national ridership declines such as low gas prices, the economic recovery and the emergence of on-demand ride-sharing services. While these may be key factors, SFMTA's research suggests that innovations in real-time transit customer information will be essential to reverse these trends and retain and grow transit ridership.

More than 15 years ago, the SFMTA became a national pioneer in real-time transit information when it implemented its first generation system on its Muni transit network. Before then, people typically would venture out to a stop randomly and just wait until a bus or train arrived, however long it took, because published timetables were not reliable. The first generation system fundamentally changed how people used transit by giving them an expectation of when Muni would come once they arrived at a stop. This basic model, largely still employed by transit systems in the United States, delivers vehicle arrival predictions through signs at stops and now through mobile apps and other means. It has become a vital tool for time management when customers are preparing to ride a bus or rail vehicle or even deciding what form of transportation to take in the first place.

Times have changed, however. San Franciscans, like other Americans, have grown accustomed to a vastly different technological landscape that continues to redefine the transportation industry through on-demand service offerings and mobile information before and during one's trip.

As SFMTA's contract with the first generation vendor will soon expire, we are looking to leverage the many innovations in technology and transportation that have occurred in the past 15 years to create a much more advancedCustomer Information System that satisfies and even exceeds today's customer expectations. As a multi-modal transportation organization, the SFMTA adheres to the City's Transit-First Policy, which prioritizes transit, bicycling and walking. While it recognizes that people may use other modes such as private vehicles and ride-sharing services, the agency also operates one of the most comprehensive transit networks in the United States such that traveling by car should be an option, not a necessity within San Francisco. By making the extensive Muni network easier to use, the SFMTA believes that the Next Generation Transit Customer Information System can help San Francisco realize substantial latent transit demand.

Expanding real-time arrival signage, displaying transit alternatives during long waits, providing crowding alerts, offering real-time transfer connection times on-board vehicles and keeping our customers continually informed of service delays and reroutes throughout their journey are examples of innovations implementable through existing technology. These will make Muni and complementary sustainable modes like walking and bicycling more attractive travel choices.

That is why we are seeking a partnership with the U.S. Department of Transportation through the Advanced Transportation and Congestion Management Technologies (ATCMTD) program to help turn these ideas into reality. To our knowledge, many of the features under consideration have yet to be implemented elsewhere in the United States. We believe that our Next Generation Transit Customer Information System will produce practical, scalable and replicable solutions that can other cities can deploy to improve their transit systems.

Why Focus on Real-Time Customer Information?

The experience waiting for and riding public transportation is a significant determinant as to whether one chooses it over other options. Long waits, overcrowding, not knowing when a bus or train will arrive, recurrent delays without explanation and missed transfers can easily drive customers to less sustainable forms of transportation. In contrast, shorter waits, real-time arrival information, minimal delays and timely transfer connections provide a show-up-and-go convenience and a positive experience that encourages more discretionary trips and customer loyalty.

Service Reliability

Real-time information throughout one's journey is essential because customers value service reliability. Transit systems that operate in mixed traffic, the vast majority of service in the United States, have challenges maintaining scheduled service frequency. Actual service differs from schedules because of traffic congestion, variable passenger loads, the deployment of wheelchair ramps, and other factors. All Muni routes, including the Muni Metro light rail system, operate all or portions of their services on surface streets, making them likely to encounter headway variability. For example, a 15-minute route might actually have two vehicles spaced 10 minutes apart, followed by a 20 minute gap.

Service Frequency

Service frequency is one of the most important factors in a person's decision on whether to take transit or another form of transportation. Unfortunately, transit systems in the United States usually lack sufficient operating funds to provide as much as service as they would like. Anything they can do to lower actual or perceived waiting times - including customer time management through real-time information - can directly contribute to ridership retention or growth.

Muni offers some of the highest levels of transit service in the country, making it possible to travel anywhere within San Francisco on transit. Not only is nearly everyone within three blocks of a Muni route, but most bus and rail routes operate from 6 a.m. to 11 p.m. or later every day and usually at least every 15 minutes during peak periods. However, there are also weaker parts of the network. In some of the outer neighborhoods or in general during the late evenings, most routes operate every 20 to 30 minutes.

Figure _____: Muni Service Frequency

Rush Hour Service
Generally every 15 minutes or more often

Late Evening Service
Generally every 20 - 30 minutes

Even with this high level of service, customer expectations of maximum waiting times are also high. As indicated in Figure ____, without knowing any real-time arrival information, most people are willing to wait at least 10 minutes and perhaps up to 15 minutes. Few people are willing to wait 20 minutes or more, which is how often many routes are operating at night of other off-peak periods. There is also a noticeable decline in willingness to wait for transfers.

Figure _____: Muni Service Frequency

	Daytime	Evening / Night	When Transferring
At least 5 min	97%	93%	94%
At least 10 min	74%	67%	60%
At least 15 min	36%	34%	22%
At least 20 min	15%	15%	8%
At least 30 min	4%	4%	2%

Source: SFMTA Next Generation Transit Customer Information System Survey (2,500 respondents as of June 7, 2017)

While Muni's frequent service during the daytime aligns fairly well with customer expectations, the discrepancy between their willingness to wait and the frequency of service suggests the importance of having real-time information particularly during off-peak periods and for transfers.

Project Vision, Goals and Objectives

The overarching goal of the Next Generation Transit Customer Information System is to increase public confidence in Muni so that customers can take transit to their destinations quickly and reliably. Specific project goals include:

- Provide accurate real-time information
- Increase discretionary and off-peak ridership
- Offer alternatives during long waits or service delays
- Understand how information and service quality impact customer travel choices
- Retain customers who might otherwise use less sustainable transportation modes
- Strengthen relationship with Muni customers

In addition, this project will improve:

Connectivity
This project will use real time arrival predictions to facilitate intra- and inter-agency transfers to other transit operators such as BART, provided that those systems use a standard software interface, and enable customers to take advantage of the interconnected transit network within San Francisco and to the rest of the region.

Reliability
While the new system would not improve transit reliability per se, it would generate real-time transit alternatives in case of long waits, service disruptions, or delays. By enabling customers to take full advantage of the density and comprehensiveness of the Muni network, the new system would reduce their waiting time and thus their actual travel time, which would make their Muni experience more reliable and less stressful.

Access

This project will provide San Francisco residents and visitors with greater access to destinations in San Francisco by making transit options clearer and easier to use. Customers will have a better understanding of what services are available in real-time, which would help them navigate a complex system and lower barriers to transit usage.

Equity

This project prioritizes providing information to people without smartphones or data plans. It will devote significant resources to expand digital signage to select, currently unpowered shelters and stops without shelters, including in low-income and minority communities.

Additionally, the Next Generation Transit Customer Information System fulfills the following specific goals of the Advanced Transportation and Congestion Management Technologies (ATCMTD) program.

Reduced costs and improved return on investments, including through the enhanced use of existing transportation capacity

The system would inform potential customers to nearby Muni services when they might have otherwise chosen less efficient transportation modes. It would also provide crowding alerts and suggest nearby less-crowded alternative routes if available; some people could alter their transit itinerary such that loads are more evenly spread across routes. This would allow the SFMTA to improve use of existing transit capacity and accommodate customers more optimally and comfortably using existing resources. By smoothing out demand, vehicles will have less crowding and less wear and tear.

Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications

To the SFMTA's knowledge, the Next Generation Transit Customer Information will incorporate many enhancements to real-time information that have not been widely implemented elsewhere in the United States. It will also generate a large amount of data, including by the system itself and system users, that can be matched with ridership and operational data to understand the impacts of an advanced real-time customer information system. SFMTA's customer research to date indicates a high potential for project to change user behavior. The project includes a robust analytics component as well as independently-conducted data interpretation to quantify impacts on customer satisfaction, mode choice and ridership.

Delivery of environmental benefits that alleviate congestion and streamline traffic

By making it easier to ride Muni, this project will shift people from less environmentally-sustainable modes to transit. Muni generates about 90% less greenhouse gas emissions and other air pollutants per trip (or mile) relative to automobiles, including ride-share vehicles. Muni's fleet - which includes zero-emission electric trolley coaches, light rail vehicles, historic streetcars and cable cars - is one of the greenest in the country.

Collection, dissemination and use of real-time transportation-related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services.

Real-time transit information at the right times and places will make it easier to ride Muni, which will help increase discretionary ridership. It will also empower both regular and occasional customers to feel comfortable riding Muni to new or unfamiliar places, which will allow people to use transit to access multiple destinations including social services, jobs, businesses and medical facilities. As such, the project will shift people from less sustainable and less space-efficient modes to transit. A full Muni articulated (60-foot) bus displaces more than 90 single-occupant vehicles. A full two-car light rail train displaces over 235 single occupant vehicles. Shifting people from low-capacity to high-capacity vehicles will mitigate traffic congestion on San Francisco's limited roadway space.

Delivery of economic benefits by reducing delays, improving system performance and throughput, and providing for the efficient and reliable movement of people, goods and services

The SFMTA estimates that faster travel times from reduced congestion attributable to Muni ranges from $192.4-$236.8 million per year. A modest 3% ridership increase due to the project would yield $5.8-$7.1 million in monetized economic benefits alone. Transit is often less expensive than driving alone or using a ride-share service, which allows people to save more.

Reduction in the number and severity of traffic crashes and an increase in driver, passenger and pedestrian safety

By attracting riders to Muni, the project will improve overall system safety. On a per trip basis, the number of injuries and fatalities is about 77% on Muni than in automobiles, including ride-sharing vehicles. Fewer single-occupant vehicles, particularly in the downtown area and major corridors, would reduce the chances of automobile collisions with pedestrians and bicyclists to help the City achieve its Vision Zero safety goals.

Integration of Advanced Technologies into Transportation System Management and Operations

This project will take advantage of maturing and advanced technologies, including:

- Sophisticated real-time transit arrival prediction algorithms
- Algorithms that generate alternatives based on location and nearby vehicles
- Mobile technologies and associated user information to understand system usage and customer preferences
- Real-time passenger counting to assess vehicle loads
- Real-time signage on-board vehicles
- Solar-powered information signs

The project will employ advanced but readily available technologies that have been used in other industries but generally on a much more limited basis in public transportation.

Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges

Many cities are facing similar challenges as San Francisco with regards to long-term ridership trends, new transportation technologies and the potential for real-time information to impact them. The Next Generation Transit Customer Information System is large scale primarily due to the size and complexity of San Francisco's transit network and fleet. However, the project's elements are scalable to any city or region and have widespread applicability particularly for smaller and less extensive transit systems where service is less frequent and it can be more challenging to attract ridership that prioritizes short wait times. By engaging vendors and developing innovative system requirements, this project will help define best practices for real-time information systems for peer agencies and cities nationally.

Customer Research: Information at the Right Times and Places

To achieve key goals of the ATCMTD Initiative, the Next Generation project will need to increase Muni ridership. Why does the SFMTA believe that there is a high potential for this project will grow transitridership? We asked our customers.

Informed by product development user research best practices, the SFMTA has embarked on an extensive customer research initiative to determine what is most critical to making informed travel decisions and incorporate them into system requirements. To date, public outreach has consist-sted of two primary ongoing efforts:

Quantitative

A broad-based online survey to capture the public transportation travel patterns, attitudes and preferences of as many Muni customers as possible. In addition to demographic and general travel behavior questions, the online survey contains hypothetical situational questions to assess the potential for providing transitcustomer information at the right times and places to influence travel behavior.

Qualitative

To ensure that the SFMTA hears the opinions of Muni's diverse customer base, including voices that might be underrepresented in the online survey, the SFMTA is conducting focus groups to various community stakeholders including Senior and Disability Action, Independent Living Resource Center, LightHouse for the Blind and Visually Impaired and the Youth Commission.

On a scale of 1 to 5 (1 = poor, 3 = good, 5 = excellent), customers rated the overall quality of the current real-time information system a 2.5. This leaves ample room for improvement. High-level findings to date reveal that real-time information at the right times and places is essential to transit's usability and provides an opportunity for ridership growth.

How the Project Would Address Deterrents to Riding Transit

SFMTA's online survey asked customers to recall the last time they chose another form of transportation over Muni and to select up to two factors that influenced their decision. As indicated in Figure _____, the vast majority were service-related. Most importantly, the Next Generation Transit Customer Information System project has the potential to mitigate some of these factors and turn negative experiences into neutral or even positive ones. Over the long term, improved customer satisfaction should translate into ridership retention and growth.

Figure ____: How the Project Would Address Deterrents to Transit Ridership

Deterrent to Riding Transit	Percent	What the Next Generation Transit Customer Information System Will Do
Ride on-board Muni would take too long	**34%**	While the new system would not directly address vehicle speeds, it could potentially recommend faster route options if available and reduce total travel time by shortening customer waits.
Scheduled service was too infrequent	**33%**	While the new system would not directly increase service, it could reduce the negative impacts of infrequent service by allowing customers to delay their arrival at a stop or take a nearby alternative route coming sooner.
Muni did not arrive when predicted	**30%**	By providing more accurate predictions, the new system would improve customer perceptions that Muni is "on time" and lower the chances that customers would "give up" on Muni while waiting.
Muni was too crowded	**22%**	While the new system does not directly increase resources to reduce overcrowding, it would provide crowding alerts to allow bus customers to wait for a later trip or find a nearby less crowded route.

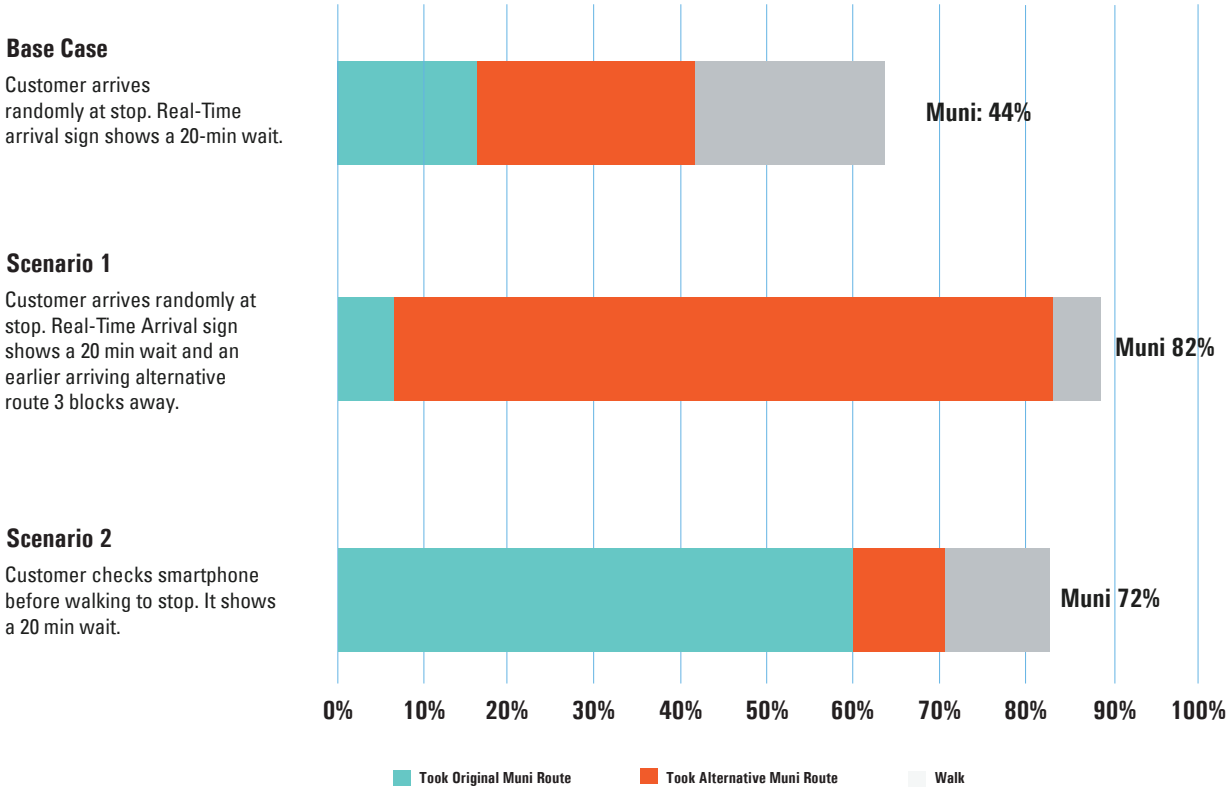
Factor	Percent	What the Next Generation Transit Customer Information System Will Do
There was a service delay	22%	While the new system would not directly eliminate service delays, it would inform customers of service disruptions or reroutes during their journey so they can seek alternatives and/or inform those waiting on them at their destination that they will be late.
Transfers were required	8%	By providing real-time transfer connection times online and onboard vehicles, the new system would make transferring more predictable and give customers confidence they can take multiple Muni routes to more destinations.
I did not feel safe or secure	8%	By providing arrival predictions that allow customers to reduce waiting times, the new system may improve perceptions of safety and security, at least while waiting for Muni.
Muni did not stop for me	6%	A primary reason that vehicles do not stop for customers is that they often are full. By providing crowding alerts, the new system would allow bus customers to wait for a later trip or find a nearby less crowded route.

Source: SFMTA Next Generation Transit Customer Information System Survey (2,500 respondents as of June 7, 2017)

How Better Transit Customer Information Can Influence Mode Choice

As part of our public outreach, the SFMTA presented survey respondents with some situational questions to determine how different types of customer information delivered at various times could influence travel choices. As shown in Figure _____, we asked survey takers to imagine a situation where they were going home from work or school and had to wait 20 minutes for their Muni route. A 20-minute wait is not uncommon if there is a service gap or if one just missed a bus during the evenings or on weekends. Based on SFMTA's survey, only 15% of people indicated they are willing to wait this long for Muni.

Figure _____: Customer Information at the Right Times and Places Can Increase Ridership



Source: SFMTA Next Generation Transit Customer Information System Survey (2,500 respondents as of June 7, 2017)

In the base case, respondents arrive randomly at a stop and see a digital sign saying their route would arrive in 20 minutes. We asked respondents what they did the last time they encountered a situation. Then we tested a couple of scenarios. In one scenario, the real-time arrival sign at the transit shelter showed an alternate route three blocks away that was arriving sooner. In another scenario, they saw that their wait would be 20 minutes on their smartphone prior to walking to their stop.

The results were dramatic. In the base case, only 44% took Muni, either waiting the entire 20 minutes or finding an alternative transit route on their own. Displaying a nearby, earlier-arriving transit alternative on the real-time arrival sign at the stop nearly doubled the percentage of people who chose Muni to 82%. Additionally, 72% of respondents chose Muni when they could see the expected waiting time on a mobile device before starting to walk to the stop.

A final set of questions asked customers how they would travel if their trip required transferring between two Muni vehicles, with and without a prediction of the connection time. Assuming a hypothetical 6-minute wait, providing transfer time predictions boosted the percentage of respondents would take Muni for at least a portion of their trip from 75% to 90% and for the entire length of their trip from 48% to 83%. Though responses to a stated preference survey do not always reflect revealed preferences, these numbers imply there is significant potential for the Next Generation Transit Customer Information System to increase Muni ridership.

Qualitative Research Findings

To date, the SFMTA has carried out 8 focus groups, 12 ride-along sessions, and 17 one-on-one interviews with a wide variety of Bay Area residents to gain a deeper understanding of the Muni customer experience. Our research has generated many findings that will assist in shaping the project.

For example, many customers understand there is traffic congestion and do not expect Muni to operate precisely according to the official schedule. However, they will consider Muni to be "late" if it does not arrive according to the real-time prediction displayed at a stop or on a mobile device. Therefore, by improving prediction accuracy, the SFMTA can also improve customer perceptions that Muni is reliable and operating "on-time."

Information Tools

Customers are heavily reliant on technology for trip planning, including live maps. Many customers simultaneously use multiple apps.

Many seniors and customers with disabilities prefer speaking with a live person on 311.

Accessibility

Many customers with disabilities use Muni extensively and know routes well, but must monitor disparate sources of information to find out about accessible stops and elevator/escalator outages.

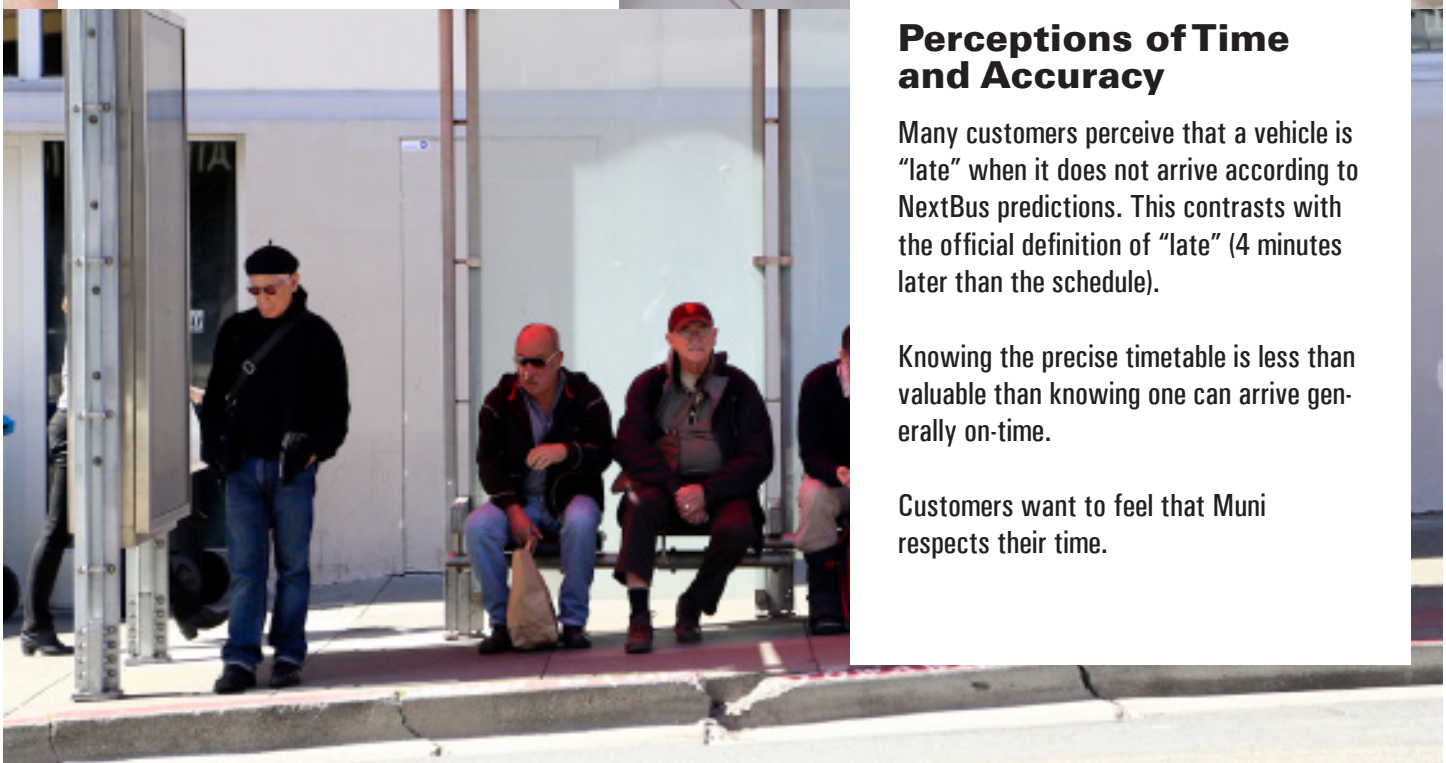
Customers with wheelchairs are concerned about not being able to board crowded vehicles.

The SFMTA project team is currently organizing, coding and analyzing the qualitative data collected from the first round of research to uncover more customer needs. In addition, the SFMTA will begin its next round of research by speaking with stakeholders in the San Francisco business and tourism community. To ensure the validity of research findings, the SFMTA will triangulate the qualitative data with the results from the on-going quantitative survey.

Branding

Muni does not have to be "cool" like newer forms of transportation.

It has to function effectively within its constraints.



Perceptions of Time and Accuracy

Many customers perceive that a vehicle is "late" when it does not arrive according to NextBus predictions. This contrasts with the official definition of "late" (4 minutes later than the schedule).

Knowing the precise timetable is less than valuable than knowing one can arrive generally on-time.

Customers want to feel that Muni respects their time.

SECTION II

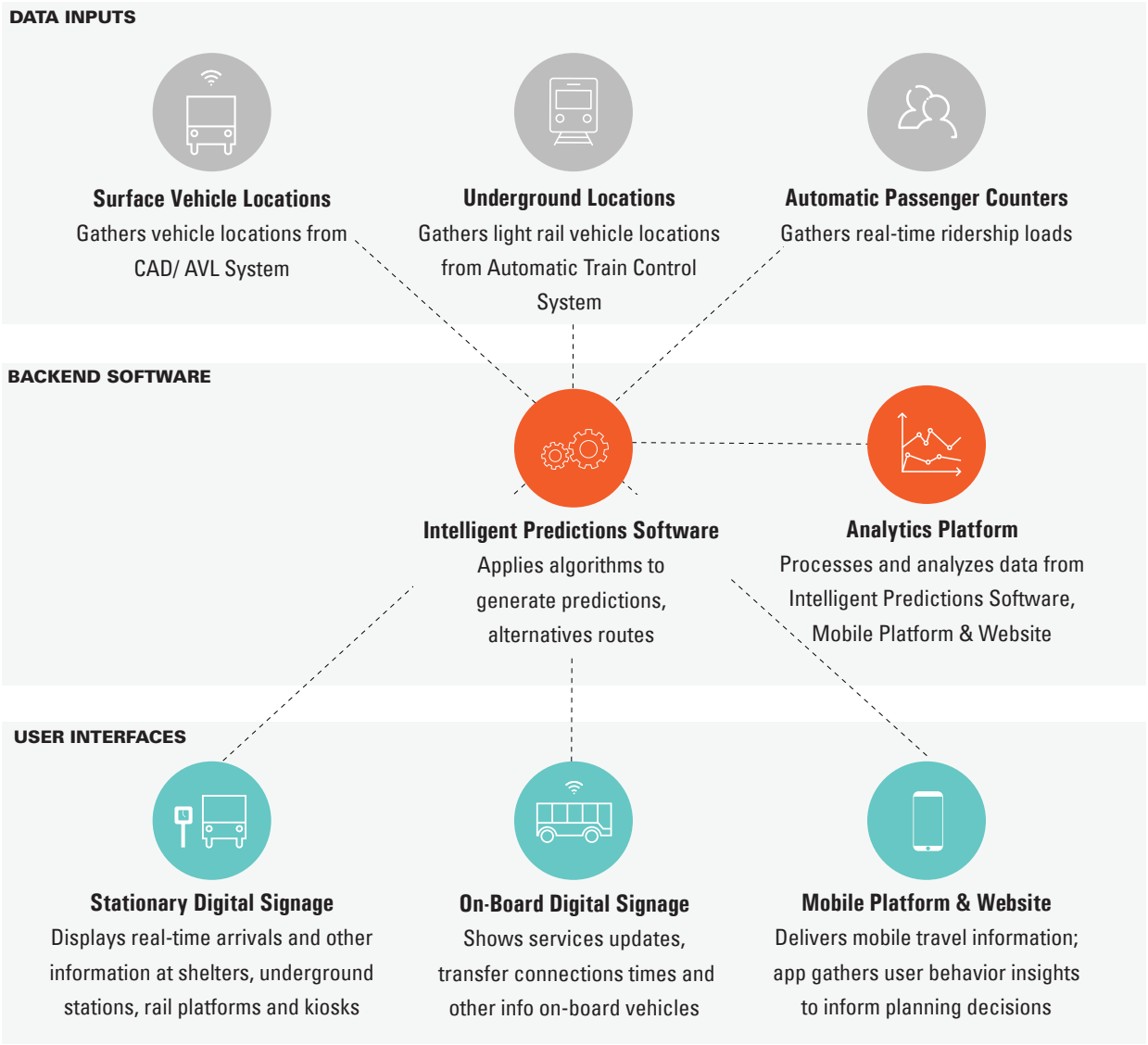
SYSTEM ELEMENTS

VOLUME I

System Elements

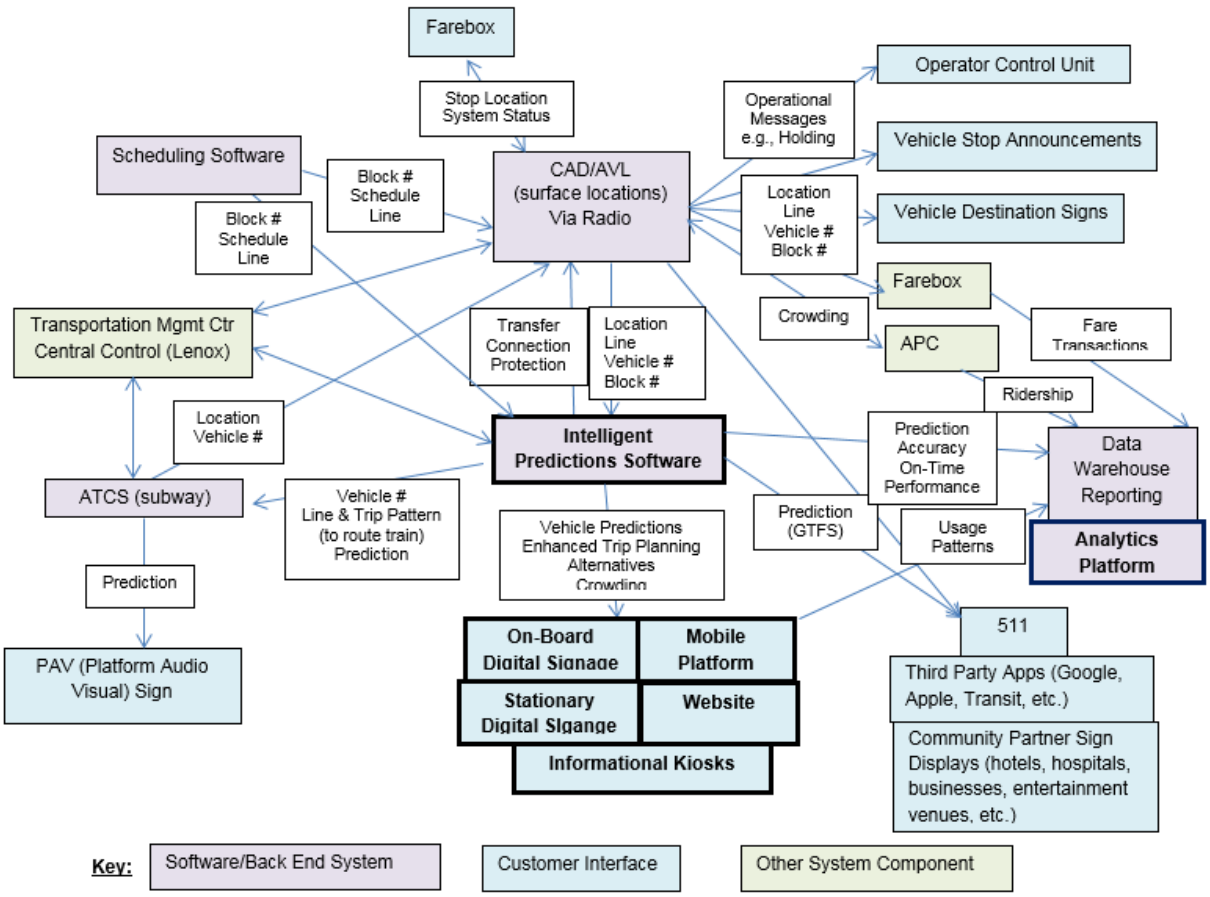
The Next Generation Transit Customer Information System is a complex initiative requiring integration among multiple new and existing systems. To manage the project, the SFMTA is proposing to divide it into five primary modules as shown in Figure ____: (1) Intelligent Predictions Software, (2) Stationary Digital Signage, (3) On-Board Digital Signage, (4) a Mobile Platform and Website, and (5) an Analytics Platform.

Figure ____: System Elements



Illustrating the complexity and interconnectedness of this project, Figure _____ is a schematic example of how the Next Generation Transit Customer Information System would integrate with other major SFMTA software and hardware systems. Below are technical descriptions of each system element.

Figure _____: Systems Integration with Other Hardware and Software



Bold font: Vendor-provided components under the Next Generation Customer Information System
Regular font: Third-party provided components (requires integration)

Intelligent Predictions Software

The heart of the next generation system is its Intelligent Predictions Software. The fundamental purpose of this element is to generate vehicle arrival and load predictions for downline stops. To accomplish this, it would take inputs from the following systems:

Computer Aided Dispatch/Automatic Vehicle Location (CAD/AVL) System

The CAD/AVL system tracks Muni vehicles, their locations and their corresponding operators, route and schedule assignments. It reports vehicle locations every 60 seconds through a radio communications system.

Automatic Train Control System (ATCS)

ATCS, which controls light rail vehicles on the underground Muni Metro system, monitors the positions of trains in real time. This information is then provided to the CAD/AVL system.

Automatic Passenger Counters (APC)

Starting in 2015, the SFMTA began equipping all rubber-tire vehicles (trolley and motor coaches) and light rail vehicles with state-of-the-art Automatic Passenger Counter (APC) sensors that observe ridership and calculate occupancy in real-time. The CAD/AVL system processes this data and delivers it to SFMTA databases every 60 seconds. The project would also include an option of installing APCs on motor coaches and light rail vehicles procured prior to 2015 that the SFMTA anticipates would still be operating through 2025.

Base Functionality

Generate more accurate vehicle arrival predictions by improving forecasting algorithms, which may include machine learning and incorporation of variables like traffic congestion, ridership loads and weather conditions

Provide predictions based on fixed time-point-based schedules, headway-based scheduling, special event/real-time route adjustments and demand-responsive routing

Eliminate “ghost bus” issues where the existing system shows a prediction for a vehicle that never arrives

Show transfer connections (both within Muni and to regional systems like BART and Caltrain), including estimation of connection times

Base Functionality (continued)

Incorporate information about real-time reroutes and delays from the Transportation Management Center (TMC)

Push other public messages (such as fare and service changes, elevator alerts) to stationary signage, on-board signage and mobile devices

Provide predictions consistent with SFMTA's Transit Signal Priority (TSP) system, which modifies traffic signals to enable rubber-tire vehicles to catch up to schedule

Provide predictions based on fixed time-point-based schedules, headway-based scheduling, special event/real-time route adjustments and demand-responsive routing

Suggest alternative parallel transit routes within walking distance when there are long wait times, service delays and/or overcrowding

Facilitate usage of complementary sustainable transportation options, such as bike sharing and taxis/on-demand transportation services

Forecast potential vehicle overcrowding

Alternatives

One of the most critical "value added" features of the Intelligent Predictions Software is to automatically generate alternatives to push out to stationary digital signage, on-board digital signs when there may be a long wait, service delay or crowding. As illustrated in Figure _____, in many parts of Muni's comprehensive network there are nearby parallel services. As demonstrated in SFMTA's public outreach survey, informing someone waiting at a stop of a nearby alternative arriving sooner could increase the chances of remaining with Muni from 44% to 82% under the right circumstances. Over time, that customer may be more likely to view Muni system as more reliable and less likely to switch to less sustainable modes.

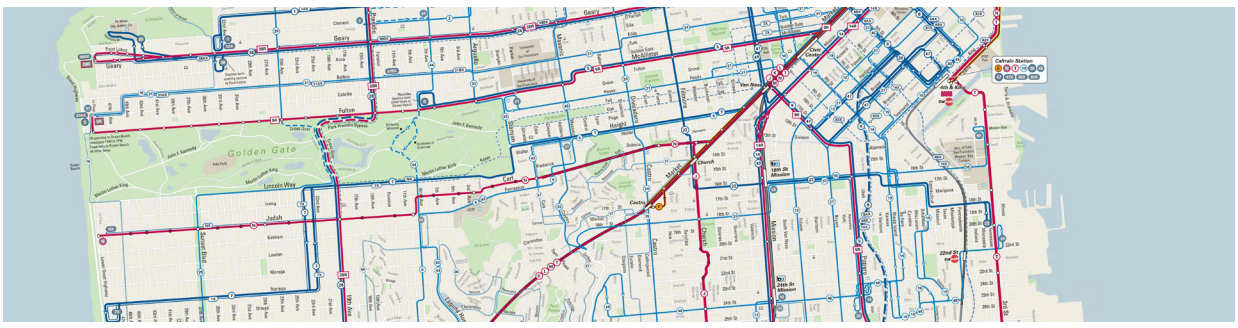


Figure _____: Muni Network Density and Alternatives
In many parts of San Francisco, the density and interconnectedness of the Muni network provides customers with multiple paths to reach their destination. Taking advantage of the robustness of this network, the new Customer Information System aims to display different alternatives if the initial choice is subject to a long wait, service delay or overcrowding.

Stationary Digital Signage

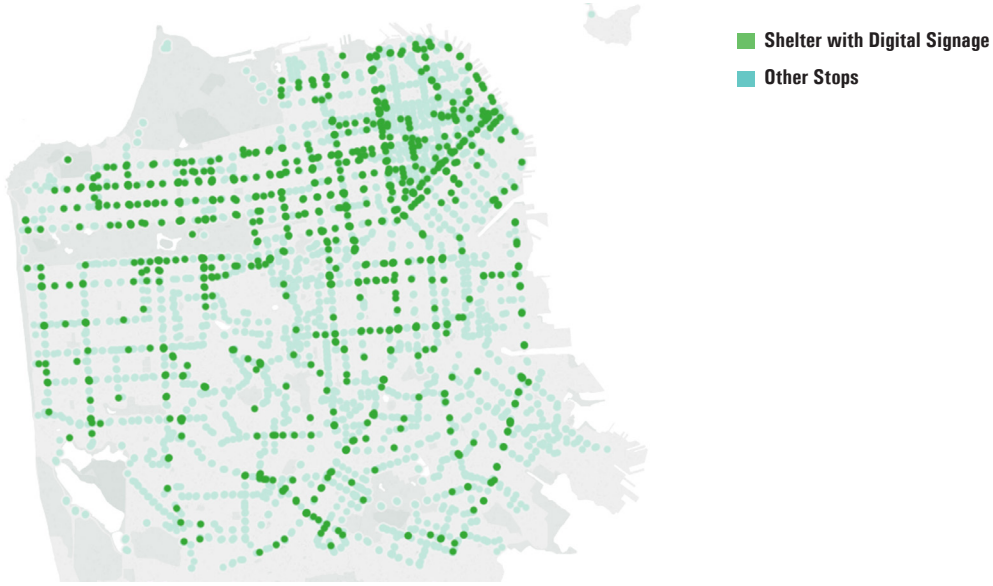


Figure ___: Existing Shelter Locations with Digital Signage

Although San Francisco is a hub of the tech industry, many customers do not own smartphones or maintain a data plan. In addition, the City welcomes millions of visitors each year who, even with a smartphone, may not have a data plan and may need additional tools to navigate San Francisco's geography and complex public transportation system. To ensure equitable access to real-time information, the project will include a widespread signage network so that customers have access to real-time arrivals and system status without needing to rely on a smartphone.

Signage at Powered Shelters

The new system would replace the over 850 current Light Emitting Diode (LED) signs at shelters and rail platforms with Liquid Crystal Display (LCD) (or similar technology) signs with LTE communications and WiFi capability. Unlike the current LED signs that show text-only, the new signs would enable a more flexible and user-friendly graphical interface that allows for graphics and text in multiple languages.

Signage at Unpowered Shelters

San Francisco currently has approximately 150 shelters without signs. Providing power to these locations has proven to be technically infeasible and/or cost prohibitive. The SFMTA is reaching out to vendors to explore the potential for cost-effective, solar-powered sign solutions for these locations.

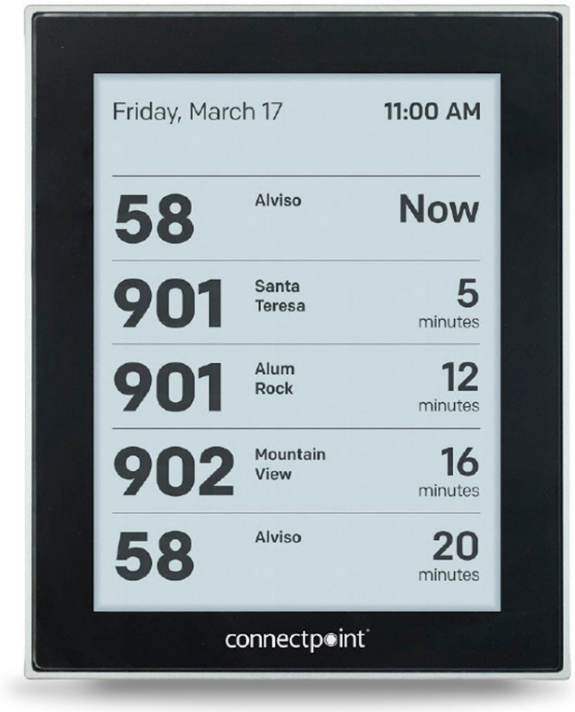


Figure ___: Potential Solar-Powered Digital Signage
(Photo does not imply SFMTA endorsement of a particular vendor).

Signage at Stops without Shelters

There are also over 2,500 stops without a shelter, some of which may be suitable for real-time information signs. Stops without shelters are primarily in lower ridership areas, which often have less frequent service. Therefore, it is all the more important to have real-time signage to inform customers of their expected wait. The SFMTA is seeking cost-effective, solar-powered sign solutions for these locations.

Informational Kiosks

The project would also include a limited number of informational kiosks at locations other than transit stops such as areas with high visitor and tourist traffic. They would assist in pedestrian wayfinding and provide directions to nearby transit stops, in addition to showing real-time transit arrival predictions.

On-Board Digital Signage

In the United States, digital signage on board vehicles is currently limited to displaying and announcing the next stop or next few stops, showing pre-recorded messages, and perhaps listing transfer routes whether or not they are operating. The SFMTA would like to take advantage of new technology to do much more. Examples of new information include:

Transfer Opportunities and Connection Times

Following international best practices, on-board signage with real-time transfer connections (Figure _____) will notify customers when their transfer point is approaching and help them better manage the "last mile" leg of their trip. While connecting services may appear physically on a system map, not all routes operate at all times. Real-time information on-board vehicles can tell a customer whether their connecting bus is just a few minutes away or not operating at all, allowing them to assess their options and avoid attempting to make a non-existent connection.

Service Delays and Disruptions

The SFMTA would like to integrate its Computer-Aided Dispatch/Automatic Vehicle Location (CAD/AVL) and radio systems with on-board signage to enable to send timely messages about line reroutes, delays and cancellations from its Transportation Management Center to the on-board digital displays. This will enable customers to keep continually informed about service status and let them decide whether to exit the vehicle if there is a service delay or disruption.

The SFMTA would like to install digital signage on-board approximately 842 buses (New Flyer electric trolley coaches and motor coaches). The 215 next generation Siemens Light Rail Vehicles currently in delivery or on order come with on-board screens. These LCD screens announce stops based on GPS location and pre-recorded messages under a content management system that allows the SFMTA to upload changes via WiFi when a vehicle arrives at a division. Under the Next Generation Transit Customer Information System project, back-end systems and communications would need to be upgraded in order to provide real-time information to Siemens Light Rail Vehicle screens.

Figure ____: On-Board Digital Signage
Following international best practices, SFMTA on-board signage could alert customers of intersecting routes and their connection times to reduce the uncertainty and trepidation associated with transfers. (Note: Photo does not imply SFMTA endorsement of a particular vendor.)

Mobile Platform and Website

This project will convey customer information in a variety of online formats, including a standard desktop website, a tablet, and a mobile app. Given the widespread use of smartphones in particular, it is important to deliver accurate and timely information through a mobile app. SFMTA's public outreach efforts have revealed that customers often rely on multiple mobile apps - sometimes two, three or even more - for transit information. This suggests that even the most popular apps do not have all the necessary features that customers are seeking to plan their trips.

The SFMTA now has a separate account-based mobile platform called MuniMobile, which currently offers mobile ticketing and a link to predictions generated by the current real-time information provider. The future system will include a customized app with the capability to integrate with any MuniMobile platform (Figure ____). The mobile app will enable customers to plan their trips, follow along while they are enroute to their destination, rate their travel experience and provide feedback and requests relating to service. It will also feature information about sustainable transportation options such as bike sharing and partner transit services.

Rather than create a mobile app from scratch, the SFMTA is open to partnering with an established company that it would designate and endorse as its official and preferred mobile app. However, in contrast to relying on third-party developers to produce independent mobile apps, a widespread model in the United States, the SFMTA will manage app content to ensure that directions and predictions are subject to quality assurance standards.

Figure ____: MuniMobile Platform Trip planning and real-time information will be available through an all-in-one mobile app accessible from the MuniMobile platform

The app will also have the capability of supporting foreign languages such as Chinese and Spanish commonly spoken by San Franciscans.

The proposed model will also enable the SFMTA to better understand how people use the San Francisco's transportation system. As is standard with customer-focused businesses, understanding consumer preferences with emerging technologies enabled by mobile phones is essential to designing user-focused public services. In conformance with federal, state and local laws and regulations as well as industry best practices, and with user consent, the mobile app and website will be capable of collecting basic locational data to provide context-appropriate vehicle predictions and trip planning and to assist SFMTA with service and operational planning.

Analytics Platform

Once implemented, the Next Generation Transit Customer Information System will provide an advanced analytics platform to help the SFMTA uncover user needs and make service and operational planning decisions that are both data-driven and user-centered. Transaction-level data generated by the proposed Intelligent Predictions Software and the Mobile Platform and Website modules will help calibrate ridership models and project resources required to address unmet or underserved transit demand.

The Analytics Platform will store and process transaction-level data to provide customizable reports, dashboards, and other tools. It will include visualizations for both high-level and in-depth analysis, permitting the SFMTA to assess trends and address issues. The SFMTA will also store this data in its own data warehouse to answer ad hoc queries and for archival purposes.

Data Analytics & Interpretation

Traditional real-time vehicle arrival systems have focused on providing accurate predictions to make easier and less time consuming for people to ride transit. With advancements in technology, particularly in mobile devices as well as processing and visualization of big data, the Next Generation Transit Customer Information System will vastly improve the SFMTA's understanding of the transportation system. Transit agencies have made great strides in measuring operational performance. The next major challenge is to understand and quantify how transit information and service quality impact customer travel choices. This knowledge will inform service and operational planning decisions, help shape transportation policy and ultimately increase ridership.

The new system will generate and store a vast amount of data. The SFMTA envisions partnering with an independent third party, possibly an academic institution, to interpret this data and create models that answer pressing questions. Examples of subjects that the analytics platform could help answer include:

Performance Management

On-Time Performance
What are the system's basic on-time performance statistics by route, route segment and time of day?

Travel Time Variation
How do vehicle travel times vary from time period and from day-to-day along different route

Real-Time Prediction Accuracy
How reliable are real-time predictions? What algorithm changes will improve prediction accuracy?

Service and Operational Planning

Service Interventions
What real-time service intervention strategies are most effective in minimizing customer inconvenience and delays?

Interval Reliability
Where are bunches and gaps most likely to occur? How do bunches and gaps affect the predictability of end-to-end customer travel times?

Transfer Reliability
During owl periods, do vehicles arrive on time so that customers can make transfers successfully when there are scheduled timed transfers?

Network Connectivity
How do changes in the network affect customers' ability to move around efficiently?

Customer Responsiveness to Service and Operational Reliability

Mode Choice & Abandonment
How often do potential customers look up the next Muni arrival time and either take Muni or use another transit mode? When does this happen?

Wait Tolerance
How long are customers willing to wait for Muni? How does this wait time vary by time of day, route and location?

Ridership Elasticity
How do service changes affect ridership at a route and network level?

Crowding
How much crowding are customers willing to accept before choosing a different transportation mode?

Origin- Destination Patterns
At an aggregated level, what route(s) are customers taking to travel from their origin to their destination? Is their trip linking with other transit providers or other transportation modes?

Latent Demand
Are there many requests for next Muni arrival times when service is sparse and ridership is low? If so, this may suggest that latent demand that could materialize with longer service hours and/or more frequent service.

Customer Feedback
How do service and operational reliability issues impact public perceptions in terms of customer ratings, requests and other feedback?

Figure ___: Summary of Envisioned Next Generation Transit Customer Information System Features and Innovations

Envisioned System Feature	Current	Future	Innovation*
Intelligent Predictions Software			
Real-Time Prediction Algorithm	✓	✓ (improved accuracy)	✓ (more sophistication)
Real-Time Crowding Alerts	✗	✓	✓
Real-Time Alternative Route Suggestions	✗	✓	✓
Real-Time Transfer Connections within Muni and with other systems	✗	✓	✓
Stationary Digital Signage			
Powered Shelters	✓	✓ (LCD or similar)	
Unpowered Shelters & Stops	✗	✓ (LCD or similar)	✓
On-Board Digital Signage			
Stop Announcements	✓	✓	
Real-Time Transfer Connection Times	✗	✓	✓
Real-Time Service Delay & Reroute Alerts	✗	✓	✓
Mobile Platform & Website			
Mobile App	✓	✓ (Enhanced capabilities)	
Data Collection	✗	✓	✓
Mobile Platform & Website			
Data Interpretation - Transit Operations and Performance Management	✓	✓ (Enhanced capabilities)	
Data Interpretation - Customer Usage and Travel Preferences	✗	✓	✓

** Not currently in widespread use in the United States*

Partnerships with the Private Sector and Public Agencies

The success of the Next Generation Transit Customer Information System will depend on strong partnerships. The SFMTA will be working closely with the following groups:

Community Stakeholders and Advocacy Groups

The SFMTA is listening to how people currently use information and what they would like to see in the new system. The agency is reaching out to the business community, tourism industry and advocacy/public interest groups such as San Francisco Bay Area Planning and Urban Research Association (SPUR) and the San Francisco Transit Riders. The SFMTA is also engaging organizations representing youths (San Francisco Unified School District and the Youth Commission) and seniors and people with disabilities (Senior and Disability Action, Independent Living Resource Center, LightHouse for the Blind and Visually Impaired, and SFMTA's Multimodal Accessibility Advisory Committee (MAAC)).

Other Transit Agencies

Muni connects with other transit systems such as AC Transit, BART, Caltrain, Golden Gate Transit, SamTrans and ferries that link San Francisco with other parts of the Bay Area. The SFMTA will partner with those agencies for technical assistance in incorporating information about connecting services so that customers can transfer seamlessly between systems.

Vendors

This spring, the SFMTA released a Request for Information (RFI) for the Customer Information System to assess the state of customer information in the transit industry. The SFMTA received responses from 24 entities, excluding potential subcontractors, reflecting widespread interest in the industry to innovate in real-time information delivery. We expect to partner with more than one private sector partner on project implementation.

Academic Institutions

Through the procurement process, the SFMTA will be seeking an analytics platform and data interpretation services to assess the project's success and to answer the performance management, service and operational planning, and customer responsiveness questions. Based on the proposals submitted, it is possible that the SFMTA may select an academic or research institution to provide those services. The primary benefit would be that the academic or research institution would provide independent analysis, including of the performance of the real-time information system itself.

Regulatory, Legislative & Institutional Obstacles

The SFMTA does not anticipate any substantial regulatory, legislative or institutional obstacles with the Next Generation Customer Information System. The SFMTA has jurisdiction over the management of the transportation system in San Francisco. Signage and other project hardware components will be installed on SFMTA-owned or managed locations.

Knowledge Transfer

The SFMTA is excited that the Next Generation Transit Customer Information System will bring many new innovations and could transform how real-time information can contribute to ridership growth. As a potential partner with the U.S. Department of Transportation through the ATCMTD Initiative, we also believe that we would have an important responsibility to share and disseminate project findings so that other cities and transit systems can learn from our experience. The SFMTA fully expects that knowledge transfer and idea sharing through forums and conferences organized by entities such as the US Department of Transportation, Transportation Research Board (TRB) and American Public Transportation Association (APTA) will be an important part of the project.

While San Francisco has a unique, complex transit operating environment, it shares commonalities with many other cities across the United States. For example, it has grown quickly in recent years, faces transit funding shortfalls and has experienced a surge in ridesharing services and automobiles competing for limited roadway space. As such, the impacts of the Next Generation Transit Customer Information System on public transportation's overall attractiveness and utility will have implications for many other cities. By engaging vendors and developing innovative system requirements, this project will also help define best practices for real-time information systems for peer agencies and cities nationally

This project is large-scale primarily due to the size and complexity of San Francisco's transit network and fleet. Aside from some base elements such as a prediction algorithm and software integration, the SFMTA estimates that costs will be roughly proportional to the size of digital signage networks at stationary locations and on-board vehicles. Thus, the project's elements are scalable to any city or region. What we will learn from implementing this system will be particularly applicable for smaller and less extensive transit systems where service is less frequent and it can be more challenging to attract ridership that prioritizes short wait times.

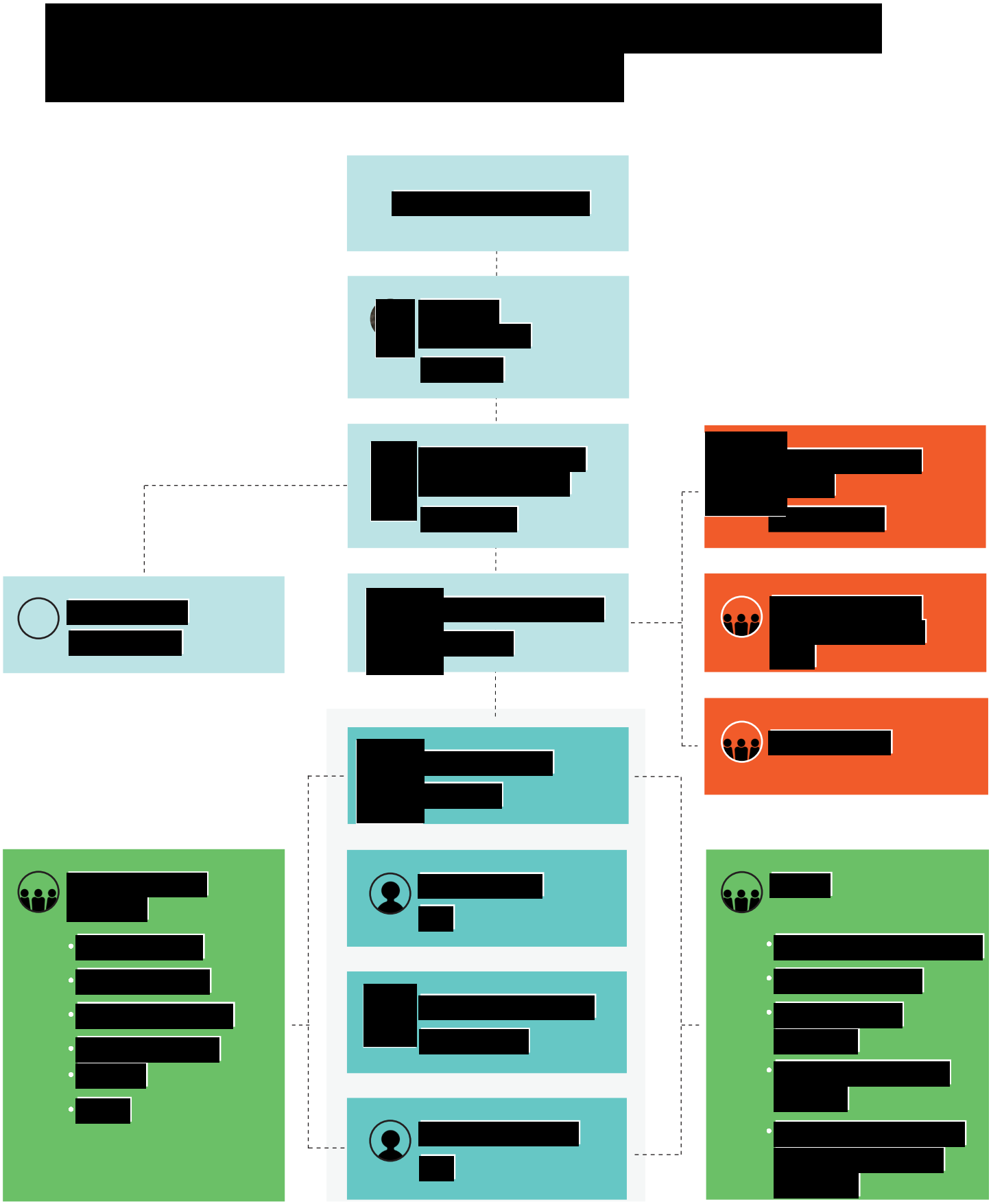
SECTION III

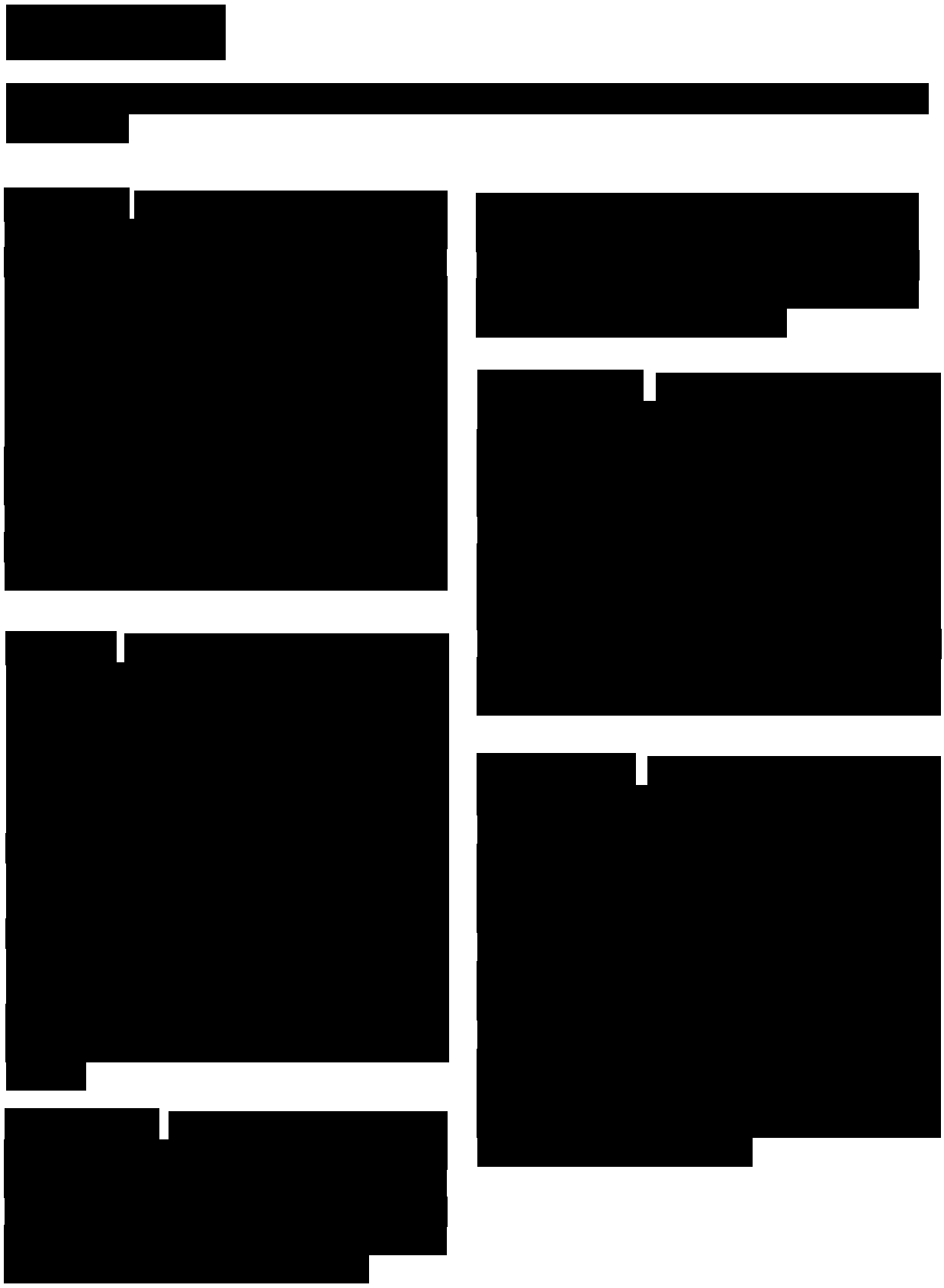
STAFFING & MANAGEMENT

VOLUME I

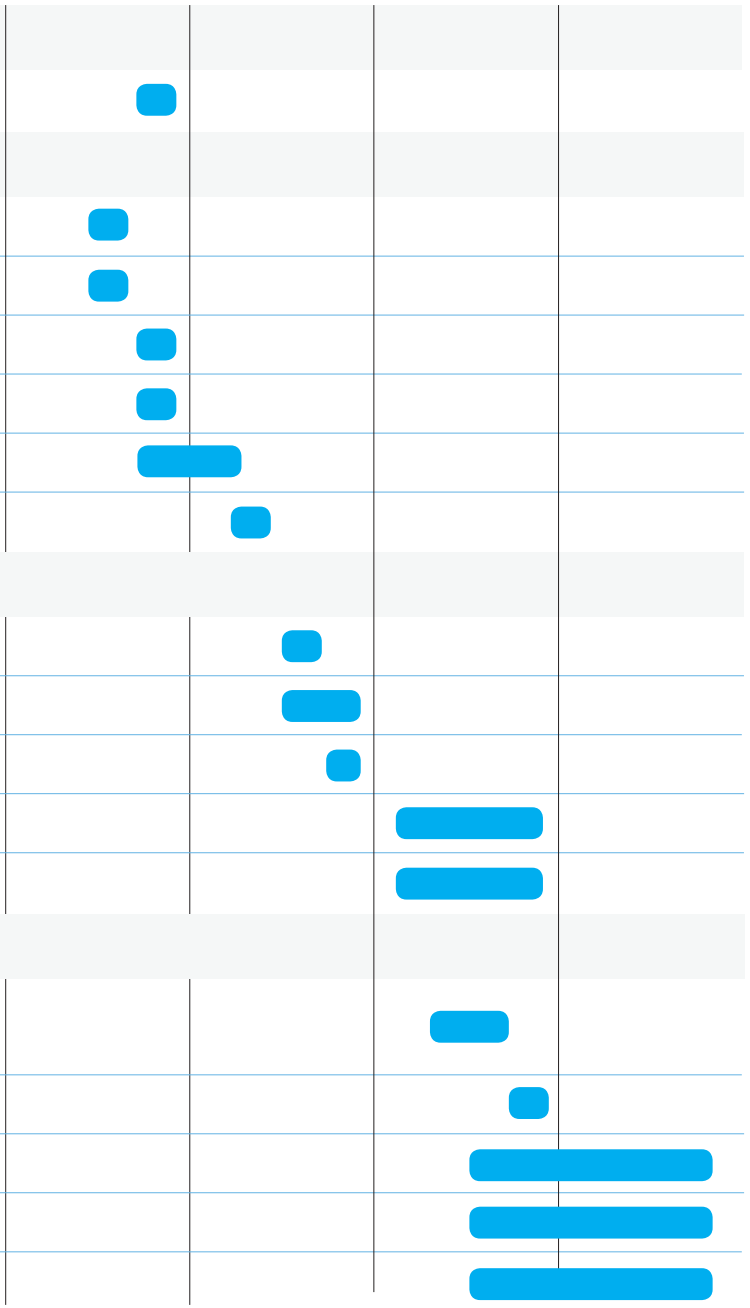
Staffing & Management

The Next Generation Transit Customer Information System is a multi-disciplinary initiative that will be led by the Technology group within SFMTA's Finance & Information Technology Division. Under the leadership of the Chief Technology Officer Lisa Walton, the Systems Integration Project Management Office (PMO) will provide general project oversight and controls to ensure the prudent and appropriate use of ATCMTD funds and timely delivery of project modules.





Milestone	Dates
Grant Agreements & Approvals	
SFMTA/FHWA Grant Agreement & Authorization to Proceed	Fall 2017
Project Planning & Procurement	
Request for Information (RFI) Review & Synthesis	Early Summer 2017
Request for Proposals (RFP) Development	Summer 2017
Request for Proposals (RFP) Release	Fall 2017
RFP Responses Due	Fall 2017
RFP Oral Evaluations and Selection	Fall 2017 - Winter 2018
Approvals: Civil Service Commission, SFMTA Board, Board of Supervisors	Spring 2018
Phase I - Replacement of Existing System	
Notice to Proceed	Summer 2018
Base Software System - Predictions, Mobile App and Basic Analytics Development	Summer - Fall 2018
Base Software System - Testing	Fall 2018
Base Hardware - Replacement of Existing Signs at Powered Shelters	Winter - Spring 2019
Go-Live (System activated as shelter signs are replaced)	Winter - Spring 2019
Phase II - Enhancements	
Software System Enhancements - Alternatives, Crowding Alerts, Advanced Analytics, Integration with LRV4 screens	Spring - Fall 2019
Software System Enhancements - Testing	Fall 2019
Additional Hardware - On-Board Signage	Summer 2019 - Fall 2020
Additional Hardware - Unpowered shelters, solar-powered signs	Summer 2019 - Fall 2020
Go-Live (System activated as shelter signs are replaced)	Summer 2019 - Fall 2020



SECTION IV

BUDGET

VOLUME II

Budget

The SFMTA estimates a budget for the Next Generation Transit Customer Information System of approximately $58.1 million through 2020. Incorporating responses from vendors through the Request for Information (RFI) process, the SFMTA has prepared cost estimates which we believe to be reasonable if not conservative. Later in 2017, the SFMTA expects to issue a Request for Proposals (RFP), at which point the agency will be able to refine cost estimates and project scope. The SFMTA also expects to negotiate quantity discounts given the large size of its transit fleet and system.

Phase I consists of replacing the existing real-time information system, including digital signage at all powered shelters and rail stations. Phase II consists of system enhancements, including the capability to generate alternatives and crowding alerts as well as advanced analytics. Phase II will also include on-board digital signage on new electric trolley coaches and motor coaches, and integration with screens aboard new light rail vehicles to permit real-time information. The Phase II budget and scope will be more fully defined by the implementation of Phase I. The budgetary and 'real-world' aspects of Phase II's enhancements will depend on each element's cost-effectiveness, project readiness (off the shelf viability), and relevance to a richer and better transportation experience. All aspects of Phase II development will be reported on to USDOT, and we will look forward to USDOT's guidance as a partner in helping SFMTA deliver a well-conceived array of enhancements after Phase I is complete.

The budget assumes that the SFMTA will cover all fully-loaded soft costs, including project and support staff, planning and contracting, public outreach and operating costs. SFMTA's in-kind match will also cover project contingencies. The project has been entered into the agency's Capital Improvement Program (CIP) for specific funding programming. The SFMTA respectfully requests a 20% ACMTD funding match for Phase I and II capital expenditures, or $10.1 million, through 2020.

The SFMTA has an array of non-federal funding sources at its disposal to provide local match to the $10.1 million ATCMTD request:

- SFMTA fund sources:
    - Revenue Bonds: the Agency has the authority to release its own revenue bonds. To date, the agency has issued $366 million of revenue bonds and has an outstanding rating. In May 2017, Moody's affirmed the SFMTA's rating of "Aa2" and a Stable Outlook. Moody's analyst indicated SFMTA has the highest transit rating of any system in the US. Also in May, Standard & Poor's noted that the Agency's "AA' rating is currently the highest rating on revenue bonds or certificates of participation issued by a transit agency in the U.S."

    - Array of operating revenues: in addition to fares, the Agency has a broad array of revenue sources at its disposal including sales tax revenues (State Transportation Development Act), State Transit Assistance (recently augmented by the enactment of State Senate Bill 1), parking revenues, advertising revenues, developer impact fees, etc.

- San Francisco General Obligation bonds (GO Bonds): The voters of the City and County of San Francisco have authorized the release of up to $500 million of general obligation bonds for capital transportation projects. The program has approximately of $430 million of capacity left.

- Prop K Local Transportation sales tax program: this ½-cent sales tax generates approximately $102 million per year, with approximately 70% of these funds available for SFMTA capital projects.

- New State Sources: the passage of Senate Bill 1 (noted above) will bring billions of new transportation capital dollars to the State of California. Though the mechanics of the program are still being developed, the SFMTA is guaranteed $11 million annually of new State Transit Assistance funds for capital projects.

Next Generation Transit Customer Information System - Funding Plan By Year (in Thousands)

Milestone	2017 Planning & Procurement	2018 Planning & Procurement + Phase I	2019 Phase I + Phase II	20120 Phase II	Project Total
Capital Expenditures					
Staff Support					
Core Project Team	$581	$1,180	$1,215	$616	$3,592
Technical Working Group	$67	$161	$174	$81	$483
IT Support	$20	$68	$96	$47	$230
City Attorney's Office	$15	$30			$45
Public Outreach	$29	$59	$61	$31	$181
Project Modules					$581
1. Intelligent Predictions Software		$5,400			$5,400
2. Stationary Digital Signage					
Powered Shelters			$5,085		$5,085
Rail Stations			$581		$581
Unpowered Shelters & Stops			$3,050	$3,050	$6,101
Information Kiosks			$366	$366	$733
3. On-Board Digital Signage					
New Flyer Buses (Trolley & Motor Coaches)			$5,002	$5,002	10,004
Siemens Light Rail Vehicles			$2,148	$2,148	$4,297
Breda Light Rail Vehicles			$1,114	$1,114	$2,228
4. Mobile Platform & Website					
Mobile App, Website and Associated Software		$410	$410		$820
5. Analytical Platform (includes Data Interpretation)		$500	$500		$1,000
Other (Automatic Passenger Counters on unequipped vehicles)			$2,035	$2,035	$4,071
SFMTA In-Kind Contributions: Capital Expenditures	$712	$6,231	$16,765	$11,063	$34,771
ATCMTD Grant Request (25% of Phase I & II Capital Expenses)		$1,578	$5,073	$3,429	$10,079
Total Capital Expenditures	$712	$7,808	$21,838	$14,492	$44,850
Operating Expenditures					
1. Intelligent Predictions Software			$800	$412	$1,212
2. Stationary Digital Signage			$838	$432	$1,270
3. On-Board Digital Signage			$223	$223	$446
4. Mobile Platform & Website			$160	$166	$326
5. Analytical Platform			$200	$124	$324
Total Operating Expenditures (SFMTA In-Kind Contributions)			$2,221	$1,356	$3,577
Summary					
SFMTA In-Kind Contributions	$712	$6,231	$18,986	$12,419	$38,348
ATCMTD Grant Request (25% of Phase I & II Capital Expenses)		$1,578	$5,073	$3,429	$10,079
20% Contingency	$142	$1,562	$4,812	$3,170	$9,685
Grand Total (Operating + Capital)	$855	$9,370	$28,871	$19,017	$58,113

Next Generation Transit Customer Information System - Funding Plan By Phase (in Thousands)

Milestone	2018 Planning & Procurement	2019 Phase I	20120 Phase II	Project Total
Capital Expenditures				
Staff Support				
Core Project Team	$1,162	$1,197	$1,233	$3,592
Technical Working Group	$135	$187	$162	$483
IT Support	$39	$96	$95	$230
City Attorney's Office	$50	$15		$45
Public Outreach	$59	$60	$62	$181
Project Modules				$581
1. Intelligent Predictions Software		$5,400		$5,400
2. Stationary Digital Signage				
Powered Shelters		$5,085		$5,085
Rail Stations		$581		$581
Unpowered Shelters & Stops			$6,101	$6,101
Information Kiosks			$733	$733
3. On-Board Digital Signage				
New Flyer Buses (Trolley & Motor Coaches)			$10,004	10,004
Siemens Light Rail Vehicles			$4,297	$4,297
Breda Light Rail Vehicles			$2,228	$2,228
4. Mobile Platform & Website				
Mobile App, Website and Associated Software		$820		$820
5. Analytical Platform (includes Data Interpretation)		$1000		$1,000
Other (Automatic Passenger Counters on unequipped vehicles)			$4,071	$4,071
SFMTA In-Kind Contributions: Capital Expenditures	$1,425	$11,220	$22,125	$34,771
ATCMTD Grant Request (25% of Phase I & II Capital Expenses)		$3,222	$6,858	$10,079
Total Capital Expenditures	$1,425	$14,442	$28,983	$44,850
Operating Expenditures				
1. Intelligent Predictions Software		$400	$812	$1,212
2. Stationary Digital Signage		$419	$851	$1,270
3. On-Board Digital Signage			$446	$446
4. Mobile Platform & Website		$80	$246	$326
5. Analytical Platform		$100	$224	$324
Total Operating Expenditures (SFMTA In-Kind Contributions)		$999	$2,578	$3,577
Summary				
SFMTA In-Kind Contributions	$1,425	$12,220	$24,703	$38,348
ATCMTD Grant Request (25% of Phase I & II Capital Expenses)		$3,222	$6,858	$10,079
20% Contingency	$285	$3,088	$6,312	$9,685
Grand Total (Operating + Capital)	$1,710	$18,529	$37,873	$58,113

SECTION V

APPENDICES

VOLUME II

Project Name

Eligible Entity Applying to Receive Federal Funding

Total Project Cost (from all sources)

ATCMTD Request

Are matching funds restricted to a specific project co nent? If so, which one?

Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications

Related to MTC's Regional Transportation Plan RTPID 17-10-0029 "511 Traveler Information Program".

Related to the following TIP Listing SF-990003 "Global Positioning System"
Design, implement, install and provide ongoing support services for a GPS (Global Positioning System)-based Automatic Vehicle Location (AVL) system for MUNI''s revenue fleet and inspector vehicles. The two principle system outputs would be: (1) real-time vehicle location and arrival prediction information for patrons, available through a variety of media: shelter signs, internet, cellular phones, at a minimum; and (2) archived data on vehicle tracking through time, suitable for statistical analysis, for performance monitoring, schedule adherence, and related reporting. The specified system would have an open architecture, ready for interfacing with and future replacement of MUNI''s radio system. This will be the ultimate solution for the NextBus and @Road demonstration projects. This project is associated with MTC's Regional Transportation Plan RTP ID 240536 (Implement Transit Management Systems in San Francisco (includes fare management, transit GPS tracking systems)

Technologies Proposed to Be Deployed

This project will take advantage of maturing and advanced technologies, including:
Sophisticated real-time transit arrival prediction algorithms.

- Algorithms that generate alternatives based on location and nearby vehicles
- Mobile technologies and associated user information to understand system usage and customer preferences
- Real-time passenger counting to assess vehicle loads
- Real-time signage on-board vehicles
- Solar-powered information signs

1. Identify any exceptions to the anticipated award terms and conditions as contained in Section F, Federal Award Administration Information. Identify any preexisting intellectual property that you anticipate using during award performance, and your position on its data rights during and after the award period of performance.

SFMTA Response: The SFMTA has not identified any exceptions to the anticipated award terms and conditions. The SFMTA anticipates that all of the data/information to be created during the project will be public information and open data accessible. The SFMTA does not know at this time whether it will use any proprietary software or other intellectual property for the project.

2. The use of a Dun and Bradstreet (D&B) Data Universal Numbering System (DUNS) number is required on all applications for Federal grants or cooperative agreements. Please provide your organization's DUNS number in your budget application.

SFMTA Response: The SFMTA organizational DUNS number is 9566174350000

3. A statement to indicate whether your organization has previously completed an A-133 Single Audit and, if so, the date that the last A-133 Single Audit was completed.

SFMTA Response: The SFMTA completes an A-133 Single Audit every year. The most recent A-133 Single Audit was completed by KPMG on January 27, 2017 for the year ended June 30, 2016.

3. A statement to indicate whether your organization has previously completed an A-133 Single Audit and, if so, the date that the last A-133 Single Audit was completed.

SFMTA Response: The SFMTA completes an A-133 Single Audit every year. The most recent A-133 Single Audit was completed by KPMG on January 27, 2017 for the year ended June 30, 2016.

4. A statement regarding Conflicts of Interest. The Applicant must disclose in writing any actual or potential personal or organizational conflict of interest in its application that describes in a concise manner all past, present or planned organizational, contractual or other interest(s), which may affect the Applicants' ability to perform the proposed contract in an impartial and objective manner. Actual or potential conflicts of interest may include but are not limited to any past, present or planned contractual, financial, or other relationships, obligations, commitments or responsibilities, which may bias the Applicant or affect the Applicant's ability to perform the agreement in an impartial and objective manner. The AO will review the statement(s) and may require additional relevant information from the Applicant. All such information, and any other relevant in- formation known to DOT, will be used to determine whether an award to the Applicant may create an actual or potential conflict of interest. If any such conflict of interest is found to exist, the AO may (a) disqualify the Applicant, or (b) determine that it is otherwise in the best interest of the United States to contract with the Applicant and include appropriate provisions to mitigate or avoid such conflict in the agreement pursuant to 2 CFR 200.112.

SFMTA Response: At the current time, the SFMTA knows of no personal or organizational conflict of interest regarding the proposed project. City officers and employees are subject to strict conflict of interest laws. The California Political Reform Act (Cal Govt. Code Sections 87100, et seq.) imposes broad conflict of interest rules, gift limits, and financial disclosure requirements. The City and County of San Francisco, through its Campaign and Governmental Conduct Code, enforces additional conflict of interest rules and gift limits. Further, as a federal grantee, the SFMTA takes pains to iden- tify and evaluate potential organizational conflicts of interest as early in the procurement process as possible, in order to avoid or mitigate any potential conflicts before contract award.

5. A statement to indicate whether a Federal or State organization has audited or reviewed the Applicant's ac-

SFMTA Response: The Federal Transit Administration conducted a Triennial Review of the SFMTA in May 2016.
Deficiencies were identified in the following review areas: Financial Management and Capacity; Technical Capacity; Maintenance; ADA; Title VI; Procurement; Satisfactory Continuing Control; Public Comment on Fare Increases and Major Service Reductions; Drug-Free Workplace/Drug and Alcohol Program; and Equal Employment Opportunity (EEO). A schedule for corrective actions was created in order to address these deficiencies and included in the final report, issued in July 2016. As of May 2017, all deficiencies have been corrected and are closed.

6. Terminated Contracts - List any contract/agreement that was terminated for convenience against the Applicant within the past 3 years, and any contract/agreement that was terminated for default within the past 5 years. Briefly explain the circumstances in each instance.

SFMTA Response: Not applicable.

The Applicant is directed to review Title 2 CFR Part 170 (http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfr- browse/Title02/2cfr170_main_02.tpl) dated September 14, 2010, and Appendix A thereto, and acknowledge in its application that it understands

SFMTA Response: The SFMTA acknowledges that it has reviewed Title 2 CFR §170 and it has the necessary pro- cesses and systems in place and is prepared to fully comply with the reporting requirements if it receives funding from this Notice.

8. Disclose any violations by the Applicant of Federal criminal law involving fraud, bribery, or gratuity vio- lations. Failure to make required disclosures can result in any of the remedies described in 2 CFR 200.338 entitled Remedies for Noncompliance, including suspension or debarment. (See also 2 CFR Part 180 and 31

SFMTA Response: None