CITY AND COUNTY OF SAN FRANCISCO
BOARD OF SUPERVISORS
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Policy Analysis Report

To: Supervisor Yee
From: Budget and Legislative Analyst's Office
Subject: Vehicle Telematics for City Vehicles
Date: February 23, 2015

Summary of Requested Action

You requested that our office research the cost estimates and considerations of implementing and maintaining a vehicle telematics, or black box, program for all City-owned vehicles. The potential program would cover a broad range of capabilities and policy objectives. The devices can be used for monitoring and analysis of vehicle cost efficiency, use optimization, post-incident investigation, and other implicit benefits such as fraud/waste prevention and encourage safer driving practices.

For further information about this report, contact Fred Brousseau at the Budget and Legislative Analyst's Office.

Executive Summary

- Vehicle telematics, sometimes known as black boxes or global positioning system (GPS) tracking, allow for tracking vehicles individually and collecting and reporting data on their location, history, speed, mechanical diagnostics, safety and other information.

- Vehicle telematics systems have the potential to save the City significant time, money and, potentially, lives. Data collected from vehicle telematics devices in City vehicles can help the City correct and improve unsafe driving habits, inappropriate use of City vehicles, and missed vehicle maintenance. The systems can provide information to refute groundless claims against the City regarding vehicle accidents.

- Vehicle telematics are currently in place in 2,332 vehicles and planned for 776 more in the near-term for a total of 3,108 vehicles. Deploying these systems across the City's remaining 4,733 vehicles in the fleet would cost an estimated $1.3 million in one-time equipment and installation costs and approximately $1.8 million for ongoing annual service, training and support costs.

- For maximum effectiveness, data collected and reported from vehicle telematics systems need to be analyzed and used by managers to improve vehicle cost-effectiveness and performance. If treated as an additional tool for managers, some of their time and use of the system would be absorbed into their current duties though in some cases, use of the telematics data would be replacing manual monitoring systems.

- If departments don't fully utilize it, some of the value of the system's data might go to waste. However, even if partially used to monitor and improve just one objective such as vehicle usage, case studies from other governments suggest that significant benefits can be realized early on.

- To fully realize the benefits of a telematics system, the Board of Supervisors should ensure that City departments have plans in place to use and manage system data, with any privacy concerns also addressed. The Board of Supervisors should also ensure that system security is incorporated into current and future agreements with the City's vehicle telematics vendors.

Introduction

The City and County of San Francisco (the City) has a fleet of 7,841 active vehicle assets including sedans, parking enforcement vehicles, fire trucks and heavy equipment such as bulldozers and backhoes. While these vehicle assets are critical to many of the City's core services, they also can also represent a liability for the City. They expose the City to safety and financial liabilities in the event of accidents and inadequate maintenance, are vulnerable to misuse and theft, and they have the potential to produce more emissions than necessary if not operated properly. Management of these assets, and their liabilities, can be aided by current vehicle telematics technology.

Vehicle Telematics

Vehicle telematics, sometimes known as black boxes or global positioning system (GPS) tracking, allow for tracking vehicles individually and collecting and reporting data on their location, history, speed, mechanical diagnostics, safety and other information. Typically vehicle telematics systems are comprised of data recording devices, often referred to as "black boxes" installed in vehicles, with the recorded data transmitted to remote systems using cellular data or, in some instances, satellite data connections.

In recent years, many commercial vehicle fleets managed by the private sector have implemented vehicle tracking and telematics systems at a rapid pace and in nearly every commercial industry. Industry sources report that adoption of these

technologies grew by 305 percent between 2005 and 2010[1], and is thought to have continued at a similar pace into 2014[2]. In recent years, government agencies have also begun implementing these systems across the United States. For example, in 2014 the California Department of Transportation (Caltrans) spent $2.5 million, or an average of $333 per vehicle, to outfit 7,500 sedans, trucks, snowplows and portable signs with telematics systems, and a data-reporting service that will cost another $1.5 million annually, or an average of $200 per vehicle per year.[3] Another example is the City of Los Angeles's pilot program testing systems in 50 police vehicles beginning in January 2015 at a similar per-vehicle cost to Caltrans[4]. Vehicle telematics systems are also already deployed on 2,332 of the 7,841 vehicle assets, or approximately 30 percent, owned by San Francisco, discussed further below.

Safety Benefits

Vehicle telematics has the potential to improve safety, reduce operating costs, reduce vehicle emissions, and identify potential fraud and waste. One of the simplest benefits of vehicle telematics is that driver behavior can be improved by simply knowing the system is in place and that their vehicle use is being monitored, which can encourage more driver attention to safer and more efficient driving practices. Beyond this, managers can be alerted or observe in reports that certain employees are engaging in unsafe driving practices such as harsh acceleration or braking. Such results were realized in Yolo County in 2012, when the Yolo County Sheriff's Department used speed data collected from their vehicle telematics system to coach deputies' driving practices, specifically targeting unjustified high-speed driving above 90 miles per hour. Once the system was implemented they reported that over half of the deputies dropped their incidents of unjustified high-speed driving to zero, and the rest had two or fewer incidents. [5]

There is also a financial benefit to improving driving habits. Over the past five years the City has paid a total of $76.9 million in settlements and judgments from claims

[1] Nam D. Pham, Ph.D., "The Economic Benefits of Commercial GPS Use in the United States and the Costs of Potential Disruption", June 2011 NDP Consulting, accessed January 27, 2015
[2] Directions Magazine "Almost 50 Million Non-trucking Commercial Fleet Vehicles Equipped with Telematics by the End of 2019", accessed January 27, 2015
[3] Jon Ortiz, "Caltrans outfits fleet with high-tech devices", October 10. 2014, The Sacramento Bee: the state worker, accessed January 27, 2015
[4] 89.3KPCC, "LAPD to track how safely officers are driving patrol cars LAPD Begins Tracking Officer Driving" December 22, 2014, accessed January 27, 2015
[5] Larry Cecchettini, "Don't Just Provide Training, Change Culture How Yolo County, Calif., used Below 100 to drive down crashes & save money", March 2014 Issue, and online Monday, March 24, 2014, accessed January 27, 2015

and litigation relating to its vehicles[6]. Since the presence of telematics systems makes drivers more aware and attentive and allows managers and supervisors to identify and correct unsafe driving habits and drivers, some accidents could be avoided altogether, which would save the City money in its annual settlements and judgments. When accidents do occur, the data recorded by a telematics system can be used to correct driver behavior in cases where City drivers are shown to be at fault or to provide data to dispute claims against the City when drivers were not at fault. Compared to eye-witness accounts, which can be obscured by memory and imprecision, telematics systems record accurate and precise information that can be used to exonerate drivers, and reduce wrongful claims and litigation against the city.

Efficiency Benefits

Vehicle telematics systems can also reduce costs through monitoring and reporting vehicle efficiency. This is can be achieved through reduction of vehicle idling time using driver scorecards, wireless vehicle maintenance alerts, and optimized fleet utilization. Without a telematics system maintenance and diagnostics rely on regular and time consuming visits to the City's central shops or other repair facilities. In contrast, telematics systems wirelessly report vehicle diagnostics such as engine warnings or malfunctioning airbag systems, and can remotely report annual smog check information on most new vehicles, saving additional in-person diagnostic checks. These efficiency benefits also overlap with the safety benefits as fewer miles on the road and early system warnings equates to a lower exposure to safety liabilities. In 2011 the City of Sacramento spent $100,000 to outfit a tracking system in 184 of its vehicles, and immediately realized a reported $60,000 in fuel savings in the first month by reducing vehicle idling time and unnecessary use.[7]

Similar results were observed when the Eastern Municipal Water District in Riverside County installed vehicle telematics systems in its fleet of 350 vehicles. The District calculated that employees drove 165,000 fewer miles and saved $354,000 in the first six months.[8]

[6] Settlements and judgments can vary year to year depending on a number of factors and when larger settlements are spread across multiple years. In the past five fiscal years the smallest year was $6.4 million paid in 2013, the median year was $16.5 million paid in 2011, and the largest year was $19.6 million paid in 2010.
[7] City of Sacramento results reported in Memo to City of Missoula City Council from Park and Recreation Director Dona Gaukler, "GPS Fleet management benefits" May 5, 2011, accessed January 27, 2015
[8] Shelley Mika, Government Fleet "Case Study: Water District Reduces Operating Costs with Telematics", government-fleet.com, December 2013, accessed January 23, 2015

Environmental and Other Benefits

City departments could use vehicle telematics tools to optimize their fleet and comply with the City's Healthy Air and Clean Transportation Ordinance (HACTO), which requires an annual 5 percent citywide fleet reduction from July 2011 to July 2015. A telematics system would help City Departments identify underutilization or inefficient use (e.g. excessive idling) of vehicles, and implement strategies to optimize fleet usage, thus lowering operating costs and enabling fleet reductions. As costs for fuel, maintenance, and inefficient vehicles are saved, reductions in the levels of vehicle emissions would also be realized.

Tracking and reducing vehicle emissions would help departments report and reduce their annual emissions for the City's Climate Action Plan initiative that began in 2004 with a Citywide goal of reducing greenhouse gas emissions. Departments are required to track and report their emissions and update their plans annually. Other benefits such as discouraging unauthorized use, identifying fraud, and preventing waste have the potential to save the City additional money. Additionally, under the City's current vehicle telematics contract with USA Fleet Solutions covering vehicles already using this technology, roadside assistance services are included such as 25 miles of towing, fuel delivery, tire changes, and lost/stolen vehicle recovery. These included services are not necessarily part of all telematics systems on the market.

Emergency Management Benefits

Vehicle telematics offer potential benefits for emergency management, medical response and law enforcement. For example, vehicle telematics were used during the 2013 Rim Fire in the Stanislaus National Forest, which burned 257,135 acres and reached the edges of Hetch Hetchy Reservoir watershed. The San Francisco Public Utilities Commission (SFPUC), which had installed vehicle telematics several years prior, reports that it used vehicle location data to efficiently manage emergency response and account for its staff and equipment.

City public safety departments not currently using vehicle telematics such as the Police, Fire, and Sheriff's Departments could also potentially benefit from these technologies. For example, the Police Department does not currently have any location or telematics technology deployed in its cars, and dispatchers have limited information on the location of police vehicles at any given moment. A telematics system could augment and support the current voice-reporting system, giving dispatchers the ability to more efficiently assign resources when incidents or emergencies occur.

Privacy and Security Issues

As with any information technology, vehicle telematics raises policy considerations concerning individual privacy rights and system security. Similar to City owned computers, email and internet access, employee use of which can be monitored by City management, vehicles are also the City's property and, with proper controls in place, should reasonably be expected to be monitored as a management control. In fact, various management methods are currently in place at present to monitor City vehicle use, but in departments without vehicle telematics, these are mostly manual systems, without systematically collected and reported real-time usage data available.

The City's vehicle use policy, adopted in 2014 states that "…operating an organizational vehicle is a privilege." The policy, which is primarily focused on promoting safe driving and speed reduction, specifically addresses vehicle telematics in the Business Use Declaration of the Program:

> "…the City reserves the right to install GPS systems in order to complement the City's Asset Management Program. GPS data may be used during the course of vehicular incident or personnel disciplinary investigations." *[Item 19]*

In the current vehicle telematics system deployed in some City vehicles, none of the information collected is shared publicly. Instead, the system provides a secured web application where approved managers can logon, monitor, and manage their fleet's data. Access to the system and data on specific vehicles is only granted to information on vehicles within the managers' purview or oversight. The Department of Human Resources reports that there are no known limitations in any labor contracts that would exclude the use of telematics systems on City vehicles.

Any security vulnerabilities vehicle telematics present might also be considered in connection with privacy. Recent research[9] and inquiries into the automotive industry[10] have identified security vulnerabilities apparent in consumer vehicles from a wide range of manufacturers. These vulnerabilities exist regardless of the presence of vehicle telematics systems. However, the research implies that vehicle telematics systems could add an additional entry point that could further expose

[9] Dr. Charlie Miller and Chris Valasek, "Adventures in Automotive Networks and Control Units," accessed February 10, 2015
[10] Staff of Senator Edward J. Markey, "Tracking & Hacking: Security & Privacy Gaps Put American Drivers at Risk", February 9, 2015

vehicles to potential vulnerabilities. To mitigate this risk, current and future implementations of telematics systems in the City should consider both physically and digitally securing these units to prevent tampering and block malicious access.

If expanded Citywide, maintaining enterprise-level security and privacy standards that meet the same standards used for other information regarding City employees could ease any privacy and security drawbacks.

San Francisco's Current System

As of December 26, 2014, the City had installed telematics systems on 2,332 vehicles out of 7,841 total vehicle assets, or approximately 30 percent of the total fleet. Departments can opt into the system, which is managed by the General Services Agency's Fleet Management/Central Shops Department. An additional 776 vehicles are planned to have systems installed in the near-term, for a total of 3,108 vehicles. Until September 2014, individual City departments had implemented vehicle telematics systems through individual contracts with different contractors and a variety of systems. In September 2014, the Fleet Management/Central Shops Department consolidated the various contracts into one contract with USA Fleet Solutions[11] serving all City departments using the same technology and service level. This standardized system and contract offers installation, support, and training for these systems across all departments. The distribution of the 3,108 City vehicles with vehicle telematics installed, by department, is shown in Figure 1.

[11] USA Fleet Solutions is a reseller of the Networkfleet service, which is owned by Verizon.

Figure 1: City Departments Participating in Vehicle Telematics Program

Department	# of Vehicles
San Francisco Municipal Transportation Agency	930
Public Utilities Commission	774
Department of Public Works	596
Recreation and Parks Department	306
Public Health Department	120
Building Inspection Department	100
Port of San Francisco	94
Human Services Agency	64
Department of Technology	50
Airport Commission	42
General Services Agency Central Shops	18
Treasure Island Authority	13
Real Estate Department	1
Total	**3,108**[12]

Source: Fleet Management/Central Services Department

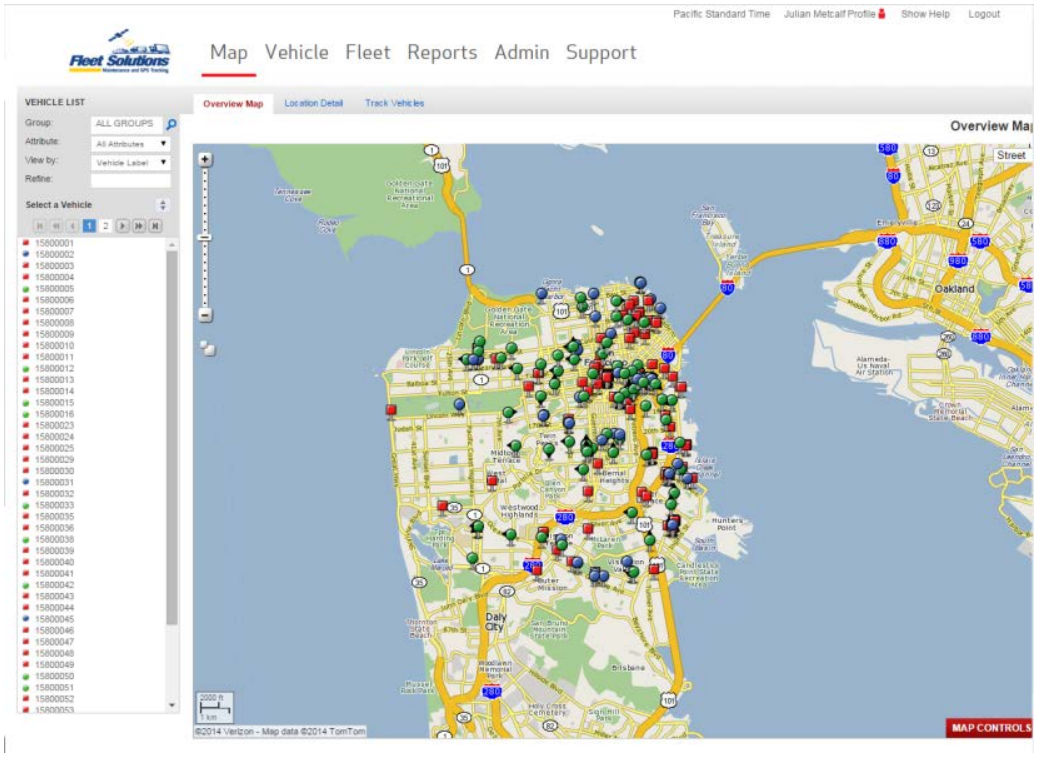
The largest participating department is the San Francisco Municipal Transportation Agency (SFMTA), which has installed telematics devices in 930 of its non-revenue fleet, or vehicles that do not provide direct transit services. These vehicles are primarily used by the portion of SFMTA that oversees bike and pedestrian programs, taxis, parking and traffic control operations in the City. Vehicle telematics are not being used for SFMTA's revenue fleet of light rail vehicles, buses and trolley cars, as discussed further below.

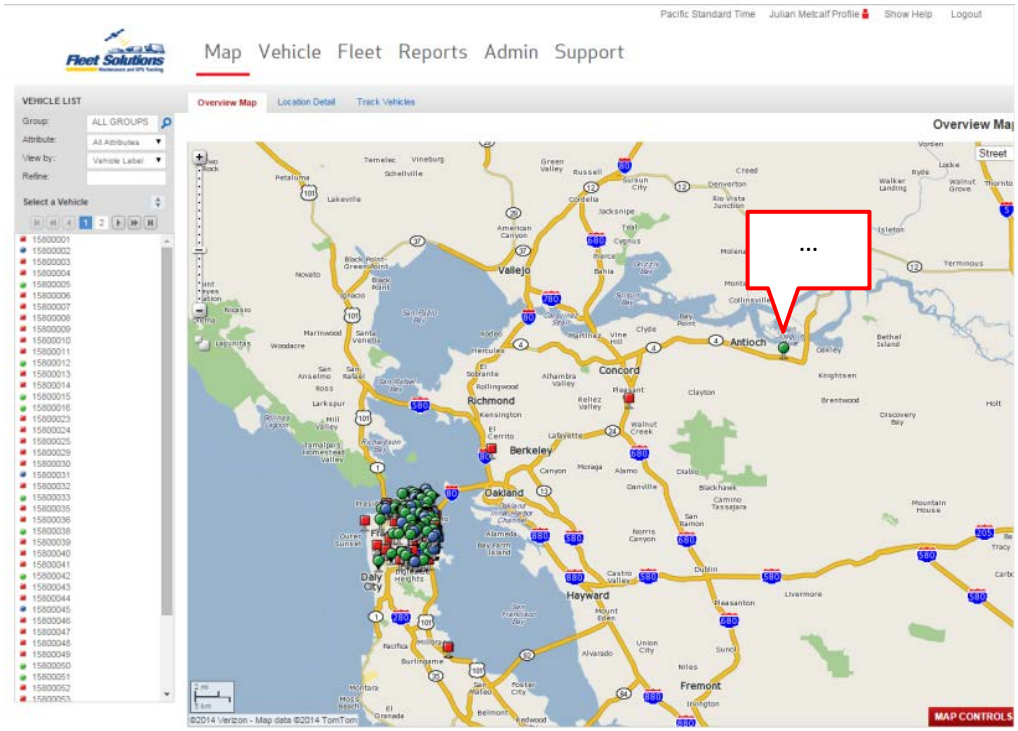
While still in its implementation phase, select SFMTA managers have been granted access to monitoring of their staff's vehicle use. SFMTA managers are granted access to only the vehicles relevant to their purview and can view reports and setup monitoring alerts pertinent to the nature of their operation's vehicle use. For example, with limited training on the system, managers have been able to establish geo-fences, or geographic areas such as the City's boundaries for vehicles for which they are responsible. When vehicles not assigned for take home use or other activities outside of the City cross the geo-fence, managers can receive instantaneous alerts or subsequent summary reports. Managers are then able to follow up with users of the City's vehicles that have crossed the established boundaries to determine why the vehicle was outside of City boundaries and correct any possible misuse of City property.

[12] As of the end of December 2014, telematics systems using the new contract had been installed on 2,332 vehicles. An additional 776 are scheduled to be installed in the near-term bringing the total to 3,108

The panel on the top in Figure 2 shows the real-time location within the City of all vehicles for which a particular manager is responsible. The panel on the bottom shows part of an alert message that would be sent to the manager reporting the real-time location of a vehicle not authorized to leave the City.

Figure 2: Managers can easily monitor potential unauthorized vehicle activity





The San Francisco Municipal Transit Agency (SFMTA) revenue fleet already has partial systems in place that achieve some of the features and policy objectives of a full vehicle telematics system. The revenue fleet includes the light rail vehicles, buses and trolley cars that provide MUNI services across the City. All of the vehicles are outfitted with a NextBus system, which uses GPS and cellular radio signals to estimate arrival estimates to passengers. SFMTA reports that information is not used for fleet management purposes. The revenue fleet also has camera systems in place. Notably, the bus and trolley fleet have a system called DriveCam that records video when activated by fast acceleration or hard braking, examples of which are presented in Figure 3. The SFMTA reports that after the first year of operation in 2010, the total number of bus accidents dropped from 964 in 2009 to 483 in 2010, a 50 percent decrease. Additional information on the partial systems used by the SFMTA's revenue fleet is discussed in the Appendix.

Figure 3: SFMTA's DriveCam systems record eight seconds of video before and four seconds after a fast acceleration or hard braking event.

City-Wide Implementation Cost Estimates

Equipment and Service Costs

If vehicle telematics systems were implemented in all 4,733 City vehicle assets that currently do not have any systems, including SFMTA's revenue fleet, the City would incur approximately $1,312,033 in one-time equipment and installation costs under the current contract, or an average of $277.21 per unit. Unit cost could vary slightly as some specialized vehicles might require unique mounting hardware or installation.

For ongoing maintenance, data collection and reporting and staff training, the cost would be $1,782,337 annually for the 4,733 vehicles, or an average of $376.58 per vehicle. This assumes almost all additional vehicles use cellular data (as opposed

to the more expensive satellite data option), and includes other costs such as training and system administration staff.

The vast majority of systems already installed in the City's fleet use the standard two-minute reporting interval in which vehicle locations are reported every two minutes. However, the location of some vehicles, such as SFMTA's 300 parking enforcement vehicles, is reported every 30 seconds. This option costs slightly more at $370.20 per unit per year instead of the $274.20 per year for two minute interval reporting under the City's current contract. The $1.3 million ongoing cost estimates assume that the Police, Fire, and Sheriff's Departments' 1,251 vehicles would also require 30-second cellular reporting, given the potential benefits to managing time-sensitive emergency response activities. There may be other instances where the more expensive 30-second reporting service could be beneficial.

In some rare cases telematics units that use satellite communication instead of cellular may be useful in remote areas or occasions when cellular networks are unavailable. Currently, 10 of these satellite units are deployed in vehicles used by the Public Utilities Commission, for managing water and power systems at the City's Hetch Hetchy Reservoir in the Sierra Nevada. The satellite units cost more at $771.83 per unit to purchase and install, and $419.40 per year for 15 minute reporting intervals compared to $274.15 one-time installation costs for most City vehicles and between 179.40 and $370.20 for vehicles using cellular coverage. This use of satellite connectivity would likely be a rare exception since most of City's fleet operates within City boundaries or in relatively urban areas with cellular coverage. Accordingly, additional satellite units were not considered in the cost estimates.

Figure 4: Cost of Adding Vehicle Telematics to the remainder of City Vehicles using City's existing vendor

	Total Number	Already On Full Telematics Systems	Total Without Vehicle Telematics	One-Time Cost to Add per Unit (Equipment & Installation)	One-Time Cost to Add(Equipment & Installation)	Annual Cost of Added Systems per Unit	Annual Cost of Added Systems
Primary Fleet:	5,623	3,108[13]	2,515	274.15	689,487	321.95	809,709
Requiring 2-minute cellular updates	*3,937*	*2,673*	*1,264*	*274.15*	*346,526*	*274.20*	*346,589*
Requiring 1-minute cellular updates	*125*	*125*	*-*	*274.15*	*-*	*322.20*	*-*
Requiring 30-second cellular updates[14]	*1,551*	*300*	*1,251*	*274.15*	*342,962*	*370.20*	*463,120*
Requiring 15-minute satellite updates	*10*	*10*	*-*	*771.83*	*-*	*419.40*	*-*
Component Fleet	1,168	-	1,168	286.56	334,702	228.75	267,178
Vehicles, Requiring 2-minute cellular updates	*608*	*-*	*608*	*274.15*	*166,681*	*274.20*	*166,714*
Trailers Requiring 15-minute cellular updates	*560*	*-*	*560*	*300.04*	*168,023*	*179.40*	*100,464*
SFMTA Revenue Fleet[15]	1,050	-	1,050	$274.15	287,853	$274.20	287,910
System Administration 4 FTE							400,000
Training Costs[16]							4,640
Repair and Support Costs[17]							12,900
Total Citywide Fleet	**7,841**	**3,108**	**4,733**	**$ 277.21**	**$1,312,033**	**$376.58**	**$ 1,782,337**

Source: Unit and annual service costs from City contract with USA Fleet Solutions "Global Positioning System/ Automated Vehicle Locator (GPS/AVL) For the Term September 1, 2014 through August 31, 2018." Annual administration, training and repair costs are estimates by the Budget and Legislative Analyst.

[13] As of the end of December 2014, telematics systems using the new contract had been installed on 2,332 vehicles. An additional 776 are scheduled to be installed in the near-term bringing the total to 3,108.
[14] Currently, 300 vehicles use the 30-second reporting interval. An assumed additional 1,251 Police, Fire, and Sheriff's Departments' vehicles would also use the 30 second reporting intervals.
[15] As discussed above and in the Appendix, SFMTA's revenue fleet has partial systems in place that achieve some of the features and policy objectives that a full vehicle telematics system would.
[16] Assumes that the General Services Agency's Fleet Management/Central Shops Department will conduct 40 hours of training annually at the rate of $116 per hour.
[17] Assumes that 50 hours of repair work will be required annually at the rate of $108 and that a 100 hours of technology support provided annually by the contractor will be provided at $75 per hour.

Management and Analysis Costs

A critical consideration of any telematics system is how the data generated by the system is used and analyzed. Without analysis of the data to determine how to more efficiently route vehicles, coach employees with poor driving habits to drive more safely, ensure timely vehicle maintenance or refute groundless claims that City vehicles were responsible for damages, the system will yield fewer benefits.

There are different scenarios for how the data can be used and managed, each with different cost implications. In one scenario access to the data and its analysis can be deployed as another tool for managers to use. This assumes that managers will primarily run pre-generated reports and the cost of their time will be absorbed in existing duties, as the system will serve as another tool to enhance their responsibilities. This scenario might be feasible in smaller departments, but may erode the value of the telematics system in a large department with hundreds of cars to manage. The larger departments would probably benefit from greater dedicated staff time to provide more sophisticated monitoring and reporting to managers. In any case, without time or staff dedicated to the analysis and management of the data the system might be wasted, resulting in data being collected from telematics equipment that yields little value to the City.

The Fleet Management/Central Shops Department estimates that it requires approximately one full time equivalent (FTE) to administer the program for every 2,000 devices. If four FTE were allocated for the 7,841 full Citywide fleet at approximately $100,000 per FTE, this would bring the annual cost to $400,000. The Fleet Management/Central Shops Department reports that even with the larger departments that currently have dedicated administration of the program, that at least one of these four FTE would be required for central administration. This estimate is drawn from their recent experience launching the current program; where the Fleet Management/Central Shops Department continues absorb these costs providing central oversight and administration.

In any case, training is required to enable fleet managers, department managers, or analytical staff to utilize the system. So far, the Fleet Management/Central Shops Department has hosted system introduction and kick-off trainings for various departments. There have been five of these sessions totaling 40 hours at the Central Shop's rate of $116 per hour, or a total of $4,640. Even after vehicles have the technology installed, training sessions will likely need to continue on a periodic basis. Beyond these in-person training sessions, the Fleet Management/Central Shops Department has been developing training manuals and on-line training modules in how to manage and analyze the data. This is mostly a one-time activity that will be easily shared with future users of the system. So far, the Fleet Management/Central Shops Department has absorbed these development costs and its own time as implementers of the system.

Other Costs

There are other potential costs that are not addressed in the unit cost estimates above, such as technical support and repairs. The vendor's contract includes repair and technical support at hourly rates ranging from $75 to $115 per hour. In addition, the Fleet Management/Central Shops Department charges $108 per hour to departments for repair and replacement work. The majority of the units, with the exception of the satellite units, are offered with a lifetime warranty from the contractor. This tempers the potential cost of physical repairs since replacement and swapping of units is said to be fast and at a negligible time cost. Given the recent implementation of the system and contract the frequency of repairs and problems has not been tested.

Future equipment upgrades by 2017 may also be necessary when the current cellular network technology in the system, known as 2G, will begin to be phased out. The devices will continue to work, but with declining efficiency and coverage. In the future, the Fleet Management/Central Shops Department estimates that, similar to consumer smartphones, vehicle telematics devices might benefit from equipment upgrades every three to four years to maintain compatibility with network technology. Whenever equipment updates are deemed necessary in the future, one-time equipment and installation costs would be incurred.

Ways to Save

The total cost of implementing telematics systems Citywide could be lowered by excluding some vehicles that already have some type of telematics installed. In particular the SFMTA's revenue fleet and vehicle assets such as trailers could be excluded. The SFMTA's revenue fleet already has systems that cover many of the benefits of a full telematics system, and its next generation fleet will have a full telematics system pre-installed. SFMTA plans to phase out existing buses for the new vehicles over the next few years, but the current light rail vehicles are expected to remain in operation until 2025.

Figure 5: Potential Cost Reduction for Vehicle Telematics if Certain Vehicles Excluded

	Total Vehicles	One-Time Costs	Annual Cost for Added Systems
SFMTA Revenue Fleet	1,050	$ 287,853	$ 287,910
Trailers	560	$ 168,023	$ 100,464
Total	**1,610**	**$455,876**	**$388,374**

Source: Vehicle counts from SFMTA.

If the technologies in the current SFMTA revenue fleet are deemed sufficient for the timing being, then an estimated one-time cost of $287,853 and an annual cost

of $287,910 of the total estimated costs for the full fleet shown in Figure 5 could be removed.

A second option would be to exclude the City's 560 trailers in its component fleet. The trailers range in size and use from small equipment trailers used by the Department of Public Works, to highly technical and equipped Fire Department trailers. The trailers are expensive City assets that would benefit from a tracking and telematics system particularly in terms of tracking their location and managing use. However, since the trailers are generally used in conjunction with other vehicles that would otherwise have telematics installed, installation of the devices on trailers could be duplicative. Trailers have slightly higher one-time costs of $300.04 per unit, because the equipment must be housed in a weatherproof box, but have a lower annual cost of $179.40 per unit since they transmit less data. The exclusion of trailers from a Citywide vehicle telematics programs would reduce the cost estimate by another $168,023 of one-time costs and $100,464 of annual costs.

Conclusion

Vehicle telematics systems have the potential to save the City significant time, money and potentially people's lives if implemented across the fleet's 7,841 vehicles. Private industry and other governments have found significant and rapid benefits from use of these systems. Given the value of the City's vehicle assets, in both their financial worth and in the services they provide, better managing these assets and their potential liabilities would have a citywide impact.

The Board of Supervisors could consider the deployment of these systems as a tool capable of achieving a variety of policy objectives covering safety, efficiency, cost savings, limiting environmental impact, and adding tools for emergency management and law enforcement.

To fully realize the benefits of a telematics system, the Board of Supervisors should ensure that City departments have plans in place to use and manage system data, with any privacy concerns also addressed. The Board of Supervisors should also ensure that system security is incorporated into current and future agreements with the City's vehicle telematics vendors.

Appendix

SFMTA's Partial Telematics System Already in Place

The City's Municipal Transit Agency (SFMTA) revenue fleet has partial systems in place that achieve some of the features and policy objects that a full vehicle telematics system would. The revenue fleet includes the light rail vehicles, buses and trolley cars that provide MUNI services across the city. All of the vehicles are outfitted with a NextBus system, which uses GPS and cellular radios to estimate arrival estimates to passengers. The SFMTA reports that information is not used for fleet management purposes, and does not have the full capabilities of a full telematics system.

The current generation of light rail vehicles made by Breda has a combination of technologies that cover many of the same areas that a full telematics system would, but may lack the same level of precision that a dedicated telematics system might otherwise provide. The vehicles have fault recorder computers which record speed and braking data. The systems are intended mostly for mechanical diagnostics, and the SFMTA reports that the system doesn't always function properly, but has occasionally been used in accident reconstruction. These recorders reportedly work best while underground in the subway, where Automatic Train Control computers are active. The light rail vehicles also have cameras that record train operators and can be reviewed if an incident occurs. Overall, the combination of technologies covers many same areas that a full telematics system would, but may lack the same level of precision and reporting capabilities that a dedicated telematics system might provide.

The bus and trolley fleet also have a similar combination of technologies, which also lacks the same level of precision and reporting that a full telematics system could provide. The bus and trolley fleet had a system known as DriveCam installed over five years ago. The system has a camera pointed at the driver and a second camera pointed outward recording the driver's general view. The cameras are always on but only record video when activated. They are activated by fast acceleration and hard braking. They then record eight seconds of footage from before activation, four seconds after activation, and vehicle's speed is noted too. These devices lack the same telemetry precision other systems might yield, but they have been noted as effective at encouraging driver safety. After the first year of operation in 2010, the total number of bus accidents dropped from 964 in 2009 to 483 in 2010, a 50 percent decrease. The DriveCam units cost the SFMTA approximately $508 not including the labor and installation, and cost approximately $479 per year, not including training and technical support. Even without the full capabilities of a telematics system, DriveCam seems to have provided an effective safety tool.

The SFMTA's next generation fleet will come with full vehicle telematics systems, with live video transmission as a standard feature. The bus and trolley fleet will

gradually be replaced by vehicles provided by New Flyer, but the current generation of buses and trolleys will not begin to be phased out until 2019. The SFMTA's light rail system is also getting 215 modern vehicles from Siemens that will arrive between 2016 and 2030. However, these will only augment the current generation of light rail vehicles and not replace them outright. The current generation of light rail vehicles is expected to remain in place until 2025.