



U.S. Department of Transportation

Notice of Funding Opportunity Number DTFH6116RA00002

“Beyond Traffic: The Smart City Challenge”



City of Fresno Application



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Part 1 – VISION NARRATIVE

- 1. Define your vision for your Smart City. Describe your city's challenges and how the proposed elements of this proposed project can be used to address those challenges. The vision should define your approach for implementing and operating the demonstration project, including your program management approach.**

The City of Fresno envisions a Smart City comprised of an interconnected transportation network which is efficient, user-focused and embraces leading technology to address regional health, social and economic challenges.

Challenges

The City of Fresno comprises over 111 square miles in the San Joaquin Valley, and is California's fifth most populated city at the geographic center of the state. Fresno serves as the economic hub of California's Central Valley, with surrounding cities



Fresno is located at the heart of California, and faces many social, economic and transportation challenges.

predominantly tied to large-scale agricultural production. The San Joaquin Valley region is the 17th largest agricultural area in the world, feeding one-third of the world's population with \$26 billion in agricultural production annually. However, amidst this agricultural abundance, real economic and health challenges exist. Poverty, unemployment, asthma and rates of obesity outpace state averages.

Economic challenges faced by residents are troubling. According to the Economic Development Department, the County-wide unemployment rate for 2014 was 11.6%, compared to the statewide rate of 7.5%. This ranked Fresno County as 51 out of 58 counties in the state for highest unemployment. Due to widespread poverty, all students in Fresno Unified School District are eligible for free meal programs. Over 79,000 free meals are served daily.

Health indicators are also cause for concern. Obesity rates for adults in Fresno County are staggering, with 77% of residents identified as overweight or obese by the California Department of Public Health (CDPH), compared to 62.5% statewide. Rates of asthma prevalence are also high for children age 5-17 in Fresno County (23.6%), compared to statewide averages (17.1%). The American Lung Association (ALA) ranks Fresno 1 out of 220 metropolitan areas for annual particle pollution and 24-hour particle pollution ratings. Given the ALA findings, and a 2011 designation of Fresno by the World Health Organization as the second most air-polluted city in the United States, the prevalence of asthma in Fresno is not surprising.

According to the World Health Organization, in 2011 Fresno was the second most air-polluted city in the United States.

With disconcerting health and economic indicators, low educational attainment (just over 20% of residents hold a Bachelor's degree or higher) and median household income resting at \$42,015 per year, an economic catalyst is desperately needed to address health variables and create a healthier environment for the future.

“We have to face the challenges of inner city Fresno and fix them, instead of ignoring them and pretending they will go away.

Face and fix.”

*-- Mayor Ashley Swearingin,
January 2015 State of the City
Address*

The economic center of Fresno has long migrated north; movement which has encroached on precious farmland while emptying the downtown area and creating urban sprawl. Amidst these challenges, the City of Fresno is in a state of positive transformation. The need for reinvestment in the City's downtown area has been the catalyst for a reexamination of development priorities over the last several years. Under the Swearingin Administration, the vision for large-scale investment in creating a more cohesive network for travel along inner-city corridors, revitalizing key business districts and actively limiting urban sprawl has taken root to begin to address local challenges.

A vision for transformative transportation is also underway, one that seeks to address social and economic challenges through investment in transportation infrastructure. The Smart City Challenge provides an unprecedented opportunity for Fresno to creatively address significant local health and economic challenges through transportation innovation and data sharing. The City of Fresno believes changing the built environment through smart transportation upgrades can have a positive impact on the overall wellness of residents. The challenges faced in Fresno are many, but can begin to be addressed through the development of a smart transportation system which synchronizes traffic signals throughout the city, encourages the use of electric vehicles and public transit alternatives, and engages residents in planning multi-modal trips and innovating with local data.

Vision

As a Smart City, Fresno would create a transportation system which:

- Operates with an interconnected transportation network utilizing advanced Adaptive Intelligent Transportation Systems (ITS) to improve efficiency and safety and reduce vehicle emissions.
- Reduces congestion, addresses climate change and improves air quality through traffic synchronization, investment in electric vehicle charging infrastructure, public transit infrastructure and resources which support active transportation.
- Is user-focused; reducing barriers to mobility through information sharing, mobile transit applications and open data.
- Bolsters opportunities for collaboration, continuous improvement, entrepreneurship and innovation through public access to transportation metrics.

These vision elements can improve air quality, support more active transportation and facilitate greater equity in transportation across socioeconomic statuses. Furthermore,

the potential economic impact of the Smart City challenge is exponential. A more effective transportation network and access to data can impact residents' ability to commute to work with greater efficiency and safety, provide transportation information which can illuminate new insights into travel patterns, identify opportunities for innovation, and inform future policy and decision making.

Program Management Approach

This program would be managed through the development of a taskforce comprised of City of Fresno staff, business leaders, educational leaders and stakeholders to synergistically advance key vision elements and ensure effective process evaluation. Capital projects, parking and construction projects would be managed through the City of Fresno's Public Works, Development and Parking departments. Information technology components of the vision elements presented will be managed by the Information Services Department (ISD). Public transit upgrades would be overseen by the City of Fresno's Transportation Department. Reporting requirements would be managed through the City's Grants and Financial Administrators, ensuring timely and comprehensive reporting. Numerous letters of support from both public and private partners are also attached to this application and demonstrate a commitment to a multi-disciplinary program management approach.

2. **Describe the population characteristics of your city and show how it aligns with the USDOT's characteristics for a Smart City, including:**
 - a. **Mid-size city with population between approximately 200,000 and 850,000 people in the city limits;**
 - b. **Dense urban population; and**
 - c. **Represents a significant portion (preferably more than 15%) of the population of your local urbanized area.**

According to Census 2010 data, the City of Fresno has a demographically diverse population of 494,665 residents. Thirty percent of residents are Hispanic or Latino, and over 12% of residents identify as Asian. According to 2010 Census calculations, the City of Fresno possesses a dense urban population with 76% of residents residing in a local urbanized area. This is a significant portion of the population. The City of Fresno is also the 34th most populous city in the nation. These demographic characteristics, particularly the significant diversity and vast urbanized area, uniquely qualify the City of Fresno as an ideal mid-size Smart City.

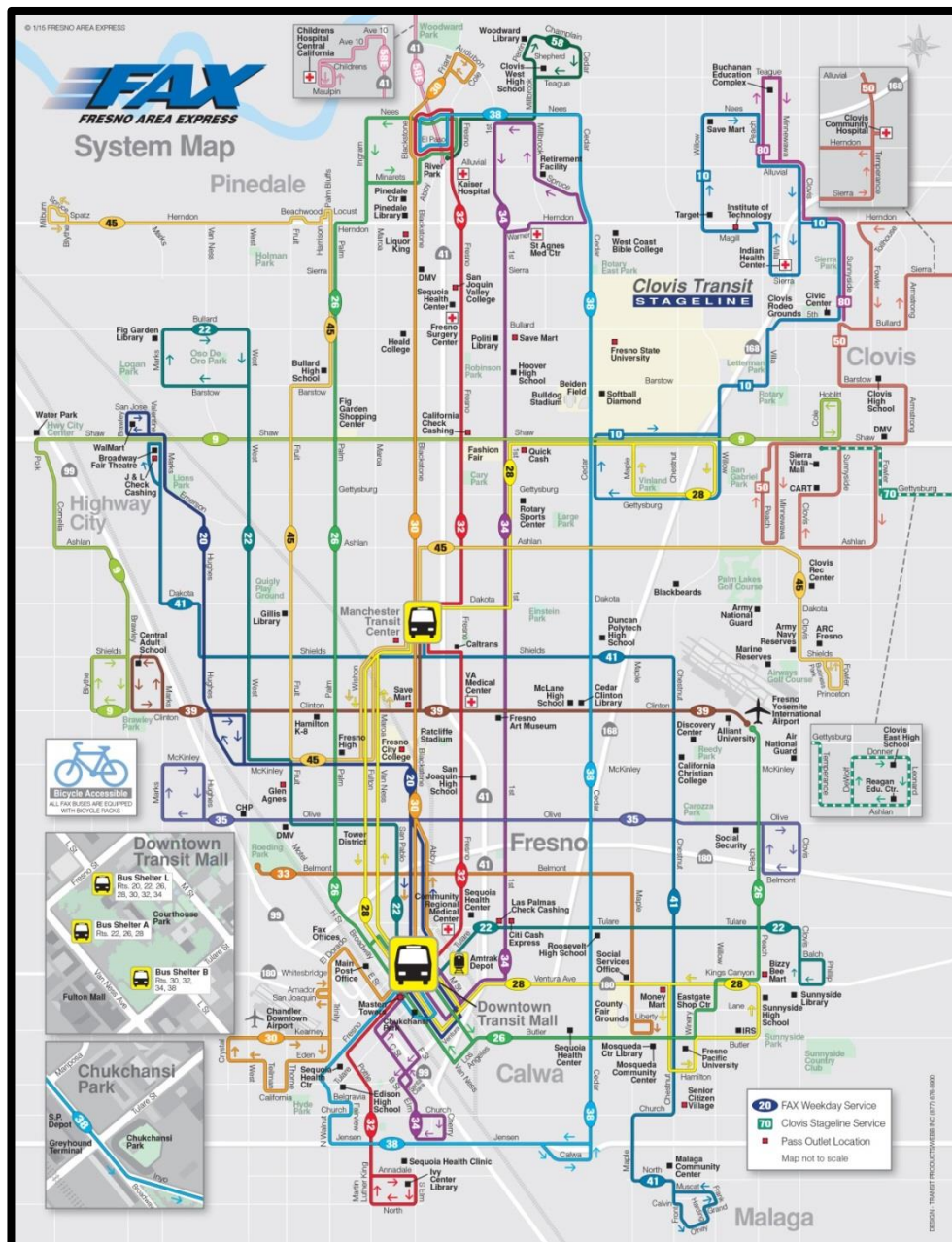
3. **Describe other characteristics of your city and show how it aligns with the USDOT's characteristics for a Smart City, including:**
 - a. **Existing public transportation system;**
 - b. **Environment that is conducive to demonstrating proposed strategies;**
 - c. **Continuity of committed leadership and capacity to carry out the demonstration throughout the period of performance;**
 - d. **A commitment to integrating with the sharing economy; and**

- e. A clear commitment to making open, machine-readable data accessible, discoverable and usable by the public to fuel entrepreneurship and innovation.

Existing Public Transportation System

The City of Fresno has an evolving public transportation system, which provides a great foundation for advancement to the Smart City Challenge. The public transit options are numerous. In terms of bus transit, Fresno Area Express (FAX) is comprised of 16 fixed routes spanning the city and connecting with neighboring transit systems to optimize the ease of commute for residents.

FIGURE 1 | The existing fixed route public transportation system is known as Fresno Area Express or FAX.



The FAX fixed routes typically follow many of the City's arterial roadways, which are generally spaced with a one-half to one-mile separation. Most of the FAX routes operate at 30-minute frequencies, with four routes providing 20-minute frequencies during peak commute periods. There are two routes, (45 & 58) which operate on 60-minute frequencies. Within the next year, FAX will establish two 15-minute routes near Fresno State, along portions of Shaw (East and West) and Cedar (North and South) routes. The Shaw and Cedar routes will serve as companions for a planned Bus Rapid Transit System.

A first phase Bus Rapid Transit (BRT) system is planned and funded along the Ventura Street/Kings Canyon Road and the Blackstone Avenue corridors, meeting in downtown (Figure 2). Groundbreaking for the BRT is expected in 2016, with service planned in 2017. BRT is an integrated system of facilities, equipment, services and amenities that improve the speed, reliability and identity of bus transit. BRT is, in many respects, rubber-tired light rail transit with greater operating flexibility and potentially lower costs.

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A demand-response service, *Handy Ride*, provides transportation for eligible persons with disabilities who cannot functionally use the fixed route system. FAX services over 2,700 clients, with over 700 weekday passenger trips. The *Handy Ride* service area is the same as FAX's fixed route system. The FAX bus system also provides connections to the Amtrak passenger rail station and the Greyhound bus station, both of which are located in Downtown. The bus route system is focused primarily on heavily urban areas, with fewer services offered to urban edge development. This focus allows the City to maximize ridership and reduce congestion in urban areas. FAX partners with the City of Clovis transit system, The City of Visalia V-Line, and the Fresno County Rural Area Transit Agency to provide connections outside of the City.

Additionally, phase one of the California High Speed Rail (HSR) Project, the largest of its kind in the nation, is slated to run through the City of Fresno with estimated construction completion by 2019 and final route completion by 2029. HSR will serve as a regional transportation system for Fresno and surrounding communities. The HSR tracks through Fresno's metropolitan area will run generally parallel to the Union Pacific Railroad tracks. A HSR station will be located in Fresno, and it is anticipated that the HSR system would significantly increase the accessibility of Fresno to major population and economic hubs of California.



Fresno's Downtown area in January 2014. Investment in public transit solutions will help to reduce emissions in an area plagued by poor air quality. Image: Craig Kohlruss, MCT/Getty Images for Tme.com.

The Fresno Council of Governments also operates a line of the Yosemite Area Rapid Transit System (YARTS) along HWY 41 in conjunction with the Merced County Association of Governments. YARTS provides travel connections between neighboring outlying communities, the City of Fresno and municipal transit lines, greyhound bus systems, the Amtrak train and the Fresno Yosemite International Airport.

Figure 2 | The map below depicts the planned Bus Rapid Transit Routes and Stations along Blackstone and Ventura/Kings Canyon Corridors. The Smart City Challenge would allow the City to enhance this plan with WiFi and greater user-focused mobility services.



Environment that is conducive to demonstrating proposed strategies



The City of Fresno has an environment that is conducive to demonstrating proposed strategies, and a track record of embracing technology to advance city priorities. In 2013, the City of Fresno was one of 31 cities selected worldwide to receive the *IBM Smarter Cities Challenge* grant.

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The city of Fresno was recognized as a Smarter City due to unique assets which also make it a prime candidate for this challenge. These assets include diversity, affordability, proximity to larger cities, and well-developed relationships that create synergies across industries. As a past Smarter City, Fresno demonstrated the ability to engage with key stakeholders to collectively envision an instrumented, interconnected and intelligent City that utilizes data to inform decision making and enhance the economic health and overall wellbeing of residents. Key recommendations emerged from Smarter City funding which related to open data and collective efforts to advance change. These key recommendations poise Fresno to initiate greater collaboration with businesses, dial into urban analytics, and foster more robust partnerships with universities and citizens as a Smart City.

The City of Fresno also has a history of leading the way on cutting edge technologies, and transferring knowledge gained to others. In 2009, Fresno Yosemite International Airport (FAT) was selected by the Federal Aviation Administration as one of 10 airports nationwide, one of only two located on the west coast, for funding to develop a

A 2-megawatt solar power generation system installed at FAT in 2008 was the nation's first of its size at an airport.

Sustainability Management Plan which was released in 2012. The resulting plan has laid the groundwork for a commitment to a green city which protects the environment and promotes smart growth. A 2-megawatt solar power generation system installed at FAT in 2008 was the nation's first of its size at an airport, and has resulted in generating 30,002,118 kWh of solar energy to date. This is the equivalent of the CO₂ absorbed by 118,403 trees and the CO₂ emitted from driving

17,365,037 miles. Based on best practices and lessons learned the City of Fresno Airports Department has provided technical assistance to support other region's green efforts. This track record of leadership in green energy and transportation technology demonstrates an environment in Fresno which welcomes and encourages innovation of the scope and scale required to achieve a Smart City vision.

The environment in terms of existing transportation infrastructure, experienced engineering staff, information technology staff and technical staff is also uniquely poised to embrace the Smart City Challenge. The resources which



create an environment conducive to demonstration will be discussed at length in questions 7,8,12 and 13 of this application.

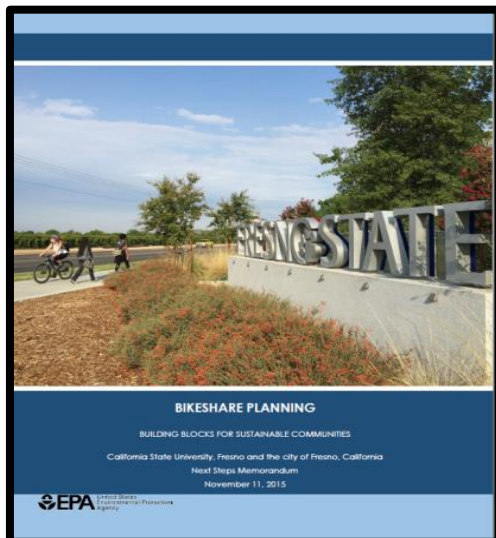
Continuity of committed leadership and capacity to carry out the demonstration throughout the period of performance

Leadership in the City of Fresno is invested in a long-term vision for city-wide improvements, particularly with regards to transportation. The *City of Fresno General Plan 2035* casts a vision for smart growth, multimodal travel enhanced by technological innovation, and a commitment to the use of evaluation metrics and performance standards to prioritize transportation projects and focus on continuous improvement. The City has also committed to a county-wide plan for Intelligent Transportation Systems and a Fiber Optics Communication Network, which align to many of the proposed elements in this grant. Existing momentum toward comprehensive connectivity which reflects a balanced multimodal transportation system makes the City of Fresno an ideal candidate for a connected Smart City.

Directors overseeing the Departments of Public Works, Development, Transportation and Information Services are highly experienced and have united in support of this proposal. Becoming a Smart City would accelerate existing plans by providing otherwise unmet funding. The city has successfully executed large scale capital and technical projects and has the internal leadership capacity and organizational structure to carry out the demonstration throughout the period of performance with excellence.

A commitment to integrating with the sharing economy

Fresno has a demonstrated commitment to integrating into the sharing economy. This is evidenced by partnerships with the region’s largest university, and business activity in Downtown Fresno. In 2014, California State University Fresno (CSUF) and the City of Fresno partnered on a request to receive technical assistance from the Environmental Protection Agency (EPA) to explore bike share programs. The findings of the report, released in November 2015, have helped to inform several of the vision elements in this proposal. CSUF is currently exploring shared digital bike locking systems and remains open to other opportunities.



In 2015, the EPA provided technical assistance for Bikeshare planning in Fresno which produced the report pictured above.

Growth of businesses in Downtown Fresno demonstrates the growth of the sharing economy in the local private sector. In May 2015 Uber opened a downtown office, followed a few months later by the launch of Uber Español in November 2015. Many local companies like BitWise and Hashtag also utilize sharing economy principles by working out of shared spaces and utilizing shared equipment to bring their products to market.

A clear commitment to making open, machine-readable data accessible, discoverable and usable by the public to fuel entrepreneurship and innovation

Entrepreneurship and innovation are supported and encouraged by the City of Fresno. In the 21st Century, data is the key ingredient fueling ideas and discoveries which make businesses of all sizes successful. The City of Fresno recognizes this fact, and has put forth key commitments as part of the *2013 Smarter Cities Challenge Report* centered on data sharing between internal and external partners. Other key recommendations the city has expressed a commitment to include: building relationships with local IT developers and fully adopting open data policies.



There is a growing tech community in Fresno which has invested in training the next generation of developers.

Fresno has a burgeoning independent IT developer community, which currently participates in the *59 Days of Code* project and works in creative spaces like *Hashtag* and *Bitwise* in downtown Fresno. This is a talent pool of primarily entrepreneurial-minded developers who could help the City leverage advanced transportation technology to revitalize downtown areas while enhancing the commuter experience city-wide. The City of Fresno is committed to making open, machine-readable data accessible, discoverable and usable within all legal frameworks.

- 4. Provide an Annotated Preliminary Site Map. The map shall identify the specific geographic location being proposed for the Challenge and indicate locations related to key issues, proposed roadside technology locations, connected automated vehicle operations, and other explanatory features to support strategies that align with the USDOT vision elements. The map shall be no larger than one page (up to 11 inches by 17 inches is acceptable for this item only) when printed.**

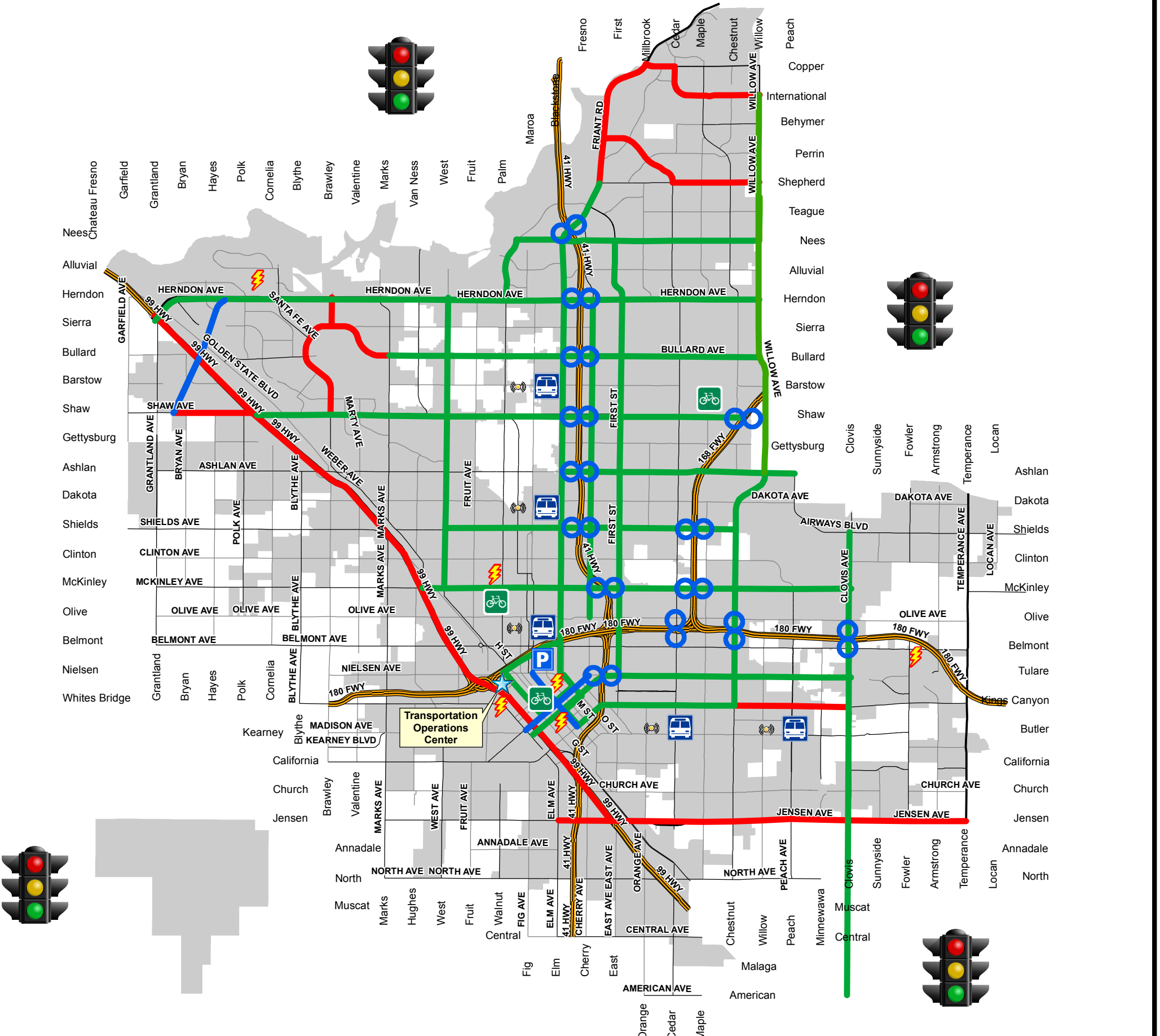
The annotated preliminary site map is provided on page 12. The map's legend identifies existing infrastructure and proposed Smart City elements to be developed if selected for the challenge.

- 5. Describe how your holistic, integrated approach aligns to the twelve USDOT vision elements described in this solicitation. For each vision element, describe your approach including the technology solutions proposed. Illustrate how the proposed technology solutions can synergistically combine to create measurable impact while reducing costs associated with both deployment and operations.**










The City of Fresno's Smart City approach is holistic and integrated with a focus on investing in key infrastructure and technological innovation to increase the efficiency and effectiveness of city-wide transportation systems. The City of Fresno's vision is borne out of a robust transportation infrastructure already in existence, as well as a

City of Fresno Smart City Challenge Preliminary Site Map

The City of Fresno's Smart City Challenge proposal demonstrates the way a mid-sized city can improve safety, enhance mobility and address climate change through innovative transportation solutions. This map includes proposed Smart City Vision Elements, as well as Fresno's past and current investment in Intelligent Transportation Systems. With support from the Smart City Challenge, the City of Fresno is well poised to lead the way in 21st Century Transportation.



Legend

-  Smart City Fiber Optic ITS Infrastructure
-  Completed ITS Corridors
-  ITS in Design/Construction
-  Citywide FWY Ramp Traffic Signal ITS (14 Locations)
-  Smart City Enhanced BRT WiFi Route & DSRC pilot (Blackstone Avenue only)
-  Smart City Bikeshare & Digital Racks
-  Smart City Electric Vehicle Infrastructure
-  Smart City Parking
-  Smart City Adaptive Signals, 300-400



regional *Integrated Transportation System Plan* and numerous studies developed by transportation experts. The City of Fresno is committed to executing these vision elements with excellence so that they may serve as a replicable and scalable model nationwide.

Vision Element #1: Urban Automation

Driver-assisted automation has the potential to increase efficiency and safety while decreasing congestion and improving public transportation systems. The City of Fresno plans to partner with Mobileye Shield+ to equip buses with the hardware and software required to improve **collision avoidance**. The City of Fresno's approach to urban automation also involves the use of **enhanced Global Positioning Software (GPS) technology** to ensure public transit buses remain on-route and on-schedule. Existing technology solutions utilized in the City's public transportation system include Automated Vehicle Location (AVL) and scheduling software provided by Trapeze ITS which allows for real-time tracking of fleet buses and vehicles. Funding from the Smart City Challenge would allow for retrofit of buses with **mobile data terminals** to assist drivers. Additionally, the City has been approached by Google X, to discuss the feasibility of piloting **automated vehicles** in the area if selected as a Smart City. A letter of support from Google X is included with this application. These automated additions to the local transit system can enhance the public transit experience by improving timeliness, informing new ways to automate travel in an urbanized area and reducing costs incurred due to route delays.



Vision Element #2: Connected Vehicles

Vehicle to Infrastructure (V2I) connectivity is a key element of the City of Fresno's vision. V2I connectivity would be achieved through the development of intelligent, Sensor-based infrastructure or **Intelligent Transportation Systems (ITS)** throughout the City, and a pilot of **Dedicated Short Range Communications (DSRC) systems** along a key route. The ITS system would allow for V2I signal preemption, while the DSRC system would transmit synchronization speeds, and potentially freeway and ramp information to vehicles. Due to its emerging nature, DSRC would be placed as a pilot along a key corridor such as Blackstone. As part of this pilot, the City is also interested in exploring V2I connections to mobile phone users.



Emergency preemption systems would utilize V2I technology that can override traffic signals in emergency situations utilizing Mobile Infrared Transmitters along the ITS system. These emergency preemption systems would allow a greater number of emergency personnel including ambulances and Police to more safely respond to accidents and emergencies. **Traffic Signal prioritization** could also be expanded to public transit with Smart City funding. This would allow buses along key corridors to notify Adaptive ITS traffic signals of their impending approach and receive more "green time" to get through each signalized intersection. This would alter adaptive signal timing

using infrared technology allowing for a more rapid public transit system. This vision element works in conjunction with the City of Fresno’s vision for a more synchronized traffic system which encourages the use of public transit by offering user-focused, efficient and timely services.

With all of these vision elements working synergistically, public transit will ultimately become the most desirable way to navigate an increasingly urban area.

Inter-city passenger transfer communications for public transit operations are currently utilized when transporting FAX riders to other nearby cities. Connected V2V technology could further develop this communication system to allow for greater levels of automation. This would be achieved by upgrades to the existing Automated Vehicle Location programs on key routes. These upgrades would support other vision elements of this proposal, such as urban

automation, user-focused transit, synchronization and the use of data and analytics to provide for greater synchronization between cities. With all of these vision elements working synergistically, public transit will ultimately become the most desirable way to navigate an increasingly urban area.

Vision Element #3: Intelligent, Sensor-Based Infrastructure



The key to the successful implementation and realization of synergies between vision elements lies in the foundational delivery of Vision Element 3, the **adoption of intelligent, sensor-based infrastructure throughout the city**. The City of Fresno proposes to install Adaptive Intelligent Transportation Systems (ITS) in nearly all city intersections, and signal interconnect infrastructure along freeway 180 and 99 exits.

Adaptive Intelligent Transportation systems allow for real time automated adjustment between signals to cater to variant traffic needs and mitigate congestion. Funding from the Smart City Challenge would enable the City of Fresno to retrofit and construct Adaptive ITS at 300-400 traffic signals. Approximately 7% of the city’s 466 traffic signals are currently adaptive or in the process of being updated to adaptive technologies. Approximately 292 traffic signals have the fiber or wireless communications installed to become adaptive, but are in need of detection upgrades and adaptive technology. The remaining signals are in need of full ITS construction including communication for adaptive synchronization. The installation of fiber optic infrastructure along State Route 99 and Jensen Avenue Corridors will be required to retrofit traffic signals along the corridors with Adaptive ITS using fiber and wireless communications. Experience from past adaptive synchronization projects provides the City of Fresno with the practical knowledge and expertise to execute an adaptive synchronization project of this scale. Figure 3 on page 24 demonstrates the extensive project portfolio for FY2016, and long-term plans for regional ITS.

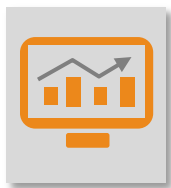
The installation of fiber-optic cables along two remaining corridors would provide traffic signal interconnect back to the Traffic Operations Center (TOC). Fiber hubs along the corridors would be established to allow for connections. ITS elements such as CCTV cameras, ITS communication cabinets and Opticom Emergency Vehicle Preemption

Equipment would be included throughout the system. The City has standardized Type 332 traffic signal cabinets and would utilize standard 5.2-5.8 GHz wireless network equipment to extend fiber communications across the remaining city signals. This would result in a significant cost savings, as it would eliminate the need for installation of infrastructure underground.

The City of Fresno has an existing *Intelligent Transportation Systems Master Plan* in place for the next 20 years through the Fresno Region's Council of Governments. This plan reflects an incremental roll out of ITS as funding becomes available. However, Smart City funding would accelerate deployment and allow the City of Fresno to benefit from the insights that come with early, large-scale adoption. The technology that would be adopted throughout the City of Fresno as part of the Smart City challenge follows the U.S. department of Transportation's *Intelligent Transportation Systems 2015-2019 Strategic Plan* for ITS programs by **servicing as a foundation for interoperability and a source for enterprise data**. The City of Fresno has published Standard Drawings and Specifications that are utilized for all new traffic signal and ITS installations and modifications.

Adaptive ITS infrastructure, hardware and software throughout the city would provide traffic and emissions data which could benefit operations, researchers and open opportunities for private sector innovation. Traffic and emissions data would be generated from key corridors, while traffic data patterns could be collected on a larger scale. The partnership opportunities this equipment provides, and the extensive data to be collected as part of this demonstration will be discussed in greater detail in questions 7 and 9.

Vision Element #4: Urban Analytics

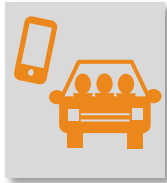


The 21st Century is a data-rich environment in which a Smart City can leverage performance data for informed decision-making and problem solving across multiple policy areas. Data is currently generated by public transit programs and the Traffic Operations Center. **Adaptive ITS software throughout the city would provide intersection specific urban analytics including traffic patterns, arterial travel time, green times, volumes and volume to capacity ratios.** These analytics could be used for traffic modeling to identify opportunities for road-diets, or locate areas with excessive queuing and emissions. This data could also provide information regarding pedestrian crosswalk use, which would inform the City's long-term active transportation planning.

These respective datasets can be analyzed to establish baseline operations numbers, and the impact of Smart City vision elements to traffic flow, emission reductions and greater use of public transit. The City's commitment to dialing in on urban analytics works synergistically to improve the effectiveness of the transportation system city-wide and capture the impacts of implementing numerous vision elements in this challenge. Generating data to inform transportation decisions will provide a cost-benefit in the form of greater efficiency and the ability to demonstrate tangible impacts to the environment.

This is also a vision element which our university and private partners find enormously valuable. Providing urban analytics data can aid scholars in identifying new insights, and the private industry in more effectively managing urban logistics and planning.

Vision Element #5: User-Focused Mobility Services and Choices



The City of Fresno's vision for user-focused mobility services and choices includes a number of upgrades to public transit such as enhanced dynamic travel planning services, enhanced ticket vending and rider notification systems, user-oriented parking and greater support for the sharing economy through investment in mobile bike share.

Dynamic Travel Planning Services

The City has launched a transportation website that is mobile friendly to aid residents in planning their public transit routes. This website is called *Plan my Trip*. As a Smart City, Fresno envisions expanding on this website to provide **real-time public transit information**, and increased access to public transportation services for all residents. Real-time transit information generally includes information on projected vehicle arrival and departure times, service disruptions and delays, transfers and other transportation services; as well as other related information, such as date and time, weather, public announcements, security related information, updates during terrorist/emergency events, and other general events in the local area. This information is provided to assist riders in making pre-trip and en route (including in-vehicle) trip decisions. Next generation programming would also allow for the integration of **location-based trip planning**, utilizing Google Maps 'Where am I?' technology. These website enhancements would be cost effective as they would benefit from Google generated data and could be layered on to an existing web-based service.



Existing trip planning services would be further enhanced.

Moreover, the provision of real-time transit information would help to improve the visibility of transit services within the community. In addition to web-based information, **access to trip information would be made through a variety of media**, including dynamic message signs (DMS) at stops and stations; kiosks at bus shelters, office buildings, shopping centers and other locations. Currently FAX is one of two agencies in the region with a real-time Automated Vehicle Locator (AVL). However, as other agencies upgrade, it will be possible to work toward integration into a fully regional system.

Enhanced Transit Ticket Vending

To expand user-focus, the City of Fresno also envisions **upgrading FAX Ticket Vending Machines (TVM)** and adopting **Smart Card technology**. TVM kiosks located alongside Bus Rapid Transit routes would be updated to accept Smart Cards and high-tech payment options such as Apple Pay and Google Pay. These payment capabilities would make payment more modernized and convenient for users. The ability to pay for Smart Cards online would also be added. Additional updates to TVM kiosks would

include **36-character LED signs** along key areas of the BRT route which will provide greater capacity to display more information such as station information, ticketing information, schedule and next arriving bus.

Rider Notification Systems

Greater user-focus would be achieved through the use of rider notification systems which can **send SMS text messages to registered riders** in advance of the arrival of their FAX bus or Handy Ride utilizing AVL software. This eliminates the need for users to wait at bus stations for long periods of time by providing real-time updates and push notifications to mobile devices. This technology could also enable users to text message a standardized number to receive real-time updates on the status of their next arriving bus.

User-Oriented Parking Services

Upgraded parking services in the downtown area would improve on-street and off-street parking solutions for residents and mitigate congestion. On-street parking services would be streamlined through the use of smart meter technology which would replace standard coin-operated meters. **Tiered capabilities** would allow the City to adjust pricing structure and timing digitally, which would result in the ability to open up street meters during events with set fee pricing, and respond to demand. This could help offset the congestion that occurs at existing lots. Off-street parking would be improved through the use of **digital ‘pay-on-foot’ stations** to reduce traffic congestion and CO₂ levels at the point of exit at 13 parking garages and lots. The smart parking solutions discussed would provide reporting features related to usage, revenue and repairs needed.



Existing city meters would be replaced with Smart Meters.

The Sharing Economy

The City of Fresno would like to explore **micro transit opportunities** to streamline public transportation routes utilizing the sharing economy, electric vehicles and vouchers for seniors. To achieve this, the City would examine areas with less ridership along fixed route bus systems (for example Cedar from Herndon to Friant, where ridership gets sparse) and divert buses from that less popular portion of the route to areas with higher demand. This would increase frequencies along routes with higher ridership. The City would encourage the use of ride-sharing services to fill in the gap, and is open to partnership opportunities to encourage the use of electric vehicles for ridesharing. The City would also explore providing vouchers for seniors with the Council of Governments and ride-sharing companies to expand mobility and address the “last-mile” challenges of public transit via the sharing economy.

New technology also provides unprecedented opportunities for the sharing economy to flourish, particularly when it comes to **Bikeshare programs** and high-tech bike rack equipment. Through a partnership with California State University Fresno (CSUF), the City of Fresno would implement recommendations from the Environmental Protection

Agency's *2015 Bike Share Plan* by establishing a bike share system. For a nominal fee, this system would allow students and pedestrians to utilize a bike to travel around campus or to nearby FAX stops. This would eliminate barriers to cycling by providing publicly available access to bicycles, and create greater amenities to attract students. It would also solve a common "last-mile" challenge in public transit by providing greater transportation options to link between bus stops and final destinations. Bicycles would be tracked using GPS technology. In addition to a Bikeshare program, the City would also like to install **mobile device operated locking bike racks** throughout key regions of Fresno. This would provide a space for residents engaged in active transportation to secure their bicycle as they travel to their next destination.

The user-focused services to support mobility and choices in transportation would result in a significant collective impact. Greater access to public transit and bicycles would support improved air quality and a streamlined system which would encourage multi-modal movement throughout the City. User-focused options could reduce long-term overhead costs for City transportation and parking departments through greater automation and a more complete spectrum of analytics to utilize when planning. All of these features would work synergistically to create a more connected community through the use of advanced technologies.

Vision Element #6: Urban Delivery and Logistics



Data sharing is key to supporting long-term urban delivery and logistics planning. According to the *2013 IBM Smarter Cities Challenge* findings, the City of Fresno is positioned to embrace the use of technology in agricultural production and transport. Building on that momentum, the Smart City Challenge would allow Fresno to provide **transportation data generated by ITS equipment through third-party partnerships**.

This would enable end-users to identify traffic patterns and design route delivery and logistics schedules around peak periods. Fleet managers could also opt to analyze data to determine the best routes to deploy the electric vehicles in their fleet. For example, data from the City could be analyzed to support the allocation of electric vehicles in delivery fleets to strategic areas with greater congestion to reduce the environmental impact of deliveries and fuel costs. Transit data sharing to support urban delivery and logistics could occur through software such as OpenGov which would allow anonymized transit specific datasets to be made public through the City of Fresno website.

The combined impact of supporting Urban Delivery and Logistics through data sharing would create a highly-tuned transportation environment in which businesses could proactively plan and coordinate delivery and logistics to cut costs and improve air quality. The resulting impacts may ultimately lead to improvements to economic and health indicators in the City.

Businesses could proactively plan and coordinate delivery and logistics to cut costs and improve air quality.

Vision Element #7: Strategic Business Models and Partnering Opportunities



The City of Fresno is home to several universities, community colleges and technical programs, the 4th largest school district in the state of California, a thriving tech hub located in the downtown area, and an emerging creative scene responsible for engaging young professionals in bettering their community. These traits, along with longstanding relationships make Fresno an ideal location for public-private partnerships. Letters of support included in this application demonstrate multidisciplinary and cross-cutting enthusiasm for Smart City collaboration.

The City of Fresno envisions **partnership with many government partners** including the Fresno Council of Governments, the County of Fresno, California Department of Transportation, Fresno County Office of Education and surrounding cities to accomplish infrastructural plans and efforts to interconnect fiber optics. The City of Fresno has worked closely with these partners for many years and is confident in continued collaboration. Bringing together leaders in the industry from across institutions will result in a more coordinated deployment and mitigate unnecessary costs associated with a lack of proactive planning.



The Lyles School of Engineering and the Community Regional Planning Center are key partners in the Smart City Challenge.

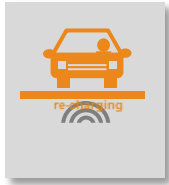
Fresno also foresees partnership with school districts, technology companies and universities to make publicly accessible datasets available to entrepreneurial programs, and engage the millennial generation in identifying new opportunities for multimodal and connected transit. These partners will play a key role in applying transportation insights to solve social and economic challenges locally. California State University Fresno's (CSUF) Department of Transportation is interested in partnering on bikeshare efforts and there is widespread support from the University to maximize the urban analytics collected. Letters of support have been provided from CSUF's Office of Community and

Economic Development, Lyles Department of Engineering, Lyles Center for Innovation and Entrepreneurship and the CSUF Community Regional Planning Center.

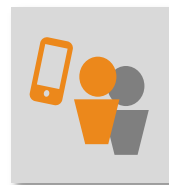
Private partnerships are also key to the success of a Smart City. The City of Fresno has been contacted by many potential private partners. If selected, the City would like to explore partnership with Google X for the urban automation vision element included in this proposal, and discuss opportunities for increased mobility with ride-sharing companies. Fiat of Fresno has also communicated interest in supporting electric vehicle vision elements and BitWise Industries is also highly interested in collaboration. It is anticipated numerous opportunities will exist for additional private partnerships. The City of Fresno looks forward to discussing them further.

Vision Element #8: Smart Grid, Roadway Electrification and Electric Vehicles

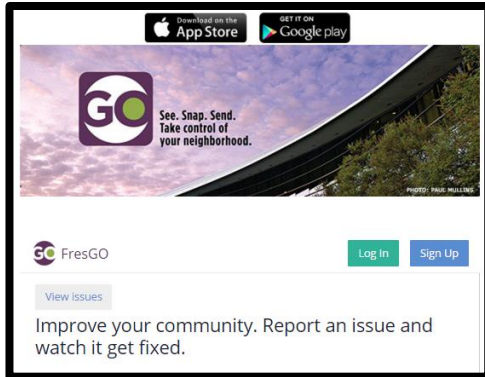
As electric vehicles (EVs) become more widely available, the City of Fresno aims to encourage their use through providing **charging stations** at 5-10 locations throughout the City for public use, as well as City fleet charging stations. This would result in a 50-100% increase in publicly available charging locations in Fresno. Ideal locations include stations near City Hall, downtown, along “Park and Ride” lots, near public transit and High Speed Rail facilities and close to exits along the State Route 99 and 180 freeways. Station types would vary based on projected charge time. Charging stations will create greater incentive for the adoption of electric or hybrid vehicles, as there are currently limited locations to charge them within the city. The City also envisions **upgrading approximately 30% of the parking enforcement fleet and approximately 60% of public transit support vehicles to EVs**. If selected, the City plans to dialogue with electric utility service providers regarding feasibility of **charging station interface with a local smart-grid pilot effort**. This would allow users to charge vehicles in long-term parking during off-peak periods. Finally, to incentivize electric vehicle use, the City plans to explore **partnership with local EV retailers** to connect ride-share service providers to electric vehicle solutions. This would not only increase the use of EV’s, but also support the increased mobility elements of this proposal. The City of Fresno’s plans for electric vehicle infrastructure work in synergy with the overall vision for a coordinated, user-focused and environmentally friendly transportation system city-wide by providing the tools for residents to more fully adopt EV transportation options.



Vision Element #9: Connected, Involved Citizens



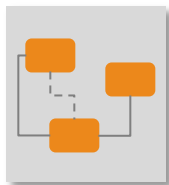
To support greater citizen engagement, the City of Fresno plans to install **Free Public WiFi on City buses along BRT routes and stations**. The installation would also support the City’s vision to increase user-focused mobility. Providing free access to the internet while using public transit can aid users in planning their trip, multitasking on their way to and from work or school, and serve as an incentive to adopt more multi-modal or car-light lifestyles. In addition to WiFi, the City of Fresno plans to engage and inform citizens of advanced technologies through the deployment of **targeted informational and social media campaigns** and dedicated Smart City web space. These campaigns would encourage the use of public transit and exploration of tools that enable citizens to engage in the connected transportation system. Tools to be promoted include the availability of WiFi at BRT public transit centers, promotion of the FresGo application and promotion of available City data sets.



Screenshot of FresGo, Fresno's crowd-sourced reporting system.

The City of Fresno currently utilizes crowd-sourced data to identify needed repairs around the city. This engagement could be increased to identify public transit needs by further developing the FresGo application to receive comments and **allow users to rate their public transit travel experience.** This would provide customer service feedback and allow the City of Fresno to observe trends. Actively promoting advanced technologies, available data sets and opportunities to generate insights through the use of crowd-sourcing would result in a smart transportation system which engages citizens in digital democracy. This could result in reduced overhead costs and a measureable impact on future operations based on user feedback.

Vision Element #10: Architecture and Standards



The foundational component of the Smart City Vision for the City of Fresno is Information Technology Systems which are interoperable and can be iterated in surrounding areas. The architecture and standards for existing and planned Adaptive ITS infrastructure under vision element number three would follow the Department of Transportation's Connected Vehicle Reference Implementation Architecture (CVRIA) and Systems Engineering Tool for Intelligent Transportation SET-IT software tools. The City is committed to following established architecture and standards to reduce installation and maintenance costs, and create seamless connectivity.

Vision Element #11: Low-Cost, Efficient, Secure, and Resilient Information and Communications Technology



The City of Fresno is committed to low-cost, efficient, secure and resilient information and communications technology that ensures privacy and information safety. To that end, the City of Fresno would invest in additional hardware to manage public facing servers as part of a sub-network or "demilitarized zone" (DMZ). "Big data" is a key component of Fresno's Smart City vision as it allows for entrepreneurship, innovation and user-engagement. In order to manage the data, the City will use Dell (Intel Based) servers, VMWare for virtual services, Cisco networking related equipment and fiber internet connections. Internal and external firewalls will provide protection to the data generated.

Investing in low-cost, efficient, secure and resilient information and communication technology in conjunction with all vision elements of the Smart City challenge provides the City of Fresno the opportunity to reduce long-term costs. Cost savings are realized through economies of scale. Investing in smart information and communications

technology at scale, rather than incrementally, will position Fresno with the software, hardware and capital investment in information equipment needed to execute the Smart City vision.

Vision Element #12: Smart Land Use



The City of Fresno has taken a balanced approach to land use over the last 7 years. The 2035 General Plan and 2015 council adoption of reduced fee policies in targeted areas encourage downtown infill, revitalization of blighted neighborhoods and a robust business district. The General Plan shifts emphasis from the historically dominated suburban growth patterns, to a vision of growth that shares increased urban development in the form of infill and rehabilitation, along with new Activity Centers with mixed-uses and neighborhoods in growth areas. These Activity Centers are located along the planned Bus Rapid Transit system and focus on walkability, complete streets and reinvigorating neighborhoods.

As a Smart City, Fresno would have a more robust transportation dataset for public transit and local traffic patterns. This data would add additional information to public and private planning and development efforts. By realizing the vision elements included in this proposal, the City would have new insights into local challenges which could potentially be addressed or mitigated through smart land use policy. The Smart City vision elements presented support a continued commitment to smart land use. Vision Elements maintain Fresno's focus on improving major arterials through the installation of Adaptive ITS, increasing connectivity, and linking mixed use areas to business districts to encourage residents to adopt public transit or active transportation alternatives. Continued smart land use results in interconnected urban areas, and provides the foundation for Vision Elements in this proposal to be realized. Policies which support smart land use are fully woven into City operations and will continue throughout the deployment of the Smart City grant and into the future.

6. Identify and rate key technical, policy, and institutional risks associated with the deployment vision and discuss plans for mitigating those risks.

As with any major undertaking, the City anticipates some risk related to technical, policy and institutional challenges. There are technical details regarding WiFi range near BRT stations to explore, transaction fees for mobile technology which can impact operational costs, and long-term questions regarding sustainability and maintenance costs for Bikeshare programming and DSRC equipment. Each of these risks will require in-depth exploration and the identification of solutions to overcome or mitigate barriers to the implementation of Smart City Vision Elements. Fortunately, many of the proposed Vision Elements are already part of approved plans or technical reports including the *City of Fresno General Plan*, *Regional Information Technology Systems Master Plan*,

2015 Fiber Interoperability Report and Smarter Cities 2013 Findings. City leadership is confident in the ability to mitigate aforementioned risks utilizing effective planning methods and strategic collaboration.

7. Outline team partners, key stakeholders, and demonstration governance processes. Describe existing and future public and/or private partnerships, including university research partnerships.

Becoming a Smart City will require interdepartmental collaboration and public-private partnerships. The City of Fresno's vision cannot be achieved working in a silo, but must be part of a joint effort supported by stakeholders for maximum impact and sustainability. **Key internal partners** within the city will include Directors, Engineers, Project Managers and technical staff from the departments of Public Works, Public Utilities, Transportation, Development and Information Services. **External partners** may include international tech leader, Google, and technological innovation staff from local companies such as BitWise. The City of Fresno has been approached by **Google X**, to discuss a pilot for self-driving vehicles. A letter of support expressing Google's interest is attached to this application. Educational institutions will also be key partners in creating a Smart City. Local institutions which may collaborate include Fresno State, Fresno City College, Fresno Unified School District, Clovis Unified School District, Fresno County Office of Education and Central Unified School District. The list of partners is not all encompassing, and the City remains open to new opportunities to achieve the Smart City vision elements.

Demonstration governance processes will be dictated by standard policies and procedures, including City of Fresno Administrative Orders and relevant Memoranda of Understanding between partners. There is broad support for the initial proposal, as evidenced by the letters of support attached to this application.

8. Describe existing transportation infrastructure and system features in your city, including: arterial miles, freeway miles, transit services, shared-use mobility services, information and communication technology (ICT), intelligent Transportation Systems (ITS) including transportation management centers and field equipment, smart Grid Infrastructure including electric vehicle charging infrastructure.

Arterial and Freeway Miles

The City and County public roadway network, together with State highway routes, comprise the predominant transportation infrastructure in and around Fresno. The roadway system configuration has been primarily based on a traditional grid pattern. The oldest part of the city (the traditional Downtown area) is an urban grid oriented to the Union Pacific (originally Southern Pacific) railroad alignment that traverses the San Joaquin Valley in a northwest to southeast direction. Outside of this area the grid shifts to a north-south orientation based on Township, Range and Section lines. Almost all of the Arterial and Collector Streets (roadways) within the Metropolitan Area are regularly

spaced at half-mile intervals. This roadway pattern has been modified in the past several decades to include several curvilinear and diagonal alignments, and neighborhood street patterns have sometimes deviated from the grid pattern. The City of Fresno has approximately 185 arterial miles connecting the community.

Over time, Fresno's street circulation system and developed urban form have also been framed by limited access State highways that traverse the city. There are approximately 50 miles of freeway in Fresno. State Route 99 traverses the city from northwest to southeast, connecting Fresno to other communities throughout the central and southern San Joaquin Valley. State Routes 41 and 180 bisect the city north-south and east-west connecting Fresno to Yosemite and Kings Canyon National Parks, respectively. State Route 168 links Fresno to Clovis and Sierra Nevada recreational attractions at Shaver and Huntington Lakes to the northeast. The construction of the freeway system removed a substantial amount of the "through" traffic from the local roadway network (e.g.: Blackstone Avenue, Golden State Boulevard, Kings Canyon Road), freeing up capacity on the local streets except at intersections near freeway interchanges. This urban freeway system has shortened commute times from the northern areas of the city and Clovis, and to the east for bedroom communities and foothill communities.

Transit System & Shared Use Mobility System

As discussed in question three, the City of Fresno has a robust public transit system which includes the FAX bus transportation system, a Bus Rapid Transit system on two major arterials slated for groundbreaking in 2016, on-demand *Handy Ride* services for eligible persons with disabilities who cannot functionally use the fixed route system, and connections to the Amtrak and Greyhound public transit systems. Preparations are underway for the High Speed Rail (HSR) system, the first of its size in the nation, which will connect Fresno to major cities and economic hubs of the Golden State. Fresno's transit system also includes infrastructure which supports multi-modal transportation such as walking or riding a bicycle. Fresno recently received bronze level recognition for bike lanes throughout the city from the *League of American Bicyclists*. This is the second recognition received since 2011, extending current bronze designation through 2019.



The City of Fresno has been recognized for multi-modal travel infrastructure by the League of American Bicyclists.

Information and Communication Technology

The City of Fresno has adopted advanced Information and communication technology which includes Dell (Intel-based) servers, VMWare for virtual servers, Cisco for networking equipment and connects to the internet through high speed fiber optic infrastructure. Information and communication technology is also utilized to track Fresno's FAX system and provide traveler information through San Joaquin Valley 511 services as well as a mobile friendly website. Information and communication technology utilized as part of the FAX system includes Automated Vehicle Location Systems (AVLS) software provided by Trapeze ITS. This is a stand-alone system that tracks the location of the FAX bus fleet and transmits real-time bus location information

to the FAX Dispatch Center. The AVL system utilizes the 800 MHz narrowband conventional spectrum with one data and two voice channels. The current polling rate is approximately one poll every 70 seconds. All of the AVL servers (database and application servers) are housed at the FAX Administration Building. The AVL database server is a virtual Dell power Edge ESXI with dual processors running Microsoft Windows Server 2012 R2 and SQL server 2012. The Application server is a virtual Dell power Edge ESXI running Microsoft Windows Server 2012 R2. On-board the buses, the AVL equipment consists of the Trapeze ITS TransitMaster Gen I and Gen II AVL tracking equipment including a VE IVLU Assembly, Tait TM8105 without DR and MDT, color and DVI with brightness board. There is also a single line sign with base communication software on-board the buses.

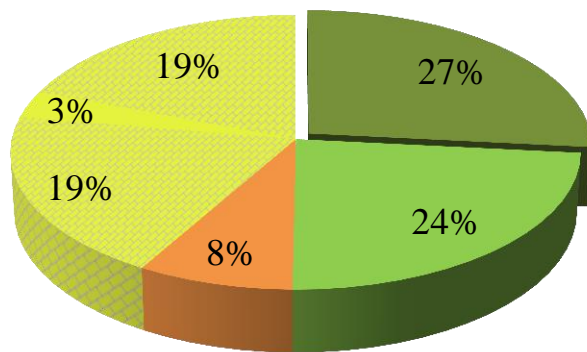
Intelligent Transportation System, Field Equipment and the Traffic Operations Center

Over the last 10 years, the City of Fresno has made a significant capital investment in Intelligent Transportation, and has emerged as a leader in the Central Valley through the development of a Fresno-Clovis Metropolitan Region Traffic Coordination System. In 1995, the City of Fresno embarked on a goal to build a Traffic Operations Center (TOC) and a city-wide fiber optic network that would interconnect the City of Fresno, City of Clovis, County, Council of Governments, and Caltrans District 6, providing the foundation for a coordinated traffic management system. The Advanced Traffic Management System (ATMS) has connected the Traffic Operations Center to a fiber network, connecting key arterials and expressways for an efficient city-wide traffic coordination system. A network of controllers, cameras and radar systems relay “real time” traffic or accident information to many City departments including: Transportation, Transit, Fire and Emergency Services.

In 2012, the City of Fresno adopted an *Intelligent Transportation Systems Management Plan* which included identified user priorities paired with ITS elements to address and mitigate problems such as barriers to communication, and signal coordination. These user priorities and ITS elements were paired as part of a 20-month study jointly funded by the California Department of Transportation and the individual counties participating in the San Joaquin Council of Governments (SJCOG). Bourne out of an extensive planning process, crucial funding from the Congestion Mitigation and Air Quality program and California’s Proposition 1B, the City of Fresno currently has state-of-the-art technology to monitor, model and coordinate traffic on several of the City’s major arterials. This improves safety, operations, energy conservation and the effective capacity of major arterials. ITS equipment currently in place includes a Transportation Operations Center control facility with client workstations connected to the City LAN with access to the Advanced Traffic Management System, a fiber core network switch that receives video and data from the traffic signals, CCTV cameras and other peripheral devices for the City to remotely monitor and control the field devices. Outside of the TOC, there is an extensive fiber-optic network, communication cabinets, vaults and splice closures, CCTV cameras and wireless installations placed along traffic signals throughout the city. Existing and currently obligated infrastructure is equipped to support future needs through the use of wireless technology, and is primed for expansion along

two remaining stretches (if funded by the Smart City challenge) to bring the entire city online.

**Figure 3 | Public Works Department
Traffic Signal Synchronization Projects
Fiscal Year 2016**



- FY2016 PROJECTS: 11 Corridors, 56 Miles, 151 Traffic Signals Constructed & Synchronized
- SYNCHRONIZED: 7 Corridors, 45 Miles, 134 Traffic Signals Synchronized
- FUTURE: 55 Traffic Signals with Fiber/Conduit Constructed.
- FUTURE: 110 Traffic Signals City-Wide (A mix of 170 & 2070 Controllers)
- FUTURE: 18 Electro-Mechanical Traffic Signals (F-Type)
- FUTURE: 109 Shared Traffic Signals with City of Clovis & County of Fresno

Figure 3 demonstrates the extensive project portfolio for FY2016, and long-term plans for regional ITS.

Smart Grid Infrastructure & Electric Vehicle Stations

The local focus on electric vehicles is growing, from both the public and private sector. The City of Fresno has seen an emerging network of electric vehicle (EV) charging stations installed at private businesses, hotels, car dealerships, non-profit organizations and local universities. There are currently just over 30 EV stalls throughout 9 areas of the city equipped with level 2 and or DC/Fast charging equipment.

EV stations will offer Level I and Level II charging capabilities. As of January 2016, Telsa is in the process of installing 10 quick charging stations in the Marketplace at El Paseo shopping Center along Highway 99. Fresno is also home to the first of three SmartGrid hubs for Pacific Gas and Electric Company

“If we finally are to cleanse our Valley air and make this a more healthy place, we must get belching old cars off the streets and start adding electric cars and plug-in hybrids to our garages. We wish the path to ending premature deaths and our high asthma rates weren’t so narrow. But the reality is that a combination of the Valley’s bowl shape and warm, sunny weather are the perfect recipe for forming ozone.”
**- Editorial Board, the Fresno Bee
December 26, 2015**

(PG&E), and a pilot for Electric Vehicle Variance technology.

9. Define the data your city currently collects.

The City of Fresno collects numerous data points across departments, and practices data-driven decision-making. The data currently collected by the City's FAX system includes: ridership, revenue, service hours and miles, on-time performance, operating speeds, average deadhead time, late pull out percentage (non-revenue and out-of-service hours) and service related incidents (passengers, equipment, drivers). The data currently collected by the Transportation Operations Center and the Traffic Engineering Department includes traffic patterns along ITS corridors, incidents, signal timing, average daily traffic and accident reports. The data currently collected by Parking includes daily parking revenue for on street and off street meters. Crowd sourced data is also collected by the Information Services Department utilizing the FresGo App.

- a. **Describe how these data, along with new data to be collected and shared during the demonstration may be used by the lead agency, project partners, other agencies and stakeholders to further address city challenges.**

As it relates to traffic, new data to be collected during the demonstration includes all of the data discussed in the previous section, as well as intersection specific traffic patterns throughout the city, travel time, queue length, pedestrian travel patterns, emergency preemption, emissions, peak volumes, green times and weather patterns. With respect to public transportation, sales data from upgraded TVMs and trends in trip planning data would be collected. This data would be made publicly available and/or licensed following Memoranda of Understanding which would be completed in conjunction with public and private partners following City of Fresno procedures. This data could be used to support policy making and shift public transit to address areas of congestion and demand for services. It could also be used to inform future grants to provide funding to address city challenges or improve active transportation planning.

- b. **Describe how transportation data could integrate with other functions or services in a city (such as public safety, human services, transit, and public works) to improve the management and operations of the city.**

Data from newly Adaptive ITS traffic signals will integrate with FAX public transit data to create a more effective public transportation system. Much of this integration will be done autonomously through computer algorithms. This autonomous calculation will save staff time and increase efficiency in signal timing. Additionally, reports which include extensive time-series data points collected at traffic signals would be reviewed for insights into best practices and areas for improvement. The City would also be able to quantify emissions in new ways, and thus adjust traffic patterns as feasible to mitigate environmental impacts. Public safety departments may utilize transportation data to locate trends in emergency response patterns and timing. Given the vast amount of

data that will be generated, the City of Fresno anticipates significant benefit to management and operations city-wide.

- c. **Likewise, describe how other data could be integrated with transportation data to improve transportation operations.**

Other data could be integrated with transportation data to improve transportation operations through collaboration with educational institutions and social service agencies. For example, data from social service agencies and educational institutions regarding peak demand and course scheduling can be used to inform FAX public transit planning so that public transit routes can adjust frequency or timing to accommodate peak demand. This would allow for greater coordination city-wide, which would ultimately encourage increased ridership and use of multi-modal travel options.

- d. **Describe any existing policies and identify their sources (local executive order or policy, local ordinance or state legislation, etc.) applicable to the proposed data to be collected and shared as part of the proposed project.**

There are currently no City of Fresno Administrative Orders that apply to data collection and distribution. Given the nature of the data to be collected in the Smart City Challenge, City of Fresno staff will work closely with the City Attorney's office to ensure all legal guidelines are followed within this project.

- e. **Submissions describing cross-cutting partnerships to advance smart city technologies, related programs and policies are encouraged, but not required. If you plan to partner with outside organizations (nonprofits, universities, corporations, etc.) you should address whether and specify how (e.g., limitation on sharing or use) data from those organizations or interests will be collected, managed, and shared across sectors or with the public, if appropriate. Identify candidate data that is expected to be shared, used, and used for other purposes by the participating project partners or with the public.**

The City of Fresno has many interested partners from both the public and private sector. Should the City of Fresno be selected as a Smart City, all partnerships will follow City of Fresno guidelines to obtain any relevant Memoranda of Understanding and/or Letters of Agreement to clearly identify roles and relationships with respect to data sharing.

- f. **Describe the terms and conditions that exist or will be established and managed in partnership agreements, data or information sharing agreements, agency specific policies and operating procedures to establish and maintain the systems and interfaces to maintain the integrity of the data and share the information identified in the proposal.**

Terms and conditions and any partnership agreements established will be developed following existing City of Fresno procedures and legal guidelines. Given the innovative nature of many of the elements in the proposal, terms and conditions will need to be developed alongside project scoping and tailored specifically to data sharing. The City of Fresno has extensive experience with collaboration and is confident terms and conditions can be established and managed between partners.

10. Describe your approach for using existing standards, architectures, and certification processes for ITS and connected vehicle based technologies and plans for documenting experiences and cooperating with architecture and standards developers to improve the quality of these products based on lessons learned in deployment.

All ITS technologies will be adopted based on standards and architectures which allow it to fully integrate into existing systems. The City of Fresno has published Standard Drawings and Specifications that are utilized for all new traffic signal and ITS installations and modifications. These standards and architectures comply with Federal Highway Administration guidelines as well as national ITS standards from the Department of Transportation, and the 2015 *Fresno County Intelligent Transportation System Strategic Deployment Plan* developed in conjunction with the Fresno Council of Governments. Connected vehicle technologies will adhere to Dedicated Short Range Communications (DSRC) systems standards from the Department of Transportation which are currently under development. The City of Fresno plans to share best practices and challenges faced in deploying the products to better inform Smart Cities of the future. This documentation and cooperative effort could be established through meetings, regular correspondence and standardized progress reports which identify lessons learned.

11. Provide measurable goals and objectives for your vision and describe your approach for monitoring the impact of the demonstration on mobility, safety, efficiency, sustainability, and climate change. Note: The selected city for the demonstration will be responsible for identifying a set of targeted performance measures that relate to the primary impact of their proposed deployment. The system deployed must be capable of generating the data needed to calculate these measures over time – that is, to show how well the system is performing with respect to these target measures. Independent evaluation will also be required to validate site system performance with respect to the targeted measures, to collect or infer contextual data that allows for the isolation and mitigation of confounding factors, and to provide supplementary evaluation with respect to a broader set of safety, environmental, mobility and public agency efficiency measures of interest to USDOT. Sites are responsible for supporting the independent evaluator’s access to the site and to site staff to conduct evaluation-related experiments, interviews, and surveys.

This proposal provides a high-level view of the City of Fresno's plan. Goals and objectives are written from this perspective and will be further quantified should Fresno advance to the next round of the Smart City Challenge. There are 5 key goals which represent all 12 vision elements of the City of Fresno's Smart City application.

Goal #1

Install Adaptive transportation infrastructure at traffic signals throughout the city. Corresponding Vision Element(s): 3, 4 and 10

Objectives to achieve measurable goal #1:

- Install fiber optics along SR99 and Jensen Avenue.
- Install wireless relays at identified signals to extend fiber connectivity.
- Install Adaptive Transportation equipment and synchronize 300-400 traffic signals.

These objectives will be monitored and evaluated using the City of Fresno's well-established ITS project management methods and reporting of qualitative data including average daily traffic, congestion patterns and collision reports. Emissions calculations will also be utilized.

Goal #2

Create a more connected public transit system which is user-focused and leverages crowd sourced data for continuous improvement. Corresponding Vision Element(s): 5 and 9

Objectives to achieve measurable goal #2:

- Install WiFi on Bus Rapid Transit buses and at key stations.
- Connect real-time transit tracking for FAX routes to an existing mobile-friendly website, *Plan My Trip*.
- Analyze ridership data to implement and plan routing changes based on load frequency and ridership.
- Adopt two-way SMS technology for FAX transit system.
- Allow transit customers to rate their experience using mobile devices.
- Install smart parking meters with tiered pricing functionality.
- Upgrade Ticket Vending Machines (TVM) to accept greater payment options.
- Expand public transit payment options to accept online payment processing.
- Partner with Fresno State to establish a Bikeshare pilot program.
- Install high tech bike racks throughout the City.

These objectives will be monitored and evaluated by tracking metrics such as the number of WiFi users, strength and speed of WiFi connections, project status updates, user analytics, validity testing, thematic analysis of customer comments, parking meter installation, bikeshare and bike rack use, and tiered pricing outcomes.

Goal #3

Leverage Urban Analytics to inform public and private decision making and foster innovation and entrepreneurship. Corresponding Vision Element(s): 2, 4, 6, 7, 11 and 12

Objectives to achieve measurable goal #3:

- Install hardware and software upgrades needed to secure data.
- Follow data-cleansing and security procedures to ensure privacy.
- Compile and release transportation data generated by ITS infrastructure, transit software upgrades and parking improvements to the public.

These objectives will be monitored and evaluated by tracking the type of data released and web download analytics. Partners will also be engaged in sharing outcomes resulting from access to city data.

Goal #4

Increase the use of urban automation and expand connected vehicle capabilities through investment in transit infrastructure.

Corresponding Vision Element(s): 1, 2 and 4

Objectives to achieve measurable goal #4:

- Install Mobileye's Shield+ equipment on City of Fresno FAX buses.
- Upgrade FAX GPS mobile data terminals.
- Utilize passenger transfer interfaces to connect to Fresno County Rural Transit Agency.
- Include communications technologies along Bus Rapid Transit, Shaw Avenue and Cedar Avenue corridors to utilize vehicle to infrastructure (V2I) preemption equipment to expedite public transit routes.
- Deploy V2I DSRC pilot technology along Blackstone Avenue.

These objectives will be monitored and evaluated by tracking FAX route timing and travel patterns and signal synchronization patterns.

Goal #5

Increase the use of electric vehicles (EV) for private and public transit by increasing Fresno's charging infrastructure and electric fleet by an average of 50%, and encouraging EV use in micro-transit.

Corresponding Vision Element(s): 8

Objectives to achieve measurable goal #5:

- Provide greater infrastructure to charge vehicles through the installation of charging stations at 5-10 locations within the city.
- Replace 30% of vehicles in Parking Services and 60% of FAX support vehicle fleet with electric vehicles.

These objectives will be monitored and evaluated by tracking the number of stations installed, baseline and long-term use reporting, The Department of Energy's AFLEET calculation tool, and any other relevant charging records.

12. Provide evidence that establishes your capacity to take on a project of this magnitude, including executive commitment, workforce capacity, degree of infrastructure readiness, data and performance management capabilities.

The City of Fresno has a comprehensive staffing structure in place made up of highly skilled executives, engineers, information technology experts, transportation and planning teams which equip the City to take on a project of this magnitude. Executive, management and technical staff across City Departments have been engaged in the preparation of this proposal, and will be fully involved in transforming the City of Fresno into a Smart City. Represented departments include: Public Works, Transportation, Information Services, Development and Parking. Workforce capacity exists through teams of designers and project managers who currently oversee the City's capital projects, have well established systems in place and regularly advance projects from concept to completion. Over the last two fiscal years, the Department of Public Works alone has delivered over \$16.5 million in intelligent transportation systems, road maintenance and active transportation capital projects.

The City of Fresno Information Services Department (ISD) manages large amounts of data successfully, and has the capacity to accommodate Smart City needs. ISD is broken down into four key divisions including Administration, Communications, Computer Services, and Systems and Applications. These divisions have the technical expertise to manage telecommunication, network infrastructure, AS/400 operations and traffic operations, enterprise-wide applications, database administration, GIS and web development.

A more synchronized traffic system throughout the entire city provides the foundation of our Smart City vision. ITS infrastructure to accomplish each of the vision elements and goals included in this plan is under development, meets industry standards and can be leveraged to advance the proposed objectives. The City of Fresno Department of Traffic Engineering has gained extensive experience in synchronization projects, and is currently overseeing construction on 12 corridors spanning 58.5 miles with a projected emissions reduction of 225,255 lbs per year.

Where infrastructure is currently unavailable, extensive feasibility studies, white papers, requests for proposals, reports and long-range plans provide well researched and informed "next steps" for infrastructural improvements. For cutting edge technologies, the combined years of experience within the City of Fresno department leadership and well established stakeholder relationships provide the kind of expertise needed to pave the way.

13. Describe any opportunities to leverage Federal resources through cost share, in-kind donations, and partnering.

The City of Fresno maintains a substantial portfolio of federally funded projects which are currently changing the transportation landscape across Fresno. Past and current projects have laid the foundation for many of the vision elements in this proposal. The City of Fresno plans to explore partnerships with local universities to support bike share efforts, and leverage existing partnerships to maximize funding. Please find attached to this application numerous letters of support from partners in the public and private sectors.