MEMPHIS USDOT SMART CITY CHALLENGE

Application for U.S. Department of Transportation

Notice of Funding Opportunity Number DTFH6116RA00002

"Beyond Traffic: The Smart City Challenge"

by

City of Memphis, Tennessee

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1.   Define your vision for your Smart City.

The Smart City Challenge will help the City of Memphis create new partnerships and deploy emerging technology to lower the net transactional cost of travelling around a city that is geographically over-built and has a sparse population. Through this challenge, Memphis will further develop its current infrastructure, systems, and plans to better use automation and analytics to shrink the impact of this sprawling environment. Memphis will partner with global industry leaders including FedEx to develop and implement an advanced, interconnected, smart, safe, convenient and sustainable transportation system demonstration to overcome the geographical mismatch between jobs and workers within a specific region of the city. Resources available through this grant can fundamentally change Memphis, increasing the quality of life and productivity of its citizens while decreasing their cost of living.

In Memphis, public and private sectors are rallying around transportation choices and particularly transit like never before. Memphis is pursuing cutting edge technology, data, and innovation to move people, driven by the same urgency with which a package moves from Memphis to anywhere in the world in eight hours or less. Memphis has the brightest minds in transportation and logistics at FedEx and is forming new public-private partnerships to help solve its transportation challenges. Top leadership within all sectors – public, private, higher education, philanthropy, and community advocates – are committed to the Smart City Challenge and proving what improved and integrated transport and logistics can mean to a mid-sized U.S. city. To that end, we have created the Memphis Smart City Transportation Alliance to coordinate the proposal and hopefully implementation of the Smart City Challenge. Partners in the Alliance include: FedEx, MATA, and the University of Memphis (see #7 for the full list of partners). As a city, as a community and as a global leader in transport and logistics, Memphis is primed for the Smart City Challenge.

Memphis' vision is for people, packages, traffic, and cargo to move non-stop through a seamless technologically-connected system. This transportation system encompasses all modes and features a public transit system that includes a fleet of vehicles both publicly and privately owned that connect people regardless of age, income, and physical ability. The system will grow purposefully to improve mobility and access to jobs, decrease pollution and the use of single occupancy personal vehicles, make roadways safer for all users, and reduce the inefficient movement of traffic and freight. It will connect all Memphians with the goods, the destinations, and community they seek.

A user will be able to utilize smart phones or other hand-held devices to plan, purchase, and track trips from origin to destination in a safe, cost-effective manner using multiple modes such as bus, bike, Uber, or taxi. Using real-time information on smart devices enables tracking the arrival of the next scheduled bus or taxi to get people from home to work or confirm that a bike share or Zipcar will be available upon their arrival downtown.

To accomplish this vision, Memphis will work to address two significant challenges: 1) overcoming the geographical disconnect between where Memphians live and where they work; and 2) developing ways for goods to slip quietly and cleanly into and out of the city.

These two challenges are uniquely interrelated in Memphis. Memphis is America's distribution center and is the global leader in transportation, distribution, and logistics. In 2014, Memphis International Airport ranked as the number one airport in the U.S. in landed cargo weight and number two globally. Memphis is home to five Class I railroads, the fourth-largest U.S. inland port, and the connection between four interstate highways.

The strength of Memphis' transportation, distribution, and logistics industries is demonstrated by the city's location quotients (the relative distribution of employment locally versus the national average, Table 1). Memphis has 10.7 times the national average of the distribution of employment in couriers and messengers, almost 3.4 times as much in warehousing and storage, and 2.4 times as much in truck transportation.

2014 Memphis MSA Location Quotients -Transportation, Distribution, and Logistics

Industry	Location Quotient	Total Employment
NAICS 492 Couriers and messengers	10.70	26,424
NAICS 493 Warehousing and storage	3.38	10,949
NAICS 483 Water transportation	2.49	739
NAICS 484 Truck transportation	2.41	14,852
NAICS 488 Support activities for transportation	1.97	5,344

Location Quotient: Ratio of analysis-industry employment in the analysis area to base-industry employment in the analysis area divided by the ratio of analysis-industry employment in the base area to base-industry employment in the base area.
Source: Quarterly Census of Employment and Wages, U.S. Bureau of Labor Statistics.

And yet, Memphians struggle to reach the job opportunities that the logistics economy presents. Only 20% of Memphis residents can access the typical job in under 90 minutes using transit. Overall, 11,000 jobs in the Memphis metro area remain unfilled. Sprawl and suburbanization of job centers have led to a mismatch between where our citizens live and where they work. And while the logistics industry represents an opportunity for growth and new employment, its location at the city limits augments the geographical challenges that we face in connecting unemployed Memphians with work.

Those challenges are critical in a city with a poverty rate of nearly 30% and an unemployment rate that's the second highest among major U.S. metros (population of one million or more). Memphis tops city rankings for household income spent on transportation (24%). However, these challenges can be overcome. Connecting Memphians with just half of the city's unfilled jobs

would reduce unemployment by 1%. Filling all of the unfilled jobs would boost our employment ranking to 20th out of the 51 major U.S. metros.

Among the nation's largest metro areas, Memphis ranked 5th most dangerous for pedestrians. Transportation for America, a national traffic safety coalition, released a study in 2014 ranking the danger to pedestrians in the country's metro areas. It ranks each city on its Pedestrian Danger Index. The PDI is based on the relationship of pedestrian fatalities to the percent of residents walking to work. The largest number of pedestrian deaths in Memphis was 30 in 2013. Last year, 23 pedestrians were killed. On average, 15 pedestrians are killed each year in Memphis.

Grant funds will be used to develop a demonstration project in the proposed study area that improves access to employment through flexible transit services as well as to enhance the efficiency of goods movement. Access to modern, flexible transit services will also allow residents to utilize local activity nodes providing a variety of personal and leisure services. Memphis must improve the movement of both people and goods; this will be accomplished through the following efforts:

1. SMART NETWORKS: Lay the groundwork for a future-forward, sustainable transportation network that includes electric / alternative energy vehicles, autonomous trucks and a comprehensive fiber optic/Bluetooth and sensor network
2. MULTIMODAL DYNAMIC TRANSIT OPERATIONS: Create an innovative program and rider-centric application that allows residents to seamlessly combine multiple public and private transportation options for more efficient and cost effective transportation
3. TRANSPORTATION AIDED PROGRAM: Develop a real-time interface for transportation and logistics providers to proactively and collaboratively respond to transportation needs and challenges, such as traffic congestion. Implement an intelligent routing system for moving people and goods across the city
4. TRANSPORTATION INFORMATION WAREHOUSE: Develop a robust data infrastructure that enables all stakeholders to make more informed routing, planning and investment decisions
5. COMPLETE STREETS INFRASTRUCTURE: Invest in data-driven safety and infrastructure improvements that facilitate walking, biking and shared or public transportation usage

2. *Describe the population characteristics of your city.*

The City of Memphis is a prime example of a U.S. mid-size city both in its demographic characteristics and the challenges it faces in meeting the transportation needs of its population. In addition to being a typical example of a mid-sized U.S. city, the City of Memphis also struggles with a poverty rate of 27.4% and unemployment of 6.1%, both above the national averages of 14.8% and 5.0%. (Census ACS 2010 – 2014, BLS November 2015). These

characteristics make Memphis an excellent choice for the U.S. Department of Transportation's Smart City Challenge.

The USDOT defines a mid-size city as having a population between 200,000 and 850,000 people. The City of Memphis' population is 646,889. The USDOT is seeking a city that has the appropriate density to implement a Smart City initiative. There are 95 cities in the 2010 Census that have populations that fall between the range of a mid-sized city as defined by the USDOT. The median density of these 95 cities is 3,218 people/mile. The population density of the City of Memphis is 2,054 people/mile. (Census 2010)

While lower than the median, the density reflects the sprawl that Memphis and many other mid-sized cities face and will continue to face. This lack of density creates the demand for new technology to meet the transportation needs of populations where traditional public transportation strategies found in large densely populated urban cities has fallen short.

Memphis is home to FedEx World Headquarters and its Distribution Center and a BNSF Intermodal Facility located in a transportation related employment center in the southern portion of the City. The FedEx Distribution Center is located at the Memphis International Airport, which is the world's second busiest cargo airport according to Airport Council International. The proposed study area consists of seven zip codes that create a corridor in the southern portion of the City. The corridor encompasses this transportation-related employment center and a population of 190,061, 29% of the City's population. (Census 2010) This corridor makes up 37% of the City's primary employment, 31% of which is associated with transportation and warehousing. (Census, LEHD, 2013)

The study area is currently served by several bus routes with the Winchester Road bus route serving as a primary public transportation corridor running through the center of the study area. The Memphis Area Transit Authority (MATA) operates two public transportation centers located within the study area, the Airways Transit Center and the American Way Transit Center. Dedicated bike lanes have been added in the past five years. The western portion of the study area also includes the Pidgeon Industrial Park where a future industrial and transportation-related employment center has been planned.

The City of Memphis and the demonstration study area provide an excellent case study and opportunity to develop a Smart City transportation initiative that can be replicated in other U.S. mid-sized cities. This is due to Memphis' demographic characteristics and the transportation challenges that occur in mid-size cities with low density. New technologies and strategies will be used to address transportation barriers contributing to poverty and unemployment in Memphis.

3.   *Describe the characteristics of your city and show how it aligns with the USDOT's characteristics of a Smart City.*

a. *Existing public transportation system;*

MATA provides public mass transportation in the City of Memphis, as well as portions of the City of Bartlett and Lakeland (Paratransit Service), City of Germantown, and unincorporated Shelby County, Tennessee. MATA's mission is to provide a reliable, safe, accessible, clean and customer-friendly public transportation system that meets the needs of the community. MATA provides fixed route bus and paratransit services throughout the service area, and rail trolley service in the downtown area. The Fixed Route bus system operates 365 days a year on 32 routes with annual ridership of about 7.9 million passengers. MATAPlus Paratransit service for individuals with disabilities operates in the same areas and the same times as fixed route service. MATA's trolley shuttle service operates along seven miles of track in downtown and midtown Memphis.

MATA has faced several challenges in recent years; a stagnating or even shrinking budget, an overbuilt service area, a growing spatial mismatch between low wage workers and employers, and a political environment that has historically favored auto-centric transportation planning. However in recent years there has been a promising shift, as more Memphis residents and city officials see transit as an essential component for making Memphis a thriving, economically competitive city. In the last ten years MATA obtained funding for several studies with the purpose of improving the quality of service, including a five year Short Range Transit Plan and a Midtown Alternatives Analysis exploring the implementation of Bus Rapid Transit. MATA has also been part of regional planning efforts, including the 2040 Regional Transportation Plan, the Aerotropolis Plan, and the MidSouth Regional Greenprint's Transit to Workplace study.

MATA is also actively pursuing more local funding. MATA recently applied for Surface Transportation Program (STP) funds in the Memphis Metropolitan Planning Organizations (MPO) 2017-2021 Transportation Improvement Program (TIP) for more buses and for "superstop" locations. MATA is actively collaborating with the City of Memphis, community transit advocates, and other partners to produce a white paper exploring possible sources of dedicated funding for transit, including local taxes and fees that could increase local funding for transit operations and capital improvements. The collaboration occurring between the city, MATA, and other community groups shows a growing local commitment to support public transit as an integral part of the city's transportation system.

MATA Quick Facts

Number of employees	446
Service area	338 square miles - 755,141 population
Annual Bus ridership	7.9 million passenger trips
Annual Trolley ridership*	0*
Annual MATAPlus Paratransit Service	232,601 passenger trips

ridership

Vehicles Operated in Maximum Service

Mode	
-Bus	108
-Demand Response	42
-Street Car Rail*	0
Total	150

*In 2015, rail trolley service was temporarily discontinued for maintenance reasons, and trolley buses are currently being used in their place.

Approximately 30.0% (45 of 150) of MATA's vehicle fleet utilize diesel hybrid-electric technology.

b. *Environment that is conducive to demonstrating proposed strategies;*

Memphis has a history of entrepreneurship and innovation. Many now world-famous businesses started or grew in Memphis such as FedEx, AutoZone, and Holiday Inn. Memphis was selected in the first round of cities to incubate a Bloomberg Innovation Delivery Team (Innovate Memphis) that helped grow a culture in city government of risk tolerance and willingness to test creative strategies to address persistent problems. In Memphis there exists a robust ecosystem of public private partnerships within sectors of government, philanthropy, business, and higher education that encourages quick, coordinated action to get things done. Examples of this coordinated partnership include the recent large-scale planning and implementation efforts like the Airport City Master Plan, MidSouth Regional Greenprint and Sustainability Plan, and resilience planning as a part of HUD's National Disaster Resilience Competition (NDRC) which have all proven effective in getting buy in from all sectors.

The proposed grant demonstration area has a concentration of logistics, distribution, and transportation jobs. The area lacks frequent transit service but has good access to two transit hubs and residential areas. Large employers in the area have the motivation and will to work with public partners to solve the puzzle of getting more of citizens to jobs, reducing vehicle miles travelled, and preventing traffic and freight congestion.

MATA and the City of Memphis have begun building a system of ITS infrastructure that is the backbone of a Smart City. MATA is partnering with private entities such as Uber, TransLoc, and others to provide customers more flexible, on demand service.

MATA is at the forefront of partnering with technology companies that are revolutionizing the transportation industry. In 2015, MATA launched TransLoc Rider, which allows transit users to see in real time where the bus is and when it will be arriving at the designated stop. TransLoc is a transportation technology company founded in 2004, whose products include

Rider mobile app (available in the iOS App Store or on Google Play), RealTime control center, Traveler visualization and planning tool and OnDemand automated demand-response system. TransLoc Rider is the official app for 135 municipal, university and corporate agencies.

MATA is part of a pilot project in partnership with TransLoc and Uber to integrate Uber and transit services. This launch will take place in Memphis in mid-February, and is one of only two places nationally (Memphis and Durham, NC) that will be piloting this project. The new Rider app will allow users to simply input their destination and receive a personalized journey that incorporates the optimal combination of walking, transit, and Uber. This is the first step in a new user-centric approach to transportation, allowing users to make use of multiple modes of transportation quickly and easily. This partnership will be a crucial foundation for building flexible, on demand transit service in Memphis, improving reliability of service for existing riders and making it possible for more people to go car free or car light.

MATA also has a long standing history working with Premier Transportation, Memphis' largest cab company. Premier was the original provider of MATAplus paratransit [called Handilift]. MATA has used Premier to test proposed route extensions before making them permanent, or determining their feasibility on a short term contract, under very flexible terms. Premier has also twice been selected as a sub-recipient for New Freedom funds to purchase wheelchair accessible vehicles. These funds allow Premier the ability to accommodate on-demand requests that MATAplus' reservation requirements exclude, to supplement service during MATAplus vehicle shortages or breakdowns, or in the event of broken lift/ramps on a main line bus. The partnership with Premier, with its fleet of wheelchair accessible vehicles will be a valuable resource in the implementation of the Smart Cities grant.

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

Leadership in all sectors recognizes that Memphis will not reach the level of economic growth and prosperity its citizenry deserves without addressing its transportation challenges. New Mayor Jim Strickland was sworn in for a four-year term on January 1, 2016. Before taking office the new Mayor's incoming executive team was working with leadership of the Greater Memphis Chamber, FedEx, MATA, and the University of Memphis to aggressively compete for this Smart City Challenge.

The City of Memphis, University of Memphis, and MATA have a long history of collaboration with each other on transportation and many other civic issues. Each has experience in managing millions of federal grant dollars. The City of Memphis Law Division

has a grants compliance department to ensure all milestones and targets are met in a timely manner and most divisions of government have grants management staff.

All partners in the Memphis Smart City Transportation Alliance (currently FedEx, the Greater Memphis Chamber, University of Memphis, Metropolitan Planning Organization, Innovate Memphis, Memphis Area Transit Authority, Memphis Light Gas and Water, City of Memphis, Memphis and Shelby County Airport Authority, Memphis and Shelby County of Planning and Development / Office of Sustainability, and the Shelby County Health Department Pollution Control) formed in response to the Smart City Challenge have the staff expertise to execute the demonstration and strategies proposed herein. All partners are committed to continue collaboration and build upon the elements of a Smart City to successfully launch the Memphis demonstration.

d. *A commitment to integrating with the sharing economy;*

Memphis is committed to enabling the sharing economy to make life better for its citizens and visitors. Uber and Lyft operate in the City of Memphis including providing service to Memphis International Airport. Negotiations are underway with a selected vendor to launch bike share in Memphis in 2016. Zipcar has a presence in Memphis and will soon expand to serve more parts of the city. MATA is partnering with Uber and TransLoc to make the transit system better able to serve and communicate with riders. Memphis participates with the Shared-Use Mobility Center (SUMC), a public-interest organization working to foster collaboration in shared mobility (including bike sharing, car sharing, ride sharing and more) and help connect the growing shared mobility industry with transit agencies, cities and communities across the nation.

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

The City of Memphis is committed to providing accessible open and machine-readable data to the public to fuel entrepreneurship and innovation. Partners of the Memphis Smart City Transportation Alliance will be governed by Memorandums of Understandings (MOUs) which outline the datasets, frequency of data updates, and service level agreements surrounding the collection and dissemination of the data for the demonstration project.

4. Provide an Annotated Preliminary Site Map
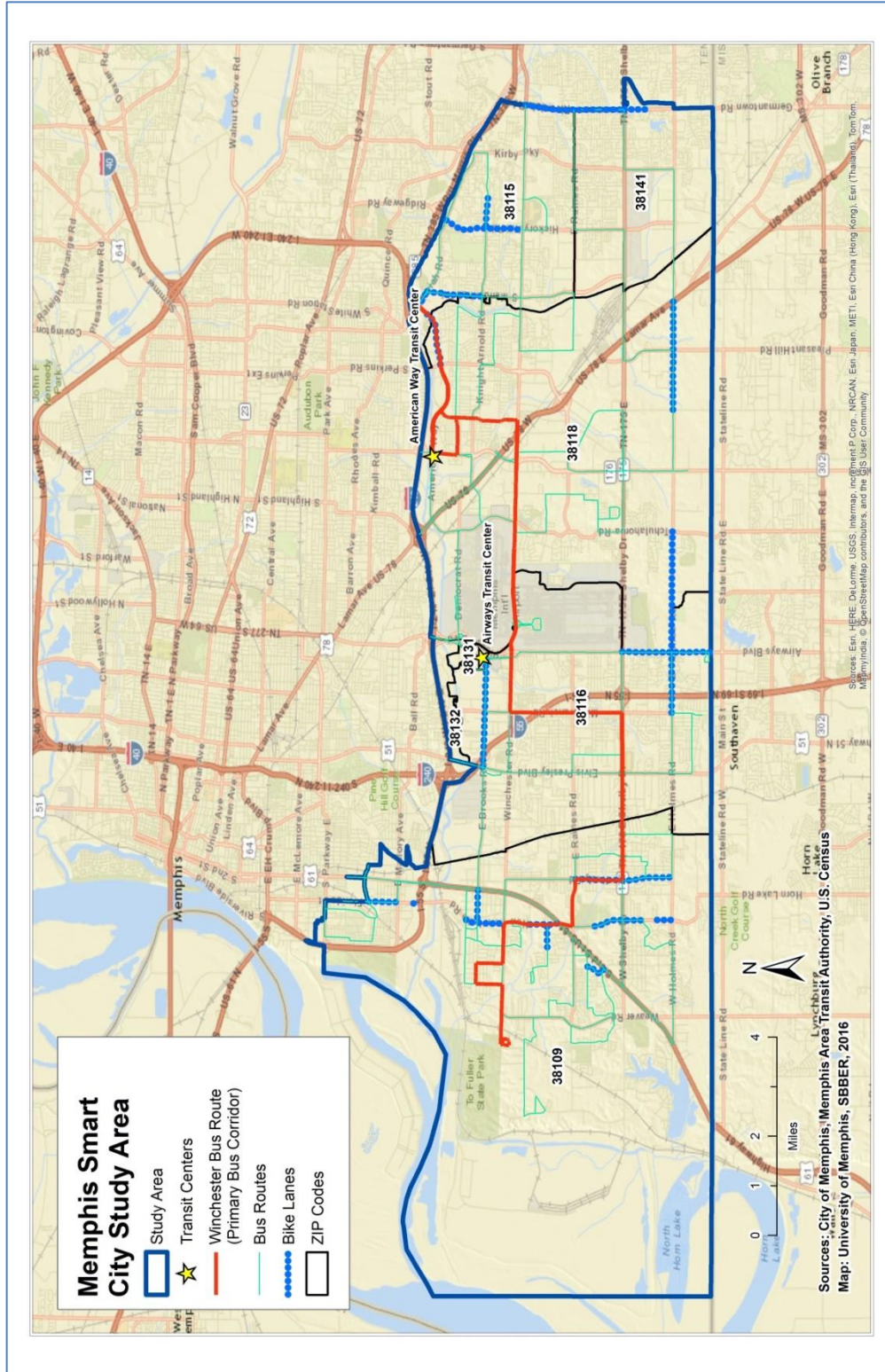
5. *Describe how your holistic, integrated approach aligns to the twelve USDOT vision elements described in this solicitation.*

CONNECTING PEOPLE AND PLACES

The logistics industry is vital to Memphis' economic base; the challenge the city faces is how to connect low-income, transit-dependent people to jobs in this sector. Logistics jobs in the proposed demonstration area are hard to serve by traditional fixed-route transit (buses). These jobs tend to be off-peak hour shift times and are often filled through temp agencies – factors that make it difficult for workers to coordinate transportation. The warehouse employment destinations are on large lots and located far from the street. A poor pedestrian environment makes it difficult for transit users to get from stops to the employment destination.

Funds available through this grant will begin the construction of a Multimodal Dynamic Transit Operations (MDTO) application that provides innovative, flexible transit services and multimodal electronic payment systems. This application will allow travelers to request trips on-demand using a handheld mobile device or a computer. This app would act as a trip planner that evaluates individual travel preferences (for instance, fastest or cheapest route) against network conditions to recommend ideal journeys. The app would cover multiple transportation services (public transportation modes, private transportation services, shared-ride, walking, and biking), and allow users to pay for their entire trip electronically or with a smart card. MATA would also install trip scheduling kiosks with multiple payment options at key nodes throughout the area, such as transit centers, shopping centers, employment centers, and transit super stops, to better accommodate transit users who do not use mobile phones or electronic payment methods.

To implement this dynamic, on-demand transit service, MATA will partner with Uber, TransLoc, local employers and Transportation Management Associations (TMA), and local bike shares to develop a fleet of transportation options. Residents in the demonstration area will be part of the design process to ensure the needs of transit user are taken into account when creating both the app and overall transit experience. MATA will also develop the optimal mix of fixed stops and routes, on-demand direct service transit, and partnerships with private transportation companies, and refine this data based on origin destination data collected from users of the app. This application builds on MATA's existing ITS systems, including Computer Aided Dispatch and Automated Vehicle Location (CAD/AVL) systems and automated scheduling software, as well as connected vehicle technology that would allow transit vehicles and private partners to respond and continually modify their routes and trips to meet demand.

It is anticipated that users will take traditional transit services to get to transit centers located in the study area, though this will be further validated with the community. By integrating GPS, mobile data terminals, web-based payment, data analytics, and real-time dynamic scheduling, smaller flexible shuttles will respond to move customers from the transit centers to their job destinations.

To address pedestrian safety, an issue that will grow in importance as use of personal vehicle decreases and more people walk or bike for part of their transportation journey, the City of Memphis will prioritize pedestrian safety improvements to infrastructure where data indicates the highest level of pedestrian and bicyclists, or in areas with where there are high volumes of transit trips originating. Memphis will also explore using the Bluetooth and fiber optic network of traffic signals to integrate smart infrastructure applications to warn pedestrians on their mobile apps, communicate the presence of pedestrians to connected vehicles, and even give preference to pedestrians at certain intersections.

MOVING GOODS EFFICIENTLY

Memphis' position as a freight-centric community signals the critical need to address congestion and safety caused by extremely high truck and rail volumes. The Port of Memphis is one of the nation's largest inland ports with a concentration of warehouse/distribution centers, and it supports major trade routes of national significance that traverse the area. An additional consideration is the high volume of truck traffic and the challenge of delivering goods in the urban area.

Memphis will immediately begin to use enhanced sensor technology to optimize network flows. Basic starting elements include the existing "Smart Way" system operated by the Tennessee Department of Transportation on the region's freeway network and the Bluetooth network currently being installed on key surface streets. These networks will provide real-time traffic information to improve reliability and reduce delays. The networks will be expanded and linked together to provide advanced traveler information to commercial vehicle drivers through the Transportation Aided Program (TAP). In addition, using approaches based on the Freight Advanced Traveler Information System (FRATIS) platform, trucks will be provided with information to select optimal routes and times to utilize the roadway network. The use of electric or alternative fuel vehicles to perform the drayage movements will be explored. In addition, for certain repetitive routes that are off the major roadway network the use of autonomous trucks will be investigated and tested.

The realization of the City's approach through the application of new and existing technologies will smoothly integrate with the following Vision Element Statements:

1. Urban Automation:

   Memphis will aid implementation of driver-assisted automated vehicles in the demonstration area by developing an interconnected transportation infrastructure sensor device network. This network will provide drivers with real time transportation data to influence the routing and dispersal of vehicles. Private transportation companies and individual transport providers could also utilize this Transportation Aided Program (TAP).

2. Connected Vehicles:

The data infrastructure and TAP will allow for the connectivity of commercial and private vehicles through existing technologies, such as fiber optics, Wi-Fi, Wireless, LTE, and Bluetooth technologies. The vehicles that participate in this program consume data and information and return their own data for research and analysis. These additional data elements will allow for the analysis of traffic patterns, and movement elements. Alerts and notices will also be published through the TAP to allow drivers to adjust their routes. Connected vehicle technology will also enable public and private transportation carriers to respond immediately and seamlessly to demand and coordinate with each other. Other travelers can plan their trip and pay for multiple modes in one easy electronic payment.

3. Intelligent Sensor-based Infrastructure:

Memphis will design, implement, and expand sensor-based infrastructure gathering information on vehicle, bicycle, and pedestrian traffic. The sensor data will be housed in a centralized data repository, known as the Transportation Intelligence Warehouse (TIW). The City proposes to build upon the existing fiber optic infrastructure already deployed in support of the Intelligent Traffic System network and the University of Memphis's Internet 2 network. The University will serve as the central clearinghouse for our data collection efforts and will be responsible for the care and maintenance of the clearinghouse technology.

4. Urban Analytics:

The combination of the previously identified sensor network and the TIW will allow the City to provide a data-rich environment through the TAP and other applications developed by other public and private groups or individuals. The TIW will also allow University of Memphis researchers, FedEx, and others to access information that was not previously available. This information will provide research opportunities to enhance and develop new traffic algorithms from which Memphis and other cities will be able to route public, private, and commercial traffic. Through the analysis of traffic and weather patterns, the City of Memphis can send alerts or requests to limit movement in specific locations, which will help to reduce emissions.

5. User-Focused Mobility Services and Choices:

The system of Multimodal Dynamic Transit Operations is a user-focused system that will make it easier for travelers to plan their trips, simplify payment, and make it easier for more people to reduce car usage. Payment stations and monitors, and/or the use of payment cards will also make these transit options accessible to people who do not use smart phones or electronic payment methods. The system design will incorporate input from residents and employers in the demonstration area to insure the solution is intuitive

and effective. This will not only yield a better design, but also help us to recruit early users.

The development of the TAP and TIW provide the infrastructure and data elements necessary for Memphis citizens and leaders to make strategic and tactical transportation choices. Tactical choices may include whether to use mass transit, private commercial transportation, or other choices such as ride share or bike share. This technology can be deployed at existing bus stops, libraries, and community centers for citizens to "call" for a variety of transportation options.

6. Urban Delivery and Logistics:

   As mentioned in Vision Element #4, the TAP and TIW components will allow for transportation, delivery, and logistical providers to implement new delivery modes and efficient routes that will utilize real time data to reduce idling and decrease carbon emissions. Memphis has a dense freight and logistics corridor in the demonstration area. Memphis proposes to test intelligent routing of freight and logistic vehicles, as well as utilizing the urban automation elements mentioned previously to transport workers to and from their place of employment.

7. Strategic Business Models and Partnering Opportunities:

   The City of Memphis is connecting with private and public entities in support of this demonstration. Partners include but are not limited to FedEx, BNSF, Memphis Area Transport Authority, Memphis Light Gas and Water, University of Memphis, Memphis Chamber of Commerce, and The FedEx Institute of Technology at UofM. This collaboration will be able to expand to include new partners. The City of Memphis has had initial discussions with technology providers and vehicle manufacturers to deploy cutting edge technology to provide a unified transportation ecosystem.

8. Smart Grid, Roadway Electrification and Electric Vehicles:

   Through the development of a unified transportation ecosystem Memphis proposes to deploy an infrastructure that builds upon and expands the existing Intelligent Transportation System and Smart Grid environment to provide real time information. For example, based on location-aware technology and sensors, the system will inform EV drivers of the distance and time to the next EV charging station. Memphis also plans to build and deploy EV charging stations at public locations such as libraries, community centers, parks, fire stations, and police precincts.

9. Connected, Involved Citizens:

   The TAP and TIW infrastructures connect citizens and allow their active involvement in their transportation choices. Many citizens in the demonstration area have historically not had a voice in how their neighborhoods have developed. This effort will give citizens,

particularly those without personal vehicles, more choice and control in their daily lives. For example, as a citizen gets ready to leave their apartment or home, they can access the TAP and view which transportation options are available for their use. They will be able to see estimated arrival times for mass transit and whether a ride share vehicle or bicycle are available. The TAP and TIW will let citizens and citizen's groups communicate and provide direct feedback on services and operations. In addition to allowing travelers to plan and pay for multimodal trips on demand, the app used for the MDTO will also offer opportunities for citizens to provide feedback or report current travel conditions.

10. Architectures and Standards:

The TAP and TIW infrastructures will be designed using existing frameworks such as the National ITS Architecture, Connected Vehicle Reference Implementation (CVRIA).

11. Low-Cost, Efficient, Secure and Resilient Information and Communications Technology (ICT):

Through the development of our interconnected transportation environment Memphis will use the National Institutes of Technology (NIST) framework when designing and deploying the technology and infrastructure. Memphis intends to deploy solar technology as the primary and, if applicable, the secondary method to power deployed technology elements. This is an example of how resiliency will be built into this demonstration. Another example is to install redundant communication paths utilizing fiber optic and wireless technology.

12. Smart Land Use:

Our newly designed transportation environment will be layered into future plans and existing neighborhood master plans and regulations, including the Aerotropolis Plan and the Unified Development Code (UDC), a form-based code that allows higher density mixed-use development and incorporates land subdivision regulations and zoning into a single document. This will assist in planning and development for new areas and the redevelopment of blighted areas. For example, enhanced transportation offerings will increase the desirability of a neighborhood, encourage infill development, and discourage urban sprawl. Data about high concentrations of pedestrians or large volumes of trip requests will also enable the city to focus its efforts in building infrastructure that improves pedestrian and bicycle safety using Complete Streets principles and guidelines already adopted by the City of Memphis.

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

Risk is inherent when adopting a slew of new technologies. In the demonstration, risk will be lessened by the sensor research specialty at the University of Memphis and the expertise offered

by FedEx. Other risks include incurring cost of future system maintenance, future liability associated with automation, traffic network hacking, and compromise of city network. Policies must be constantly reviewed and updated to adequately address concerns such as privacy, data governance, guidelines for providing open data, and addressing security concerns.

7. *Outline team partners, key stakeholders, and demonstration governance processes.*

The Memphis Smart City Transportation Alliance is the working group advancing this proposal and shall stay in place to implement solutions in the demonstration area and eventually on a citywide scale. Current Alliance members are FedEx, the Greater Memphis Chamber, University of Memphis, Metropolitan Planning Organization, Innovate Memphis, Memphis Area Transit Authority, Memphis Light Gas and Water, City of Memphis, Memphis and Shelby County Airport Authority, Memphis and Shelby County of Planning and Development / Office of Sustainability, and the Shelby County Health Department Pollution Control. Other partners in future may include employers partnering in a Transportation Management Association in the demonstration area, transportation companies providing additional service in the demonstration, and groups that have worked on past Memphis planning efforts such as Nelson/Nygaard and Center for Neighborhood Technology. The Alliance will be governed by a board with a representative from each partner organization appointed to serve. The board may adopt rules, hire staff, and enter contracts necessary to advance its mission to monitor the demonstration project, ensure strategies are implemented, metrics are tracked, and program design is constantly evaluated and revised when necessary.

8. *Describe existing transportation infrastructure and system features in your city.*

a. Arterial miles: 511
b. Freeway miles: 63, Other roads miles: 2,108
c. Transit services

The Memphis Area Transit Authority (MATA) provides public mass transportation in the City, and portions of the City of Bartlett and Lakeland (Paratransit Service), City of Germantown, and unincorporated Shelby County, Tennessee. A contract service is also operated in the City of West Memphis, Arkansas. MATA provides fixed route bus and paratransit services throughout the service area, and rail trolley service in the downtown area. Annual ridership is about 7.9 million passengers. The Fixed Route bus system operates about 7.6 million miles annually on 32 routes. Service is available 365 days per year. The span of service is 4:30 a.m. to midnight on weekdays; 4:30 a.m. to 10:30 p.m. on Saturdays; and 7:00 a.m. to 7:30 p.m. on Sundays and Holidays. MATAPlus Paratransit service for individuals with disabilities operates in the same areas and the same times as Fixed Route service. Paratransit service runs about 1.7 million miles per year. MATA's Trolley shuttle service operates along seven miles of track in downtown and midtown Memphis. The span of service is about the same as the Fixed Route system with slightly later service on Friday and

Saturday nights. The lines serve numerous restaurants, retail stores, and attractions throughout downtown.

MATA uses Genfare Inc. (GFI) software for its current fare box systems (http://www.genfare.com/). The last software update that MATA installed was 2008. MATA has been using CENTSaBILL fare collection hardware for over 25 years. The current system is a non-validated system, which means it accepts bills but cannot distinguish between different bills. The fare box system accepts cash, exact change only, and will not make change. In 2000 it was upgraded with the Ticket Reader/ Issue Machine (TRiM), and is now equipped with a magnetic swipe pass reader that allows riders to purchase and use one day, three day, weekly, and monthly passes.

d. Shared-use mobility services:

Zipcar offers car-sharing services in Memphis, serving downtown, Rhodes College and the adjacent neighborhood, and Memphis International Airport. Zipcar has nine cars as of February 2016 and will expand to 20 cars by March 2016. The City of Memphis supports car sharing services by providing on-street reserved parking spaces.

Explore Bike Share has raised private funds to pursue the local implementation of bikeshare with coordination from the City of Memphis (http://www.explorebikeshare.com/). The organization is on track to have a public bikeshare system fully operational in 2016 that will feature 60 stations and 600 bikes. The University of Memphis offers a bike-sharing system for its students.

Transportation network companies Uber and Lyft are both in service in Memphis. Memphis' partner TransLoc will launch its transit partnership with Uber in February 2016, one of two pilot markets nationwide.

d. Information and communication technology (ICT)

The City of Memphis is nearing completion of an ICT/ITS Signal System Project (SSP) interconnecting 439 Traffic Signals and 188 system detectors. The SSP network allows staff to remotely communicate with interconnected traffic signals to monitor, diagnose, and maintain local traffic controller operations from the City Hall Traffic Management Center (TMC). The SSP network also allows operations staff to coordinate signal timing to improve travel time and coordinate the traffic flow while traveling major routes in Memphis.

We have deployed sixty-six of the SSP detectors, which track Bluetooth signals and MAC addresses in smart phones, headsets, music players, and many newer cars from point-to-point. This initial deployment allows the City to determine travel times, speeds, origin and destinations within the Bluetooth network, route patterns, and trip lengths. Real-time data collected allows seeing changes in travel speeds (indicating an incident). Data on average

travel speed, travel time, and Origin/Destination trends will be shared with the public, through our open data portal.

MATA is part of a pilot project in partnership with TransLoc and Uber to integrate Uber and transit services. The TransLoc system tracks vehicles in real time from GPS data and provides arrival predictions and transit information on the web through an open API, and with the Rider app on Android and IOS devices free of charge. TransLoc also offers the option for transit agencies to access anonymized origin and destination data, although this service has not yet been utilized by MATA due to cost. The app also allows users to set alerts to let them know when a bus is arriving, and allows transit operators to post announcements to notify users about delays or other changes in service.

e.   Intelligent Transportation Systems (ITS) including transportation management centers and field equipment:

City of Memphis Division of Engineering is in the later stages of a 120 mile fiber optic ITS/Signal System Project, which will, interconnect approximately 439 Traffic Signals and 188 system detectors. This ITS network will allow staff to remotely communicate with the interconnected traffic signals to monitor, diagnose, and maintain local traffic controller operations from the City Hall Traffic Management Center (TMC). This network also allows city staff to coordinate the signal timing on several corridors to improve travel time and reduce the number of stops experienced when traveling on major routes.

Of the 188 system detectors, 122 count stations that allow the remote monitoring of speed and traffic volume throughout the system. This data is used to coordinate traffic flow and signal timing efforts. The remaining 66 detectors gather the Bluetooth signal and MAC addresses as persons and vehicles travel throughout the City. The City can match the MAC addresses with those detected at other locations to determine travel times, speeds, origin and destinations, route patterns, and trip lengths. This information is reported "real time" and provides the City visibility into changing travel speeds (indicating an incident). The statistical data is then stored for future analysis and to ensure privacy the unique MAC and Bluetooth addresses are discarded. No personal data is collected or stored. There are a multitude of uses for this information.

The City is currently designing a CCTV camera project that will install PTZ (Pan, Tilt, Zoom) cameras at approximately 50 locations throughout the city. This will allow city staff to remotely view live traffic conditions from the TMC along major corridors like Poplar Ave., Germantown Pkwy, and Lamar Ave. The City of Memphis will eventually be able to share the live video feeds with the public and the media. The number of cameras will be expanded over time.

Subject to available funding, Memphis is considering installation of Dynamic Message Signs at various locations throughout the city to post the current travel time from point-to-point. Once complete, the fiber optic network will expand to 150 miles and interconnect approximately 511 traffic signals, approximately 70% of all traffic signals in the city. This fiber network serves as the backbone for all future ITS initiatives.

MATA ITS

Xerox provides MATA's current ITS system (https://www.xerox.com/en-us/services/transportation-solutions/public-transport-management), which includes the following components:

- Radio System
- Computer Aided Dispatch (CAD)/Automatic Vehicle Locator (AVL)
- Automatic Passenger Counters (APC)
- Automatic Vehicle Annunciation (AVA)
- Automatic Vehicle Health Monitoring (AVM)
- On-Board Security Cameras
- Customer Information Signs

The Xerox system transfers its scheduling data from the Trapeze system. Further, MATA has worked with City of Memphis Engineering to give buses traffic signal priority on Poplar Avenue, and portions of Bellevue Blvd. and Elvis Presley Blvd., three of the city's most heavily used transit corridors. All of MATA's fixed-route buses are equipped with the latest Global Positioning System (GPS) based transit priority emitters from Global Traffic Technology.

e. *Smart Grid Infrastructure including electric vehicle charging infrastructure:*

The Smart Grid is generally defined as a modernized electrical grid that uses information and communications technology to gather and act on information in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. Memphis Light Gas and Water (MLGW) is currently converting residential customers to Smart Meters, allowing ratepayers to monitor time of use and adjust household energy consumption. MLGW is expanding use of electric circuits connected via automated distribution switches. These circuits will connect different neighborhoods, communities, and transportation systems and enable MLGW to manage power distribution to meet local needs and better respond to demand and outages. Twelve electric vehicle charging stations serve Memphis and Shelby County.

9. *Define the data your city currently collects.*

The City of Memphis' Travel Time system currently collects and stores MAC (Media Access Control) address match information for all device pairs and routes for a minimum of 12 weeks. A

match would be one MAC address being detected by one device and then also by another paired device within a reasonable time frame that provides information on the actual speed and travel time for that particular MAC. City Staff is able to access this information by running speed and travel time reports for individual pairs and/or routes.

Currently, city staff run speed and travel time reports for major corridors periodically, but not on any strategic schedule due to staffing limitations. The City of Memphis initially invested in this travel time system to provide information on performance measures associated with newly implemented signal timing plans on CMAQ projects. This information is vital to document potential air quality improvements.

The initial data collection process involved collecting pre-improvement and post-improvement data. Once the system was in place data was collected to document how our transportation system was functioning under existing conditions. A baseline was established for comparison once the newly installed timing plans were in place. After the improvements were in place and the new timing implemented, reports were run to compare and document improvement. During this period reports were run along major routes monthly to track any trends.

Since the pre-improvement and post-improvement reports were documented, reports have been run as needed (i.e. when additional timing changes are implemented or when we receive complaints from the public on system performance). Ideally reports would be run and data gathered for all pairs and routes on a monthly cycle, but staffing challenges makes this difficult. The system as it currently stands can easily do this, but staff is needed to define the report parameters and run the reports. The system also allows running origin and destination reports, which can give vital information for transportation planning purposes. City staff currently runs O/D reports as needed. The system is also able to provide information on travel time reliability, which is a tool to document variability in average travel time and congestion. With proper staffing or partner assistance, this information can be easily shared with the public to equip travelers with valuable information. The Smart City Challenge could make it possible to gather this critically valuable data on a more systematic basis.

Data that MATA collects:

MATA reports information to the National Transit Database (NTD) about funding sources, ridership, and amount of service provided for fixed route, direct service (MATAplus), and rail as is required by FTA for all transit agencies in the U.S. MATA also reports monthly performance measures to MATA's Board of Commissioners and also reports on monthly ridership and On Time Performance to the City of Memphis.

Using Xerox, Trapeze and other systems, MATA collects and tracks a variety of data, including but not limited to, On-Time Performance, Passenger Boardings, Vehicle Miles Traveled, fuel

usage, vehicle hours, road calls, customer service call wait times, number of complaints, accidents and preventable accidents. MATA uses this data identify trouble areas where performance can be improved, as well as for planning and scheduling routes that better fit customer demand.

The University of Memphis will become the central repository for transportation data. The University will gather, collect, store, and disseminate the collected data to entities and organizations that need the data. The collected data could include data from the City of Memphis' signaling infrastructure, location of potholes, street cuts, etc., service work completed by the City and MLGW which impact the transportation infrastructure as wells MATA route and ridership data.

Through the centralized management of this data, Memphis will be able to ensure equitable access to the gathered information. Partners will enter into Memorandums of Understandings (MOUs) which outline the datasets, frequency of data updates, and service level agreements surrounding the collection and dissemination of the data.

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.*

The Memphis MPO is responsible for maintaining the Regional ITS Architecture which covers the four county, two State MPO area including the City of Memphis. The Regional ITS Architecture provides a framework for implementing ITS projects, encourages interoperability and resource sharing among agencies, identifies applicable standards to apply to projects, and allows for cohesive long-range planning among regional stakeholders. ITS architectures allow local stakeholders including the City of Memphis to plan for what they want their system to look like in the long-term and then break out the system into smaller pieces that can be implemented as funding permits.

Within the Memphis Urban Area there have been several ITS initiatives and deployments throughout the Region. These programs have come from multiple agencies and cover multiple transportation modes as well. Some of the larger ITS initiatives and deployments that exist or are underway in the Memphis Urban Area are listed below.

- TDOT SmartWay Program – This freeway management program is continuing to evolve and grow in the Memphis Urban Area and includes CCTV cameras, Dynamic Message Signs (DMS), and vehicle detectors. The communications for the system are handled through a fiber optic backbone with a wireless connection.

- TDOT HELP – The TDOT HELP program has been in operation in the Memphis Urban Area since July 1999. The HELP program trucks patrol I-40, I-55, I-240, Sam Cooper

Boulevard, and portions of SR-385, assisting motorists with flat tire changes, fuel, and minor vehicle repairs. The HELP program also provides assistance to the local police and State Highway Patrol with the management of incidents by providing traffic control and advance warning to motorists.

- 511 Traveler Information Number – TDOT currently operates a statewide traveler information number that provides real-time traveler information throughout the state. Information is put into 511 through the TDOT Statewide Information for Travelers (SWIFT) system. 511 information can also be accessed through the TDOT SmartWay website (http://www.tdot.state.tn.us/tdotsmartway/) which includes a subscription for Rich Site Summary (RSS) feeds, TDOT SmartWay App, and several social media sites such as Twitter and Facebook.

- City of Memphis Traffic Operations Center (TOC) – The City of Memphis has an existing signal system that supports real time monitoring and control of traffic signals. From the TOC and the Signal Maintenance facility, the City has the capability to implement traffic signal timing plans, monitor traffic conditions and the operations of the signals, and to monitor the status of equipment. The City of Memphis also provides signal maintenance to all traffic signals within Shelby County. Memphis plans to begin the installation of CCTV cameras in the future as funding becomes available.

- Shelby County Congestion Management Program (CMP) - The CMP is a countywide effort that includes the City of Bartlett, City of Germantown, City Lakeland, City of Memphis, City of Millington, Town of Arlington, Town of Collierville, and unincorporated areas of Shelby County. This initiative includes installing new traffic signals in addition to upgrading, replacing, retiming, and connecting various traffic signals and signal components throughout the county. ITS elements that will be installed include video detection, fiber optic cable, and emergency vehicle preemption.

- MATA ITS – MATA has developed an extensive ITS program that includes automated vehicle location (AVL) on fixed-route buses and trolleys and paratransit vehicles, automated passenger counting that can distinguish a person from an inanimate object, onboard security cameras, transit signal priority for certain routes, and automated transit fleet maintenance monitoring. Additionally, MATA provides riders with next bus arrival DMS at all trolley stations and real-time bus location information on the MATA website and the TransLoc Rider app.

Implementation of the ITS Architecture requires agreement among stakeholders to share information needed to provide the ITS services. The following is the list of existing agreements in the MPO region between City of Memphis and other entities:

- Memorandum of Understanding between the City of Memphis and the City of Germantown regarding traffic signal ITS coordination;

- Agreement developed by TDOT for live CCTV video access for governmental agency users;

- Agreement developed by TDOT for live CCTV video access for private entity users.

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.*

Unemployment rates have fallen across the nation and Memphis is no exception. As the economy has improved, employers are increasingly seeking workers and pay rates are rising in response to market conditions. Yet many Memphis neighborhoods continue to have high rates of poverty and unemployment. Labor markets and economic development efforts suffer from the continuing mismatch between job opportunities and workers from poor neighborhoods who lack access to adequate and affordable public transportation. These needs will be addressed in the demonstration area by providing flexible on demand service with public and private alternatives. Demonstration strategies will include using connected vehicles to move people in the target area to transit stations and other collections points using various modes of transit, hybrid and electric vehicles, and alternative fuels where possible.

Goal 1. Connect residents from high poverty neighborhoods to the employment opportunities concentrated in the demonstration area in a consistent, timely, safe, and environmentally friendly manner using modes other than single occupancy vehicle.

Moving people to jobs consistently, quickly, effectively, and efficiently is one key to reducing poverty and creating employment and income opportunities for the people most in need. Getting people to work on time consistently and having dependable public transportation is crucial to sustaining long-term employment relationships between people in need of jobs and employers in need of workers.

Our demonstration project will use smart technology applications to reduce many of the transportation barriers in the targeted labor market. Memphis has a large area of concentrated poverty surrounding the largest concentration of industrial, distribution, and transportation employers in the city. Yet the match between jobs and workers is constrained in part by the lack of transportation and the congestion found throughout the area. Traffic corridors in the area move both freight and employees and are heavily congested, especially at peak periods when shipments and shift changes occur. The use of a multimodal approach that includes both biking, walking, and private/public transit partnership initiatives is designed to shift employee traffic increasingly to highly flexible and responsive combinations of private and public transit alternatives that mix traditional public transit with new transportation modes.

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Objectives for Goal 1:

Improve access to jobs by low-income participants in the study area by 5% (share of jobs in transit area reachable via transit within 90 minutes)

Increase transit ridership in the study area by 10%

Improve transit passengers per hour on selected routes that serve the study area by 5%

Improve paratransit passengers per hour within the study area by 10%

Increase bicycle usage by 5%

Increase protected bicycle lanes by 15%

Improve pedestrian sidewalks, paths, and connectivity by 20%

Reduce bicycle accidents in the study area by 10%

Increase walking trips by 5%

Reduce pedestrian accidents in the study area by 20%

Reduce freight traffic delay in selected corridors within the study area such as Lamar and Winchester by 5%

Outcome Measures for Goal 1:

Achieve 28 percent increase of commuters using transit, walking, and bicycling to work within the study area by 2020. The increase in transit ridership can be measured using MATA's automatic passenger counters, origin-destination data from TransLoc application users, and private cab company records and Uber customer information. Cycling data can be obtained from bike share usage records and counters installed along selected routes. Estimates for increase walking trips may be inferred based on increases in walking and biking trips and estimates.

Improve the model public transit system designed to serve the target area by expanding the use of transit signal priority in the study area in the most congested corridors such as Winchester Avenue, Elvis Presley Blvd., and Lamar Avenue. Using the technology available with traffic signal priority, transit, general traffic, and freight movements can be monitored and travel-time improvements or delay can be measured on a corridor-by-corridor basis. The resulting data can be used to quantify the objectives outlined in Goal 1 above and measurable outcomes will be reported for each of the objectives listed for Goal 1.

Upgrades will include conversion of MATA bus fare boxes to accept RFID cards or other smart devices usable for additional modes of transport including bike share, ride share, taxi, transportation network providers, and perhaps access to other services such as libraries, museums, and other cultural assets.

MATA using open API will allow developers access to software applications to help establish common open transit API that can be used by any transit agency.

Increase the network and responsiveness of MATA using smart technology and logistics models provided by FedEx. FedEx is one of the world's foremost logistics and distribution companies and is headquartered in Memphis. Using logistics models to locate transit collection points, streamline the network of private/public transportation providers and create collection and distribution networks would initiate the generation of replicable models for the entire city of Memphis and other cities. The process metrics will include (a) developing the models that expand the coverage and usage of the existing matrix of public and private transportation alternatives; (b) increasing ridership to reduce time lost in travel and the cost of getting to work for area residents; and (c) generate partnerships between neighborhoods and employers to reduce congestion and travel times along area transit corridors.

New public-private partnerships will be formed with area employers, MATA, University of Memphis, City of Memphis, FedEx, and others to develop, test, and evaluate strategies deployed to get more people to work in the target area at all times.
Transportation Management Associations will be formed to move people and goods within the employer campuses and around the demonstration area using connected, automated vehicles.

The City of Memphis will continue building out and expanding the fiber optic network and test a concentration of ITS initiatives like traffic signalization, infrastructure for connected vehicles, CCTV cameras, and dynamic message signs in the demonstration area.

Increase protected bike and pedestrian infrastructure in the demonstration area.

Increasing the miles of protected bike and pedestrian infrastructure that links employers to surrounding neighborhoods will increase safety, and reduce congestion, pollution, and the cost of transportation. Bike ridership and the reduction in the number of car trips and miles estimated can be measured for each employer. More employees biking and walking decreases the congestion and generates positive benefits for neighborhoods, employers and the community.

Goal 2. Memphis is a freight-centric community and areas of the city are often paralyzed with congestion and accompanying safety problems caused by extremely high truck volumes. Advanced sensor technologies, using the existing sensor networks in place as a basis, will be employed to facilitate the movement of trucks throughout the region and to explore the

development of an optimal system of moving freight from the area intermodal rail yards to the warehouse/distribution centers, and especially the 'last mile' deliveries in the urban core. The use of these proposed technologies will streamline the supply chain, reduce congestion, enhance air quality, and improve safety and reliability. Peak period congestion brings traffic along Lamar Avenue, the primary arterial road through the area and an urban extension of Interstate 22 in Mississippi, to a standstill for multiple periods each day. The congestion limits economic development, constrains the expansion of the Aerotropolis since the airport is located in the same target area and prevents local residents from getting to and from work. Measureable goals and objectives and the data items to be monitored include the following process and outcome measurements.

Objectives for Goal 2:

Improve freight movement through selected corridors such as Lamar Avenue (I-22) within the study area by 5%

Reduce delay of freight and traffic at high volume intersections such as Lamar and Winchester and Lamar and Shelby Drive by 5%

Reduce freight greenhouse gas emissions by 10%

Reduce freight related accidents within the study by 5%

Outcome Measure for Goal 2:

Increase the use of sensor technology to enhance freight movement along Lamar Avenue and in the Aerotropolis area surrounding Memphis International Airport.

This technology will be focused on optimizing the drayage movement from intermodal rail yards to warehouse/distribution centers and improving delivery systems in the urban area.

Measuring the adoption of alternative freight movement technologies that expedite the movement of freight from rail yards and between employers will generate reductions in congestion and pollution. The adoption rate, partnership agreements between employers and shippers, freight movements, traffic reductions and travel time reductions can be measured and will generate cost saving estimates. Congestion reductions will allow employers to expand employment and income opportunities in the area.

Similar to Goal 1, measurable outcomes will be developed and reported for each of the objectives listed above for Goal 2.

Outcome Measurement for both Goals 1 and 2:

Return on the Investment

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Efficiency will be measured in terms of the return on investment via the Value of Travel Time Savings (VTTS) brought about by reducing the average wait time (headways) for transportation in demonstration area. Using data derived from the U.S. Department of Transportation Values of Time Savings analysis, the VTTS in terms of cost of waiting for transportation is valued at $25.00 per person per hour (see Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis, 2015, at http://ostpxweb.dot.gov/policy/reports.htm).

- MATA is the largest transit agency in the State of Tennessee, transporting some 40,000 riders every day throughout Memphis and the surrounding areas.

- MATA routes generally operate for 13 hours per day (roughly 6:00 am to 7:00 pm) with 30 or 60 - minute headways.

    o Headway is a measurement of the distance or time between vehicles in a transit system.
    o Average waiting time for the next bus could be around 45 minutes (average).
    o Estimated system-wide cost of waiting for transportation would is approximately $273,750,000 a year.
    o A 10.0% reduction in headways would result in a system-wide savings of $27,375,000 per year.
    o MATA riders would experience significant quality of life improvements by recapturing this headway time, allowing more time for family, home responsibilities, resting, or working a second job.

- Return on Investment (ROI). Specifically the reduction in headways for the demonstration area will be measured to determine the VTTS. The demonstration VTTS total will be compared with total grant costs to generate a Return On Investment.

Value of Travel Time Savings in Terms of Cost from Waiting for Transportation

Population*	Days of Service**	Headways***	Cost Per Hour****
40,000	365	45	$25.00
Annual Cost	**$273,750,000**		

* MATA transports some 40,000 riders every day.

** Number of days in a year.

*** MATA operates with 30 to 60 minute headways.

**** U.S. DOT VTTS in 2013 Dollars

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 Memphis is confident in its ability to implement and execute our proposed Smart City Challenge demonstration, which was developed through collaboration and consultation with other government agencies, private enterprise, local philanthropic institutions, and a local university. In addition to the previously stated commitment from executive leadership, the partners in the Memphis Smart City Transportation Alliance are committed to implementing world class technology and have access to staff that are the foremost innovators and brightest minds working in transportation and logistics today. The Alliance partners commit to providing resources including staff, data, and access to information necessary to successfully launch our proposed demonstration. The City of Memphis has the technological ability and infrastructure necessary for automation and connected vehicles and we are ready to expand our current ITS projects. The City of Memphis has an in house performance management team available to assist with the demonstration which has established an open performance platform and performance management business processes for the City of Memphis.

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

In addition to the Memphis Smart City Transportation Alliance providing resources such as necessary staff, consultants, technology, and general office needs, various activities are underway in Memphis that the Smart City Challenge will leverage, most led by members of the Alliance.

Local philanthropy has funded a Transportation Mobility Project Manager housed with Innovate Memphis charged with analyzing issues and developing innovative solutions around local transportation options including development of sustainable funding models.

Explore Bike Share has raised millions of private dollars to launch of a 60 station, 600 bike system which will be installed in 2016.

Transportation issues are a focus area of the Greater Memphis Chamber's Chairman's Circle, a leadership body created to engage Memphis business leaders on a variety of issues that affect Memphis and the Mid-South.

One of FedEx Cares' (the charitable arm of FedEx) five pillars of strategic investment to strengthen communities is Sustainable Transportation: Developing solutions that connect the world responsibly and resourcefully.

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The University of Memphis is home to the Intermodal Freight Transportation Institute, a nationally recognized leader in linking people to solutions in freight and logistics through research, education, and technology transfer activities.

Additionally, the Smart City Challenge will align with many recent federal investments. The City of Memphis ITS infrastructure was federally funded. Total obligated construction funding of $30 Million, $19.24 Million of CMAQ,$10.76 Million of STP. An additional $7.9 Million is being invested in the coordinated signal system through the Shelby County Congestion Management Program (SCCMP, CMAQ funded). Total investment = $37.9 Million.

The Master Plan for Airport City (Aerotropolis) was funded by a $2.5 million HUD Sustainable Communities Community Challenge Grant.

Shelby County was recently announced as one of 13 winners of HUD's National Disaster Resilience Competition, securing $60.4 million, including funds for resilient redevelopment of a neighborhood on the western edge of the target area and a regional resilience plan that has significant impact on the target area.

Sources of Federal Funding that MATA can leverage include New Starts, Congestion Mitigation

Air Quality (CMAQ) grant, TIGER, and STP funds in addition to FTA formula funds.

MATA has received roughly $5.8 million per year in discretionary grants from 2000 to 2015. These include:

- $54 million New Starts for Madison Avenue Rail Line

- $12 million in FTA capital funds for construction of the Airways Transit Center

- $1 million in FTA Alternatives Analysis planning funds

- $6.3 million CMAQ for new routes, park and rides, and equipment

Other competitive federal transit grants include bus replacement and rehabilitation funds (FTA Section 5339); capital investment, technical assistance, and training grants (FAST Act Section 3016, adopted December 2015); and possible re-appropriation of unspent highway funds under the "Use It or Lose It" provision.

MATA is also eligible to receive Federal Highway Administration (FHWA) Surface Transportation Program (STP, soon to be renamed Surface Transportation Block Group) funds through the Memphis Metropolitan Planning Organization (MPO). Memphis MPO has divided STP funds into major roads and repaving, signals, bridge repair, and bicycle/pedestrian projects. MATA can apply for STP funding for major capital projects, including vehicles.