Live from Austin, Texas

Vision for a 21st Century Mobility System

Beyond Traffic: The Smart City Challenge

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1. AUSTIN'S SMART CITY VISION—AND HOW IT WILL BE ACHIEVED

"Igniting Austin's spirit of innovation to accelerate mobility that creates real opportunity for all."

As the USDOT Smart City, Austin, Texas, will harness the power of technology and data to …

… help people shift their travel behaviors in ways that work for them. **Faster, better, cheaper.**

… advance big societal goals for climate action and sustainability. **Cut vehicle emissions.**

… keep people far safer on our streets. **Prevent fatal and serious injury crashes.**

…. power up economic vitality. **Create services, products, companies; give people a hand up.**

It will take a **Smart City** *to seize the moment and figure it all out.* **Meet Austin, Texas!**

WHY AUSTIN?

Austin is America's "IT" City. We are the **capital of the state of Texas**. We're home to both the University of Texas at Austin (UT Austin)—one of the nation's **premier research universities**, and a USDOT Tier 1 University Transportation Center for Data-Supported Transportation Operations and Research – and within close reach of the nationally renowned Texas A&M Transportation Institute (TTI). We are internationally known as a **"creative class" magnet** where the mantra is "Keep Austin Weird." We are "the live music capital of the world" home to SXSW interactive, film, and music festivals. We are a progressive, and innovative community that embraces climate with early adoption of all things green. Due to our younger demographics and an innovative and vibrant high-tech community, there is a demand for more choices for transportation that incorporate technology and keep people connected. Austin is a growing city that still has a connected, small town community feel that is part of our allure and charm.

Austin is already **recognized by industry** as the place to demonstrate smart transportation technology. Austin is the first mid-size test city for the Google Car, a first city for Google Fiber, and General Motors recently expressed interest in testing its automated vehicles in Austin in partnership with ridesharing company Lyft. Austin was chosen by Daimler as its pilot U.S. city for Car2Go, which has since expanded nationally. The business climate is seen as friendly toward autonomous vehicles and smart technologies more generally. The warm temperatures allow year-round testing. And, of course, Austin is a major U.S. hub for the high-tech industry, known as an Research and Development center. In 2015, Austin was named the "#1 city for tech job growth" by *Forbes*. In the last four years, we've seen a 73 percent job growth in the tech industry, resulting in more than 53,000 tech jobs.

Austin's potential was also recently recognized by Rocky Mountain Institute (RMI) when it was chosen after a nationwide selection process to be the lead partner for a new **mobility transformation initiative**. Austin is making **robust investments** in new transportation options – Bus Rapid Transit (BRT), rapid implementation of a bicycle network featuring new protected facilities, the first U.S. City for Daimler's Car2Go, the B-Cycle Bike Share system, and more. Austin's public transit agency has received national recognition for its innovation with **mobile ticketing**. Additionally, and importantly, Austin **owns its electric utility**, Austin Energy, which has been a leading innovator for climate protection, clean power, electric vehicles, and a smart grid.

Among mid-size cities, Austin's need for smart transportation solutions may be the greatest due to its **rapid growth and booming economy**. Austin is the fastest-growing mid-size city in the U.S. (1.8 million regional population, a 2.8 percent growth rate), absorbing tens of thousands of new

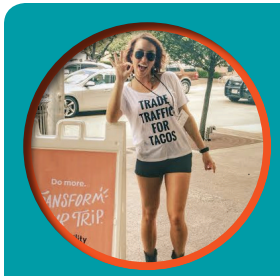
residents annually. A city in such constant flux provides a fertile environment for innovation as people adopt new travel options and behaviors.

Austin is prepared to take advantage of this opportunity to hasten its transition to a Smart City. Many of the ideas in this proposal have resulted from discussions with the City's partners for over a year. Additionally, Austin has several relevant plans in place that have been crafted within an **extensive public process**. These include plans for **smart growth** (Imagine Austin Comprehensive Plan, 2012), **climate action** (Community Climate Plan, 2015), **zero traffic fatalities** (recently selected as a Vision Zero Network city), and more. Further, Austin is committed to **tech incubation** and was recently listed by Entrepreneur Magazine as the #1 city for startups.

OUR CHALLENGES

Austin is also on some "top" lists we are not so proud of, and from which our residents want to escape. Despite the incredible advantages we enjoy, we are too often stuck in traffic, frustrated, and demanding mobility solutions:

- Traffic: Austin routinely rates as one of the most congested cities in the country (with I-35 through Downtown among the very worst freeway segments in the nation). In Texas A&M University Transportation Institute's (TTI) 2015 Urban Mobility Scorecard, Austin commuters suffered the third greatest delay – 52 hours per year - for "large" urban areas in the U.S. If the growth trajectory continues, peak hour delay is projected to more than double in the next 20 years.
- Sprawl: Like many U.S. cities, Austin grew in sprawling patterns in the latter half of the 20th century. In our outlying car-dependent areas, people lack good transportation options and often have no access to transit.
- Safety: Transportation system safety has been a huge concern for the City as 2015 proved to be a record year for traffic fatalities with 102 deaths. The City is seeking ways to leverage smart transportation technologies and data to address unsafe conditions and provide more educational opportunities before a serious injury or fatality occurs.
- Climate Change and Emissions: Austin's transportation infrastructure has been negatively impacted by recent droughts - floods, and wildfires as documented in a recent City climate resiliency project funded by FHWA. As of 2010, about 35 percent of annual greenhouse gas emissions were from the transportation sector. The Austin region is currently in attainment due to an early action compact with the EPA, but is at the tipping point of falling into non-attainment for air quality.



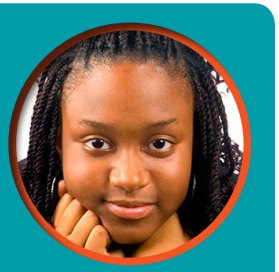
Jolene

2016 Challenges: Works in catering. Dreams of having her own taco trailer. Can't quite afford a car.

2020 Smart City Future: Takes transit to a great job in marketing autonomous vehicles. Uses an app to rideshare to culinary school at night. Happily car-free.

Perhaps even more importantly, **our community faces significant Economic Disparity**. We recognize that daily life is a struggle for many people – especially for our low-income residents, who are disproportionately female and people of color. Austin is a diverse "majority minority" city and the most economically segregated large metro area in the US, according to a recently released study by the Martin Prosperity Institute. In Travis County, Hispanics (now about 35 percent of the population and growing) are 3.4 times more likely than Whites to be living in poverty; African Americans are 2.8 times more likely.

Jayla



2016 Challenges: Needs a path out of poverty at 15. Too young for a job or driver's license. Solo vocalist in her church choir.

2020 Smart City Future: Takes a "green" EV taxi home from her band's late-night gigs. Rides an EV shuttle to college campus; doing internship at a traffic-sensor tech start-up.

The Mendez Family

2016 Challenges: Altogether, they commute by car 150 miles a week to work, school, and soccer; two car payments; behind on savings for the kids' college.

2020 Smart City Future: Shifted some trips to transit; commute time is reliable, thanks to better traffic flow; avoided cars for teens, put the money toward college instead.

Our fastest-growing population sector is children living in poverty. According to the Brookings Institute, the Austin metro area ranks #2 in the nation for percentage growth of poverty in the suburbs between 2000 and 2011. Our suburban poor are generally not well transit-connected, nor within reasonable walking or biking distance of jobs; they are painfully burdened by the costs of car ownership, which can drive them further into poverty. New transportation options, coupled with smarter land use decisions and housing policies, are needed to provide our disadvantaged communities the "Ladders of Opportunity" they need to overcome income and transportation inequality.

Reversing these trends will not be easy. The conventional solutions to Austin's challenges are neither scalable nor sustainable. Even incremental progress will require a great many people to shift their assumptions and familiar ways of doing things. We need to demonstrate, in tangible ways, how mobility can be more accessible, safer, cleaner, and more affordable for all citizens. With the funding behind the Smart City Challenge – and the additional investment that we attract from our partners – we believe that we will be in an excellent position to drive this change.

OUR FUTURE

We intend to move **Beyond Traffic** to achieve a future of new transportation possibilities. In the Austin of tomorrow, our downtown remains vibrant, but people no longer need to assume they'll drive their own car to get there. Instead, they think first of on-demand automated electric vehicles, transit, biking, shared and on-demand vehicles, and other options. Prime sites once devoted to parking garages have redeveloped as mixed-use projects with homes. On the major corridors of the city, automated and electric vehicles and drones zip along; they interweave alongside personal vehicles through intersections with minimal need to stop and wait for a traffic light. These corridors connect compact "Activity Centers" around Austin -- cool, interesting, "Austiny" places where people are enjoying car-free or low-VMT lifestyles in walkable, mixed-use, transit-oriented areas. Thanks to thoughtful rezoning, new mixed-use redevelopments have sprung up around the central city. People of all races, incomes, and ages live in them together – and enjoy choosing between many travel options to get to good jobs, good schools, live music venues, and other opportunities.

The suburbs and exurbs feel different too. On the perimeter of the city, **Travel Access Hubs** bustle with activity. People drop off their personal vehicles, or exit trains and buses, and step into waiting autonomous transit and shared electric vehicles where they relax or check email on the way. Suburban commuters drop off their kids at an on-site daycare, grab a coffee at the coffee bar, and hop into an electric, automated bus that will whisk them to their job. Large trucks drop off packages and goods, which will be transported by small, agile automated vehicles. Low-income residents have access to low-cost and convenient mobility options that provide them access to jobs in any part of the city. Not only is this new mobility system faster and less expensive, but it is also much safer, since the vehicles and infrastructure have advanced communication and sensor technology. Private vehicles throughout the core are still present, they just aren't the predominant

Florence and George

2016 Challenges: Live in suburban Round Rock; car-dependent, love their old GM; help out with the grandkids in Austin.

2020 Smart City Future: Use Metropia app on smart phone to navigate traffic; get points for shifting travel off peak. Take grandkids on electric bikes for in-town adventures.

mode of travel and are only one of many choices each resident and visitor has to choose from.

With investment in smart transportation, this is a viable and possible future. The critical question is: "How do we get to this vision from where we are today?"

The answer is: "Make Austin, Texas the innovation epicenter for introducing, testing, evaluating, refining, commercializing and scaling a 21st Century Mobility System."

But how? In collaboration with some of the world's most innovative companies, cutting-edge universities, and world-renowned experts, the City of Austin has identified five immediate opportunities that will engage a variety of public and private partners to deliver enhanced mobility and economic opportunities for Austinites of all income groups. These initiatives are consistent with the ideals of USDOT's Smart City Challenge and are the concepts which will be refined – with an eye towards implementation and ensuring an equitable distribution of benefits for all members of our community.

Before we describe these initiatives, however, it is important to first discuss a unique and collaborative feature of Austin's 21st Century Mobility System—**Austin's Mobility Innovation Center (MIC)**. The MIC is the foundation of our proposed Smart City network, consisting of four components, which will work synergistically to deploy our Smart City initiatives in a holistic and integrated fashion.

AUSTIN'S MOBILITY INNOVATION CENTER

The Mobility Innovation Center (MIC) will serve as a "Center of Excellence" for incubating cutting-edge ideas and deploying and operating a 21st Century Mobility System. The MIC is operational; a think tank; an economic generator; public-facing; and most importantly, multi-jurisdictional. It also serves as project management central, the vehicle for managing the City's Smart City effort.

A. Two-Way Open Data Portal

As described in Section 9, the City of Austin already has an Open Data Portal (data.austintexas.gov). A 21st Century Mobility System, however, will generate an enormous amount of new and very valuable data from mobility and other sectors. While the systems are one-way, the new transportation portal, operated by the **The University of Texas at Austin Center for Transportation Research**, will allow for accelerated open data sharing. The proposed two-way portal will allow data to flow in to and out from all partners, including both authoritative as well as crowdsourced data. Our proposed Two-Way Open Data Portal will provide a "one stop shop" to facilitate easy access to data streams that are currently siloed among many disparate sources and governed by fragmented licensing terms. These include traffic and transportation information systems; users' smartphones

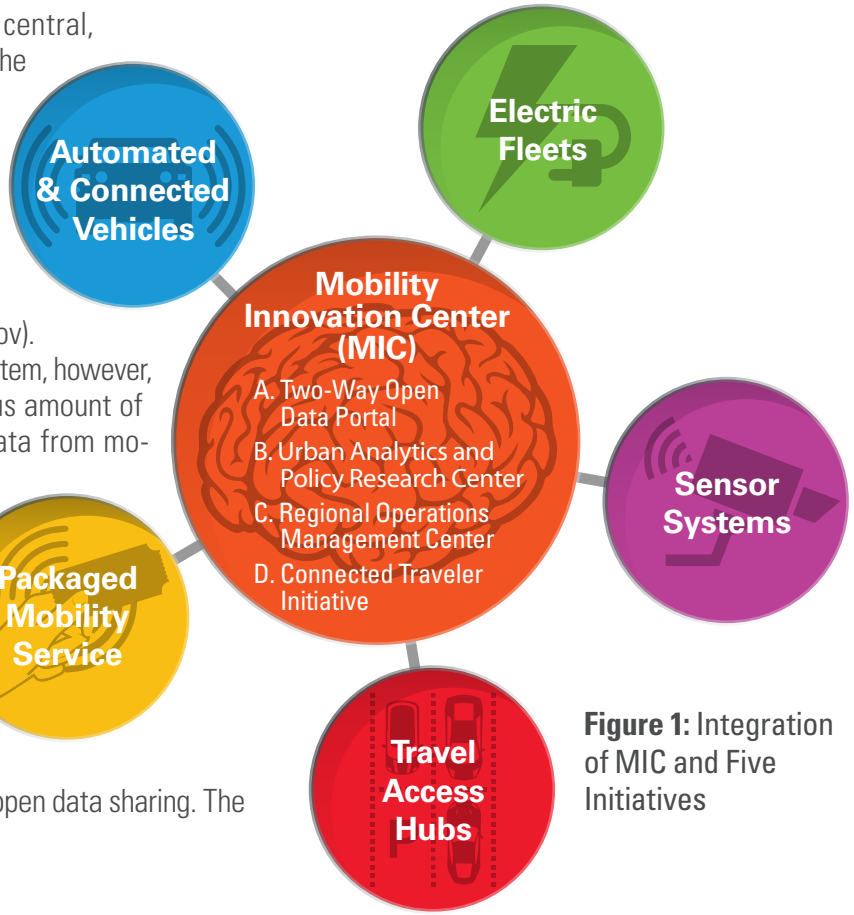


Figure 1: Integration of MIC and Five Initiatives

(anonymous and/or opt-in); private data (such as third party location, weather, or schedule data); and transit vehicle location systems. Existing information will be complemented with access to the new and unique data elements within data streams associated with our Smart City initiatives. The Portal will:

- Be multi-dimensional, serving data consumers such as city traffic managers who optimize traffic flow and private application developers wishing to develop Multi-modal planning tools.
- Protect privacy and security of data through measures such as anonymization, especially for crowd-sourced consumer data from private companies; and
- Broker agreements with private transit and software companies to incorporate their data and establish common, replicable accessibility and licensing practices.

B. Urban Analytics and Policy Research Center – A multi-disciplinary team of professionals will engage in ongoing support to help us better understand and analyze the performance data we collect, and model future impacts on travel demand. The Urban Analytics and Policy Research (UAPR) Center will manage the deployment of our planned Smart City initiatives and other projects and share lessons learned throughout the nation.

As we enter a new era of unprecedented change in the established models for mobility, aligning supportive public policy and regulations is essential. We will leverage established research and university expertise in technology policy **(e.g., The University of Texas at Austin Center for Transportation Research, Texas A&M's Transportation Policy Research Center, UT Austin's Lyndon B. Johnson School of Public Affairs, and Southwest Research Institute)** and work with technology businesses to share newly created knowledge with decision-makers. The UAPR Center will provide resources such as technical and analysis papers that will help policymakers understand and balance potential social benefits and risks in a dynamic, fast-changing market. This includes research to evaluate and ensure that these benefits are equitably distributed across the city's diverse socio-economic groups.

UT Austin's Tier 1 University Transportation Center for Data-Supported Transportation Operations and Planning (D-STOP UTC) team will develop novel methods for working with the large-scale data coming into and out of the portal. They will develop applicant programming interfaces (API) and other tools to allow for ease of use by third-party companies. This partnership with the UTC will ensure that the work is done at the state of the art and that the Austin Smart City effort pushes the boundaries of what is possible.

Performance management is also a vital component in our 21st Century Mobility System. Having an advanced data team reviewing trends and analyzing characteristics will help us to better understand important variables like defining a new vehicle class to represent connected/automated vehicles, defining driver behavior parameters for the new Connected and Autonomous Vehicles (C/AV) class with smaller headways, and conducting sensitivity analysis for different penetration levels of the C/AV class.

Through collaborative partnerships with the brightest public and private sector minds, the UAPR Center will build a foundation for a commercialization cluster dedicated to sustainable growth and "smart" mobility innovation.

C. Regional Operations Management Center

A common challenge for cities around the country is the fractured, isolated nature of transportation management – freeways are managed separately from arterials, state centers are independent from city management centers, traffic operations are managed independently from transit needs, etc. As part of our effort, Austin will launch a new regional operations management center (ROMC), at first in a virtual setting until a brick and mortar facility is established. The ROMC will be an operational arm of the Mobility Innovation Center, and the forum for multi-jurisdictional governance and engagement described in Section 7. It will serve as a unified "command center" for both traffic and transit operations, supervising everything from incident management to transit route planning and optimization. **Working with data made available from the Two-Way Open Data Portal, ROMC personnel will optimize signal systems, engage existing and future traffic management tools, proactively communicate live travel conditions and alternatives to travelers, and begin mainstreaming V2I applications as they become available.** Operationally, the ROMC will support existing

functions but also provide an optimal transition to the 21st Century Mobility System as the home for the newly deployed initiatives.

The ROMC will further function as a training ground for new mobility professionals as they graduate from local trade schools and universities – giving them first-hand experience in utilizing predictive, real-time, and historical data in pursuit of reliable and safe transportation throughout Austin. Finally, the ROMC will serve as the maintenance hub for Austin's 21st Century Mobility System, monitoring the health of technology devices, working with technicians to manage up-time of services and systems, and generating performance statistics that are the life-blood of ensuring long-term sustainability of the program.

D. Connected Traveler Initiative – Every user of Austin's transportation network – residents, delivery services, visitors, etc. – will have access to real-time and predictive information to make travel decisions that work for them. The connected traveler also will be a source of information to enrich the reliability of information being disseminated. Innovative companies can use this same data to develop new products and services that further serve travelers. We will also assure that residents and visitors who might be technology challenged have access to data via public systems such as on-street wayfinding tools, dynamic message signs, etc.

This connected traveler initiative (CTI) will also serve as the interface for community engagement for Austin' 21st Century Mobility System. Citizens can provide feedback and ideas to help influence initiatives. The public communications capability will include program and project websites, feedback and input loops such as focus groups, and opportunities for the public to contribute to the enhancement of the effort through crowdsourcing. SpeakUpAustin.org (administered by the City's Communications and Public Information Office) and MobilityATX.com (administered by a private organization) are two local examples of existing online platforms we can build upon. We will expand the toolkit to add features integrated with social media (such as Twitter and NextDoor, already used by the City). Promising ideas submitted by the public will directly reach transportation engineers and planners.

AUSTIN'S 21st CENTURY SMART CITY MOBILITY INITIATIVES

With the MIC serving as the platform for management and innovation, we will launch a coordinated program that leverages all of the technology, innovations, and forward-thinking of the leading universities, experts, and private sector companies right here in Austin. Each initiative synergizes and overlaps with the others, and is focused on moving Austin's transportation mobility infrastructure systematically towards our holistic vision. Under the institutional, functional and operational guidance of the MIC, we can deploy these initiatives, manage them long term, and learn from them for future enhancements and sharing.

Below are our five priority initiatives to be implemented during the Challenge grant period and why they are "ready for success."

INITIATIVE #1: AUTOMATED AND CONNECTED VEHICLES

Consumer-Facing Deployment of Connected and Automated Mobility Services

Goal: Implement automated and connected vehicles in a variety of settings, helping solve a number of mobility challenges and demonstrating their safe and efficient benefits to Austinites.

With leading tech company partnerships and an enabling Federal, state and local regulatory environment already in place, Austin is in a unique position among US cities when it comes to deployment of connected & automated vehicles (C/AV). This deployment will be coordinated with the evolving public transportation system, as well as bicycling and walking, to create a comprehensive network of mobility options within the region. Since automation without connectivity won't help us realize the level of safety and mobility benefit we seek, connectivity is a fundamental component of all automated elements. Technology leaders Google and Car2Go (Daimler) are already "on the ground" in Austin, and we will further partner with leading private sector companies to deploy their technology in several different environments -- considering

Austin's Five Smart City Initiatives

1. Automated and Connected Vehicles
2. Electric Fleets
3. Sensor Systems
4. Travel Access Hubs
5. Packaged Mobility Service

dedicated short-range communication (DSRC) and connectivity requirements, specific needs of the public, and different business models to fit each situation.

- **Airport Automated Shuttles/Circulators** Through a partnership with Capital Metropolitan Transit Authority (Capital Metro) and tech partners who specialize in electric-powered automated shuttles, and based on interest already expressed by the industry through an **"Accelerate Texas"** request for interest (RFI) solicitation (conducted in 2015), the City of Austin will deploy transit circulators and smart infrastructure to Austin's international airport, as an early testbed for future full automation of the Austin transit fleet. The first component will be a low-speed automated and connected shuttle that moves passengers between the main terminal and a new **mobility hub** and staging area to be located in conjunction with a cell phone parking lot. This reduces the number of vehicles entering the terminal road system (thereby reducing congestion and pedestrian safety hazards), and increases the visibility and "comfort level" for our customers with adopting automated vehicles. Because of the simplified urban street network located wholly on airport property, it will provide a valuable learning environment for future deployments in more complicated urban street networks and to other areas like business parks and eventually in the future to full public transit routes including on-demand paratransit and transit shuttles in our downtown.
- **Downtown On-Demand Automated Vehicle Service** Electrified, automated, on-demand vehicle and shuttle services have the potential to increase safety and reduce the cost of mobility. Smaller vehicles and mid-size transit shuttles can be used for first/last mile applications to enhance transit use, while larger transit vehicles can themselves be instrumented to facilitate a shift to automation of transit. These vehicles can be most effectively deployed by integrating them directly with "A to B" commuting solutions that are already being planned in downtown Austin. These vehicles will also benefit from connectivity and sensor-based infrastructure described in Sections 5.2 and 5.3. The City and its partners will closely examine access to the system to make sure service is available to everyone, to improve the lives of all Austinites, including those with low incomes, the elderly, and the disabled. Specifically, this demonstration project will seek to bridge the jurisdictional gap for urban residents outside the Capital Metro service area that lack access to transit, despite their growing need.
- **Urban and Suburban Automated Car Share Vehicles** Austin has some of the world's most innovative car share and logistic companies, but the service areas are often limited to high density areas due to the logistics of repositioning vehicles; parking is still a challenge in the urban core; and some citizens can't or won't walk to pick up a vehicle. We seek to minimize these challenges by repurposing existing parking to increase the number of dedicated car share parking/storage opportunities, creating several specific routes that an automated car share vehicle could use to arrive at your departure point, and increasing the visibility of car sharing options in currently under-served areas. Varying levels of vehicle automation would be present so that once a driver accesses their car share vehicle they have an option to manually take over control and navigate outside the boundaries of the network – but being able to re-engage when they return to a specific area so that the car could drop them off at the nearest transit or centralized hub and then return itself to a nearby storage/parking facility.
- **Urban Package Delivery Unmanned Vehicles (UVs):** In exploring the concepts above, several private companies indicated an interest to pilot commercial parcel delivery with autonomous drones. We are open to this possibility and other ground and aerial package delivery concepts as large delivery trucks can cause congestion in our urban core. If safe, reliable drones could perform last-mile delivery, perhaps integrating with our extensive bike facility network in our downtown or Mueller Neighborhood, they could reduce the number of large trucks that need to enter and navigate our community. Already, Whole Foods and H.E.B. Stores, two leading grocery corporations in Austin, provide free home delivery. Automating these services could likewise help travel

impaired or homebound residents of Austin achieve their daily food needs.

Ready for Success: With leading tech company partnerships and an enabling regulatory environment already in place, Austin is in a unique position among U.S. cities when it comes to deployment of connected & automated vehicles (C/AV). This deployment will be coordinated with the evolving public transportation system, as well as bicycling and walking, to create a comprehensive network of mobility options within the region. Technology leaders Google and Car2Go are already "on the ground" in Austin, and we will further partner with leading private sector companies to deploy their technology in several different environments, addressing specific needs of the public, and considering different business models to fit each situation.

INITIATIVE #2: ELECTRIC FLEETS

Electrification of High-Mileage Fleet Vehicles

Goal: Mainstream the acceptance and usage of electric vehicles to lower traveler costs and reduce emissions in the city. In order to accelerate proliferation of electric vehicles, Austin has identified several public mass transit and high-mileage vehicle fleets as the next intervention point for electrification. Taxi, transportation network companies (TNC) like Uber and Lyft, and some municipal vehicles travel up to 70,000 miles annually. At this mileage, Electric Vehicles (EV) make pure economic sense due to lower operating costs (even with very low gasoline prices). And when these vehicles are eventually automated, we believe they will be cost-effective and convenient enough to start displacing personal vehicles at a very high rate.

Our approach will be to provide a first of its kind and nationally-scalable "Fleet Electrification Marketplace" that connects fleet owners like TNC and taxi companies (many of whom have expressed keen interest in electrifying their fleets) to companies specializing in electrifying fleets which are just now getting off the ground. Vision Fleet's Evercar and Green Wheels are having success with initial deployments in Los Angeles and Chicago and are eager to scale their business models to enabling environments like Austin. The Marketplace will clarify the value of electrification, help fleet owners strategically plan for adopting electric vehicles, provide the latest quick-charging infrastructure for fleet owners (and assist in planning future infrastructure), provide incentives and innovative finance options to mitigate some of the upfront purchase cost (for both EV and charging infrastructure), and provide education to fleet owners and drivers. In addition, this initiative will create significant community awareness by using a service in Austin to accelerate the adoption of EVs, and link EVs to public transportation, walking and bicycling networks to provide a suite of energy-efficient mobility choices for the community.

Ready for Success: With GM's recent investment of $500 million in Lyft, we are exploring the possibility of deploying large numbers of GM electric TNC and taxi vehicles. GM's EVs also boast state-of-the art V2V and V2Cloud technology systems that will be very valuable to our MIC and other projects. Our deployments build upon efforts to standardize DSRC-based V2I and other wireless communications. EVs, especially those fueled by 100 percent renewable energy, can create an unparalleled benefit to environmental quality. Our utility partner, Austin Energy (a wholly owned agency of the City of Austin), is a recognized national leader in demonstrating clean energy generation, energy efficiency programs and electric transportation initiatives. The National Electric Drive Transportation Association and ChargePoint have recognized Austin as a top "plug-in ready" city in the U.S. due to infrastructure already installed and utility programs which signal our commitment to EV adoption. In addition, Capital Metro already operates several electric hybrid buses and is now pursuing a phased transition of the full fleet to sustainably powered electric propulsion.

INITIATIVE #3: SENSOR SYSTEMS

Intelligent, Sensor-Based Infrastructure

Goal: Collect more robust data to make operating decisions and traveling decisions in real time. Comprehensive and coordinated intelligent transportation sensors will provide robust data and safety information to more efficiently operate and maintain the mobility network and communicate with travelers to make more informed decisions and provide future connected vehicles

with real time information needed for guidance and optimized travel.

The Smart City Challenge grant will enable both public and private partners to advance our infrastructure-based detection and verification network to the next level by considering deployment of strategies such as:

- Acquiring private sector data for operations (e.g., real-time alerts, performance monitoring, etc.) and to accelerate network coverage while reducing costs.
- Integrating rainfall sensor data, speed data and the traffic signal system to adjust signal timing.
- Installing temperature sensors on bridge structures for early detection of icing conditions.
- Deploying detection systems to monitor pedestrian activity in crosswalks and dynamically change pedestrian clearance times.
- Implementing a red light running and near-collision identification system using advanced detection techniques at signalized intersections.
- Extending app-based services to the visually impaired community to navigate work zones, for push-button activation at signals, and for notification of when walk signals are displayed.

This is also an opportunity to show the interconnectedness of the overall Smart City effort. By considering additional infrastructure-based sensor technology in concert with C/AV needs, and coupling it with smart open data exchange protocols, we have an opportunity to advance the state of operations from both the public and private points of view. The presence of the MIC and its Two-Way Open Data Portal are critical components in this program – it's much more than simply "hanging devices on poles" – it's about 360 degree consideration of devices, benefits to the citizens, and long term sustainability of the program. Its about putting the "I" in "V2I."

Ready for Success: The City of Austin has already made a strong initial investment in intelligent sensor based detection including video-based detection for adaptive signal control, GPS-based transit signal priority on BRT corridors, an app-based bike detection system that provides trajectories/paths through the network, and low water crossing monitoring stations. Likewise, the Texas Department of Transportation (TxDOT) has just approved a new initiative that will re-envision how ITS and traffic signal control technologies can be integrated with roadway operations and first responders. Their program includes a number of enhancements such as a new performance-based and preventive maintenance programs based on new data collection schemes. Additionally, Capital Metro buses will become probes in the traffic stream providing information regarding position, travel times, schedule reliability, and passenger loadings.

INITIATIVE #4: TRAVEL ACCESS HUBS

Increased Multi-modal Options

Goal: Put transportation options and access where people need it. We will remake the "park-and-ride" into a "one-stop shop" for a large number of mobility options including public transit buses, trains, car share, automated taxi/TNC, bike share, and other services that have yet to be introduced.

While some existing park-and-ride facilities will be converted, the aim of this program is to also identify new locations. Hubs on the perimeter of the urban core will reduce single occupant VMT into and out of the core, while additional hubs beyond the perimeter will target employment centers and high-traffic corridors, including those supporting suburb-to-suburb commutes. Hubs can target areas underserved by transit—including lower-income neighborhoods – thus benefitting first and last mile transit solutions and even enabling on-demand tech-enabled automated mobility services.

The mobility hub concept will extend to high capacity transit nodes in the urban core to support modal transfers. The hubs will also give us the opportunity to pilot advanced smart infrastructure technology like low-cost parking sensors and automated garages, advanced electric vehicle charging, automated on-demand car sharing and ride sharing systems that are synced in real time with the arrival of buses and trains through advanced trip planning software, V2V connectivity, and more. In the future, a strategic network of these hubs could eliminate the need for human-driven vehicles in the urban core altogether.

Ready for Success: Austin has many well-used park-and-ride locations that can be outfitted with

sensors and transformed to include more modal options and connectivity.

INITIATIVE #5: PACKAGED MOBILITY SERVICE

Pilot of a "One-Pass/One-App" Multi-modal Mobility Service

Goal: Make traveling on different services effortless, with payments that are affordable and easy for travelers. We will develop a fully functioning service system where users access their customized mobility service package (e.g., transit, car share, ride hailing services, bike share, etc.) with a "one-pass and pay"' through a single interface.

The idea of "one-pass/one-app" Multmodal mobility service is not new. Cities in Europe and Asia have implemented systems of this type successfully. However, the U.S. is lagging in this mobility arena, largely because of barriers such as the interoperability of data, competition among mobility providers, and logistics of single-payment/revenue sharing.

The City aims to accelerate the roll out of this type of service in the U.S. by piloting a "one-pass/one-app" program despite the barriers listed above. It will be a fully functioning service system where users access their customized mobility service package (e.g., transit, car share, ride hailing services, bike share, etc.) with a single pass, paying for services through a single account. We want to see how the system would work with real people to demonstrate its value and grow the market size of this type of service. Capital Metro already has efforts underway in this space. RideScout, an Austin-born transportation technology and transportation aggregator company, chose Austin specifically for its early adoption of innovative transportation options like bike share, car share, and ride hailing services and opportunities to deploy a seamless payment system across modes.

Ready for Success: Capital Metro, RideScout and others are already working on solving mobility service interoperability, and connectivity for Austin.

MOVING BEYOND TRAFFIC

As Austin's Smart City Challenge Grant proposal demonstrates, our vision and our initiatives are consistent with USDOT's goals for our Nation to move Beyond Traffic, placing a priority on improving safety, enhancing mobility, and addressing climate change. With the implementation of Austin's Smart City vision, we will be able to positively address the following:

- **How We Will Move** – Our proposed Smart City initiatives and complementary land use strategies strive to optimize Austin's existing transportation infrastructure, rather than attempt to build our way out of congestion. Our **Travel Access Hubs** will be a place to match individuals with unused passenger capacity, TNCs, and new bike and car share opportunities, thus reducing single occupancy vehicle travel and reducing greenhouse gas emissions. Our Packaged Mobility Service provides users with options for trip-making without an automobile – critical for low-income households that are disproportionately burdened by transportation costs. Even our C/AV deployment contemplates rolling stock of different sizes to accommodate different markets and car share opportunities. Underlying all of it, the City's recently adopted Imagine Austin Comprehensive Plan and CodeNext development regulations provide for the densification of new development and promote a non-car dependent quality of life.
- **How We Will Move Things** – While the focus of our Smart City initiatives is the movement of people, the City of Austin understands that Smart Cities of the future will also need to develop technologies and strategies to handle urban freight delivery more efficiently and effectively. Our 21st Century Mobility System will address, through pilot testing and implementation, several issues related to freight delivery for commercial businesses and individuals within the city. With ridesharing and intelligent traffic management contributing to less congestion, traditional freight shipments will move through Austin more quickly and safely than ever before. The exploration of other innovative freight strategies and solutions will be a part of the next stage of Austin's Smart City concept refinement.
- **How We Will Move Better** – The City and its partners are driven by the desire for continuous improvement. The proposed MIC will serve as the vehicle for how Austinites – and eventually all urban Americans – will move better. The Urban Analytics and Policy

Research Center is our think tank, bringing together experts from the public, private, and academic sectors to cultivate new ideas and technologies, with a commitment to advancing transportation as a ladder of opportunity and an eye on commercialization. The MIC's Regional Operations Management Center will implement the deployment of Smart City initiatives – the first step towards experiencing improved mobility – and monitor and evaluate their performance. The MIC – indeed Austin's entire Smart City effort – is supported by a foundation of rich, open source data managed through a Two-Way Open Data Portal.

- **How We Will Adapt** – Austin is actively engaged in reducing and reversing the negative climate change impacts associated with urban sprawl and an overly auto-dependent population. The City Council approved Austin Community Climate Plan, authored by its Office of Sustainability, which sets a long-term net zero community wide greenhouse gas emission goal by the year 2050. Our Smart City concepts fully align with the City's proposed solutions to achieve this goal. In 2015, Austin produced the Central Texas Extreme Weather and Climate Change Vulnerability Assessment of Regional Transportation Infrastructure report which has identified critical resiliency needs and vulnerable areas and assets in the city's transportation network, and has provided possible solutions for agencies citywide to collectively pursue. The City's CodeNext land use regulation process emphasizes the need for compact and connected development, minimizing sprawl and the reliance on automobiles, while further supporting resilient and sustainable land use.
- **How We Will Align Decisions and Dollars** – Working closely with our public and private partners, Austin will continue to prioritize transportation investments based on the most critical needs of residents as defined by the eight priorities set in Austin's comprehensive plan, Imagine Austin, such as providing low-income residents transit oriented affordable housing and increased transportation options to access the workforce. If selected as a Smart City Challenge finalist, the next phase of the application process will define a prioritization plan and schedule for the implementation of our proposed initiatives, as well as outline how these projects will meet the objectives already identified our comprehensive plan.

As our Smart City Challenge proposal demonstrates, we have already established strong partnerships with cutting-edge research and technology entities, and have made the foundational investments in technology infrastructure that make us "ready" for this extraordinary grant opportunity. With the help of the Smart City Challenge grant and the anticipated financial investment from our partners that the grant will unlock, Austin looks forward to being the U.S.'s first true Smart City of the 21st Century.

2. POPULATION CHARACTERISTICS

The City of Austin is a mid-size city with a population of 790,390 inhabitants (as of the 2010 U.S. Census). Austin is an urban city with 83 percent of the city's land area located in the Austin urbanized area (UZA) and 2,653 people per square mile across the Census Designated Place (CDP) land area. The City of Austin's population accounts for 58 percent of the UZA.

3. SMART CITY CHARACTERISTICS

3.a Existing public transit system

Capital Metro is a full and enthusiastic partner in all aspects of the proposed MIC and its Smart City initiatives. Capital Metro serves Austin and is already innovating in Smart City ways: the agency has established a goal to fully electrify its fleet; has executed partnerships with technology companies specializing in flexible, real-time route planning, mobile ticketing, and ride sharing; and has plans underway to deploy automated vehicles into its fleet. Section 8 provides more details on Capital Metro's current services.

3.b Environment that is conducive to demonstrating proposed strategies

The City and Capital Metro have partnerships with major software companies devoted to improving transit information and access, including

Capital Metro recognizes that in an age of automated vehicles and big data, urban transit agencies need to innovate. Its leadership is prepared to embrace electrified, automated, on-demand vehicle services with flexible routing. Elements of the Smart City Challenge that Capital Metro transit is excited to join include:

- New airport "circulators" and smart applications that pilot consumer-facing, automated public transit.
- New agreements with private transit and software companies.
- Future automated public transit that can increase service frequency, service area, and route flexibility.
- Transit route optimization and the new Mobility HUBs.
- Developing seamless connectivity between transit and on-demand, tech-enabled, automated mobility services.

Hacon, Bytemark, RideScout and others. South by Southwest Interactive, among other Austin events, provides a globally watched forum for sharing demonstration project innovations with other cities and agencies. As discussed in Section 1, Austin also has an outsized presence in the investment and startup community. The City is recognized as a third center, after Boston and San Francisco, for Angel/VC investment in innovation and startup companies.

As a business environment, Austin consistently ranks #1 or high up on virtually every "Top 10 Cities" list. Forbes magazine this month named Austin "America's next boomtown." The recently published Dell Future Ready Economies Model projects that Austin will be one of the nation's fastest growing city economies over the next five to 10 years. Austinites are famously open-minded, and eco-conscious early adopters – providing an ideal base of mobility service consumers with which to pilot innovative new ideas that require individuals to try new ways of getting around the city.

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

Mayor Steve Adler, who began a four-year term in 2015, ran on a platform of improving transportation in Austin. The USDOT Smart City Challenge has been embraced by the Mayor and City Council as an ideal fit with their two top policy priorities: transportation and affordability. City Manager Marc Ott, Capital Metro President and CEO Linda Watson and their executive teams (and the leadership teams of the Core Team partners identified in Section 7) have pledged their full commitment to the project throughout its period of performance.

To provide continuity independent of political cycles, an "Austin Smart City Consortium" will be established with a Joint Executive Team (JET) and dedicated full-time staff to oversee implementing the Smart City project; the Consortium is described in Section 7. This structure will provide for stability, expanded capacity, nimbleness ,and continuity not only for the three-year USDOT Challenge period but beyond, to carry on implementing future projects. Our many stable, established partners will ensure both continuity and capacity. Austin is investing in this for the long haul and has already started down the path towards a new smart mobility system. Our big-picture goal is to launch a whole new economic sector in Austin in addition to solving our transportation challenges, give residents a range of safe and automated mobility choices, and improve our environment through electrification of our region's fleets.

3.d Commitment to integrating with the sharing economy

Austinites are enthusiastic participants in the sharing economy; it's the corporate home of HomeAway and a top AirBnB city as well. Austin is the fastest-growing market for TNCs in the nation; Austinites have embraced not only Uber, Lyft and GetMe, but newer app-based peer-to-peer vehicle sharing services such as BuddyTruk and FlightCar. Both ZipCar and Car2Go maintain active and large Austin fleets. It's no surprise that Austin is cited as a model in the National League of Cities report, "Cities, the Sharing Economy, and What's Next."

Due to the explosive growth of TNC utilization, elected officials have been developing a protocol to provide enhanced safety for Austin users. Uber, Lyft, and GetMe have expressed interest in participating in our Smart City effort, and we welcome the opportunity to continue working closely with TNCs.

3.e Clear commitment to making open, machine-readable data

As a tech innovation center, Austin is already deeply engaged with open data. As described in Sections 1 and 9, the enhancement of our existing Open Data Portal is a major initiative within the proposed MIC. It will serve as a regional, two-way open data center "warehouse."

The effort builds upon the City of Austin's existing municipal open data portal which utilizes the platform Socrata. This open government resource offers the public data sets, downloads and APIs. The portal is enhanced for smartphone use, and intended to improve both accessible government and private sector innovation and collaboration. It also maintains an open government platform, AustinGo. Austin Finance Online is an award-winning tool that allows citizens to access city financial and purchasing data. The City remains actively engaged in a national dialogue on standards for municipal open data initiatives.

Austin's Open Data Initiatives

Code for America – Partnership since 2011 yielding model projects that benefit cities nationwide. Austin maintains an "Active Brigade" within the City's thriving tech community of civic hackers, innovators, and urbanists.

City Innovation Office – Created in 2013 to further engage civic tech transparency and growth.

ATX Hack For Change – Hosts events using open data to develop innovative community based solutions. Projects have included local bus, bike, and walking travel apps.

Capital Metro already shares both static data in General Transit Static Feed Specification (GTFS) format and its real-time (RT) fleet information (in GTFS-RT format) on state and city open data portals, as well as its own website. This data has allowed mobile ticketing through a partnership with Bytemark and a head start toward a next-generation Multi-modal trip planning and payment tool currently in development through a partnership with Hacon.

Our Smart City Challenge partner, the Center for Transportation Research at UT Austin, is already working with the City to develop an open data project, the "Data Discovery Environment." It allows sharing of Central Texas real-time and historical trip and traffic data (from the City and Capital Metro), and provides a framework for using big data to help transportation agency staff and decision makers. The data platform is web-based and the project includes developing appropriate protocols for access and governance. This will give us a huge Smart City head start on the proposed MIC's Two-Way Open Data Portal.

4. ANNOTATED PRELIMINARY SITE MAP

See Figure 2 on page 15.

5. SMART CITY VISION ELEMENTS

Austin's MIC will serve as a focal point for deployment and coordination of all aspects of our Smart City Challenge initiatives – current and future. We share USDOT's vision of a successful Smart City and understand that only through a combination of a) cutting edge technology; b) innovative approaches to urban transportation development and delivery; and c) "smart" architecture, communication, and land use can this vision be achieved.

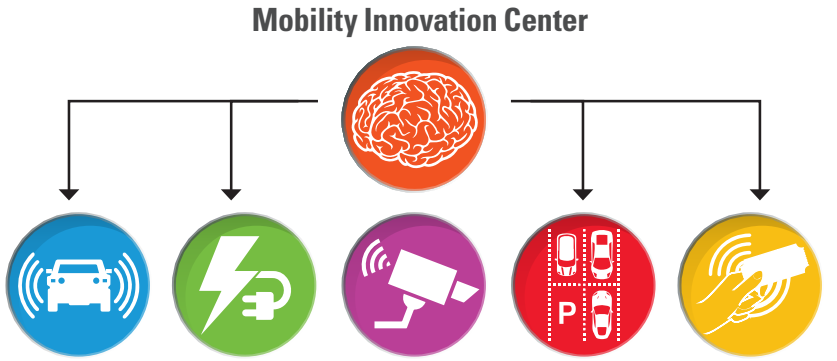
We have developed our proposed initiatives accordingly. The following sections and table describe how Austin's Smart City vision aligns with USDOT's 12 vision elements for a truly Smart City – and a 21st Century Mobility System.

5.1 URBAN AUTOMATION

The safe, optimized introduction of urban automation is a cornerstone element of our application. Clearly, our Autonomous and Connected Vehicle Services initiative is a multi-dimensional effort to deploy urban automation boldly and safely in order to pave the way for proliferation of automated vehicle services across the nation. In addition, **Travel Access Hubs** will serve as physical (and visible) epicenters for the introduction of urban automation.

With an eye beyond our initial deployments, the MIC will monitor and iterate our efforts related to urban automation. The technology and business models are evolving so rapidly that we need to

Table 1: MIC's Fulfillment of 12 Vision Elements



VISION ELEMENTS	A/C Vehicle Services	Electric Fleets	Sensor Systems	Travel Access Hubs	Packaged Mobility Services
5.1 Urban Automation	✓		✓	✓	
5.2 Connected Vehicles	✓	✓	✓	✓	✓
5.3 Intelligent, Sensor-Based Infrastructure	✓		✓	✓	✓
5.4 Urban Analytics	✓	✓	✓	✓	✓
5.5 User-Focused Mobility Services and Choices	✓	✓	✓	✓	✓
5.6 Urban Delivery and Logistics	✓		✓		
5.7 Strategic Business Models and Partnering Opportunities	✓	✓	✓	✓	✓
5.8 Smart Grid, Roadway Electrification, and Electric Vehicles	✓	✓	✓	✓	
5.9 Connected, Involved Citizens	✓	✓	✓	✓	✓
5.10 Architecture and Standards	✓	✓	✓	✓	✓
5.11 Low-Cost, Efficient, Secure, and Resilient ICT	✓	✓	✓	✓	✓
5.12 Smart Land Use			✓	✓	✓

Project Highlight

A critical aspect of Austin's Autonomous and Connected Vehicles initiative is coordinating the deployment of such vehicles with the evolving public transportation system, car share/car pool/van pool networks, as well as bicycling and walking, to create a robust network of mobility for the region.

remain agile and continue to learn from and replicate our efforts to ensure optimal deployment of urban automation.

5.2 CONNECTED VEHICLES

As we implement electric and automated vehicle projects throughout Austin, we will enhance their benefits through advanced connected vehicle applications. Connectivity (V2X) will help us realize the level of safety and mobility benefit we seek, and thus it is a fundamental component of our approach.

We will work with companies like Google and Daimler, along with Savari (DSRC) and NAUTO (V2Cloud) that make aftermarket systems that can be installed in existing vehicles. We will then be able to test DSRC, 3G/4G/5G, cellular Wi-Fi, Satellite (XM Sirius) and other V2X technologies side-by-side to demonstrate that devices from various suppliers are interoperable and that various communication technologies can coexist without harmful interference, particularly

Figure 2: Annotated Map of Austin's Smart City Projects

Project Highlight

In the Airport Automated Shuttles/ Circulators component of our Automated and Connected Vehicles project, we have a unique opportunity to utilize CV technology in the electric automated vehicles to help with any intersection crossing or interaction and transit stop safety or conflicts with human-driven vehicles, to present real-time car location to patrons waiting in the cell phone lot, and to react or respond during differing weather or environmental conditions.

to safety critical systems. The MIC will collect and analyze performance data so that we can continually improve the system and make relevant data available to innovators.

We will work with emerging companies that responded to the **Accelerate Texas** Request For Interest (RFI) to deploy technologies already being tested in other parts of the world here in Austin, exposing our community of early adopters and tech industries to the opportunities and realities presented by electrification and automation.

5.3 INTELLIGENT SENSOR-BASED INFRASTRUCTURE

A key element in Austin's 21st Century Mobility System is awareness. With the advent of sensor-equipped vehicles, automakers are implementing systems that use these sensors to warn drivers of vulnerable road users, such as pedestrians, construction workers, and cyclists. Unfortunately, these onboard sensors are sometimes occluded from directly sensing the vulnerable road users due to buildings, other vehicles, and intersection geometries – or simply lack the depth of full system awareness with other vehicles, pedestrians, and road geometry. Intelligent, infrastructure-based sensing can fill in these gaps, and in many cases can be more robust, utilizing higher-end sensors and processors than can be accommodated on a vehicle.

Our program will focus on adding infrastructure-based detection technology at strategic positions near highly-dynamic intersections and transit stops. The data from these sensors will be analyzed in real-time by detection and classification algorithms to identify key objects of interest – and leveraging infrastructure-to-vehicle communication, such as (DSRC), the data will be transmitted to connected vehicles for use in V2V and V2I applications. Whether human-driven or automated, these connected vehicles will benefit from the shared situational awareness provided by the infrastructure. Furthermore, the infrastructure's ability to collect new, unique data from connected vehicles ties the vehicle, infrastructure and data analytics together.

Project Highlight

In our Sensor Systems project, we intend to leverage ongoing projects by City of Austin and TxDOT through the introduction of several additional and new sensor programs to further enrich our data sets and open the door to new and innovative applications.

5.4 URBAN ANALYTICS

A critical aspect of Austin's Autonomous and Connected Vehicles initiative is coordinating the deployment of such vehicles with the evolving public transportation system, car share/car pool/ van pool networks, as well as bicycling and walking, to create a robust network of mobility for the region.

Project Highlight

Our Urban Analytics and Policy Research component of the MIC can also help us better understand, analyze, and model future impacts on travel demand. By reviewing trends and analyzing characteristics we will define a new vehicle class to represent C/AVs, and conduct a sensitivity analysis for different penetration levels of the C/AV class.

The MIC features an Urban Analytics and Policy Research Center which will serve as Austin's primary vehicle for analyzing Smart City data. The data from MIC's Regional Operations and Management Center will be used to improve real-time traffic management, transit operations and traveler communication to reduce the effect of traffic incidents in the City. This real-time application of data can also be used to facilitate the use of automated and connected vehicles on arterials and highways. The integrated nature of the MIC's multiple functions lends itself to the

data optimization and sharing techniques critical to the creation – and sustainability – of Smart Cities.

5.5 USER-FOCUSED MOBILITY SERVICES AND CHOICES

Our Packaged Mobility (one-card/one-app) Service is specifically designed to provide mobility choices to all Austinites and visitors. We believe that seamless integration of multiple modes of public transportation, combined with compact and connected land use and automated vehicles will decrease dependence on personal vehicles and increase walking, biking, shared vehicle and transit use.

Project Highlight

A cornerstone of Austin's vision is a mobility subscription, or "Mobility as a Service" - the idea that users should be able to purchase a package of mobility options including transit, bike, car sharing, and ridesharing, as well as critical services to enable a nearly car-free lifestyle such as grocery delivery in a prepackaged smartphone app or card.

Likewise, the creation of **Travel Access Hubs** will create the physical epicenters for citizen engagement with the 21st Century Mobility System. These hubs are envisioned as great public spaces where users can connect to many transportation options, co-working spaces, and other travel amenities such as showers and lockers for cyclists. Using dynamic parking pricing and new parking management tools, the limited automotive space at these hubs will be prioritized for car sharing, vanpooling, and rideshare or automated vehicle pick-up and drop-off. Designed to make travel sustainable and easy, these transportation hubs would be a national model for connecting people and places.

5.6 URBAN DELIVERY AND LOGISTICS

Austin's 21st Century Mobility System will address, through pilot testing and implementation, several issues related to freight delivery for commercial businesses and individuals within the urbanized core of the city. Several large package delivery corporations are testing a variety of automated vehicle types for potential delivery of small- to medium-sized packages with implementation horizons as short as 3-5 years. FAA is still considering how it will regulate or restrict general airspace to the use of unmanned aerial vehicles (UAV); while the number and/or level to which such deliveries will become commonplace is unknown, the need for technologically Smart Cities to develop plans for managing UAV traffic within the urban core and for distribution of packages delivered in this manner is still urgent. Likewise, the use of small automated low-speed electric ground vehicles could also be considered for package delivery, perhaps operating safely and conveniently within Austin's extensive bike network.

Project Highlight

The Urban Package Delivery component of our Automated & Connected Vehicles initiative is made possible thanks to several private companies who indicate an interest to pilot commercial parcel delivery with autonomous drones. If proven safe, reliable drones could perform "last mile" delivery, and we could reduce the number of large trucks that need to enter and navigate our city.

As our effort progresses we will seek out methods for accommodating UAV- & autonomous low-speed vehicle based deliveries while preserving public safety through proper interface with V2I/V2V systems, ensuring security of the packages and citizens, and to limit the potential for UAV failure or collisions.

5.7 STRATEGIC BUSINESS MODELS AND PARTNERING

The City of Austin has a proven track record in partnering with the public and private sector on innovative transportation initiatives. We see our partners as being both technology innovators wanting to improve the transportation system in the Austin area and employers who wish to expand mobility options for their employees.

As just one example of a strategic partnership to advance Smart City concepts, the City and the Rocky Mountain Institute (RMI) are working over the next several years to develop innovative mobility solutions emerging from local and national businesses, industry leaders, and entrepreneurs. The program through its Urban Analytics Initiative will improve the information available to the public through mobility apps and other

technologies. This will help people know what their options are when they are deciding how they want to get somewhere.

Project Highlight

The City of Austin and the Texas A&M Transportation Institute (TTI) have partnered to advance Accelerate Texas, focused on deployment of connected and/or automated technologies, and adoption of the necessary policies, to deliver near-term benefits today. TTI is providing technical support in the development of strategies and applications that fuse connected vehicle and infrastructure sensors for mobility & safety applications.

5.8 SMART GRID, ROADWAY ELECTRIFICATION, AND ELECTRIC VEHICLES

Our Electric Fleets initiative is aimed at eliminating the barriers to widespread electric vehicle proliferation. This initiative will enable and incentivize electric vehicle adoption by high-mileage fleets through innovative business models and financing. In addition, we will deploy charging infrastructure intelligently and effectively to support our fleet work and encourage consumer adoption of electric vehicles as well.

Austin also owns and operates its own international airport. As such, we control the operating parameters of the taxi and transportation network fleets that have access to passengers arriving at the port. We believe we can affect a rapid conversion of these fleets to electric modes of travel through education, incentives, and infrastructure.

Federal investment has been critical to removing barriers to EV adoption and has directly supported an effective and diverse EV advisory group across utilities, academia, government, and private industry. The City values its Federal partnerships, and especially looks forward to partnering with USDOT to continue to advance – and implement - its Smart City vision.

Project Highlight

Austin's public and fleet EV charging stations are powered by 100% green-e certified renewable energy credits, so each electric vehicle mile traveled displaces the maximum CO2, oil-dependence, and pollution of a gasoline mile. Austin is the ideal city to show that electric vehicles can affordably run on wind and sun power. Low, fixed charging costs - just $4.17 per month (Austin Energy also provides charging station rebates) - greatly improves the business case for electric vehicles independent of current gasoline cost.

5.9 CONNECTED, INVOLVED CITIZENS

Through this Connected Traveler Initiative, we will engage diverse community voices – traveler input will be an R&D resource – and cultivate partners in mobility change. Austinites will not hesitate to voice their views and contribute to decisions that directly affect them. To ensure that our innovations offer workable solutions to real daily needs, we will seek out people with a variety of socioeconomic, language, and mobility perspectives and experiences. Our 21st Century Mobility System provides ways to engage the travelling public – while also motivating them to try new travel tools and behaviors. We will want to know how the new services offered are working for seniors, parents juggling the transportation of children, students, and low-income people with multiple jobs.

Project Highlight

The Connected Traveler Initiative within the MIC will become an epicenter for community engagement throughout the Smart City process. The MIC will continuously provide live, reliable information, create an opportunity for interaction among users and providers, and will offer citizens a platform to provide insights and ideas for ongoing initiatives.

Our program will also provide real-time information valuable in every-day decision making. Mode choice, route choice, time-of-day, and even whether or not to make a trip – all can be influenced by readily-available and easy-to-digest data that will come from our 21st Century Mobility System.

5.10 ARCHITECTURE AND STANDARDS

Our approach to the Smart City Challenge is to use existing or near deployment-ready ITS, communication, and connected vehicle technology

Project Highlight

For our Sensor Systems initiative, we will rely on existing ITS standards and developing C/AV standards to ensure regional and nationwide interoperability. Existing NTCIP standards for detection, cameras, and DMS will be expected, and using tools like the CVRIA to document planned V2I interactions will be foundational in our approach.

standards, architectures, and certification processes as part of all the systems and applications developed through the partnership. The Austin partnership is committed to developing applications and systems that can be extended to a nationwide or broader deployment based on accessible, well-defined standards. In those cases, where viable standards and architectures do not exist, the partnership is committed to documenting the situations and circumstances as to why current standards and architectures were insufficient to permit the desired functionality.

The Austin partnership plans to follow standard system engineering practices and utilize tools such as the CVRIA, SET-IT and others to document planned and deployed systems. Critical to this will be documenting the interfaces and data exchanges required to integrate projects with existing traffic management and data management functions currently deployed in the Austin area. As we pursue opportunities with original equipment manufacturers (OEMs) and vehicle and device manufacturers to build our V2V and V2I applications, it is critical they are built from a platform that supports the safety, mobility, and environmental applications developed by USDOT sponsored research and complies with the standards and requirements referenced in the NHTSA Advanced Notice of Proposed Rulemaking to create Federal Motor Vehicle Safety Standard (FMVSS) 150 to require DSRC technology in future vehicles for V2V Safety.

5.11 LOW-COST, EFFICIENT, SECURE, AND RESILIENT ICT

While the City's existing Information and Communication Technology Infrastructure (as introduced in Section 3) provides a solid foundation, this program will make it necessary to integrate new connected, automated, and electrified technologies; intelligent infrastructure; a data repository; USDOT's Security Credential Management System (SCMS); and other existing back-end systems that support new mobility and environment applications. Our IC T will feature a Smart City architecture that integrates information from a variety of sources and a mixture of communication mediums.

Plans for communication security, physical security, and device access control will be developed to comply with all federal standards and to include the latest technologies. As part of our collaborative environment, we will seek mutually beneficial opportunities to partner vehicle and device suppliers with IT service providers who provide proven technology which seamlessly switches between DSRC, cellular and Wi-Fi technologies based upon communication medium availability, data transfer costs, and application requirements.

The Austin team also recognizes the importance of physical security, communication security and device access control to ensure user privacy, trusted communications and secure information processing and storage. For **communication security and privacy protection**, we will utilize the established USDOT Security Credential Management System (SCMS) to ensure trusted, secure communications and user privacy for DSRC devices communications. Furthermore, we will implement security solutions for other internet of things (IOT) devices using non-DSRC communications mediums that comply with industry standards and best practices and utilize compatible cryptographic processes as necessary to interoperability and establish a necessary chain of trust. For **physical security and privacy protection**, we will analyze system level and device requirements to ensure adequate conformance to Federal Information Processing Standards (FIPS), specifically FIPS 140-1 and 140-2 for cryptographic

Project Highlight

The MIC's Regional Operations Management Center will be designed with hardened communication architecture in mind. As the epicenter of data collection and dissemination this facility requires maximum up-time of systems and secure connections to/from devices and back-office systems.

Table 2: Technical, Policy, and Institutional Risks and Mitigation

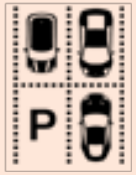
	Risks	Mitigation
Technical	▪Data formatting incompatibilities	▪Frequent collaboration during project functional requirements stage to ensure format compatibility
	▪Autonomous vehicle capabilities ready before Connected capabilities	▪Explore accelerating deployment of technology needed for vehicle connectivity so that all new programs feature connected & automated in combination
	▪Numerous communication mediums make us vulnerable to security/hacking	▪System network & architecture designs will focus on ensuring maximum security, and frequent collaboration meetings will take place (and ongoing) to ensure we are always considering the latest security measures
Policy	▪Fractured community support for an initiative	▪Early in the planning process we will engage Community members through our Connected Traveler component
	▪Socio-economic participation balance	▪Our program will engage the full range of residents, cater programs to both young tech savvy riders as well as older residents, and consider all neighborhoods for services
	▪Legislative barriers to implementation	▪Our team has already begun exploring any potential policy barriers and will work with legislators to overcome them.
Institutional	▪Focus on capital costs but not operating costs	▪A fundamental component of every project initiative will be to include a focus on sustainability (i.e. funding, policy, labor, revenue, etc.)
	▪Need a labor force trained in mobility services	▪One of our key strategies is to include recent graduates as employees to train the leaders of tomorrow and broaden the skill sets of our workforce and develop specialized training tracks in degreed and non-degreed university programs
	▪Partners are at differing capability & maturity levels	▪One of the basic tenets of TSM&O is consideration of partners with differing levels of maturity with technology, we will address this early and often in coordination meetings so that the entire program advances independent of individual agency levels

modules and their physical and operational security levels. Additionally, we will require that our partners and suppliers integrate hardware security modules (HSM) into their designs for the storage of, and processing involving, cryptographic security credentials for attack mitigation. Encrypted memory may also be specified protection of data containing Personally Identifiable Information (PII). The HSMs and encrypted storage requirements extend beyond the connected and automated devices and intelligent infrastructure to also include backend processing systems and our offsite data repository. We will develop and implement **device access control** plan beginning with an assessment of access needs at the user, device and system levels. Components of this include access, software updates, authentication, and security credential storage.

5.12 SMART LAND USE

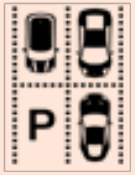
To better help real people, our Smart City tech innovations must be focused on connecting key places and supporting denser, walkable, transit/mobility-oriented new development in areas with jobs and affordable homes. That same focus will lower our carbon footprint. Fortunately, Austin has recently laid the foundation with the plans and policies needed to achieve this shift. They call for redirecting our city's rapid growth into compact areas and "activity centers" – which need rich mobility links. The City's 2012 Imagine Austin Comprehensive Plan and supporting "CodeNEXT" (our current update of the land development code) provide the essential "smart land use" basis for our Beyond Traffic Smart City initiatives. So does our recently adopted Community Climate Plan, emerging Austin Strategic Mobility Plan, Complete Streets Policy, and regional Project Connect planning. These City efforts have already spurred the rise of many new mixed-used projects in our TOD's

Project Highlight



Our proposed Travel Access Hubs would transform parking lots into intelligent and bustling transportation centers. Transit lines will converge with automated vehicle drop offs, EV charging stations, bike facilities, and more. By transforming the typical suburban park-and-ride into a Smart City facility, these hubs are the epitome of smart land use.

Project Highlight



Our Travel Access Hubs will transform parking lots into transportation centers for people in suburban/exurban areas. Transit lines will converge with automated vehicle drop offs, PEV charging stations, bike facilities, and more .

and other activity centers. City-sponsored major mixed-use redevelopments on publicly owned land include Mueller (a new urbanist redevelopment of our former Eastside airport), the Seaholm District (a Downtown EcoDistrct), and the Plaza Saltillo TOD (by Capital Metro). Envision Tomorrow, a super-data driven tool that demonstrates the benefits of directing investments in smart-growth ways (funded by a HUD Sustainable Communities grant) will provide our consortium with a unique and powerful tool for pairing land uses with Smart City transportation.

6. RISK MANAGEMENT

Because of our extensive experience, partnering, and preparation for the Smart City Challenge, we believe that Austin is a relatively "low-risk" investment of Federal and other funding for implementation of our Smart City vision. Table 2 summarizes preliminary risks and mitigation strategies that our multi-agency team has identified. A more detailed risk assessment and development of management strategies will be developed as part of the next phase of the Smart City Challenge (See Table 2 on page 20).

7. TEAM NARRATIVE

In a short period of time, Austin has galvanized the support of public agencies, universities, national labs, non-governmental organizations (NGOs), and the private sector to help build the Smart City vision and identify the Smart City investments outlined in this proposal. Our vision resonates with all key stakeholders, who are very excited to make Austin the launching pad for a 21st Century Mobility System.

Core Team: The Austin Transportation Department (ATD) will lead the charge for implementation of the vision in partnership with our Core Team, Key Partners and the private sector. The Core Team consists of local public agencies that plan, build, operate and maintain the regional transportation system.

Core Team	
City of Austin (Transportation, Energy)	Central Texas Regional Mobility Authority (CTRMA)
Texas Department of Transportation (TxDOT)	Capital Area Metropolitan Planning Organization (CAMPO)
Travis County	
Capital Metro (Transit)	

Key Partners: As shown below, our key partners include several of the nation's leading universities, NGOs, and private sector organizations that will also be instrumental in designing, implementing, reviewing, and participating in our Smart City program.

Key Partners	
Rocky Mountain Institute	Texas A&M Transportation Institute
The University of Texas at Austin Center for Transportation Research	Southwest Research Institute
Austin Technology Incubator	Greater Austin Chambers of Commerce
Austin City Up	Texas Technology Council
National Renewable Energy Laboratory	Texas State University

Austin's Smart City Challenge effort has garnered the interest and support from many of the world's most innovative and powerful companies in the mobility space. The following companies have committed their support and desire to partner on the Smart City Challenge. Their letters of support in the appendix give more detail, but each is a leader in USDOT's Smart City Vision Element areas and will bring their technologies and business models to bear in the implementation of Austin's Smart City Vision. We still need to formalize partnerships and agree to specifics, but we have some initial thoughts of how each of these companies could collaborate in our program:

- **Google** Deploy autonomous, connected, electric vehicles as a user-focused mobility service.
- **IBM** Deploy smart infrastructure, information technology, and data analytics in order to enable and run the mobility system of the future.

- **General Motors** Deploy connected, electric vehicles and user-focused mobility services powered by advanced urban analytics.
- **Car2Go/Daimler** Deploy connected, automated car share vehicles to consumers to increase area of operation, reduce cost, and increase convenience.
- **RideScout** Use strategic business models and partnerships, urban analytics, and vehicle connectivity to provide user-focused mobility options and increase involvement of citizens in non-SOV travel.
- **Peloton** Deploy vehicles and technologies related to urban automation, urban delivery and logistics, and connected vehicles.

We have also met with many other companies who have expressed interest in supporting Austin's Smart City proposal. Some have provided letters of support as well and we will solidify these relationships in the next phase of the grant application process as we continue to add new relevant private sector partners.

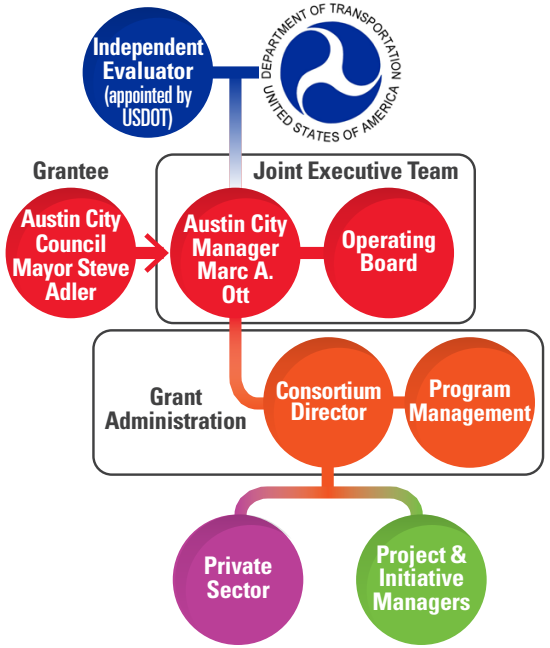
Project Delivery: Our Smart City Consortium provides the MIC's oversight structure and is the mechanism that will assure the implementation and maintenance of our interconnected project elements. Figure 3 demonstrates how we envision the institutional framework to deliver a successful Smart City program. The City and its partners recognize that the ambitious scale and timeline of the Smart City Challenge will require a dedicated team with the capacity to focus exclusively on the

Potential Partners		
Ford	Austin Community College	NXP (formerly Freescale)
ABB	U.S. Postal Service	Metropia
Austin Technology Incubator	TomTom	National Renewable Energy Lab
ChargePoint	HERE	Vision Fleet
Capital Factory	Pecan Street	Green Wheels
Lockheed Martin	NAUTO	B-Cycle
Intel	AT&T	Savari
Dell	ARM	Siemens
BMW	Uber	GetME
Spark	Lyft	Davi
PTV	Carma	Hitachi
ParkMe	Inrix	Verizon
Huston Tillotson University		

Challenge and its outcomes. Therefore, an Austin Smart City Consortium, under the auspices of the City of Austin, is envisioned to provide the oversight, structure, and support necessary to assure the transformation of Austin into a Smart City. The Consortium includes the following bodies:

- **Joint Executive Team (JET), led by the City of Austin City Manager:** Provides technical program oversight; assures adherence to grant policies; sets policy; assists with resolving escalated issues; and makes recommendations to the participating governing bodies. The Board will be composed of agency executives from the Core Team, including the City of Austin's City Manager, acting as the Principal in Charge for the City, Capital Metro's CEO, TxDOT's District Engineer, CTRMA's Executive Director, Travis County's Executive, and CAMPO's Executive Director. The City Manager, as the chief executive for the City of Austin will serve as the fiduciary point of contact for the USDOT and will be responsible for the grant.
- **Operating Board:** Provides project oversight and performance monitoring; approves draft deliverables to submit to USDOT; and facilitates partnerships. Board composition includes Departmental Executives from the Core Team.
- **Consortium Director:** Manages the Smart City project; reports to the city manager as

Figure 3: Smart City Successful Project Delivery



chair of the JET; manages private sector involvement; and serves as the point of contact to USDOT. An executive of the City of Austin and transportation professional – will be assigned this role and serve as the full-time Consortium Executive Director. The Director and the overall Smart City program will be supported by an experienced program management firm (e.g., reporting, budgeting, performance management, compliance, etc.) including a premiere data management firm to support the data infrastructure needs of our partners.

The Consortium will be staffed by project and initiative managers who oversee the day-to-day aspects of our Smart City effort; monitor and measure performance; and prepare draft deliverables. Managers are expected to be senior staff from the Core Team and Key Partners.

8. EXISTING TRANSPORTATION INFRASTRUCTURE

8.a Arterial Miles

The City of Austin's existing transportation infrastructure includes 369 centerline miles of arterial streets.

8.b Freeway Miles

Austin's freeway infrastructure includes 167 centerline miles of interstate freeway, expressway, and toll roads. An additional 110 centerline miles can be identified if U.S. and State Highways are also included.

8.c Existing Transit Services

Capital Metro operates Austin's public transportation network. In 2015, this network provided 1.4 million revenue hours of service, utilizing 398 buses, 40 MetroRapid BRT vehicles, 167 paratransit vehicles, and 6 diesel multiple unit rail vehicles. Riders have access to 2,700 bus stops, 20 transit centers, and 9 commuter rail stations.

Austin's public transportation technology infrastructure strongly aligns with the characteristics of an ideal Smart City. The City and Capital Metro have an impressive history of collaborating with each other to provide riders with the most intelligent transportation system possible. Capital Metro was the only transit agency in the nation to be named as a Premier Technology Leader in 2016 by Computerworld.

Austin's public transit mobile ticketing app was one of the first of its kind in the nation and has won multiple local, state, and national awards. The app allows riders to purchase tickets on any of Capital Metro's bus, rail, or paratransit services and to store them on their smart phones. The City of Austin and Capital Metro worked together to implement the infrastructure required to support transit signal priority allowing BRT (MetroRapid) routes through center-to-center communications.

The combination of availability of real-time AVL data via Capital Metro's website, mobile app, dynamic message signs, and open data portals and advanced mobile to mobile application public private partnership communications (which may have been the first in the nation) resulted in Metro Magazine awarding Capital Metro with its Innovation Solutions Award in September 2015.

8.d Shared-use Mobility Services

The City of Austin features an expansive array of shared mobility services including shuttle services, ridesharing, transportation network companies (TNC), bike share, car share, pedicabs, and private hired vehicles. The following list of providers on the following page illustrates that Austin offers mobility services that go well beyond Capital Metro's public transit services. These services offer safe, affordable, and innovative service options to residents throughout the City.

TNC	Bike Share	Pedicabs
Uber	Austin B-Cycle	500 operators
Lyft	**Car Share**	**Shuttle Services**
Get-ME	Car 2 Go	85 Shuttle Companies
	Zip Car	52 Airport Shuttles

8.e Information and Communication Technology

The Austin area is fortunate to have several existing partnerships that will be leveraged to support our Smart City effort. These partnerships will provide the networking backbone and information technology infrastructure that will be needed to implement our Smart City vision.

In 1993, the multi-agency Greater Austin Area Telecommunications Network (GAATN) was created. GAATN is a network that connects more than 400 partner agency sites via 339 miles of fiber optic cables. In 2002, GAATN received a "Best of Texas" award from the Center for Digital Government and Government Technology magazine. In 2011, GAATN was named recipient of the Community Broadband Organization of the Year award by the National Association of Telecommunications Officers and Advisors.

Completed in 2003, the Combined Transportation, Emergency Communications Center (CTECC) is a partnership of the City of Austin, Travis County, TxDOT and Capital Metro. CTECC is the current location of TxDOT's intelligent transportation systems for the Austin area. Roadway traffic sensor and camera information arrive at CTECC via a dedicated network and this information is used for daily operations by transportation management staff and public safety agencies. CTECC is also one of six 'super ring' sites on the GAATN allowing for ease of network interconnection.

Complementing this infrastructure is the fiber optic network operated by ATD that connects nearly every signalized intersection in Austin to an existing transportation management center. The ATD network is currently being analyzed to determine the best approach for updating the network to use the same software that is used by TxDOT so that these two systems can exchange information with the long term goal of seamless message exchange between ATD and TxDOT via the proposed Regional Operations Management Center.

Finally, a fiber optic network, operated and maintained by TxDOT along major highways (i.e., IH35, US183, US290, SH130, SH71, and Loop 1) in the Austin area serves as a communications backbone network for connected transportation.

8.f ITS Including Transportation Management Center and Field Equipment

The Austin region has multiple, independent transportation management centers (TMCs) operated by various entities including the City of Austin, TxDOT, CTRMA, Capital Metro and others. Each TMC operates independently with its own set of standard operating procedures, performance metrics, and overall goals focused on their users.

Through regional collaboration, Austin and its partners are addressing this "siloed" operational approach through the development of the ROMC component of the MIC. As described in Section 1, the ROMC would take a holistic "One System" approach to managing the region's transportation system. Creating a "One System, One Vision" approach leverages the expertise and resources of each entity to create an operational approach whose sum is much greater than the individual parts. This shifts the paradigm to improving mobility of all users regardless of the facility they are traveling along. Multi-agency staff would be located at the ROMC and coordinate through common operating objectives and integrated technology and data platforms. The ROMC provides a great opportunity to improve incident management, reduce recurring congestion, increase safety, and leverage existing resources to a scale that is greater than that achieved by individual agencies.

8.g Smart Grid Infrastructure

Austin Energy is the nation's 8th largest publicly owned electric utility serving more than 448 thousand customer accounts and more than 1 million residents in greater Austin. During peak demand, Austin Energy manages 2,714 megawatts (MW), 57 MW of reduction assets, and 3,485 MW of generation capacity which consists of 28.5 percent renewables. Austin Energy is responsible for 623 miles of transmission lines and 11,429 miles of distribution lines on Austin's electric grid. Operations are funded entirely through energy sales and services, and the utility operates within the Electric Reliability Council of Texas statewide market.

Highlights of this innovative utility, beyond traditional electric service operations, include:

- **Austin Energy Green Building** — Austin Energy launched the first Green Building program in the nation; more than 10,000 Austin homes are Green Building rated.
- **Climate Protection** — The 2014 update to the Generation, Resource and Climate Protection Plan envisions Austin Energy achieving a 55 percent renewable energy supply by 2025.
- **Energy Efficiency** — Through Austin Energy's energy efficiency achievements, the utility has been able to save 700 MW from 1982–2006. An additional 900 MW energy avoidance goal has been set for 2025, and as

of 2013, we have already avoided 376 MW toward that goal.

- **Energy Efficiency Rebates** — In FY 2013, more than 35,000 energy efficiency improvement rebates totaling about $11 million were paid to Austin Energy customers.
- **Dark Sky Compliant Streetlights** — Austin Energy continues to find ways to become a more efficient utility including automating its 56,000 streetlights and making them Dark Sky compliant. Austin Energy also converted more than 13,000 streetlights to light emitting diode technology. The automation and LED projects are expected to save more than 4.3 million kilowatts annually.
- **Electric Vehicle Charging Stations** — Austin ranks among the top four cities in the nation for electric vehicle public charging stations. In FY 2015, the Plug-In EVerywhere™ Network surpassed its 100,000th session.

9. DEFINE EXISTING DATA COLLECTION

The City of Austin has a robust data collection program and therefore a rich foundation of data to support implementation of our Smart City vision. Austin and its partners are data-driven, outcome-focused, and believe that data is an asset that has value in improving how a city (transportation infrastructure, transit, public safety, etc.) is managed and operated.

Figure 4: Data Functionality

Austin's data cache to support its Smart City vision is too large to list in this proposal. A few examples of relevant data include travel times, reliability, signal timing, transit vehicle locations, transit schedule adherence, passenger loadings, managed parking transaction and occupancy, video, air quality, weather, crash statistics, field equipment status, and incident characteristics.

Austin's commitment to open data is exemplified by City Manager Marc Ott's Open Data Initiative 2.0 directive that "with the development of new technologies and an increasingly connected and engaged population, a growing expectation is being placed on government leaders to promote transparency, citizen participation, and collaboration."

Beyond its existing data program, Austin is remaking the face of urban analytics. Austin is in the process of bringing these resources together through its Urban Analytics Initiative (UAI) to enable the broader transportation community (and others) to take advantage of the latent potential of this dynamic ecosystem. The mission of the UAI is to foster interagency and interdisciplinary collaboration, promote synergy between the public, private, and academic sectors, and to engage the Austin community with a focus on high-impact applications that address city challenges across all sectors – transportation, safety, environmental,

Data's Value in Managing a City (data driven decisions)

Austin is working on a number of exciting efforts to share data with businesses to improve and create services for their customers while simultaneously benefiting the community through reduced congestion, improved safety and less environmental impacts. For example, today, the City's low water crossing data is being consumed by Metropia – a company that provides incentive-based navigation services. When a low water crossing is blocked, Metropia's app routes traffic around the crossing reducing congestion and frustration for their users. Building on this success, early discussions are underway with Metropia to share the City's reduced speed school zone data. Access to this data enables Metropia to alert their customers when they need to begin slowing down and can also be used to divert traffic away from the school zone further enhancing safety.

affordability, and a host of others. The UAI is an integral aspect of the MIC's Urban Analytics Policy Research (UAPR) Center element.

In brief, the UAI will lead to data integration across functions and services by: (1) fostering a data sharing culture; (2) using real-time data to make real-time agency operations and staffing decisions; (3) discovering relationships among different data sets that can lead to improved decisions regarding management and operations; (4) documenting benefits of data integration. As Figure 4 shows, data across a variety of functions and services are compiled in a common database, accessible to a number of sectors. Analytics are performed, and information is generated to make management and operations decisions across a range of time frames. We believe that the outcome of UAI will be more integrated Multi-modal programs and more rapid decisions. Section 11 of this proposal further describes how data will inform the measurement of Smart City goals and objectives.

Performance measures are the 'face' and the 'guts' of the system. Real-time reporting aids trip decisions; daily reporting facilitiates changes to agency operations; and monthly and quarterly reporting helps identify the need for investments and policy changes. Data policies and agreements among data providers and users will need to be developed through the UAI to address data collection, management, sharing, storage, archiving, security, and privacy issues. It is likely that these policies will require some degree of customization to address different data types and the requirements of different data providers. Data handling procedures will be programmed into the system to the extent possible to minimize inadvertent data policy violations. Data policy audits will be performed at regular intervals by an independent entity. The UAI will also develop (1) tools to identify data integrity issues (gaps, significant deviations) and (2) procedures to flag issues and when appropriate resolve issues.

10. ITS AND CONNECTED VEHICLE STANDARDS

Austin is committed to deploying applications and systems where the interfaces and the data transferred between the systems are open and flexible to all developers and users of the system. To the extent possible, the City is committed to using existing standards, protocols, and architectures in the development of applications and systems. A sample of these is highlighted to the right of this page.

In those cases where existing standards are inadequate or incomplete to support the desired functionality, Austin will prepare appropriate documentation of the standard's deficiencies that will be introduced to standard development organizations, such as SAE, IEEE, ITE, and others to develop new or revise appropriate standards for the benefit of other cities across the nation.

Implementation of the MIC and its subsequent initiatives will be designed to integrate with the current and planned ITS architecture in the region. In June 2015, the Austin region completed an update to its ITS Architecture which documented existing and planned ITS deployments. This architecture will provide the framework for deploying the systems and technologies outlined in Austin's Smart City vision. Austin is also committed to following the approach outlined in the Connected Vehicle Reference Implementation Architecture (CVRIA) for identifying and documenting interfaces and data flow between systems in a connected vehicle environment. The CVRIA approach, and in particular the SET-IT tool, will be used to develop project architectures for systems and application deployed through the MIC.

The City further plans to utilize the framework established by USDOT for certifying the system components and technologies deployed through the MIC. It is envisioned that certification will occur at the device and system levels to ensure accuracy, timeliness and integrity/security of over-the-air and other transmitted data, as well as the application level. When possible, the MIC will utilize supplier systems, technologies, and services that have been previously certified by USDOT. In cases where certification equipment does not exist, we will make use of the third party certification services, such as the OmniAir Certification Services led by the Southwest Research Institute, to coordinate and conduct certification testing.

11. MEASURABLE GOALS AND OBJECTIVES

A cornerstone of Austin's Smart City vision is that our goals and intended outcomes cannot just be aspirational statements; they must be measurable and achievable. Each Smart City initiative – from the real-time operation of the MIC to the projects it will deploy – will be measured by a data-facilitated, stakeholder-driven, transparent performance plan. The plans will be stakeholder-driven and transparent both in their development and use.

The City of Austin and its partners have identified a series of goals and objectives which align with USDOT's expected outcomes of the Smart City Challenge: enhance mobility; improve safety; and address climate change. Efficiency, sustainability, and equity are other important goals, objectives of which are summarized in Table 3. The data analysis will be used for reporting, but as importantly, also for improving day-to-day operations and investment decisions.

To achieve these goals, Figure 4 on page 25 presented a performance management process which will be made possible with complete implementation of the UAI. The process may be summarized as follows:

- Data is provided through smart sensor infrastructure, connected citizens and vehicles, private sector sources, qualitative instruments, etc.

Existing Standards, Protocals, and Architecture

- SAE J2735 Dedicated Short Range Communication (DSRC) Message Set Dictionary
- SAE J2945/1 On-board Minimum Performance Requirements for V2V Safety Communications
- IEEE 1609 Family of Standards for Wireless Access in Vehicular Environments
- IEEE 802.11 specifications for wireless local area network (WLAN) computer communications
- The family of National Transportation Communications for ITS Protocols (NTCIP) communications protocols
- ITE's Traffic Management Data Dictionary (TMDD)

- Urban Analytics Initiative is the engine that analyzes the data, produces key performance measures, compares them to targets, and identifies the amount and timing of deficiencies.
- Information is used to make decisions about whether the project or policy needs to be adjusted to meet mobility, safety, efficiency, sustainability, and climate change objectives. These may result in real-time deployment of resources, near-term changes in operations or longer term needs for innovation, investment or policy changes.
- Engagement in the form of internal agency operations reports and project, policy and overall Smart City dashboards are envisioned to connect MIC activities to Austinites.
- Those decisions produce outcomes that affect people, organizations and the environment. Outcomes also illuminate other questions and data needs completing a feedback loop that can be used for continuous monitoring and optimization.

Austin's agencies have been sharing data and performance measures for many years in ad-hoc or project related efforts. The value of Austin's Smart City effort is that the interagency cooperation and coordination will be further incorporated into daily and annual multmodal and interdisciplinary decision-making processes. Austin's Smart Growth Plan, for example, points to desired mobility targets at the neighborhood level that prioritize pedestrian, bike and transit improvements in densely developed areas, and operations treatments that improve travel time reliability along major travel corridors. The UAI can incorporate these priorities in real time to decide which problems need solutions and which are 'usual congestion' - other urban areas can unlock the value of Austin's Smart City efforts for their citizens, businesses, agencies, etc. Local commitment to such immensely successful events such as SXSW demonstrate that Austin is proficient in sharing results with the rest of the world – Austin's Smart City commitment will join this list and ensure USDOT's goal are met.

Table 3: Goals and Objectives

Category	Goals	Objectives
SAFETY	Eliminate deaths and serious injuries throughout Austin's Multi-modal transportation system.	▪ Prioritize resources to address (1) locations and (2) behaviors that are over represented by fatalities and injuries ▪ Fund staff, projects, operations and programs to improve transportation safety using enforcement, engineering, education and emergency services
MOBILITY	Improve mobility for all people and services.	▪ Provide a wide variety of travel options – auto, bike, pedestrian, shared-ride and transit - that are efficient, reliable, and affordable ▪ Facilitate freight movement ▪ Reduce congestion in a collaborative and creative manner
EFFICIENCY	Operate the transportation system in a manner that increases productivity and reduces wasted time.	▪ Implement strategies for distributing trips in a more balanced manner across modes, time, and the roadway network ▪ Operate the transportation system across agency boundaries as One System ▪ Reduce emergency response times
SUSTAINABILITY	Create an urban environment that preserves natural resources.	▪ Reduce vehicle-miles traveled (VMT) ▪ Foster interconnected development patterns that: – Support public transit – Support a variety of transportation choices – Positively address the linkage between transportation and affordability – Increase use of environmentally sustainable practices and materials in the transportation sector
CLIMATE CHANGE	Reduce transportation-related impacts on climate change.	▪ Reduce transportation-related carbon emissions ▪ Decrease carbon-based fuel consumption ▪ Reduce transportation-related air, water, and noise pollution and impacts on ecosystems
EQUITY	Increase access to opportunity.	▪ Increase access to convenient and affordable transportation choices ▪ Improve access to transportation for people with disabilities and older adults ▪ Improve public transit experience

12. EVIDENCE OF CAPACITY TO SUCCEED

Austin has the drive, commitment, and capacity to successfully deliver its Smart City vision. City leadership is excited and highly motivated to use the Smart City Challenge opportunity to tackle Austin's transportation issues.

Austin's Strong Financial and Business Track Record

Financial Solvency – The City of Austin annually runs budget surpluses, and has a AAA bond rating. This is major discriminator and risk mitigation factor.

Proven Track Record with Business – The City continually makes Top Ten lists. Specifically, the best locations for business, most likely to succeed over the next ten years, best place to start a business, best place for millennials/retirees, and others.

Proven Record with Public-Private Partnerships (P3) – We've successfully undertaken and completed many P3 projects, in the operations, development and infrastructure areas. These include private development, national launch of Car2Go and ParkMe, and AE's chilled water system and AWU's reclaimed water system, parks facilities, and development of public works infrastructure.

As Mayor Adler has championed, "We are 100 percent committed to doing whatever it takes to make Austin the USDOT's shining Smart City demonstration project for the nation."

The city will assign an experienced transportation professional to serve as the full-time Executive Director for the Austin Smart City Consortium. This commitment provides a politically savvy, locally engaged, and tested leader at the helm. His leadership has led to an estimated $4 billion work plan to improve I-35 with a number of projects underway; signal technology and roadway infrastructure to support Capital Metro's $48 million bus rapid transit system; and, a multi-million dollar pass through funding agreement with TxDOT to accelerate needed construction. The following summarizes additional key features of the City of Austin and its partners' technical capacity to successfully deliver on the Smart City Challenge:

Governance Model: Our Smart City Consortium governance model is a proven model. It is adapted from the successful model used for multi-agency governance of the region's Combined Transportation, Emergency Communications Center (CTECC) since opening in 2003.

Regulatory and Political Environment: Our readiness is also evidenced in our enabling regulatory and political environment and demonstrated by local real-world testing of self-driving vehicles. Smart land use is occurring through the City's Imagine Austin Comprehensive Plan and updated CodeNEXT land development code.

Workforce Capacity: We will obtain new staff, consulting support, and additional program management support to free up the time of our most knowledgeable senior agency staff so that they can be available to the Smart City effort and the ongoing evolution of our mobility transformation. The Austin marketplace is also rich in technology and entrepreneurial talent that is available through our partnerships.

Infrastructure Readiness: Austin Energy is owned by the City and ranks among the top four cities in the nation for electric vehicle public charging stations. Google is testing self-driving vehicles here. Shared-use mobility services are vibrant and growing. Capital Metro operates a vast transit network and envisions an all-electric fleet with innovative first and last mile connectivity. V2I projects are implemented. Austin's transportation agencies have considerable investments in intelligent sensor-based infrastructure, software, dedicated transportation fiber networks, etc. Austin's first managed lane project will be completed this year.

Data Management Capabilities: Open data initiatives are implemented and expanding at multiple agencies. The private sector is accessing this data to improve services to their customers. The region is working with the University of Texas to develop a regional data warehouse to enhance access and analytical capabilities.

Performance Management Capabilities: Austin's agencies are data driven. Agencies routinely use quantitative and qualitative data to monitor performance, make improvements, measure

outcomes and repeat; and, share key performance indicators with their governing bodies.

Procurement: As procurement is a critical path item, Austin is already exploring paths to begin procurement processes now so we are ready to go upon receiving the award.

13. OPPORTUNITIES TO LEVERAGE FEDERAL FUNDS

As Texans, we have not been – nor will we be – shy about asking our partners to contribute the resources necessary to meet USDOT's expectations for delivering the national model of a first-rate Smart City. The City of Austin is honored by the outpouring of interest as demonstrated by the multitude of support letters from companies, agencies, and organizations seeking to partner with Austin on the Challenge. We are communicating to all potential and committed partners the expectation that they will go the extra mile to make Austin a highly competitive Smart City Challenge finalist – by generously contributing time, talent, and treasure.

If awarded the Smart City Challenge grant, all organizations and companies identified in Section 7 will be asked to go beyond policy support for our effort to provide actual – and substantive – financial support. Austin agencies have a track record of contributing resources to joint initiatives such as I-35 reconstruction, the BRT system, and freeway interchange construction. The City will explore its funding mechanisms to further leverage Federal funds. TxDOT has engaged us in discussions about a major matching grant. Capital Metro, the CTRMA, CAMPO, Travis County, and the State of Texas are all on board as investment partners, expressing financial support for accelerating our vision.

Austin's round two Smart City Challenge submission will provide more details on the robust commitments from our project partners that we expect to fully leverage USDOT's Smart City investment. The City and its partners have been excellent stewards of Federal grants for many years, and will continue to do so if awarded the Smart City Challenge grant.