

Preferred Sustainability Status City

# Des Moines

## Model Smart City Proposal



### A RESPONSE TO

U.S. Department of Transportation's  
*Beyond Traffic: The Smart City Challenge*  
Notice of Funding Opportunity Number DTFH6116RA00002

February 4, 2016

### FROM

Des Moines Area Metropolitan Planning Organization  
The City of Des Moines  
Des Moines Area Regional Transit Authority



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## **Part 2: Vision Narrative**

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

Commuters would enjoy incredible personal freedom of movement, with or without privately owned vehicles, in the future model Smart City of Des Moines, Iowa, as envisioned by the applicants, the City of Des Moines, the Des Moines Area Regional Transit Authority (DART), and the Des Moines Area Metropolitan Planning Organization (MPO). Thanks to several advancements that are possible for the urban transportation network, the morning of a savvy commuter would look very different than it does today. Imagine:



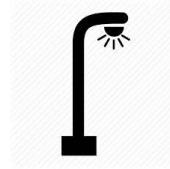
*She steps out the door of her downtown Des Moines home and walks to the nearest bike-share kiosk. She checks out a bike with her universal smart card, the same card she will use throughout her travels today.*



*After biking to a few morning errands in the shopping district, her phone buzzes with an alert: Her autonomous bus is giving her notice, per her pre-programmed request, that it will arrive at her bus stop in 10 minutes. She pedals to the bus stop, docks the bike, and boards the driverless bus. Again, she pays with her universal smart card, waving it in front of the proximity-reading farebox.*



*During her short bus ride across the river, she wakes her smart phone, opens the app by the DSM Central Transportation Communications, and books an electric, autonomous car from the car-share program. She alights the bus and the app directs her to a specific parking on the third floor of a nearby parking garage. Finding and entering the car she's just booked, she gives the address of her destination, and off the car takes her.*



*The car, communicating with smart sensors built into the city infrastructure, exits the garage and navigates the city streets to the interstate entrance ramp. The car pauses at the ramp meter, part of a system of meters along the interstate helping to manage congestion, then merges into the safe, steady motion of rush hour traffic. She's headed north to Iowa State University in Ames, Iowa, along one of nation's first autonomous interstate highway corridors.*

This futuristic vision of a seamless, comprehensive and intelligent transportation network for citizens and the business community is achievable in Des Moines, Iowa. As a [Preferred Sustainability Status City](#), Des Moines is primed with the right ingredients for a successful Smart City Challenge:

**Planning:** The Des Moines region has been actively planning to modernize its transportation network. Notably, the MPO, the City of Des Moines and DART were among the partners in developing The Tomorrow Plan, a regional sustainable development plan that was funded through a 2010 HUD Sustainable Communities Regional Planning grant and adopted locally in November 2013. Complementary plans include: DART Forward 2035, a long-range transit service plan; Mobilizing Tomorrow, the region's long-range transportation plan; Capital Crossroads, a workforce and economic development vision plan led by the business community; and PlanDSM, the City of Des Moines' comprehensive plan.

**Public Support:** Members of the public are highly supportive of Des Moines' transportation network evolving into a system of vibrant, walkable employment and residential nodes that are connected to one another by multimodal corridors. The public has consistently voiced this desire during the public involvement processes of the aforementioned planning efforts. The Tomorrow Plan, for example, by itself reached 27,000 stakeholders as part of public engagement, including public meetings, interactive online games, and a statistically valid survey.

**Preparation:** Much of the groundwork for the transportation network envisioned in this application has already been completed through the implementation to date of the aforementioned plans. Examples include DART's expansion of online applications for riders, a ramp metering study by the MPO, the planned opening of a new transload facility in Des Moines, and work by the Iowa Department of Transportation to develop the state's first automated highway corridor.

**Key Partners:** The organizations that would be critical to the success of a Smart City Challenge can all be counted on as committed stakeholders to this application.

For the Smart City Challenge, the applicants envision 12 key elements which fall into three broad categories:

**Accelerate the planned implementation of proven technologies, including:**

1. Smart traffic signals
2. Bicycle and pedestrian counters
3. Electric vehicle charging stations

**Modernize the city by advancing the research and adoption of evolving technologies, including:**

4. Autonomous bus line circulating in downtown core
5. Electric, eventually autonomous car-share program
6. Autonomous-vehicle-ready highway corridor with Iowa Department of Transportation
7. Autonomous-vehicle home-delivery through a public-private partnership
8. Smart parking
9. Smart inland port for movement of goods

**And better integrate all components of the transportation network**

10. Universal smart card for multiple transportation services
11. Virtual transportation operations center
12. Citizen communications tool

The following section provides a more detailed description of each of these elements, the challenges faced by the city, and how this project would address those challenges. The descriptions include an overview of the technology and its proposed application, as well as our proposed approach for implementing and operating the demonstration project, including our program management approach. Des Moines' capacity to carry out the project is discussed in Section 12.

**1. Smart Traffic Signals**

*Overview* -- The City of Des Moines will upgrade its aging traffic signal system with interconnected signals featuring appropriate adaptive signal technology, Wi-Fi /communication ability, or video observation. The primary goal is to ease congestion, though other benefits would be realized. Battery back-up to support traffic operations when power supply is interrupted. Wi-Fi or communication component would interconnect traffic signals and the addition of video observation would aid police and emergency responders via signal pre-emption and DART via signal priority. In addition, it would provide for vehicle-to-infrastructure and vehicle-to-vehicle communications. Video observation would provide footage to traffic operations staff to aid in adjusting signals, managing incidents, and relaying information to emergency responders.

*Implementation, Operation, and Management* -- The City of Des Moines's Traffic and Transportation Division within the Engineering Department is responsible for implementing and operating the traffic signals. The ultimate vision for traffic management using the signals is to have a central transportation operations center comprised of staff from multiple agencies, including cities, the Iowa DOT, and DART. The central transportation operations center could be virtual and accessed via the internet and/or fiber by multiple agencies metro-wide. Transitioning to a regional management structure would take place over time as neighboring communities implement similar systems.

## **2. Bicycle and Pedestrian Counters**

*Overview* -- The City of Des Moines will purchase and deploy a system of bicycle and pedestrian counters throughout the community. The goal of this project is to establish baseline information for the number of people walking and biking along routes and track changes over time. This information, in particular, will help better track the effectiveness of complete street projects and Safe Routes to School Projects. The information also will help track how well the region is meeting its objective of increasing walk and bike commuting to 10 percent of trips by 2050.

*Implementation, Operation, and Management* -- The City of Des Moines would lead efforts, in coordination with the MPO, to purchase and install counters at appropriate locations throughout the community. Initial locations would include areas of high use already – such as downtown Des Moines and the neighboring Ingersoll Avenue corridor – as well as locations that will soon see significant bicycle/pedestrian infrastructure investments. Where possible, the counters will be integrated with other technology and/or infrastructure to maximize efficiencies and ease in data collection efforts.

Prior to the purchase and installation of counters, the MPO will work with the City of Des Moines and neighboring communities to ensure the needs of all communities are addressed. This will help ensure the counters can be expanded to neighboring communities to allow for metro-wide collection and analysis.

## **3. Electric Vehicle Charging Stations**

### *Overview*

The applicants seek to promote the further adoption of electric vehicle charging infrastructure and the expansion of more advanced technologies with electric vehicle charging, such as plugless charging. This effort will be necessary should other project elements in this proposal be successful. Elements of this overall project include installing additional charging equipment, working with private sector partners to install charging equipment and convert to all electric fleets, and pursuing electric transit vehicles served by plugless chargers.

*Implementation, Operation, and Management*

The City of Des Moines will work to install electric vehicle charging infrastructure in its parking facilities and other government owned facilities, such as libraries. The City also will work with developers and other private sector partners to encourage and incentivize the installation of charging equipment. DART will work to upgrade its fleet to electric motors and install plugless chargers in locations where buses can regularly park and be recharged.

#### **4. Autonomous Bus Line**

*Overview* -- This would include the automation of DART's D-Line service, which operates on a loop route throughout downtown Des Moines. The goal of this project would be to demonstrate the application to automation technology in transit vehicles. The D-Line route was selected for this application for several reasons. The route is entirely within downtown Des Moines, operating at relatively low speeds and allowing for more efficient placement of infrastructure than a long linear route. Its downtown location also would provide high visibility of the service to a large number of people, including state elected officials at the Iowa Capitol building.

*Implementation, Operation, and Management* -- DART and the City of Des Moines would partner to implement this project. DART would upgrade its bus technology to have the appropriate software and components necessary for autonomous driving. The City of Des Moines would work with DART to ensure communications infrastructure along the route is installed. The City of Des Moines also would undertake efforts to pass ordinances and/or other policies to allow an autonomous vehicle to operate legally.

#### **5. Electric, Eventually Autonomous Car-Share Program**

*Overview* -- A car share program will be introduced to Des Moines, providing the public another mobility option. The program would use electric vehicles to help demonstrate and educate the technology to the public. As autonomous technology and infrastructure throughout the community becomes available, the car share fleet will transition to autonomous vehicles. The ultimate vision is to reduce the need for private vehicle ownership while still providing a robust number of mobility options. The future car share system would make use of a smart card for vehicle check outs, as described in number 9 below.

*Implementation, Operation, and Management* -- DART is prepared to host a car share program in addition to the other programs it operates and manages. The recruitment of, or partnerships with, established private car share companies also would be pursued. The City of Des Moines would undertake efforts to pass ordinances and/or other policies to allow car shares and autonomous vehicles to operate legally.

#### **6. Autonomous-Vehicle-Ready Highway Corridor**

*Overview* -- A second application of autonomous vehicle technology would be a partnership with the Iowa DOT to develop an autonomous vehicle-ready highway in the Interstate 35 corridor between Ames and Des Moines. This approximately 35 mile distance was selected as it would connect the Iowa DOT's headquarter and Iowa State University in Ames with downtown Des Moines. The Iowa DOT's traffic management center also is located along the corridor in Ankeny.

*Implementation, Operation, and Management*-- The Iowa DOT would be the key partner in implementing this project. This would include necessary infrastructure along the corridor as well as pursing the adoption of any statewide rules, laws, or other regulations to permit the use of autonomous vehicles in Iowa. The City of Des Moines and the City of Ames would work with the Iowa DOT to ensure that sufficient infrastructure exists within the respective communities to ensure autonomous vehicles can transition from the interstate to local road networks.

#### **7. Autonomous Home-Delivery Service**

*Overview* -- The applicants will engage local grocery store chain Hy-Vee in a pilot project to introduce automated urban delivery services. Hy-Vee, West Des Moines-based company and a strong supporter of sustainability initiatives, has recently introduced a home grocery delivery service. The applicant envision automating this delivery service to demonstrate the capabilities of autonomous vehicles for freight, goods movement, and deliver, ideally leading to additional private sector adoption of autonomous vehicles.

*Implementation, Operations, and Management* -- The applicants will work with Hy-Vee to provide grant funding received to assist with the upgrade of its fleet to automated vehicles. The City of Des Moines would work with Hy-Vee to ensure communications infrastructure throughout the delivery service is installed. The service area likely will be limited to a smaller geographic area initially, and then expand as the service and technology is refined. The City of Des Moines also would undertake efforts to pass ordinances and/or other policies to allow an autonomous vehicle to operate legally.

## **8. Smart Parking**

*Overview* -- In addition to introducing the smart card technology that would aid in parking, as discussed previously, the applicants propose to introduce other technologies that would improve parking within the community. These include sensor-based parking technology, technology to enable self-parking vehicles to operate, and electric vehicle charging infrastructure. The goals of this element are to make parking more convenient to drivers, enable the city to better understand and manage parking supply, reduce unnecessary congestion and emissions associated with finding parking spaces, reduce the amount of land required for parking facilities and make more efficient use of existing facilities, and embrace the adoption of electric vehicles.

Sensor-based parking would include the installation of sensors in structure and surface parking lots as well as in on-street parking spaces. The equipment would sense whether a space is occupied, and this information would be relayed to drivers, through either mobile applications or integrated vehicle technology, to help indicate the closest vacant spaces available. The information also could be relayed to the parking managers, which would have several benefits. The city could use the information to adjust pricing to ensure appropriate usage levels, subject to city ordinance. Parking enforcement officers could be more efficient in knowing which vehicles should be ticketed. Special event information could be easily registered online and relayed to the parking management system and passed on to drivers to indicate spaces to avoid. And a host of analytic information about parking such as locations and duration would help enable the city better manage and plan for parking. The city has an existing system of Open/Full signage for its parking structures with electronic message boards throughout downtown area. The sensors in the parking structures could be tied into this system to display messages to direct drivers to ramps that have capacity in real time during events.

To compliment the sensors, another element would be to install infrastructure and technology that would allow self-driving cars to park themselves. This would ultimately reduce the space needed for parking – companies like Audi have estimated that up to 60 percent more cars would be able to fit into parking garages because they are able to park closer together. Additional benefits could include the ability to locate parking lots away from downtown areas and connecting them with transit, as well as freeing up on-street parking to provide more room for other modes of transportation.

Finally, increased electric vehicle charging equipment would be installed throughout the project area. The City of Des Moines and businesses have installed some electric vehicle charging stations throughout the community over the last several years. As increased adoption is likely, it is important to ensure additional equipment is made available. The applicants plan to partner with local grocery store chain Hy-Vee, which has installed electric vehicle charging infrastructure at new stores over the last five years and now plans to retrofit older stores with the technology. The applicants will continue to work with private developers to support electric vehicle charging in key areas of need defined for the region.

*Implementation, Operation, and Management* -- The City would be responsible for implementing the sensor technology within city parking structures and on-street parking. Ultimately, all public parking could be incorporated to aid drivers in locating available parking. This sensor technology will provide real time data to drivers looking for parking spaces in the downtown and for driver's circulating in the ramps once they enter. These sensors could also be used to provide parking in the ramps for autonomous vehicles as that technology is developed further.

## **9. Smart Inland Port**

*Overview* -- A traditional inland port provides for the transfer of goods from one mode to another and adds associates services such as customs and freight forwarding. The opportunity exists to develop a "click and mortar" inland port for Des Moines. In this facility, traditional physical assets found at inland ports would be augmented through a web-based system to further aid in the movement of goods. This web-based system could include online payment options, reservation of loading/unloading times, permitting and customs processing, and identification and reservation of equipment such as shipping containers.

*Implementation, Operation, and Management* -- The applicants would rely on the Iowa State University College of Business's Department of Logistics, Operations, and MIS to be an adviser on the implementation of this project. The City of Des Moines will continue to develop the transload facility. The MPO and the Greater Des Moines Partnership will lead efforts to work with trade, transportation, and governmental representatives to develop a port authority to oversee the operation and management of the inland port.

## **10. Universal Smart Card for Transportation Services**

*Overview* -- The applicants envision developing and deploying a smart card and mobile payment application that would work across several transportation services including public transit, public parking, bicycle sharing, and car sharing. Currently, payment options vary amongst the different transportation service providers and modes. The goal would be to make services more convenient to the public and to increase efficiency by streamlining the infrastructure and technology necessary for several services into a single system.

*Implementation, Operation, and Management* -- The applicants propose that DART, the City of Des Moines, and B-Cycle (operated through the Des Moines Bicycle Collective) will enter into an agreement to jointly pursue a technology vendor, identify technology and infrastructure solutions suitable to all four services, costs and implementation timeline, as well as maintenance requirements. DART, who is already in the process of designing a group of new fare collection technologies will lead the procurement process, manage the ongoing maintenance and expansion of the smart card infrastructure software, data collection and distribution.

## **11. Virtual Transportation Operations and Communications Center**

*Overview* -- To adequately operate and manage the transportation network and advanced technologies proposed in this application, there is a need for a regional transportation operations center. The goal of such a center would be to share digital resources amongst all forms of transportation officials together to operate, collaborate and share resources. In a community where several different entities – transit operators, municipalities, counties, B-Cycle, the Iowa DOT, and the MPO to name a few – operate and manage various aspects of the transportation system, having a transportation operations center would help break down silos and promote the integration of decision making and information sharing across the region. This initiative would be complimented by a Communications Officer who would facilitate efforts across the agencies and with the public. Transitioning to a regional management structure would take place over time as neighboring communities implement similar systems.

*Implementation, Operation, and Management* -- The transportation entities described above would develop an agreement to jointly develop the transportation management center that suits all party's needs. The operation would need to include all metro transportation agencies and provide seamless information to the public and emergency responders. A virtual center, as opposed to a physical center, is proposed to help reduce costs and ensure early success. Sharing of digital information and technology would be used to support a virtual center that allows for collaboration and effective incident management.

## **12. Citizen Communication Tool.**

*Overview* -- The ability for citizens to become more aware of transportation options and more involved with improving mobility is of great importance to the applicants. In addition to making data available for the development of a variety of mobile applications, the applicants would partner to introduce a mobile application for citizens to directly provide feedback to government officials. This application would provide for crowdsourced feedback for maintenance related issues, and also allow government officials to push critical information to citizens. The application could, for example, allow citizens to log information on the location of potholes, bus stop shelters in need of repair, or high speed areas that require additional patrolling. Likewise, transportation departments could send notices to residents informing them of upcoming construction projects. The two way communication enabled would not need to be limited to solely transportation related information but could cover a wide range of services.

*Implementation, Operation, and Management* -- The applicants will seek an off-the-shelf solution from a vendor. The applicants will work to identify the specific capabilities and attributes required of a mobile application and work with the vendor to ensure the applicants' needs are met.

### **City Challenges**

#### ***Challenge 1: Meeting expectations***

The City of Des Moines, particularly its urban core, has seen a resurgence over the last decade. The city is consistently ranked on "best of" lists which has helped lead to tremendous population growth and development. While this is undoubtedly a good thing, the city must now be prepared to meet the expectations placed upon it and to continually strive to maintain its rank among the top metro areas.

To that end, the City of Des Moines, DART, and the MPO have helped lead the way in proactive planning over the last several years through efforts like The Tomorrow Plan (a regional sustainable development plan funded through a 2010 HUD Sustainable Communities Regional Planning grant), DART Forward 2035 (a long-range transit service plan), Mobilizing Tomorrow (the MPO's long-range transportation plan), Capital Crossroads (a workforce and economic development vision plan led by the business community), and PlanDSM (the city's comprehensive plan). The Smart City grant provides an opportunity to implement significant elements of these plans which will help meet the challenges of an aging yet growing city.

Historic trends show downtown traffic has decreased since 2006. Future forecasts show volumes in the downtown increasing 1%-3.5% annually over the next 20 years, returning to a total volumes closer to the volumes seen in 2006. This growth in traffic volumes is consistent with the anticipated growth in downtown retail, office and residential uses as well as the anticipated completion of the Southeast Connector. The new and renovated downtown land uses will result in additional local trips that will use the higher capacity routes to enter the downtown street network to access final destinations and park.

### ***Challenge 2: Congestion Management***

The Des Moines area is fortunate in that it does not currently experience high levels of congestion. However, planners and leaders understand that with expected increases in population and employment there is a greater need to manage the system to help prevent higher congestion levels and to mitigate what congestion there is. The Tomorrow Plan, Mobilizing Tomorrow, and the MPO's Congestion Management Process all place an emphasis on using operational and demand management strategies over adding capacity whenever possible, recognizing that a community cannot build its way out of congestion and that oftentimes adding capacity leads to greater congestion. ***In some instances, such as with Interstate 235, the community agreed to a limited build scenario and adding additional capacity is not an option.***

The vision outlined in this application would directly address congestion management in several ways. Ramp meters on Interstate 235 and consideration of adaptive signals throughout the roadway network would help to better manage traffic flow during peak travel periods, particularly traffic into and out of downtown Des Moines. Once into destination areas, improvements to parking services through sensor-based technologies and self-parking technology will limit congestion and unnecessary driving by better informing motorists which parking spots are available. Developing a transportation operations center to help monitor and facilitate these services would be critical.

Other aspects of the proposed vision will also likely aid in congestion management. A universal smart card to be used among a variety of modal options will make those services easier to use. Smarter parking technology and autonomous vehicles also could require less roadway space to be used for driving, freeing space for walking, biking, and transit. All of this, in turn, would further increase the amount of walking, biking, and transit usage and reducing automobile trips.

### ***Challenge 3: Multimodal Access (including goods movement)***

Public feedback received in several planning efforts all point to the desire for few cars in favor of increased ability to walk, bike, or use public transportation. The Des Moines area has made only modest strides in increasing multimodal activity over the last decade, though this is not by a lack of effort. In 2005 the metropolitan transit authority restructured to DART, and transit enhancements have been implemented periodically in the subsequent years. Recreation trails were a major emphasis area throughout the 2000s resulting in a robust network, and attention has slowly shifted to enhancing the on-street bicycle network. Regional plans like The Tomorrow Plan, DART Forward 2035, and Mobilizing Tomorrow envision an enhanced transit network built upon a 'nodes and corridors' framework, ultimately consisting of bus rapid transit service in major corridors. The City of Des Moines is in the process of reviewing its zoning ordinances with the goal of better enabling dense, pedestrian and transit-friendly developments. Likewise, street design standards are under review to provide for more complete street solutions. Additionally, the city and downtown businesses are undertaking a study to make downtown more pedestrian and bike friendly, possibly leading to several one-way to two-way street conversions.

Smart City technology applications could help spur both environmental and cultural changes necessary to advance more multimodal trips. Autonomous vehicles, if used correctly, can increase the sense of safety for travelers and pedestrians. They also can make more efficient use of the public right-of-way, thereby providing more space that can be dedicated to walking, biking, and transit. Smarter traffic signals can allow for bus priority as well as timing cycles more conducive to bicycle commuters. Sensor-based technologies also will help count usage, enabling planners and the public to better understand trends as well as popular routes. A universal smart card will make using bike share and transit easier. DART has seen significant ridership increases from employees of companies that enroll in the Unlimited Access program, which allow employees to ride free by showing their employee identification card. A smart card would have similar capabilities but could allow more corporate sponsors and provide access to more transportation services.

Challenges with multimodal access are not limited to passenger transportation. Freight access also has been a struggle for the Des Moines area. Only a few minor transload facilities are located in the region, necessitating the use of trucks to get goods to and from central Iowa. The smart port proposal would ease the ability to transport goods to and from the region on rail and other modes, which will reduce truck traffic on the highway system. This also will have a positive effect of reducing congestion and increasing safety.

#### ***Challenge 4: Funding Limitations***

As with many communities, funding needs outpace funding availability. When the MPO developed Mobilizing Tomorrow in 2014, project requests outweighed forecasted revenue by nearly \$4 billion. This has led to significant debate on the best use of limit funding.

Transit, in particular, has faced significant funding issues in the last few years. DART's operating budget is largely funded through a regional property tax levy of up to \$0.95/thousand in valuation. While DART's ridership has been steadily increasing, DART's member communities are quickly approaching this levy cap, DART is actively working with its member communities to find a local funding source that will support the needs of the community for the long-term.

The proposed Smart Cities elements provide an opportunity to showcase the efficiencies that can be realized from the use of technology. These applications can help elected leaders and technical staff to embrace the idea of carrying fewer high dollar construction projects in favor of more affordable ITS solutions. In the case of transit, the proposed demonstrations would help make it more convenient to use DART's services, and also bring efficiencies that will provide cost savings to the organization.

The operation and long term maintenance of ITS infrastructure will need to be incorporated into local budgets. For this to be successful the public benefit of the technology will need to outweigh the supporting costs and possible trade-offs.

#### ***Challenge 5: Lack of Data and ITS infrastructure for Asset Management***

The City of Des Moines, DART, and the MPO have all placed a priority on infrastructure maintenance and asset management in recent years, and have turned to data analysis to help prioritize needs. For example, the MPO has partnered with Iowa State University's Institute for Transportation Research to measure, analyze, and forecast pavement condition of the region's roads. This work has helped communities to better understand maintenance needs when developing their municipal budgets.

However, similar efforts in other areas of asset management are hampered due to a lack of data, unconnected infrastructure, and outdated ITS architecture. For example, very little information on bicycle facility usage is available. The Smart City concepts proposed in this application would all help to provide decision makers critical data that can help improve system and asset management, and also provide infrastructure necessary to have a more connected and holistic system.

**2. Describe the population characteristics of your city and show how it aligns with the USDOT's characteristics for a Smart City, including:**

Des Moines, Iowa	
2010 Population	203,433
2010 Urban Area Population	450,070
Land Area (Sq Mi)	80.87
Population Density (Persons/Sq Mi)	2,516
Percent of Urban Area Population	45%

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

**Existing public transportation system**

DART provides public transportation services for the Des Moines metropolitan area. Local and state leaders created DART out of the Des Moines Metropolitan Transit Authority, or MTA, in 2006. The move has enabled the agency to begin evolving into a more regional transit system.

DART is the largest public transit agency in Iowa, serving 18 cities and unincorporated Polk County in and around Polk County to varying degrees. Those include Alleman, Altoona, Ankeny, Bondurant, Carlisle, Clive, Des Moines, Elkhart, Granger, Grimes, Johnston, Mitchellville, Pleasant Hill, Polk City, Runnells, Urbandale, West Des Moines and Windsor Heights.

The agency is operated with the support of local property taxes and fare revenue. Residents are represented by a nine-member board of commissioners.

**Environment conducive of demonstrating proposed strategies & continuity of committed leadership and capacity to carry out the demonstration throughout the period of performance**

Regional cooperation among the Des Moines metropolitan area's leaders has been a key reason for its success over the last several years. Efforts like The Tomorrow Plan and Capital Crossroads, described previously, have proven to be successful at outlining a vision that the region can then rally around. These plans already have resulted in several successful implementation efforts in the few years since their adoption. The three primary applicants—the City of Des Moines, DART, and the MPO—all have a close working relationship with one another and have been major players in these successful regional efforts.

The City of Des Moines, DART, and the MPO all have successful experiences in working with large federal grant awards. Both the City of Des Moines and DART have received TIGER funds. DART received a US DOT TIGER 2010 award of \$10 million to help develop what is now DART Central Station, a certified LEED platinum facility that serves as the hub of its operations. The City of Des Moines received a US DOT TIGER 2012 award, also of \$10 million, for the extension of Martin Luther King, Jr. Parkway from downtown Des Moines to US 65. The MPO received a \$2 million Sustainable Communities Regional Planning Grant from the US Department of Housing and Urban Development in 2010, which was used to develop The Tomorrow Plan, and regularly administers Surface Transportation Program funding from the US DOT.

### **A commitment to integrating with the sharing economy**

The sharing economy has started to become more familiar in the Des Moines area in recent years, and leaders are committed to its integration in the region. In 2015, the Des Moines City Council approved new regulations to the city's vehicle-for-hire ordinance that provided companies like Uber the ability to operate legally. PlanDSM, the city's comprehensive plan update that is underway, also has proposed language to embrace the sharing economy.

The MPO is working to help educate planners and leaders on the topic as well. In March the MPO will be hosting a speaker, as part of an ongoing Tomorrow Plan Speaker Series, who will discuss the need to embrace the sharing economy. The speaker will also be conducting a day-long training for community staff and elected officials about working with the sharing economy.

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

The applicants are committed to making data available for public use. DART has already taken initiative to provide this kind of information. As described on the Developer Resources page of its website, DART provides resources to software developers to promote accessibility and use of transit information and services. These resources include public transportation schedules and associated geographic information published in the General Transit Feed Specification (GTFS) format. These resources also include real-time bus location information published in the General Transit Feed Specification Realtime (GTFS-realtime) format. DART also provides instructions for developers to register for an account to access and work with its data.

As more data becomes available, other parities like the City of Des Moines and the MPO commit to making similar opportunities available for the use of data they collect.

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

#### **Vision Element #1: Urban Automation**

Technology solutions proposed that fit this vision element include Smart Parking facilities that enable self-parking vehicles, a driverless vehicle-ready highway between Ames and Des Moines, automation of DART's downtown circulator shuttle, and autonomous vehicle car sharing. Implementing these three projects in the study area would allow for an entire driverless trip – into the study area with an autonomous vehicle, a parking solution for the vehicle, and an autonomous transit service to circulate once into the downtown area.

Each of these applications would help to reduce costs. Autonomous vehicles on the highway and in a parking structure would by making more efficient use of existing facilities, reducing the need for expansion. Likewise, the autonomous transit shuttle would provide cost savings through reduced personnel costs. While the Des Moines area has not been involved with autonomous vehicles, the University of Iowa has been conducting research that would be useful to this project. The university has the National Advanced Driving Simulator that has been virtually testing autonomous vehicles, and it has recently started testing the technology on a closed course in the area. The following section describes each urban automation solution in more detail.

#### *Smarter Parking*

One aspect of a larger Smarter Parking initiative would be to install technology that enable self-parking vehicles to operate. The goals of this application include reducing the amount of land required for parking facilities and make more efficient use of existing facilities. Applicants envision installing necessary equipment to all vehicles to park themselves in parking structures. Due to the precision provided by self-parking vehicles, and also because there is no need to accommodate space for people, this technology would ultimately reduce the space needed for parking. Companies like Audi have estimated that up to 60 percent more cars would be able to fit into parking garages because they are able to park closer together. For Des Moines, this would be the equivalent of adding 3 more parking structures. Parking structures offering this technology could cater to personal autonomous vehicles as well as fleets of autonomous vehicles owned by public or private entities.

#### *Driverless-Ready Highway*

The second application of urban automation would be a partnership with the Iowa DOT to develop an autonomous vehicle-ready highway in the Interstate 35 corridor between Ames and Des Moines. This approximately 35 mile distance was selected as there is significant commuting along the corridor, it would connect the Iowa DOT's headquarter and Iowa State University in Ames with downtown Des Moines, and the Iowa DOT's traffic management center is located along the corridor in Ankeny. Iowa DOT Director Paul Trombino has publicly stated his desire to have Iowa lead the nation in having an autonomous vehicle ready highway developed in the near term. Iowa State University's Institute for Transportation and the University of Iowa's Public Policy Center would also be partners in this effort – the University of Iowa's involvement with autonomous vehicles was mentioned previously.

#### *Automated Downtown Transit Shuttle*

The third component of autonomous vehicle technology is to automate DART's D-Line service, which operates on a loop route throughout downtown Des Moines. The goal of this project would be to demonstrate the application to automation technology in transit vehicles. The D-Line route was selected for this application for several reasons. The route is entirely within downtown Des Moines, operating at relatively low speeds and allowing for more efficient placement of infrastructure than a long linear route. Its downtown location also would provide high visibility of the service to a large number of people, including state elected officials at the Iowa Capitol building.

#### *Car Sharing*

An element of the Des Moines proposal is the introduction of car sharing services. While this service would begin with more traditional electric vehicles, the long-term goal is to ultimately transition to autonomous vehicles. Whereas the service may begin with vehicles housed in stations or parking facilities waiting to be checked out, autonomous car sharing services would likely be continually in service making for more efficient use of the system. Automating the vehicles also would reduce the need for personal automobiles, which would reduce the need for parking, reducing emissions and congestion, and increasing mobility.

#### *Autonomous Delivery Vehicles*

The applicants have identified local grocery store chain Hy-Vee, based in the Des Moines metropolitan area, as a partner to pilot several technologies including automated home delivery. Hy-Vee already has a popular home delivery service. The goal of partnership would be to convert Hy-Vee's delivery vehicles to electric propulsion and to add autonomous technology. The same technology and infrastructure envisioned for DART's downtown shuttle would be applied to Hy-Vee's delivery vehicles. This partnership would add cost savings to Hy-Vee by freeing delivery staff for other tasks. The service also would help reduce congestion by eliminating trips to the grocery store, and because driverless vehicles can operate closer together, the service will also help to reduce congestion.

### Vision Element #2: Connected Vehicles

The proposal for smarter, adaptive traffic signals would offer applications for connected vehicles. The signals would include adaptive signal technology, Wi-Fi, and video. Connected vehicles would benefit from this project in a few ways.

The real-time information collected from the signal technology would be relayed to a virtual transportation operations center to help manage the system, but also would be made available for use by drivers or their vehicles. For example, in heavy traffic conditions the adaptive signals would use data that is continually collected to adjust the timing cycles for more efficient traffic flow. The same data would also be shared with vehicles and mobile applications, allowing them to adjust their route to avoid these congested areas. Video observation could be used by personnel to view congestion areas and make real-time adjustments to signal timings through the interconnected communication system.

The proposed signals would provide an important function in emergency response and safety. Emergency vehicles could communicate with the traffic signals to not only preempt the timing cycle to hold green lights, but also to broadcast critical information out to other vehicles. For example, emergency crews responding to a crash could communicate with traffic signals leading to three important results. 1) The traffic signals along the route would be synchronized to allow the emergency vehicle to travel to the scene as quickly as possible. 2) Messages could be sent to other vehicles notifying them of the incident and to avoid the area. In vehicles with the appropriate technology, the vehicle's guidance system could automatically update to avoid the area. 3) The information relayed from the emergency vehicle could communicate with other signals throughout the area to automatically detour traffic away from the incident. The data also could trigger messages on dynamic message signs and other ITS equipment that might be available in the area.

As vehicle technology continues to develop, vehicles could communicate with the signals directly to the point where the signals are a critical component in the integration of fully autonomous vehicles. Wi-Fi provided by the signals would allow for vehicle-to-vehicle communications.

### Vision Element #3: Intelligent, Sensor-Based Infrastructure

Two of the technologies proposed would use sensor-based infrastructure: smart parking and smart, adaptive traffic signals. Both of these solutions would help ease congestion and offset the need for more intensive capital solutions.

#### *Smart Parking*

Sensor-based parking is one component of the Smart Parking proposal. This would include the installation of sensors in structured and surface parking lots as well as in on-street parking spaces. The equipment would sense whether a space is occupied, and this information would be relayed to drivers, through either mobile applications or integrated vehicle technology, to help indicate the closest vacant spaces available. Having this information would help reduce time, fuel, and emissions associated with circling the area to locate parking. The information collected by sensors also could be relayed to the city's parking managers and enforcement officers, which would have several benefits. Subject to City Ordinance, the city could use the information to adjust pricing to ensure appropriate usage levels. Special event information could be easily registered online and relayed to the parking management system and passed on to drivers to indicate spaces to avoid.

#### *Smart, Adaptive Signals*

Smarter traffic signals that adapt to traffic conditions use sensors to collect data on traffic flows. This data is fed into algorithms that calculate the most suitable traffic signal timings to ensure efficient traffic movement.

Reductions in congestion, fuel usage, and emissions are all benefits of smarter signals. And because traffic moves more efficiently, capital intensive upgrades to roadways and intersections may be unnecessary.

In addition to facilitating more efficient vehicle movement and reduce costs to motorist, the use of adaptive signals can also reduce costs to the city. With the city's current network of uncoordinated signals, each signal must be manually adjusted. A system of interconnected, coordinated signals would be automated, freeing city staff to do other tasks.

#### Vision Element #4: Urban Analytics

The technologies proposed in this application all would contribute to the collection and analysis of data. By collecting data from a variety of ITS applications, decision makers can use analytics to make better decisions on a variety of issues, and the public will have more opportunities to be informed and engaged in their transportation system.

##### *Universal Smart Card for Transportation Services*

A universal smart card for transportation service would make it more convenient for people to use various transportation modes and create efficiencies for transportation entities, but it also would help to collect critical information on the usage of the various systems. The smart cards would be able to collect information on the time, date, and location a service is used, which service is used, and tie the information back to the user's demographic information. Linking this type of information would help officials better understand service demand by different population groups, times, and locations, leading to better deployment of services. For example, a community goal of increasing transportation options in environmental justice areas would be aided by the ability to know whether various services are being used by minority individuals and where. This would enable the services provider to focus the services offered at the types of locations that have the most use.

##### *Smarter Parking*

Sensors installed that detect whether a space is occupied would provide tremendous data to municipal leaders and the public. The city's ability to precisely understand usage of parking facilities would aid in maintenance, enforcement, and in setting parking rates. Both the city and private interests could use information gathered for economic development purposes. For instance, the city would be able to focus development in areas with excess parking supply to minimize the need to add additional parking facilities. Likewise, a prospective retailer could use the data to identify locations that have a good balance of high turnover and adequate parking supply.

##### *Smart, Adaptive Signals*

Adaptive signal technology will help ease the flow of traffic, aid in emergency management, and provide a wealth of analytic information that can aid in travel demand management. Signals would collect information on traffic volume, turning movements, and speed, among other data. This information is not only useful for real-time traffic monitoring, but also helps to set benchmarks and evaluate progress towards performance metrics over time.

Currently traffic data in the Des Moines is limited and proprietary. Data that is available, such as traffic counts, are not dynamic and are made available once per year. Companies such as INRIX can provide information derived from cellular signals, GPS systems, and Bluetooth devices. However, this information is proprietary and cannot be easily be shared with partner agencies or the public. The ability to collect, analyze, and host this data in the public realm will alleviate many of these issues.

Smarter signals with Wi-Fi capabilities also can aid in the faster collection and sharing of data. Be it police entering crash information or a public works employee recording a street light to be fixed, the data could be uploaded immediately to a data center where it can be shared or added to algorithms used for processing a variety of information. For example, a water department employee responding to a water main break can enter the time, location, and type of issue to a central data center. That information can be used by a variety of other services or software, such as a route planning application for emergency responders or DART to detour buses from the area.

#### *Pedestrian and Bicycle Counters*

The installation of pedestrian and bicycle counters will provide metrics that have not been readily available in the Des Moines area. While the MPO has trail counters that it can deploy throughout the region, on-street bicycle usage as well as pedestrian counts are not available. This makes it difficult to understand the need for, of success of, certain types of projects such as bike lanes.

#### *Transportation Operations Center*

A virtual transportation operations center would serve as the hub for all data collection and analysis. An on-line forum where a variety of agencies could interact would make it easier for all to understand which data is collected and ease in its sharing and use.

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

The technologies proposed in this application would have benefits for governmental agencies, but also would greatly serve the public.

#### *Universal Smart Card*

The universal smart card would help provide a more streamlined opportunity for the public to use different transportation options. Instead of registering with each service independently, one card would provide access to all four services – DART, parking, B-Cycle, and car sharing.

While the services would be available to anyone, the smart card would provide opportunities for various community organizations and businesses to target assistance to particular clientele. For example, assume a human service agency focused on providing low-income individuals access to jobs provides a client \$50 for the month for transportation. Whereas today the agency may need to make a choice of which transportation service to work with, with a smart card the agency would be able to partner with all four services at once and provide their clients multiple options for their journey to and from work. The client would receive a smart card with a \$50 credit and would be able to use the most convenient service available to them. Because the one card will collect information on the trips taken – including the service used and the date, time, and location – the \$50 will automatically be distributed to the appropriate transportation service.

#### *Smart Parking*

Likewise, parking sensors are primarily intended to help drivers find available parking spaces, make payments, and track their time once payments are made. As previously mentioned, data collected from the parking sensors also will be publicly available allowing for mobile applications that use the data for a variety of purposes. For instance, a restaurant's website may have an online reservation system that also share information on the on-street parking that will likely be available during that time of day.

The smarter parking system also can provide human service benefits. One example is with parking spaces for persons with disabilities. The sensors would be able to tell if a space reserved for persons with disabilities is occupied. If all such spaces in a given area are occupied, the system could allow for additional spaces to be reserved for persons with disabilities. Mobile applications and in-car navigation services would automatically receive this update and know whether to avoid or use the space depending on their situation.

#### *Bicycle and Pedestrian Counters*

Bicycle and pedestrian counters will provide critical information about the usage of bicycle and pedestrian facilities. This, in turn, likely will help support additional investments in infrastructure which will provide more options for walking and biking in the community. The information also will help communities understand safety-related services that might be required. For example, knowing that many people are biking near high-crash areas may help to expedite projects to improve safety by reducing modal conflict points. Likewise, identifying routes used by children walking to school will aid in the deployment of crossing guards.

#### Vision Element #6: Urban Delivery and Logistics

Two elements of the proposed vision relate specifically to urban delivery and logistics – a partnership with Hy-Vee for grocery deliveries and the development of a smart inland port. A description of the partnership with Hy-Vee and its goals are described under Vision Element #1.

The opportunity exists to develop a “click and mortar” inland port for Des Moines. In this facility, traditional physical assets found at inland ports would be augmented through a web-based system to further aid in the movement of goods. This web-based system could include online payment options, reservation of loading/unloading times, permitting and customs processing, and identification and reservation of equipment such as shipping containers.

The Port Des Moines smart port concept was originally studied and recommended in the early 2000s following research conducted by Iowa State University’s College of Business. Today, some aspects of the smart port effort are underway. The City of Des Moines is pursuing the development of a transload facility that would provide access to three Class 1 railroads and one Class 2 railroad. The MPO has partnered with Iowa State University to begin development of a container location application. And the area’s regional chamber of commerce, the Greater Des Moines Partnership, has been working with the Brookings Institution on an export plan to increase trade and diversify the region’s economy.

#### Vision Element #7: Strategic Business Models and Partnering Opportunities

The proposal outlined throughout this application would lead to many strategic partnerships with public, private, and university sectors. Goals of these partnerships....

#### *Public*

The three applicants – the City of Des Moines, DART, and the MPO – would partner to develop and implement many of the proposals described in this application. Other public partners like the Iowa DOT also would be included, particularly in developing a driverless vehicle ready highway and in a transportation operations center. The transportation operations center ideally would be expanded to include other municipalities as well.

#### *Private*

As mentioned previously, a partnership with Hy-Vee would be developed for electric vehicle charging in their parking lots and the conversion of their delivery fleet to electric, autonomous technology. Data collected throughout the various systems would be made available to mobile developers and other technology companies, which will lead to additional partnerships.

#### *University*

Iowa State University and the University of Iowa, both University Transportation Centers, will be engaged with the proposals envisioned in this application.

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

The Des Moines area recognizes the need to promote cleaner energy options for all sectors, including transportation. Wherever possible, the applicants would seek to help facilitate the use of electric vehicles by directly using electric vehicles in fleets, installing electric vehicle charging infrastructure, or pursuing advanced charging technologies.

The application seeks to advance electric vehicles and advanced electrification in a few ways.

#### *Additional Electric Vehicle Charging Infrastructure*

Increased electric vehicle charging equipment would be installed throughout the project area. The City of Des Moines and businesses have installed some electric vehicle charging stations throughout the community over the last several years. As increased adoption is likely, it is important to ensure additional equipment is made available. As noted previously, adding electric vehicle charging stations in new and existing parking facilities would be component of the smarter parking proposal. Also, a partnership with Hy-Vee, a local grocery chain is leading the way in the installation of electric vehicle charging infrastructure, would be sought. Hy-Vee has installed electric vehicle chargers at new stores built over the last few years, and is now working to install chargers at older stores. The partnership with Hy-Vee would be to help demonstrate the benefits of installing charging equipment and to test advances in new technology.

#### *New Electric Vehicle Charging Technology*

The applicants and its partners would seek to pilot advanced charging technologies. This could include, for example, the installation of plugless charging systems in parking facilities. DART also would install wireless charging in transit vehicles. This would include the installation of charging devices at ground level where buses stop for significant lengths of time, such as at transfer facilities or at DART Central Station. The Des Moines area also has worked with the Omaha area to promote the development of elective vehicle charging infrastructure between the two communities along the Interstate 80 corridor. This would include the installation of quick charge stations at strategic points along the routes, possibly Iowa DOT rest areas.

#### *Electric Vehicle Fleets*

Hy-Vee also recently introduced home grocery delivery in the Des Moines area. A partnership with Hy-Vee would include converting their delivery fleet to electric, eventually autonomous vehicles. The proposal calls for the development of a car share service in the area. The goal would be for this fleet to be entirely comprised of electric vehicles, which would help to reduce emissions but also publically demonstrate the technology.

#### Vision Element #9: Connected, Involved Citizens

The ability for citizens to become more aware of transportation options and more involved with improving mobility is of great importance to the applicants. In addition to making data available for the development of a variety of mobile applications, the applicants would partner to introduce a mobile application for citizens to directly provide feedback to government officials. This application would provide for crowdsourced feedback for maintenance related issues, and also allow government officials to push critical information to citizens. The application could, for example, allow citizens to log information on the location of potholes, bus stop shelters in need of repair, or high speed areas that require additional patrolling. Likewise, transportation departments could send notices to residents informing them of upcoming construction projects. The two way communication enabled would not need to be limited to solely transportation related information but could cover a wide range of services.

#### Vision Element #10: Architecture and Standards

The applicants realize that the technologies and projects proposed in this application, while suitable for the Des Moines area, may not be solutions required in other communities. However, the applicants are committed to documenting the process taken that leads to the implementation of the proposed elements in the application, noting partnerships required, lessons learned in engaging the public, and technological challenges faced.

Many of the technologies sought, however, would be applicable to other regions and the applicants are committed to ensuring the ITS architecture and standards used would allow for broader deployment throughout the country. This would be a requirement for any vendor or partnering organization engaged throughout the process. Where possible, the applicants will seek to use, or build from, existing technologies and architecture to avoid expending limited time and resources on developing new solutions.

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

The goal of the applicants is that the ITS applications discussed throughout this proposal will operate on a software and information technology platform that is secure, private, affordable, and expandable to additional departments and agencies. The first phase of this implementation would be at a transportation operations center, but would be expanded across all departments of the applicants to inform all decision making for the agencies.

#### Vision Element #12: Smart Land Use

The technologies and infrastructure solutions proposed throughout this application would help to ensure land uses are optimized and tailored to accommodate multiple modes of transportation. Plans such as The Tomorrow Plan, PlanDSM, and Mobilizing Tomorrow all call for a nodes and corridors concept which would focus development into high density, walkable nodes connected through highly accessible roadway corridors. These corridors would have accommodations for automobiles, walking, biking, and public transportation. The City of Des Moines has begun to make land use, zoning, and design standard changes to help implement the nodes and corridors concept and smart land uses, and the items proposed throughout this application would help to hasten the land use changes envisioned in the community. The applicants seek to apply the technologies proposed to nodes and corridors network to maximize the adoption of smart land uses.

Many of the specific items proposed throughout this application would promote smart land uses, as described below.

##### *Universal Smart Card*

A universal smart card would make using public transportation, bike share, and car share more convenient. This would lead to reduced personal automobile ownership that, in addition to reducing congestion, would reduce the need for more auto-oriented developments. More alternative transportation use will foster developments that are more pedestrian oriented, fitting the tenants of smart land uses.

#### *Smarter Parking*

The smarter parking proposal outlined throughout the application includes technology that would enable self-parking cars to operate. As already noted, this would make more efficient use of existing parking structures and surface parking lots. Additional benefits pertaining to smart land use is the ability to locate parking lots away from downtown areas and connecting them with transit, as well as freeing up on-street parking to provide more room for other modes of transportation.

#### *Autonomous Vehicles*

A transportation system with driverless, connected vehicles would work more efficiently and maximize the existing roadway space. Without the need to account for driver error, vehicles travel more precisely and in closer proximity. This could result in the ability to narrow street widths, freeing space for other modes of transportation. Additionally, the rise of autonomous vehicles will likely lead to reduced auto ownership, which will lead to the need for fewer parking spaces and fewer auto-oriented developments.

#### *Smart Inland Port*

The development of an inland port for goods movement will focus freight-related activities near the port location. This will create efficiencies and reduce travel distances and costs. Freight-oriented development around the port will reduce the need for other heavy uses across the metro, allowing for more pedestrian-oriented development or redevelopment.

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

The path to implementing the vision outlined in this application will not be easy, although the applicants are confident they can overcome issues to yield success. Below is information about likely risks and how the applicants plan to address those risks. A rating for each risk is provided on a scale of 1 (low risk) to 5 (high risk).

#### Technical Risks

Technical risks likely will pose the most significant challenges to deploying the elements included in this vision. Some of elements, such as autonomous vehicles, are not widely available yet outside of a few areas in the country undergoing beta testing. However, the technologies and infrastructure necessary to accommodate autonomous vehicles, such as sensors and advanced mapping capabilities, are available now and able to be installed in the project area.

To overcome the lack of actual autonomous vehicles in the market to use or test the technologies, the applicants will seek to engage strategic partners to bring vehicles to the area. As mentioned previously, the University of Iowa's Public Policy Center is beginning to test driverless cars, specifically by using a semi-autonomous 2016 Volvo XC90 on a closed course near Iowa City. The applicants would seek a partnership to expand the university's research to Des Moines to test driverless vehicles in an urban setting.

Additionally, several large technology companies – including Facebook, Google, and Microsoft, have data centers in Iowa. These relationships may be leveraged to help the companies bring technologies they are developing to Des Moines for testing.

The applicants already have reached out to IBM's Smarter Cities program staff who have committed to being a resources as we move through the project. This relationship will yield strategic partnerships with other companies working with smart city applications, including autonomous vehicles.

Finally, the applicants envision that the area would garner significant attention if they were to receive the Phase 2 award. Companies producing or researching autonomous vehicles likely will seek to test their products in Des Moines should this application be successful.

Risk rating: 4/5

#### Policy Risks

Another challenge that the applicants will need to overcome relates to the lack of local or state policy related to many of the elements proposed in this application. Autonomous vehicles, while proving to be relatively safe in testing done in other markets, still carry risks. Liability is always a concern among public entities, and rules and regulations for driverless vehicles will need to be developed to manage risk before some members of the public as well as state and local leadership are comfortable with automated transportation.

The applicants will seek to mitigate this risk in a few ways. One is to rely on the work already done by others when developing rules and regulations. Public and private-sector partners, including the US DOT, would be instrumental in helping the applicants make connections to other states, cities, companies, and others that have experience in dealing with advanced technologies.

The applicants also will take on a strategic communications effort to ensure that the public, businesses, local, and state officials fully understand the project. The goal of this effort would be to rally support necessary for the Des Moines area to be a leader in developing an advanced transportation system. A communications effort will allow the applicants to explain the opportunities available and the challenges faced, and also provide the ability to understand concerns associated with the project. Having an open, honest dialogue will help to resolve issues and ensure that the necessary rules, regulations, and other policies are addressed in a satisfactory manner.

Risk rating: 3/5

Another policy risk is conflicting priorities among various stakeholders. The implementation of the proposed vision will take not only the US DOT Smart Cities grant funds but also an ongoing fiscal and policy commitment by the applicants to ensure ongoing success. This likely will mean other priorities may need to be set aside and lead to criticism of the smart cities effort. Some critics may question why limited funds are being used for new infrastructure when existing infrastructure like pavement and bridges still need repaired.

The applicants would address this risk through the same communications initiative outlined above. The applicants also believe that demonstrating early and ongoing success – measured through solid, reliable data – will quickly help win over critics. Highlight the efficiencies added to the system and long-term cost savings, which may lead to more funding for pavement and bridges, will be important to the applicants in winning support.

Risk rating: 2/5

Institutional Risks

One institutional risk is to secure the ongoing participation of necessary partners that will help ensure this proposal's success. As noted throughout the application and further described in the following section, partnerships are sought from two universities, the Iowa DOT, and Hy-Vee. Some proposals, such as a transportation operations center, could grow to accommodate additional partners. The applicants have already received commitments from many of these partners and are confident in the ability to receive commitments from the others. However, these partnerships will need to be long term, lasting beyond the funding allocation from the US DOT grant and persevering through any challenges faced.

The applicant team will mitigate this risk by making expectations clear up front when entering formal agreements with partners. Clear communication will partners will help to alleviate many difficulties that may arise. The applicants also will seek to develop redundancies in the type of partnerships made to ensure efforts can continue if one partner happens to drop out. For example, Hy-Vee has been identified as a private partner to work with. The applicants will seek partnerships with additional private partners to reduce the impact should Hy-Vee's commitment wane over time.

Risk rating: 3/5

Agreements among public-sector agencies and partners will also need to be made and sustained. Similarly, processes and policies to be developed to work across the agencies, and new skills will need to be acquired by agency staff. All of these issues pose a risk to the efficient installation, operation, and management of the proposed vision.

To mitigate this risk, the applicants will reach out to others who have implemented similar program to understand best practices in the institutional arrangements guiding their efforts. Process and policies will be developed jointly and in a manner that ensures all needs are addressed. Agency leaders will coordinate to ensure consistent and complimentary investments in equipment and workforce skills are made. This level of coordination will be important. For example, one partner in the transportation operations center not properly training staff could jeopardize success.

Risk rating: 1/5

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

Key team partners will include the applicants – the City of Des Moines, DART, and the MPO. Both DART and the City of Des Moines are members of the MPO and have worked successfully together for a number of years on a wide variety of transportation issues.

The City of Des Moines Engineering Departments Traffic and Transportation Division will largely lead their efforts, with support from IT staff and Public Works. DART's planning and IT staff and the MPO's planning staff, as well as managers for all three organizations, will round out key team members from the applicants.

An additional key stakeholder will include the Iowa DOT, specifically through their Traffic Incident Management, Office of Systems Planning, and District 1 office staff. B-Cycle operations, through the Des Moines Bicycle Collective, will be another key partner for the universal smart card proposal. The applicants all have existing relationships with these key stakeholders, through the coordination on capital and operational projects, funding, and plan development.

The applicants and key stakeholders would formalize their partnership through a Memorandum of Understanding. This agreement would outline expectations of all parties, management and decision making agreements, and parties responsible for implementing various elements of the proposal.

Additional public/private partnerships will be pursued for the implementation of this proposal. As mentioned previous, this includes partnerships with Iowa State University, Hy-Vee, and IBM. The MPO, in particular, has a history of working with Iowa State University in various capacities. The MPO has retained the service of the university's College of Business in the past to study the development of an inland port. This work, and the faculty who assisted, will be used to continue implementing this proposal. The MPO currently is working with CyBiz Lab, also within the College of Business, to develop a freight container tracking software that would be integral to the smart port concept. Additionally, a partnership with Iowa State's Institute for Transportation (InTrans) will be developed to assist with various aspects of this proposal. The MPO has an ongoing relationship with InTrans for a data-related services, such as pavement condition data collection and forecasting.

Grocery store chain Hy-Vee is another private partner. As noted in the application, Hy-Vee has been installing electric vehicle charging infrastructure at its new stores and will soon begin retrofitting older stores with chargers. Hy-Vee also offers grocery delivery which provides the opportunity for testing electric vehicle and autonomous vehicle capabilities for urban delivery fleets.

Finally, the applicants have developed a relationship with IBM's Smart Cities program staff who have offered to be a resource for this proposal. Applicants envision this relationship to be beneficial in identifying other strategic private sector partners and in making connections to other communities that have pursued smart city solutions.

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

### Roadway Network

The city of Des Moines has 951 miles of streets and roadways, comprised of the following:

- Interstates and Freeways: 24 miles
- Other Principal Arterials: 76 miles
- Minor Arterials: 121 miles
- Collectors: 89 miles
- Local: 641 miles

### Transit Services

DART offers fixed route, demand responsive paratranist, and rideshare services for the central Iowa area. Fixed-route service includes 15 local routes, 8 express routes, 3 flex route, 5 on-call routes, and 2 downtown circulator shuttles that collectively total 477 miles and over 15,000 operating miles daily.

### Intelligent Transportation Systems (ITS)

#### *Streets and Highways*

An Iowa DOT traffic management center operated is located in Ankeny, a suburb of Des Moines. This center manages ITS infrastructure on the region's freeway system, including 30 variable message signs (7 within Des Moines) and 65 traffic cameras (15 within Des Moines).

#### *Transit*

DART utilizes Trapeze ITS systems for its fixed route buses, paratransit and flex vehicles. This is a radio based system that utilizes an onboard computer for managing all sensors, diagnostics, messages, operator feedback and instructions, as well as GPS location, and real-time updates of on route performance. The system can integrate with arrival departure signs for real-time countdown information (not currently implemented), can provide a standard data feed for GPS locations of vehicles, and handle onboard messaging and communication. Passenger updates and announcement can happen both at the transit center via signage or announcement, or on the vehicle utilizing LED signs and overhead audio. The ITS system has the ability (not currently utilized) to send messages to multiple systems, including twitter, RSS, and any system utilizing plain text messaging.

#### Smart Grid Infrastructure Including Electric Vehicle Charging Infrastructure

There are four public electric vehicle charging stations located throughout the City of Des Moines. These stations provide a total of one Level 1 outlet and six Level 2 outlets. However, several new developments are underway that will add more.

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

DART collects traffic information using running time statistics on routes. DART also gathers traffic pattern data through APC counts, once the fare box project is implemented we could anonymize more data and send out more ridership statistics including things like traffic patterns around transfers. DART has a large collection of data around paratransit and flex trips, which could be utilized to improve access to high risk riders, medical providers wanting to improve services, or senior based programs wanting to drive more folks to utilizing services in an area. DART has a robust refugee program with the Opportunities Through Transit program, so integration with job seekers, job services, and refugees to help integrate community programs and drive participation in multiple program types may be possible. Integration with video feeds and cameras to assist with policing, traffic light efficiency, or criminal investigations could be massively improved with integrations to other city cameras and feeds. A future investment in Wi-Fi on the buses and at shelters could provide needed access to underserved regions and areas. Integrations with traffic lights and lane prioritization for transit vehicles could significantly improve congestion. Multi-modal integrations with Google and potential feeds to Uber, Lyft, or other transit providers could help solve first mile/last mile challenges and reduce congestion as well as drive foot and bike traffic in certain corridors.

The MPO collects a variety of data from different source to help monitor performance of the transportation system and progress towards achieving performance targets. This information includes pavement and bridge conditions, traffic volumes and vehicle counts, congestion level of service, crash information (including location, cause, and severity), and trail usage.

The City of Des Moines collects information on daily parking usage in its parking facilities, and also collects information on on-street parking usage when conducting special studies. Additional information

collected by the city include red light violations and excessive speed at certain locations equipped with red light and speed cameras.

The data collected, and the data that will be collected with technologies proposed in this application, will be shared among the applicants and other stakeholders to improve transportation operations. The data would improve operations through better understanding existing conditions, in real time, and being able to forecast future conditions. The information also will help improve communications with members of the public. The only limit identified by the applicants on sharing the data is the sharing of customer confidential information. Also, the applicants would set procedures in place to help ensure that any data shared and used by a third party is the most accurate and up to date information. If the information being shared is wrong or misleading, the applicants would have procedures to restrict that third party from using the data until issues are corrected.

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

The applicants are 100% open to utilizing any standard for open data communication or building an interface or integration to any system that will pass data to help collaborate better and create digital standards for better information sharing.

**11. Provide measurable goals and objectives for your vision and describe your approach for monitoring the impact of the demonstration on mobility, safety, efficiency, sustainability, and climate change.**

The region has identified goals through in Mobilizing Tomorrow that the applicants feel are appropriate for this project as well.

- Goal 1: Enhance multimodal transportation options.
  - Objective 1: Increase alternative transportation usage (walking, biking, transit)
    - Objective will be measured through setting baseline metrics and collecting updated information throughout the reporting period. Transit ridership is known today, but walking and biking information along key corridors would need to be collected using the proposed bicycle/pedestrian counters.
  - Objective 2: Decrease single occupancy vehicle trips to downtown Des Moines.
    - A baseline measure was established in 2011. An add-on sample to the National Household Travel Survey, to take place in 2016, will update this information. Additional surveys and/or information from the US Census Bureau's American Community Survey will track mode split to downtown.
- Goal 2: Manage and optimize transportation infrastructure and services.
  - Objective 1: Reduce intersection level of service
    - Objective to be measured through signal delay capabilities of the proposed smart traffic signals. Information from the company INRIX, available to the MPO, also will be used.
  - Objective 2: Increase travel time reliability
    - Information to measure travel time reliability is provided by INRIX, available to the MPO. Specific reliability goals will be established by corridor.
  - Objective 3: Increase public satisfaction of using transportation services

- Survey information will be collected, potentially through the proposed citizen engagement tool, to determine changes in satisfaction levels from different transportation services, specifically those proposed to be enhanced through this smart city project such as parking and car share.
- Goal 3: Improve the region's environmental health.
  - Objective 1: Reduce vehicle miles traveled.
    - Vehicle miles traveled data is produced annually by the Iowa DOT and available for tracking changes over time.
  - Objective 2: Increase electric vehicle ownership and usage.
    - Vehicle ownership records are collected by the Department of Motor Vehicles and data on number of vehicles registered by fuel type is available to the MPO.
    - Information on electric vehicle charging stations is available from the US Department of Energy and will be tracked over time to determine the addition of charging stations available.
- Goal 4: Further the health, safety, and wellbeing of all residents in the region.
  - Objective 1: Reduce crash rates and the overall number of serious injuries and fatalities resulting from transportation-related incidents.
    - Information on crashes is available to MPO for analysis and tracked over time.

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

Included with this application are letters of commitment from the City of Des Moines City Manager, the DART General Manager, and the MPO Executive Director that express the obligation of the three organizations to undertaking this project. The three organizations are excited for this opportunity and are willing to invest in workforce and infrastructure to ensure the project is successful. The City of Des Moines also has committed to pursuing city ordinances to permit the advanced technologies outlined in this proposal. A large of degree of infrastructure readiness exists to support this vision. Many projects are also already underway that will help support smart city technology, as outlined section 13 of this application. The following information describes the applicants' capacity to carry out each of the 11 proposed elements of its smart city vision.

*Capacity for Project Element #1 – Smart Traffic Signals*

The City of Des Moines has identified the need to upgrade existing traffic signal controllers to current technology. The proposed Capital Improvement Program includes a phased approach to the upgrade. The city's existing controllers are National Electrical Manufacturers Association (NEMA) 170 which are becoming obsolete. Replacement parts are no longer manufactured for some components forcing their eventual replacement. Approximately 80 percent of the city's 426 signals are connected to fiber. The City has 35 observation cameras in place today. During the reconstruction of Interstate Highway 235 in the 2000s, the Iowa DOT invested in traffic cameras throughout the interstate system and set a model for regional traffic management operations for Des Moines to follow. The Iowa DOT is considering implementing ramp meters on I-235 through Des Moines to help manage congestion. Retiming of traffic signals and consideration of adaptive signals on arterial streets throughout the local street network would complement this effort in easing congestion. DART also has a modern Computer Aided Dispatch/Automatic Vehicle Location (CAD/AVL) system that will support signal priority applications.

*Capacity for Project Element #2 – Bicycle and Pedestrian Counters*

The City of Des Moines has the staff resources necessary to install a system of bicycle and pedestrian counters. Both the MPO and the City of Des Moines have experience with installing trail counters throughout the region as well as collecting, analyzing, and sharing data collected from counters. The City of Des Moines has experience conducting manual counts and would be knowledgeable about specific locations counters should be installed.

*Capacity for Project Element #3 – Electric Vehicle Charging*

The MPO already has taken initiative to promote electric vehicle adoption. In 2014 the MPO received a grant from the Iowa Economic Development Authority study the region's level of readiness for electric vehicles. This study included identifying updates to municipal codes and policies to better accommodate electric vehicle infrastructure and also identified specific locations for future infrastructure to be placed. Iowa also has the energy resources to ensure that electric vehicle advances will truly lead to air quality benefits. By 2020, Iowa is expected to generate 40 percent of its energy from wind, which puts the Des Moines application uniquely qualified to make significant strides in electric vehicle-related technology adoption. The Iowa Clean Cities Coalition, housed within the Iowa Economic Development Authority, has committed to assist communities with pursuing electric vehicle efforts.

*Capacity for Project Element #4 – Autonomous Bus Line*

DART has funding to replace the current D-Line vehicles in the next three years which would allow for the opportunity for integrating autonomous vehicle technology.

*Capacity for Project Element #5 – Electric, Eventually Autonomous Car-Share Program*

DART has explored the addition of car-share services to its menu of programs and is prepared to develop this program.

*Capacity for Project Element #6 – Autonomous-Vehicle-Ready Highway Corridor*

Iowa DOT Director Paul Trombino, has publicly stated his desire to have Iowa lead the nation in having an autonomous vehicle ready highway developed in the near term. Iowa State University's Institute for Transportation also will be pursued as a partner for this project.

*Capacity for Project Element #7 – Autonomous Home-Delivery Service*

Hy-Vee has an existing fleet of delivery vehicles and an existing delivery service. The fleet would need to be upgraded to electric, autonomous vehicles. Hy-Vee has made a commitment to sustainability and adoption of forward-thinking practices, exemplified by its commitment to installing electric vehicle charging stations at its stores.

*Capacity for Project Element #8 – Smart Parking*

Parking sensors and technology for self-parking vehicles is new for the Des Moines area. However, the City of Des Moines has done extensive studies on its parking system in downtown over the last few years and have an inventory of parking locations throughout the city that could be improved with deployment of sensors.

While the Des Moines area has not been involved with autonomous vehicles, the University of Iowa has been conducting research that would be useful to this project. The university has the National Advanced Driving Simulator that has been virtually testing autonomous vehicles, and it has recently started testing the technology on a closed course in the area.

As noted previously, the City of Des Moines has experience with implementing electric vehicle charging infrastructure. PlanDSM, the city's new comprehensive plan, calls for the further installation of publically available electric vehicle charging stations.

*Capacity for Project Element #9 – Smart Inland Port*

The Port Des Moines smart port concept was originally studied and recommended in the early 2000s following research conducted by Iowa State University's College of Business. Today, some aspects of the smart port effort are underway. The City of Des Moines is pursuing the development of a transload facility that would provide access to three Class 1 railroads and one Class 2 railroad. The MPO has partnered with Iowa State University to begin development of a container location application, and the university is available to guide the implementation of other project elements. And the area's regional chamber of commerce, the Greater Des Moines Partnership, has been working with the Brookings Institution on an export plan to increase trade and diversify the region's economy.

*Capacity for Project Element #10 – Universal Smart Card for Transportation Services*

DART is in the process of overhauling its fare collection system, which is the component of the vehicles that would read smart cards and near-field communications (NFC) for using mobile devices as well as mobile payment. DART's fareboxes currently are not capable of utilizing smart cards or reading mobile payments. DART works with area businesses through its Unlimited Access program to subsidize transit passes for employees of member businesses. Riders currently show their employee identification card to bus operators in lieu of payment, and the operator must manually enter into the fare box how many riders embark from each member business. Upgrading the fare box system to accommodate smart cards would be more convenient to riders, be more efficient for operators, and would better enable DART to track the performance of the Unlimited Access program and provide analytics to businesses about the use of their membership. In addition, it will allow DART to offer a variety of other fare products to the public to better meet the needs of the community. In addition, DART has also worked with the Iowa State Legislature in anticipation of this project to ensure that privacy is maintained with customer accounts which has been an issue in other parts of the country.

The City of Des Moines operates six parking structures (4,965 total spaces) in downtown Des Moines that use credit card technology, and has another 3,550 on-street metered parking spaces. In 2008 the city upgraded its parking meters to use smart card technology, and approximately 90 percent of parking meters are now able to take the city's smart card. The city's smart card is a contact chip card, or integrated circuit card (ICC), which has embedded integrated circuits that contain data regarding a customer's balance on the card.

Likewise, Des Moines B-Cycle has 10 rental locations that use cards containing a radio-frequency identification (RFID) chip uniquely associated with a B-Cycle member's account. When the B-card is presented at a Des Moines B-Cycle dock, the B-Cycle computer is queried to confirm that the member is in good standing and to associate the member with the bike they are checking out. When a bike is returned, the B-Cycle computer updates the member's account.

*Capacity for Project Element #11 – Virtual Transportation Operations and Communications Center*

With the reconstruction of Interstate 235 in the 2000s, the Iowa DOT and the MPO partnered to fund a Traffic Management Center to help ease traffic issues throughout the construction process. Following construction, however, this center was moved to focus on other large construction projects elsewhere in the state. While it is no longer focused on Des Moines, the Iowa DOT does have a degree of infrastructure and staff, as well as lessons learned, to help initiate a Des Moines transportation operations center. The Iowa DOT's Operations Center is now located outside of Ankeny, a Des Moines suburb, and would be instrumental in several of the proposed endeavors.

Communities in the region have begun to coordinate on traffic management efforts. Several suburban communities in the metro have recently agreed to work together on traffic signal coordination. Also, the MPO will soon begin to update the ITS architecture for the region, which will further outline what transportation management capabilities currently exist, determine how they can better work together and be integrated into a regional center, and identify opportunities to grow the system.

*Capacity for Project Element #12 – Citizen Communication Tool*

DART has its own web-based application that help to communicate information on its service to the public. The MPO has had success using interactive, web-based public engagement/feedback tools in the recent years. The MPO also has partnered with other agencies to develop a mobile application that provides information about the region's trail network. The applicants are committed to furthering their capabilities and acquiring a communications tool that provides for two way communication – between the agencies and the public – to provide additional, more robust citizen engagement opportunities.

Included with this application are letters of commitment from the City of Des Moines City Manager, the DART General Manager, and the MPO Executive Director that express the commitment of the three organizations to undertaking this project. The three organizations are excited for this opportunity and are willing to invest in workforce and infrastructure to ensure the project is successful.

The City of Des Moines also has committed to pursuing city ordinances to permit the advanced technologies outlined in this proposal.

A large of degree of infrastructure readiness exists to support this vision. Many projects are also already underway that will help support smart city technology, as outlined in the section below.

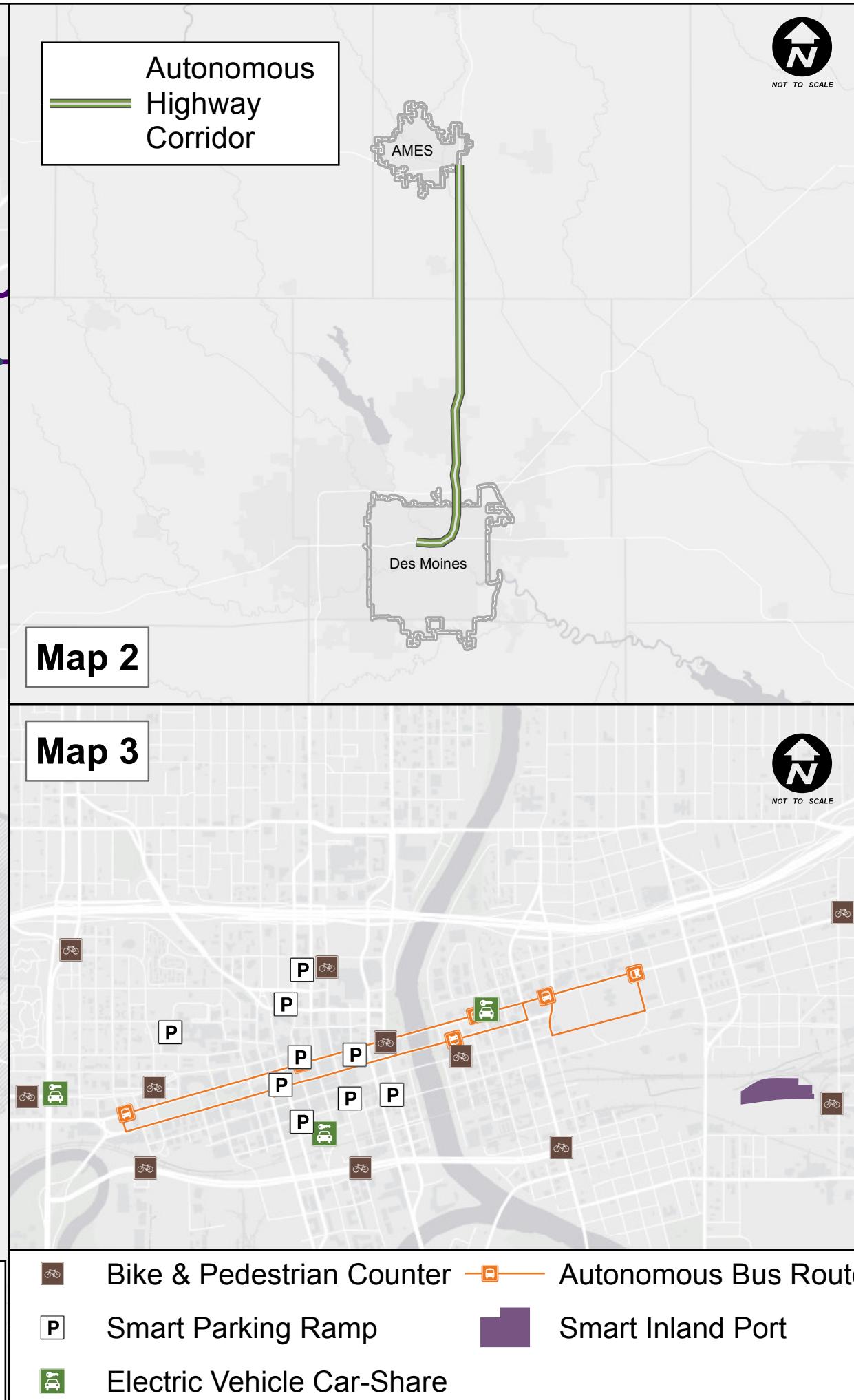
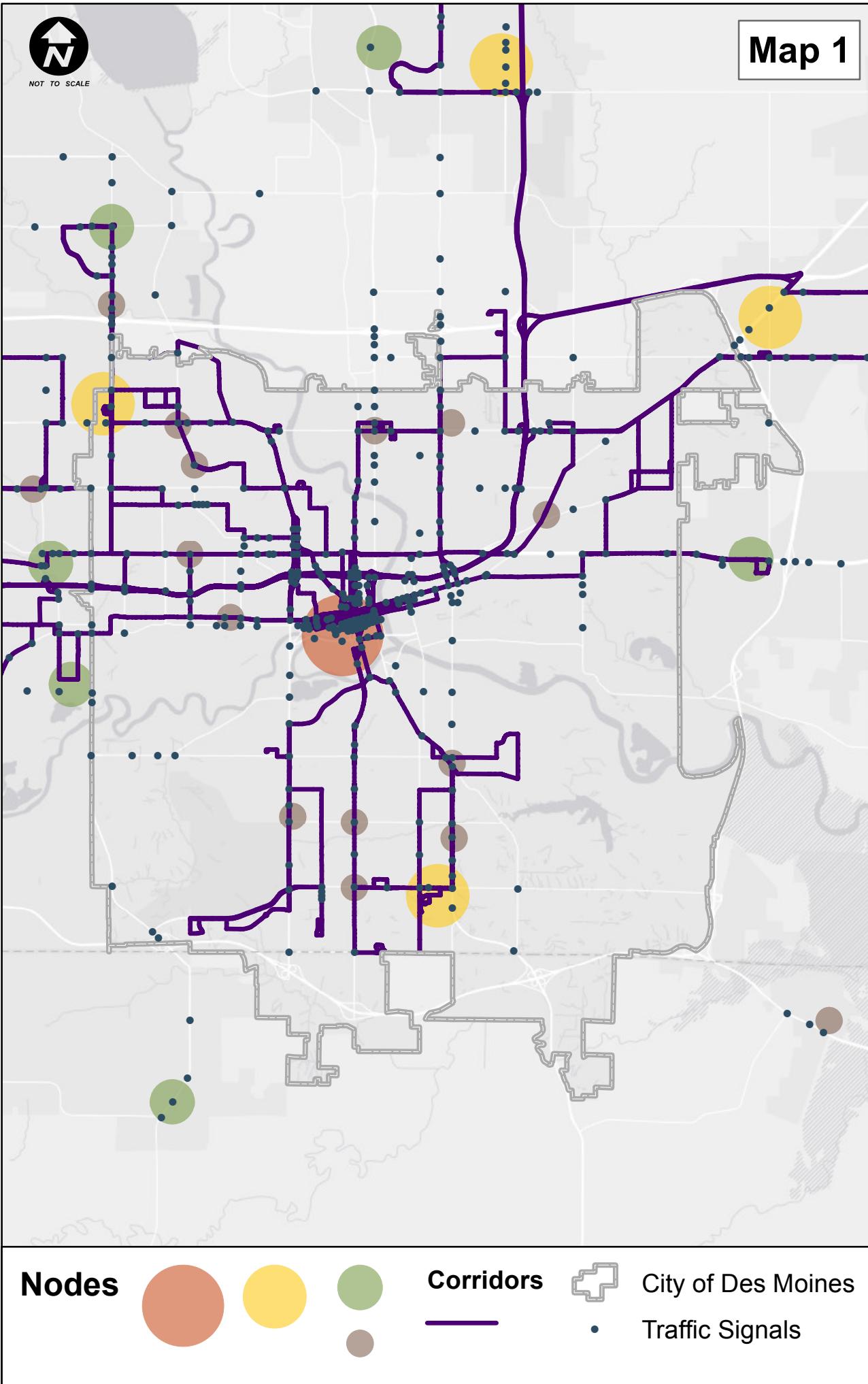
**13. Describe any opportunities to leverage Federal resources through cost share, in-kind donations, and partnering.**

The three applicants as well as other key partners have already budgeted or otherwise committed funding for many aspects of this proposal. In many instances, the Smart Cities Challenge grant would be used to help fund the addition of further capabilities on infrastructure upgrades that are already planned. This will help extend grants funds to more projects and also ensure early implementation of the proposal.

The following is a list of cost share opportunities that will help leverage any grant funds received

- DART is currently overhauling its fare collection system, providing an opportune time to add more smart, connected technologies to the project.
- The City of Des Moines plans to upgrade its existing traffic signal controllers, costs for which have been budgeted in a phased approach in the city's Capital Improvement Program. Grant funds received would help to add additional communication capabilities described throughout this proposal.
- Hy-Vee grocery stores will be undertaking the installation of electric vehicle charging at existing stores.
- The City of Des Moines is pursing the development of a transload facility and the MPO is working with Iowa State University on a container location application, both of which will be necessary for the Smart Port concept.
- DART will be replacing vehicles serving the D-Line shuttle within three years, funds for which have already been budgeted. Grant funds would help upgrade this purchase to electric, autonomous technology and to install necessary infrastructure for electric charging and autonomous communications.

- Applicants will seek additional resources and grant funding to further implement aspects of this project, if needed. These funds could include state funding such as the Iowa Clean Air Attainment program, federal funds such as the Surface Transportation Program, or local dollars. The Des Moines area also has had success with leveraging private sector funds from businesses for community improvements, which also could be pursued.
- The applicants commit to funding smart city elements through its traditional, ongoing capital improvement process. For example, DART commits to all future vehicle purchases including a fare collection system capable of using the universal smart card technology, and the City of Des Moines commits to all future traffic signal installations to be smart signals described in this application.



# City of Des Moines Smart Cities Implementation Map

**Map 1:** Traffic signals along major corridors in the City of Des Moines could be updated to improve traffic flow between the nodes of the City and prepare the City for autonomous vehicles.

**Map 2:** Regional commuting between the City of Des Moines and the City of Ames could become safer and more efficient via an Autonomous Highway Corridor. This heavily traveled corridor would be improved in advance of autonomous vehicles becoming mainstream.

**Map 3:** Downtown Des Moines would develop an integrated network of smart transportation technology. Smart parking technology would be deployed at the nine parking structures, three electric vehicle car-sharing pods would be implemented, and automated bicycle and pedestrian counters would be constructed along major bike routes.

An autonomous bus route would shuttle citizens and government officials between the East Village and the Western Gateway.

Freight would benefit from a Smart Inland Port at the planned Transload Facility east of Downtown.

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