Minneapolis/Saint Paul Smart City

Application to:

U.S. Department of Transportation

Beyond Traffic | The Smart City Challenge
Notice of Funding Opportunity Number DTFH6116RA00002

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Submitted by:

City of Minneapolis
Mr. Steven A. Kotke, PE
Director of Public Works and City Engineer

City Contact:

Mr. Jon Wertjes, PE, PTOE
Director of Traffic & Parking Services
City of Minneapolis, 203 City Hall
350 South 5th Street
Minneapolis, MN 55415
612-673-2614
jon.wertjes@minneapolismn.gov

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Attachment - Letters of Support and Agency Resolutions

Part 1 – Vision Narrative

1. Minneapolis / Saint Paul Smart City Vision

The City of Minneapolis is pleased that the USDOT is offering a grant to mid-sized cities as part of *Beyond Traffic: The Smart City Challenge* in an effort to address growing transportation challenges through innovative technologies and partnerships. We agree with the need for bold, data-driven ideas to improve lives by making transportation smarter, safer, easier and more reliable.

The City of Minneapolis is submitting this application on behalf of our stakeholder team including the Cities of Minneapolis and Saint Paul, Metropolitan Council/Metro Transit, Minnesota Department of Transportation (MnDOT), University of Minnesota, Nice Ride Minnesota, Transit for Livable Communities, McKnight Foundation, Shared Use Mobility Center and other local stakeholders. Our stakeholders have

Our Smart City Outcomes:
- *Improve Safety*
- *Enhance Mobility*
- *Address Climate Change*

a long history of working together on a variety of issues including safety, mobility and climate change. Considerable technology investments have been made and extensive innovative transportation solutions and infrastructure have already been deployed in our on-going effort to address transportation challenges within the Twin Cities. We have made significant progress with positive impacts on our cities and region but recognize we still have much to do.

Vision Statement and Approach

The Minneapolis / Saint Paul Smart City **Vision statement** is as follows:

> *"A prosperous urban center in which people can easily choose to live a car free or car light lifestyle, using smart and integrated transportation options, to travel where and when they want to go, conveniently and safely."*

Our **Smart City project approach** is to:

> *"Demonstrate in a diverse urban corridor an integrated, comprehensive and sustainable package of transportation options – "solutions for every journey" – that can successfully replace car ownership and reduce SOV use through implementation of smart transportation technologies, public-private partnerships, greener energy and compelling and convenient incentives."*

Our Unresolved Needs and Challenges

Minneapolis / Saint Paul area stakeholders have had on-going discussions related to Smart City technology improvements to address the growing demands on our transportation network. While much has been done, many challenges related to safety, congestion and the environment remain. Key needs and challenges within our urban center include:

Safety

• Crashes
• Fatalities/Injuries
• Security
• Aging Population

Mobility

• Congestion
• Unexpected Delays
• Unfamiliar Users
• Transportation Options
• Weather Conditions
• Aging Population / Increased Diversity

Climate Change

• Air Pollution
• Energy Shifts

Other

• Transportation Infrastructure Costs
• Agency/Governmental Budgets
• Urbanization and Land Use Patterns
• Parking
• Health
• Equity
• Connections to Jobs

Our Outcomes and Smart City Solutions

We are proposing unique and innovative strategies that, working together, will establish the Smart City concept in our demonstration corridor. Our vision will address the transportation challenges for Minneapolis / St. Paul and aligns directly with the USDOT goals and objectives for the Smart City Challenge initiative. Broad outcomes of our Smart City are outlined further below. Our solutions are designed to be scalable for application throughout our entire region, and could be migrated to other mid-sized cities in the country. Key elements of our vision include:

– A new **Strategic Mobility Alliance for Regional Travel (SMART)** and **Data Clearinghouse** will connect travelers in real-time with the most convenient, fast, reliable and cost effective options for every trip need. This initiative will address both the governance and technology challenges necessary to provide true Shared Use Mobility services.

– New technologies, including **advanced sensors, vehicle to vehicle communications, and autonomous electric vehicles**, will provide energy efficient trips, reduce crashes and reduce or avoid congestion. The University of Minnesota Transitway and other roadways in our proposed project area will be used to demonstrate these systems with an eye towards scalability and re-application elsewhere. Our advanced vehicle technologies will focus towards transit buses, fleet vehicles, bicycles, and potentially private cars.

– A new **Micro Transit** service model will be developed, merging the Mobility on Demand trip planning with innovative vehicle technologies and advanced safety features. The right vehicle providing the right service at the right time.

– A combination of **data analytics, decision support systems, partnerships and communications** will provide enhanced tools for **transportation management, freight movement** as well as the right **information** and the right **incentives** to allow people to tailor their choices to not only meet their travel needs but benefit overall transportation mobility and the environment.

– **Develop and implement other technology solutions** that reduce congestion, increase traveler safety and address climate change. This includes innovative **special event dynamically priced parking**, **integrated corridor management and Intelligent Transportation Systems (ITS)** enhancements and other emerging technologies.

– A synergistic approach for changing the nature of future planning and decision making that promotes **smarter land use and development**, facilitates a **growing population density** in our urban core, is more **customer and user** focused and benefits the **environment, health, and economy of the area**.

A high-level summary of our broad project outcomes is included in the table below. Our outcomes will be delivered by proposed project ideas and technology solutions that together, address our challenges and needs. Additional details on our proposed technology solutions, approach and alignment with the USDOT vision elements are provided in Section 5.

Broad Outcomes and Technology Solutions

Broad Outcomes	Technology Solutions				
	Mobility Alliance •Data Clearinghouse •Shared Use Mobility Service	**Advanced Vehicles & Mobility** •Autonomous Vehicles •Connected Vehicles – Transit •Connected Vehicles – Snow Plows / Maintenance Fleets •Connected Bikes •Electric Vehicles	**Micro Transit**	**Advanced Traveler Information and Smart Parking** •Enhanced NexTrip Mobile App •Snow Routes Status Mobile App •Smart Parking and Dynamic Parking Prices	**Advanced Sensors and Integrated Corridor Management**
A. First/last mile travel connectivity	●	●	●	●	
B. Access to options for best travel choices and flexibility	●	●	●	●	
C. Availability, access and management of open integrated data	●	●		●	●
D. Shared usage / shared trips	●	●	●	●	
E. Comprehensive incentive programs for smarter travel	●		●	●	
F. Mobility options for diverse populations and visitors	●	●	●	●	
G. Reduce travel costs – mobility, safety, energy	●	●	●	●	●
H. Integrated payment services combining travel modes and parking	●		●	●	
I. Safety for all travelers and modes		●	●	●	●
J. Reduce modal delays	●	●	●	●	●
K. Event parking information and availability	●			●	
L. Inter-jurisdictional corridor management					●
M. Ability to address policies and adapt to rapidly changing technology	●	●	●		
N. Rules for public/private partnerships	●				
O. Citizen engagement programs	●				
P. Greener energy	●	●	●	●	

Who Benefits?

Our Smart City vision creates numerous user benefits.

- A **commuter** that chooses fast, reliable transit service to and from work, knowing that any exception -- an offsite meeting, and sick child, etc. -- can be easily accommodated any day any time.

- A **parent** with children that finds it easy to navigate to and from their destinations with strollers and bags in comfort and safety at any time of day in any weather.

- A **disabled or senior citizen** (not able to drive) requests real-time travel service and enhances their quality of life and ability to contribute their talents to society.

- A **student** that travels to classes, errands, and entertainment via an ever changing mix of walking, bicycling, transit, and car share, with every trip delivered in the most convenient, reliable and cost effective manner.

- A **sports fan** navigating to an event reserves a parking space ahead of time, is guided directly to the space, and pays using a mobile app allowing quick access in and out of the parking facility.

- A **visitor** to the region that has no need to rent a car, traveling with ease to hotels, restaurants, meetings and events with just their smartphone to guide them.

- An **entrepreneur** has access to open data to create new customer services and economic benefits.

- A **Transportation/Traffic Management Center (TMC) operator** better manages daily traffic and unexpected events on our integrated transportation corridor.

- A **City planner** uses integrated data and data analytics to guide smarter land use, parking and transportation planning decisions.

- The **citizens** of Minneapolis / Saint Paul have safer and more efficient roadways, cleaner environment and better quality of life.

Our Program Management Approach

While this application is being submitted by the City of Minneapolis, the project includes a broad group of partners who will work together along with future partners to develop, test and deploy the proposed Smart City elements. Grant and financial management will be led by the City of Minneapolis who will be the USDOT's point of contact. Specific project elements will be led by the City of Minneapolis, City of Saint Paul, Metro Transit, MnDOT, or the University of Minnesota depending on the project focus and geographic location. Other private partners will support this effort as it relates to the autonomous and connected vehicle applications, vehicle safety technology and Shared Use Mobility services (discussed in Section 5). Our stakeholder agencies have expressed their support for this program and together are committed to participation, further development of our vision, and ultimately the on-going operation and management of successful solutions. Letters of Support are provided in this application.

> *"Our stakeholder partners have a successful history as national leaders in transportation innovation"*

2. Population Characteristics

The Cities of Minneapolis and Saint Paul meet the desired population characteristics for the Smart City Challenge.

	Minneapolis	Saint Paul	Totals	Urbanized Area	Percent of Urbanized Area
2010 Population Census	382,578	285,068	667,646	2,650,890	25.2%
Density (Population/sq-mi)	7,088	5,484	6,301		
Land Area (sq-mi)	53,973	51,979	105,952		
2014 Population Estimate	407,207	297,640	704,847		
Percent Increase	6.4%	4.4%	5.6%		

3. Other Characteristics

Existing Public Transportation System

The existing public transportation system in the proposed urban corridor includes local and express bus services, light rail transit (LRT) Green Line, Metro Mobility ADA paratransit service, Transit Link (general public dial-a-ride service), and University of Minnesota Campus bus services (see table below). Additional information related to our transit services is provided in Section 8

Fixed Route Services	Routes
LRT on University Ave	Metro Green Line
Local Services in the project area	Metro Transit routes 2, 3, 4, 6, 16, 21, 62, 63, 67, 83, 84, 87
Express Services on I-94	Metro Transit routes 94, 353, 355, 365, 375
On-Demand Services	
Metro Mobility (ADA paratransit)	
Transit Link (general public dial-a-ride)	

Conducive Environment for Demonstration

Minneapolis / Saint Paul is a unique geographic region in the country with two urban downtown central business districts just 9 miles apart, city borders separated by the Mississippi River, the University of Minnesota campuses in the middle and with a multi-modal corridor that connects the two largest employment centers in the state of Minnesota. Our proposed corridor includes an individual venue for every major professional sport and one of the highest density of sporting venues and other special events in the country. We have several recently completed stadiums and others under construction and we are proud to be hosting the Super Bowl in 2018 and the Final Four in 2019. A map of our project site is included in Section 4.

Our cities have natural inter-jurisdictional strength and a proven track record of interagency and public-private collaboration, cooperation, and innovation. For example, in 2011, many of the same stakeholders completed deployment of the successful $133M Minnesota Urban Partnership Agreement (UPA) program. Our proposal and Smart City vision will leverage these partnerships in coordination with existing

technology assets and intelligent infrastructure. The region already possesses a strong multi-modal mix, including a Metro Transit bus fleet equipped with a full range of ITS technologies such as computer aided dispatch (CAD), automatic vehicle location, (AVL), automatic passenger counters (APC), voice annunciators, and Transit Signal Priority (TSP), two LRT lines, Commuter Rail service, Bus Rapid Transit (BRT) on city arterials, real-time traveler information systems (transit and highway), arterial traffic management systems in Minneapolis and Saint Paul, Active Traffic Management and High Occupancy Toll (MnPASS) lanes on MnDOT freeways, bike and car share services, and a host of other improvements.

Our proposed project area is oriented around the METRO Green Line LRT service connecting Minneapolis, Saint Paul, the University of Minnesota and the State of Minnesota Capitol area. The corridor includes Interstate 94, one of the busiest freeway corridors in the state, and encompasses a wide range of land uses and diverse residential and business communities. The corridor is also home to many event venues and intermodal freight facilities (rail and shipping ports). It includes a world-class multi-modal transportation network comprised of fixed route bus and light rail transit, freeway and urban arterial roadway networks, the Union Depot intermodal transit hub and a dedicated Transitway connecting the University's Minneapolis and Saint Paul campuses. The University of Minnesota and global businesses located along the corridor provide world class research and industry that is focused on technological innovation. The corridor is complex, has significant future growth projections and associated transportation challenges. Residents, customers, businesses and other transportation users expect better access to travel options, improved real-time information, safer travel and flexibility in their travel choices.

MnDOT has begun working on a long-range vision to totally transform the Interstate 94 corridor so that it better serves regional trips as well as local urban trips within the corridor communities. Our Smart City project significantly compliments MnDOT's upcoming program and can smartly influence many of the upcoming planning and design decisions to be made.

Committed Leadership for Demonstration

As the lead agency for this demonstration, the City of Minneapolis is committed to provide necessary and appropriate staff and resources for a successful implementation and demonstration of the system. The Minneapolis / Saint Paul stakeholders through the development of this application proposal have formed a cohesive core group that is comprised of dedicated senior leadership and competent technical staff. Each stakeholder has a designated lead staff member along with the technical staff in key areas of responsibility for this demonstration. This includes a strong pool of researchers and

innovators from the University of Minnesota that supports the team and provides the needed expertise in the areas of technology development and implementation, legal review, policy analysis, community outreach, land use planning, and economic development. Such commitments are documented in the letters of support from stakeholders in Attachment. We will further expand our leadership through private partners (Vulcan, Mobileye, etc.) and other agencies and organizations.

Commitment to Integrating with Sharing Economy

The Minneapolis / Saint Paul stakeholders are committed to promote a sharing economy by using the Internet and mobile apps to allow individuals and entrepreneurs to monetize underutilized assets, skills and space in transportation, technology innovation, and business development. We recognize that the emerging sharing economy challenges traditional categories of "business" and "personal" and new business models are proliferating faster than the legal and regulatory arenas can adapt to them. Through our leadership and stakeholder commitments, we are confident that we can work with our legal and regulatory system to be flexible and to adapt emerging legal and planning concepts to promote the integration of our proposed demonstration with the sharing economy.

Commitment to Open Data

Through the Strategic Mobility Alliance for Regional Travel (SMART) model with a data clearinghouse that enables sharing of anonymous data with multiple stakeholders and entrepreneurs, the Minneapolis / Saint Paul stakeholders are committed to make open, machine-readable data accessible, discoverable, and usable to participating stakeholders and the public. We envision such open data sharing commitment will fuel further technology innovation and entrepreneurship, which in turn will provide opportunities for technology development and advancement and economic growth not only for the demonstration corridor but also for future expansion to the urban center and beyond.

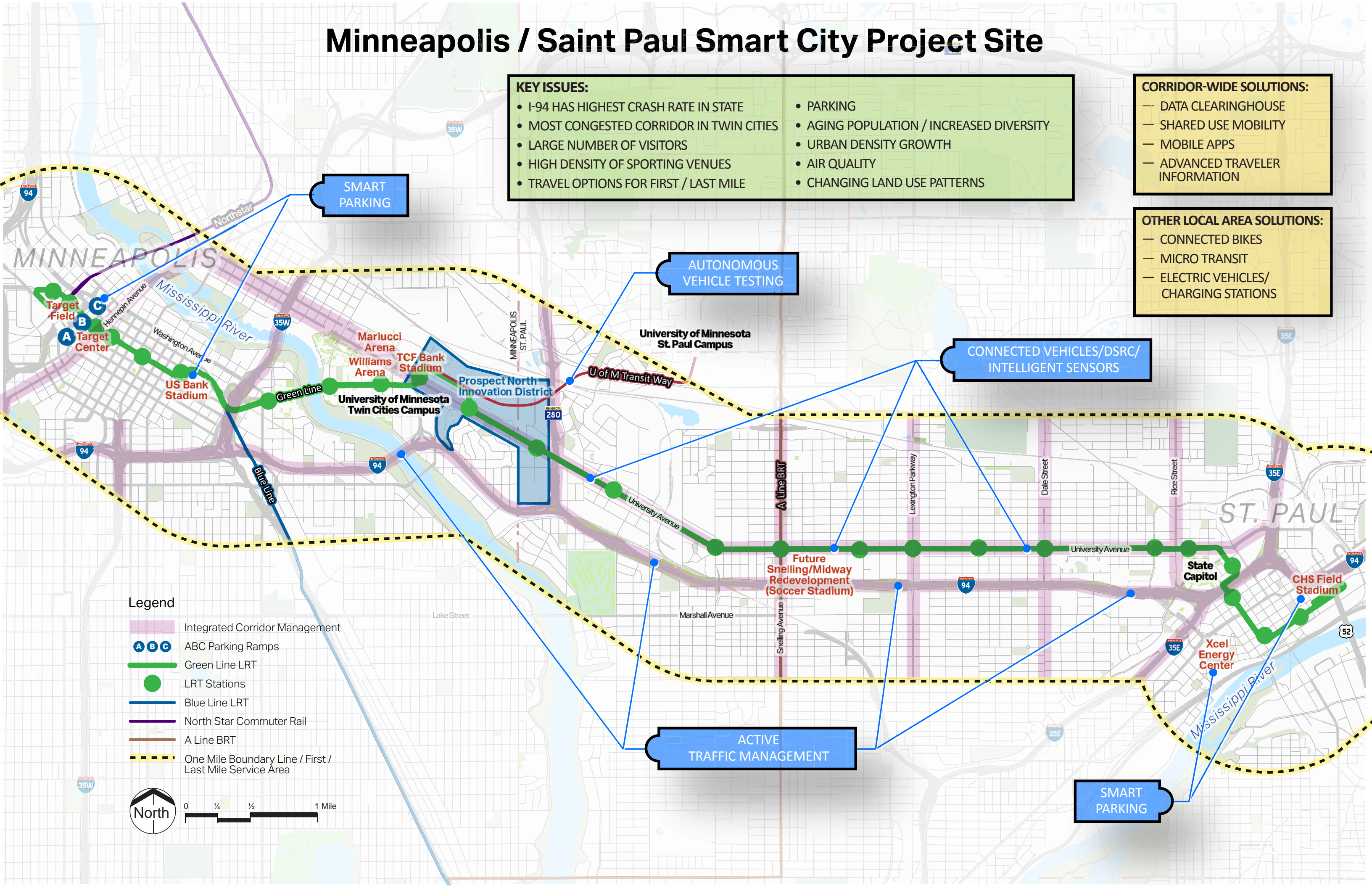# 4. Annotated Preliminary Site Map

An annotated preliminary site map that identifies the specific geographic location of the proposed urban corridor is illustrated on the next page. The map includes the proposed key issues and challenges, technology solutions, and proposed locations for roadside technology, connected automated vehicle operations, and other transportation infrastructure and strategies.
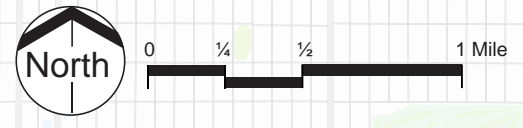
Minneapolis / Saint Paul Smart City Project Site

KEY ISSUES:
- I-94 HAS HIGHEST CRASH RATE IN STATE
- MOST CONGESTED CORRIDOR IN TWIN CITIES
- LARGE NUMBER OF VISITORS
- HIGH DENSITY OF SPORTING VENUES
- TRAVEL OPTIONS FOR FIRST / LAST MILE
- PARKING
- AGING POPULATION / INCREASED DIVERSITY
- URBAN DENSITY GROWTH
- AIR QUALITY
- CHANGING LAND USE PATTERNS

CORRIDOR-WIDE SOLUTIONS:
- DATA CLEARINGHOUSE
- SHARED USE MOBILITY
- MOBILE APPS
- ADVANCED TRAVELER INFORMATION

OTHER LOCAL AREA SOLUTIONS:
- CONNECTED BIKES
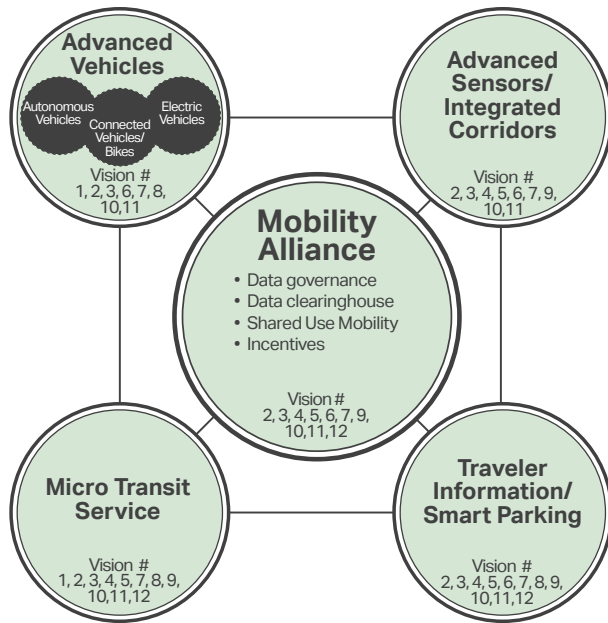- MICRO TRANSIT
- ELECTRIC VEHICLES/ CHARGING STATIONS

SMART PARKING

AUTONOMOUS VEHICLE TESTING

CONNECTED VEHICLES/DSRC/ INTELLIGENT SENSORS

ACTIVE TRAFFIC MANAGEMENT

SMART PARKING

MINNEAPOLIS

ST. PAUL

Mississippi River

Target Field

Target Center

US Bank Stadium

Green Line

Hennepin Avenue

Washington Avenue

Northstar

Blue Line

Mariucci Arena
Williams Arena
TCF Bank Stadium

University of Minnesota Twin Cities Campus

Prospect North Innovation District

University of Minnesota St. Paul Campus

U of M Transit Way

University Avenue

A Line BRT

Lexington Parkway

Dale Street

Rice Street

University Avenue

Future Snelling/Midway Redevelopment (Soccer Stadium)

Snelling Avenue

Marshall Avenue

Lake Street

State Capitol

CHS Field Stadium

Xcel Energy Center

Mississippi River

Legend

- Integrated Corridor Management
- Ⓐ Ⓑ Ⓒ ABC Parking Ramps
- Green Line LRT
- ● LRT Stations
- Blue Line LRT
- North Star Commuter Rail
- A Line BRT
- One Mile Boundary Line / First / Last Mile Service Area

North

0   ¼   ½   1 Mile

5. Minneapolis / Saint Paul Smart City Approach

The Minneapolis / Saint Paul Smart City initiative aligns with each of the twelve USDOT Vision Elements. We have proposed integrated technology solutions that intertwine and synergistically support each other for a universal approach to smart, safe and reliable travel. Our bold and unique concepts integrate and further enhance existing systems already in place and creatively prepares us for the rapid technological movement underway. A high-level concept graphic showing our primary technology solutions along with the interrelations and interconnectivity are presented below.

Advanced Vehicles
Autonomous Vehicles
Connected Vehicles/ Bikes
Electric Vehicles
Vision #
1, 2, 3, 6, 7, 8, 10,11

Advanced Sensors/ Integrated Corridors
Vision #
2, 3, 4, 5, 6, 7, 9, 10,11

Mobility Alliance
• Data governance
• Data clearinghouse
• Shared Use Mobility
• Incentives
Vision #
2, 3, 4, 5, 6, 7, 9, 10,11,12

Micro Transit Service
Vision #
1, 2, 3, 4, 5, 7, 8, 9, 10,11,12

Traveler Information/ Smart Parking
Vision #
2, 3, 4, 5, 6, 7, 8, 9, 10,11,12

The cornerstone of our vision involves the establishment of a Mobile Data Alliance called **"Strategic Mobility Alliance for Regional Travel" (SMART)** including the creation of a new agnostic entity of public and private agencies, businesses and citizens who address technology challenges and establish governance related policies for data sharing in the region. SMART will direct the development of a **data clearinghouse** that draws upon the various existing and new data sources available in the Twin Cities and can be accessed in real-time by service providers and users of the transportation network. **Crowdsourcing** will be integrated to allow those who travel the ability to be a data source and to get incentives for smarter travel choices made. The SMART concept allows for enhanced **Shared Use Mobility services** not only in our project corridor but scalable for the region.

Our Smart City proposal strongly supports the USDOT Smart City vison. An accumulation of our solutions addresses each of the twelve USDOT vision elements as demonstrated in the table on the next page.

USDOT Vision Elements and Technology Solutions

USDOT Vision Elements	Mobility Alliance •Data Clearinghouse •Shared Use Mobility Service	Advanced Vehicles & Mobility •Autonomous Vehicles •Connected Vehicles – Transit •Connected Vehicles – Snow Plows / Maintenance Fleets •Connected Bikes •Electric Vehicles	Micro Transit	Advanced Traveler Information and Smart Parking •Enhanced NexTrip Mobile App •Snow Routes Status Mobile App •Smart Parking and Dynamic Parking Prices	Advanced Sensors and Integrated Corridor Management
1. Urban Automation		●	●		
2. Connected Vehicles	●	●	●	●	●
3. Intelligent, Sensor-Based Infrastructure	●	●	●	●	●
4. Urban Analytics	●		●	●	●
5. User-Focused Mobility Services and Choices	●		●	●	●
6. Urban Delivery and Logistics	●	●		●	●
7. Strategic Business Models and Partnering Opportunities	●	●	●	●	●
8. Smart Grid, Roadway Electrification, and Electric Vehicles		●	●	●	
9. Connected, Involved Citizens	●		●	●	●
10. Architecture and Standards	●	●	●	●	●
11. Low-Cost, Efficient, Secure, and Resilient Information and Communications Technology	●	●	●	●	●
12. Smart Land Use	●		●	●	

As you can see, we have proposed an approach that synergistically addresses all of the USDOT Vision Elements along with our needs, challenges and desired outcomes. High-level descriptions and stakeholder participants for each of our key technology solutions are summarized next.

Technology Solutions

Strategic Mobility Alliance for Regional Travel (SMART)
Aligns to USDOT Vision Elements #2, 3, 4, 5, 6, 7, 9, 10, 11, 12

This technology solution, **Strategic Mobility Alliance for Regional Travel (SMART)**, serves as the cornerstone of our Smart City vision. It integrates all project elements, can evolve with future expansion and technology advancements and better prepares us for coming autonomous and connected vehicles. SMART includes the creation of a new autonomous mobility alliance or entity represented by public/private agencies, businesses, citizens and the community whose purpose is to address technology challenges, establish governance related data access/sharing policies and is obligated to consumers. Service providers join the alliance for access to the **Data Clearinghouse.** Existing transportation related data sources (public and private) will be integrated as well as new data sources becoming available from autonomous/connected vehicles. **Crowdsourcing** will feed the clearinghouse and an incentive program will be created for consumer and business participation and smarter travel choices. Opportunities to integrate smart alternative energy and rewards for Electric Vehicle usage will also be investigated. The primary goals of SMART are to share real-time data for better service to the public, be agnostic related to who provides the service, increase the pool of real-time travel requests so trips can be integrated or bundled into **ride sharing** and to provide true Shared Use Mobility services allowing better travel choices by the public. Minneapolis, Saint Paul, Metro Transit and MnDOT TMCs will be a data source and can utilize the shared data for better **data mining/analytics, planning, predictive models, decision support systems** and proactive traffic/transit/travel management. City and State planners and decision makers will be able to utilize the integrated data for smart land use planning. Freight companies and delivery services will benefit by using the data clearinghouse for better delivery logistics and on-time delivery.

The SMART concept combines open data usage with smart phone communications technology for useful, reliable and accurate data for simpler travel choices and personalized information directly to the user. Our enhanced **Shared Use Mobility** services is a key outcome and will include better access to real-time traveler information, more travel options and the ability to buy a "mobility" ticket to a destination via text message or app. Key features include:

Shared Use Mobility Services

- Integrates various forms of shared and public transportation in a single payment network

- Plans ideal route via transit, on-demand services or other vehicles and connects ride requests with potential transportation providers in real-time
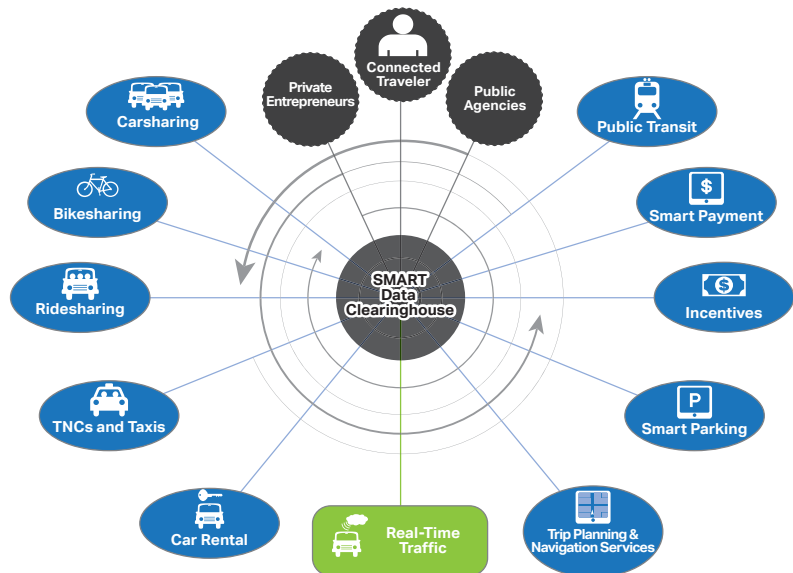
- Furnishes riders with an array of flexible and well-coordinated options so that alternative modes become more competitive with private car ownership
- Provides options for the first/last mile connections
- Integrates payments for parking
- Provides options for multimodal trips including transit, dial-a-ride, ridesharing, carpooling, car-sharing, bikesharing, Transportation Network Companies (TNC), pedicabs and taxis
- Integrates with other on-demand technology solutions like autonomous vehicles, connected vehicles/bikes and Micro Transit
- Provides customer incentives and rewards for smart travel choices and vastly expands the "pool" of shared use trip requests in lieu of traditional SOV travel

Key Elements: Data Mobility Alliance, Data Clearinghouse, Shared Use Mobility Services, Crowdsourcing, Customer/Business Incentive Programs, Integrated Payment Services, Flexible Travel Options, Promotes Smart Travel Choices, Decision Support Systems, Smart Land Use Planning, Freight/Delivery Logistics

Stakeholder Participants: Metropolitan Council / Metro Transit, Minneapolis, Saint Paul, University of Minnesota , MnDOT, Nice Ride, McKnight Foundation, Hennepin County, Ramsey County, Uber, Lyft, Car Share, Taxis, Xcel Energy, Freight Companies, Delivery Services, Businesses, Citizens

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Advanced Vehicles and Mobility
Aligns to USDOT Vision Elements #1, 2, 3, 6, 7, 8, 10, 11

This technology solution focuses on advanced vehicle applications including **Autonomous Vehicles, Connected Vehicles, Electric Vehicles** and associated partnerships for each. New transit services, transit vehicles and transit/pedestrian safety will be a primary focus.

Autonomous Vehicles

This project proposes pilot testing **autonomous driverless electric vehicle(s)** along the University of Minnesota Transitway connecting the Minneapolis and Saint Paul campuses. The University of Minnesota has been a leader in researching, testing and deploying intelligent vehicle technology since the 1990s and will work closely with private partners in the execution of this test. The University Transitway is a unique, controlled roadway with restricted access and provides a safe environment for our pilot. Options being considered for our autonomous vehicle technology include a **mini-bus, Micro Transit, small buggy or tricycle.** Plans are already underway to expand a successful pilot to other parts of the University campuses to facilitate trips by students, and to improve mobility and access to those with disabilities or unable to drive. Beyond that it could be expanded to other areas for a variety of short trips within Minneapolis and Saint Paul to local destinations, shops, restaurants, businesses as well as first/last mile connections to the Green Line LRT within our project corridor. Discussions are also underway to test a private autonomous fleet vehicle utilized by Nice Ride Minnesota as part of their bike rebalancing services.

Key Elements: Autonomous Vehicles, Self-Driving, Electric Vehicles, First/Last Mile Connections, Advantages for Disabled

Stakeholder Participants: University of Minnesota, Metro Transit, Minneapolis, Saint Paul, MnDOT, Vulcan, Nice Ride, Private Partners

Connected Vehicles - Transit

This project includes the deployment of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) technologies directed at bus, light rail and pedestrian safety. Metro Transit will partner with **Mobileye** in the instrumentation of its bus fleet to enhance detection and warning systems for buses, light rail trains and drivers.

The V2V elements will focus on:

- **Forward collision** warning for buses

- Safe vehicle **freeway merges** when transit buses utilize "Bus Only" shoulder lanes

- Safe vehicle **freeway lane merge** when transit buses utilize "Bus Only" shoulder lanes and merge into general traffic

The V2I elements will focus primarily on:

- **Pedestrian detection and bus/train operator warning systems**

- **Transit signal priority** along key arterials in our proposed project corridor

This project will also implement **driver diagnostic systems.** This will involve collecting bus operator driving performance to aide training personnel in improving bus operator driving performance.

Key Elements: Connected Vehicles for Transit – V2V / V2I, Bus/LRT Safety, Pedestrian/Driver Safety, Driver Warning Systems, Collision Warning, Transit Signal Priority

Stakeholder Participants: Metro Transit, Minneapolis, Saint Paul, MnDOT, University of Minnesota, Mobileye, Other Private Partners

Connected Vehicles – Snow Plows/Vehicle Fleets

This project includes the **deployment of V2V and V2I** technologies directed at snow plows, maintenance vehicles, local agency fleets as well as potential extension to taxis, TNCs, delivery fleets and public participants. A key component of this project will include the deployment of **Dedicated Short Range Communications (DSRC)** devices at key traffic signal locations within our project area to test the developing national DSRC standards, enable V2I communications and for the collection of vehicle probe data and road condition information for use in our proposed Data Clearinghouse

and existing agency TMCs. The V2V communications will allow instrumented snow plows, vehicle fleets and other participants to exchange real-time information as they travel the connected corridor. In summary, this project will:

- Establish **V2I and probe data sources through DSRC** installed in traffic signal cabinets to enable communication with buses, light rail trains, snow plows/maintenance vehicles, City/County/Metro Transit car fleets, delivery fleets, public participants, etc.

- Allow for **V2V testing** for enhanced real-time traveler information and safety

- Improve snow plow operations on arterials and **test signal priority during snow removal operations**

- Explore opportunities to **enhance Taxi/TNC/Pedicab** services by using connected vehicle technology to better inform taxi stand locations and share enhanced real-time information to priority pick-up and drop-off zones for TNCs or Pedicabs.

Key Elements: Connected Vehicles for Snow Plows/Vehicle Fleets – V2V / V2I, Vehicle Data Probes, Vehicle Safety, Snow Plow Signal Priority, Enhanced Taxi/TNC/Pedicab Services

Stakeholder Participants: Minneapolis, Saint Paul, Hennepin County, Ramsey County, MnDOT, University of Minnesota, Taxi, TNCs, Pedicabs, Public Participants, Other Private Partners

Connected Bikes

This project incorporates connected vehicle related technology to bikes and builds upon the successful ZAP Twin Cities Bike Commuting Program, a consortium between Minneapolis, Saint Paul and the University of Minnesota. ZAP uses University of Minnesota pioneered hardware and software and small **RFID bike tags and tag readers** for an automated **bike commuting recognition system.** It is an effortless way of verifying and logging bike trips, then rewarding and incentivizing bicycle commuters with prizes, **wellness rewards** and other incentives. Our goal is to further enhance and expand this program to our current Nice Ride bikesharing service, integrate it with our Data Clearinghouse and Shared Use Mobility incentive program and encourage more bike commuting metro-wide. We will also work with **Mobileye** on incorporating additional detection technology and bicyclist warning systems to enhance bike safety and mobility.

Key Elements: Connected Bikes, Bike Commuting, Bike Safety, Bike Data Analytics, Incentives, Mobileye Partnership

Stakeholder Participants: University of Minnesota, Minneapolis, Saint Paul, Nice Ride, Mobileye

Electric Vehicles

This project focuses on reducing negative environmental impacts and will involve the partnership with **Vulcan** and use of **electric vehicles** to showcase innovations, climate-friendly vehicles and technologies. This demonstration will catalyze further innovation and scalable, proof-of-concept solutions to increase safety, reduce carbon emissions, and enhance mobility. We will establish additional **electric vehicle charging** stations or use of more innovative ways to charge

batteries through wireless technologies or other means. This project will build upon existing partnerships and usage of electric vehicles by Minneapolis, Saint Paul, Metro Transit, University of Minnesota and Xcel Energy. The potential exists to combine this project with our autonomous vehicle pilot along the University of Minnesota Transitway. Other options being considered as part of the Vulcan partnership will include:

- Use of electric mini-buses, paratransit vehicles or shuttles as part of our proposed Micro Transit solution

- Conversion of conventional City vehicle fleets to electric vehicles

- Conversion of conventional Metro Transit buses to electric buses

- Conversion of conventional taxi cabs to electric taxis

- Conversion of other conventional private fleets to electric

Key Elements: Electric Vehicles; Electric Charging Technology, Autonomous Electric Vehicles, Strategic Partnerships, Vulcan Partnership

Stakeholder Participants: Minneapolis, Saint Paul, Metro Transit, University of Minnesota, MnDOT, Vulcan, Xcel Energy, Other Private Partners.

Micro Transit
Aligns to USDOT Vision Elements 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12

The proposed **Micro Transit** project includes the establishment of an on-demand transit service for **first/last mile connections** to areas of interest within our project corridor. This service would consist of short trips connecting and getting users to/from transit, other travel modes, the University, businesses, places of employment, State Capitol complex, downtown business districts, events, neighborhoods, etc. Micro Transit is envisioned to be a **mini-bus, small shuttle or paratransit** type of vehicle operating based on service demand and/or as a circulator. This project is expected to be led by Metro Transit but we are investigating options for this to be operated by a private service company as part of our initial demonstration. Options to utilize electric vehicles, tricycles, bikes or small autonomous vehicles as part of this service will also be reviewed. This service will give better travel options for senior citizens, the disabled, and those without access to an automobile.

Key Elements: Micro Transit, First/Last Mile Solution, Electric Vehicles, Tricycles, Bikes, Strategic Partnerships, Vulcan Partnership

Stakeholder Participants: Metro Transit, Minneapolis, Saint Paul, University of Minnesota, MnDOT, Nice Ride, Vulcan, Other Private Partners

Advanced Traveler Information and Smart Parking
Aligns to USDOT Vision Elements 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

This technology solution focuses on providing enhanced real-time traveler information to the public related to transit, alternative travel share services, parking and road conditions. The **real-time transit information** will build upon mobile travel apps already being developed and deployed by Metro Transit, the University of Minnesota and private partners. Parking challenges during special events will be addressed through **smart infrastructure based parking facilities and dynamic pricing** strategies. Options to enhance real-time information related to snow removal operations and snow emergencies will also be considered.

Enhanced NexTrip Mobile App

This project element will enhance Metro Transit's existing **NexTrip traveler information system** with expanded options, better real-time bus information and more integrated features with other shared use mobility services. The enhanced mobile app will be a key system that interfaces with our proposed Mobility Alliance, Data Clearinghouse and Shared Use Mobility Services. Enhanced NexTrip features will include:

- Real-time display of buses on NexTrip maps
- Deployment of mobile NexTrip Customer Information Systems (CIS) on the A-Line BRT, then expanded to the full Metro Transit fleet including real-time route transfer connection departure times and real-time rider alerts, service advisories, and emergency messages.

- Linkages to alternate shared services options and availability including:
    » Bike Share (Nice Ride, etc.)
    » Car Share (Car2Go, Zipcar, HourCar, etc.)
    » Taxi (iHail, etc.)
    » Ride Share (Uber, Lyft, etc.)
- Integration with existing APC systems for real-time bus seat availability (i.e. % Full using real-time APC data)
- Real-time bike rack space availability (using real-time bike sensor data)
- Crowdsourcing features such as a "See Something Say Something" App
- Incentive delivery programs based on travel choices and data/consumer behavior information gathering for analytics
- Integrated mobile payment and fares
- Integration with real-time parking status and payments
- Publically available NexTrip API

Key Elements: Real-Time Bus Information, Real-Time Bus Seat/Bike Rack Availability, Connection Protection, Rider Advisories/Alerts, Shared Use Services, Crowdsourcing, Integrated Payment Services

Stakeholder Participants: Metro Transit, Minneapolis, Saint Paul, University of Minnesota, MnDOT, Nice Ride, RideScout/GlobeSherpa, Uber, Lyft, Car2Go, Zipcar, HourCar, Taxi, Other Private Partners, Citizens

Snow Routes Status Mobile App

This project element will provide website enhancements and a mobile app for updates on snow removal operations. The system will provide **real-time alerts** related to snow emergencies, status of plowed streets and routes as well as bike route snow conditions during winter months. Crowdsourcing features will be integrated to allow data sources from the public using the roads and bikeways.

Key Elements: Real-Time Snow Removal Information, Bike Route Snow Conditions, Crowdsourcing

Stakeholder Participants: Minneapolis, Saint Paul, Metro Transit, University of Minnesota, MnDOT, Nice Ride, Citizens

Smart Parking and Dynamic Parking Prices

This project element addresses parking challenges within our project corridor by installing appropriate **sensor infrastructure, parking space management systems, real-time signs and dynamic pricing strategies** directed at parking structures and/or city parking meters for special events.

This project will also revamp existing policies related to **carpooling and incentives** at the ABC ramps located in west downtown Minneapolis. Opportunities will be pursued to incorporate more flexible options **(Flex parking)** for single occupant commuters and carpoolers, partnerships with private carsharing and ridesharing companies for guaranteed rides home, sharing of parking spaces, more **Electric Vehicle charging** stations, and updated revenue control systems to allow integration with MnPASS toll tag transponders or pre-paying for parking. **MnPASS toll tag integration** with transit and other private businesses will also be assessed. The goal would be to offer payment flexibility and incentives to encourage travelers to make other choices besides always driving alone.

Key Elements: Smart Parking, Dynamic Priced Parking, Real-time Parking Information, Carpool Incentives, Flex Parking, Smart Energy, Integrated Payment Services

Stakeholder Participants: Minneapolis, Saint Paul, University of Minnesota, MnDOT, Xcel Energy, Uber, Lyft

Advanced Sensors and Integrated Corridor Management
Aligns to USDOT Vision Elements 2, 3, 4, 5, 6, 7, 9, 10, 11

This technology solution focuses on the installation of **intelligent sensor based infrastructure, advanced signal systems** operations and **ITS traffic and transit** strategies along key portions of our proposed project corridor and around special event venues. Sensor data collected will become available to our proposed Data Clearinghouse and used for data analytics and traffic/transit operational predictions. A key component will be to enhance **Integrated Corridor Management** strategies through enhanced interagency communications and information sharing. The primary goal is to improve arterial operations, special event management and safety for all corridors users....general purpose traffic, transit, bikes and pedestrians. Potential enhancements include:

- Sensors / Cameras to monitor traffic, street lights and pedestrian movements at stadiums
- Interagency Connectivity - expand fiber connectivity for information sharing among agencies

- Dynamic Message Signs / Real-Time Bus Arrival Signs for enhanced traveler information
- Smart and Adaptive Traffic Signals for enhanced signal operations
- DSRC in signal cabinets for V2I and probe data
- Signal Priority for buses and snow plows; Transit queue jumps at selected intersections
- Apps for Bicycles, Visually Impaired Pedestrians to enhance safety and ADA way finding
- Push real-time information to businesses along the corridor
- Multi-modal way finding beacons at LRT stations
- Traffic and bus operations analytics based on sensors and cameras
- Technology controlled Reversible or Rush Hour Only Bus Lanes
- Presence Detection using RFID to enhance NexTrip Bus Arrival/ Departure information
- Transit/ Car Comparison Travel Times
- Parking and Park & Ride Space Availability

Key Elements: Intelligent Sensors, Smart Traffic Signals, Real-Time Information, DSRC, Integrated Corridor Management, Interagency Communications, Special Event Management, Operational Analytics

Stakeholder Participants: Minneapolis, Saint Paul, Metro Transit, University of Minnesota, MnDOT, Hennepin County, Ramsey County, Nice Ride, Uber, Lyft, Car2Go, HourCar, Zipcar, Taxis, Sporting Venues, Strategic Partners, Businesses

Measurable Impacts

The Minneapolis / Saint Paul Smart City vision and proposed technology solutions will together synergistically benefit travelers in the project area and ultimately lead to a smarter and more flexible approach to travel and land use, safer transportation systems and reduced impacts to climate change across the entire region. Our initial measurable impacts are presented on the next page. Once core elements of our solutions are developed and deployed, they can easily be expanded for use throughout the Twin Cities and state of Minnesota, minimizing costs associated with on-going deployment and operations.

Expected Measurable Impacts	
More convenient and flexible travel options	Less commuting time; more time with family
Faster and more reliable trips	More work opportunities for the disabled
Reduced travel costs	Fewer pedestrian and bike crashes
Less energy consumption	Lower vehicle emissions / pollutants
Fewer crashes and less congestion	Increased usage of incentive program
Smarter land use with less parking needs	Increased business opportunities for all
Reduction in single occupant vehicle trips	Better quality of life for citizens

The Smart City initiative allows the Minneapolis / Saint Paul stakeholders to partner not only in the deployment of the solutions but in the on-going operations as well. The proposed SMART Mobility Alliance will facilitate discussions and agreements related to on-going operational challenges, new policies and funding needs for our technology solutions and look for opportunities for more regional approaches to operations, maintenance and management.

6. Identify Key Risks and Mitigation Plans

Risk Management is a very important component of managing a project, and is an important complement to classic costs, schedule and requirements management activities intended to increase the probability of project success through the control of threats to project goals. Risk mitigation for the Smart City Challenge Demonstration will be conducted according to recognized principles and established practices. The risks associated with the planning, design, implementation and operation of the proposed system and elements will be identified, assessed and a series of avoidance and mitigation strategies will be developed. The table below summarizes the major risks that have been identified to date and shows an assessment and the mitigation strategies that will be employed to manage risk on the project.

Possible Risk	Probability of Occurrence	Consequences of Occurrence	Mitigation Strategy
Technical Risks			
Quantity and complexity of data integration work poses threat to project schedule and budget	Low	Severe	A substantive amount of data collected in the proposed urban corridor has already been integrated in some fashion. Following previous successful experience from many recent projects, the Minneapolis/ Saint Paul stakeholders will apply the proven systems engineering techniques to guide the design and implementation of the system to integrate existing and future data that are collected by various public agencies and private entities.
Complexity of the interface development work impacts project schedule and budget	Low	Severe	Many interfaces required for the Smart City demonstration are already in place and working. Key public agencies have already established center-to-center communications and are actively sharing information. Additional interfaces required for the demonstration will be developed and managed by conducting a detailed interface development work.

Possible Risk	Probability of Occurrence	Consequences of Occurrence	Mitigation Strategy
Failure to integrate existing or planned systems/elements	Low	Moderate	Systems engineering techniques will be applied to guide the design, implementation and integration of the planned systems and elements. The City of Minneapolis has a pool of qualified contractors under master on-call contracts. Those contractors have been involved in advanced transportation and vehicle technologies, information technology, and/or software development projects and have been proven to reduce risk.
Failure of planned mobile apps to be developed in a timely fashion	Low	Severe	Public stakeholders in Minneapolis/ Saint Paul urban areas have already had significant experience with developing mobile apps as a tool for traveler information and trip planning. We will apply systems engineering techniques to guide the design and implementation of the proposed mobile apps. As noted above, the City of Minneapolis has a pool of qualified information technology and software development contractors under master on-call contracts.
Policy Risks			
Lack of legislation for autonomous/self-driving vehicles on public roads	High	Low	Minnesota currently does not have specific laws to govern autonomous vehicles. Laws were introduced to the Senate but no further actions were taken. To mitigate potential policy risks, the autonomous vehicles will be tested on the University of Minnesota's Transitway, where non-authorized vehicles are prohibited. The Minneapolis / Saint Paul stakeholders will continue working with policymakers to introduce legislations to govern the use of autonomous vehicles in the future.
Privacy and security concerns regarding the SMART model of data sharing	High	Moderate	SMART includes the creation of a new mobility alliance or entity represented by public/private agencies, businesses, citizens and the community. The Minneapolis / Saint Paul stakeholders have already initiated a process governance model to further define the goals, roles and responsibilities for Smart City. A Steering Committee has been formed including representatives from each stakeholder agency/organization. The proposed Mobility Alliance will be established to further define the framework and governance to be utilized to address our strategies, processes, institutional policies and guidelines, rules and collaboration related to on-going technology challenges and data sharing for the region.

Possible Risk	Probability of Occurrence	Consequences of Occurrence	Mitigation Strategy
Institutional Risks			
Lack of partner commitment and proactive participation	Low	Severe	The Minneapolis / Saint Paul urban area has an established track record of inter-agency and public-private cooperation. The City of Minneapolis has taken steps to further reduce any risk with participation. The primary method to address this risk is through established policy, stakeholder core group, and working groups. The Minneapolis / Saint Paul stakeholders have established vision, goals and objectives for this demonstration. The stakeholder core group will further develop partner agreements or project charters during the Phase II effort.
Procurement of development or integration services is not achieved in a timely fashion	Low	Severe	The City of Minneapolis has master on-call contracts with a pool of qualified prospective contractors. If due to aggressive project schedule that requires a faster procurement process, the City of Minneapolis would like to discuss an alternative contracting approach with the USDOT that would allow the City to directly negotiate with additional prospective private partners necessary for successfully delivering the services and products to avoid a lengthy procurement process.

7. Team Partners, Stakeholders and Partnerships

The City of Minneapolis is the lead for this grant application. Our key stakeholder partners include:

- City Saint Paul
- Metropolitan Council/Metro Transit
- Minnesota Department of Transportation (MnDOT)
- University of Minnesota
- Nice Ride Minnesota
- Transit for Livable Communities
- McKnight Foundation
- Shared Use Mobility Center

Other local stakeholders are being discussed and will be considered for the Phase II submittal.

A key partner is the University of Minnesota including the Center for Transportation Studies (CTS), Roadway Safety (ITS) Institute, Minnesota Traffic Observatory and University Researchers. The University will lead several of the project elements and will build upon previous research and testing as it related to autonomous and connected vehicles, intelligent sensors, Smart traffic signals, transportation policy analysis, data analytics and mobility services.

Minneapolis has existing Clean Energy Partnerships with Xcel Energy (electricity provider) and CenterPoint Energy (natural gas provider). The partnerships bring together the City of Minneapolis and the two utility franchisees in support of the City's Climate Action Plan and 2040 Energy Vision. Together they plan, implement, market and track new approaches to delivering energy efficiency, energy choices and renewable energy to Minneapolis residents and businesses. In addition, Minneapolis also has a partnership with USI Wireless to provide citywide wireless internet service with speed up to 1 GB in some areas.

Other stakeholder participants have or are developing private contracts for data integration, aggregation and mobile apps development and enhancements. Several private partners have also approached the Minneapolis / Saint Paul area stakeholders offering products, solutions and services as part of the initiative. Private partners and major sports organizations expected to be involved in executing our vision include Xcel Energy, Zipcar, Car2Go, HourCar, iHail, Uber, Lyft and

the Minnesota Twins, Vikings, Timberwolves, United, and Wild. We are excited about the partner-ships that will occur with both Vulcan and Mobileye as we implement our proposed solutions.

The stakeholders have already initiated a process governance model to further define the goals, roles and responsibilities for Smart City. A Steering Committee has been formed including rep-resentatives from each stakeholder agency/organization. The proposed Mobility Alliance will be established to further define the framework and governance to be utilized to address our strate-gies, processes, institutional policies and guidelines, rules, and collaboration related to on-going technology challenges and data sharing for the region.

8. Existing Transportation Infrastructure and Systems

The Minneapolis / Saint Paul area has been very aggressive in the deployment of innovation and world-class multi-modal transportation systems and has been a national leader in the testing and deployment of emerging technologies. A brief description of our existing transportation infra-structure and systems is included below.

Arterial Miles

There are approximately 225 lane-miles of arterial roadway within the limits of Minneapolis and Saint Paul. Within our project site, University Avenue is a key arterial roadway that parallels the I-94 corridor to the north along with the Green Line light-rail transit line.

Freeway Miles

There are approximately 200 lane-miles of freeway roadway within the limits of Minneapolis and Saint Paul. The I-94 corridor connecting Minneapolis and Saint Paul is the main east-west freeway corridor in the region serving over 150,000 vehicles per day.

Transit Services

Metro Transit, a service of the Metropolitan Council, operates the fixed route transit system serv-ing the cities of Minneapolis and Saint Paul. There are 58 urban local bus routes that serve the two cities, in addition to two light-rail lines with a total of 37 stations, and one commuter rail line connecting Minneapolis with the northwest suburbs.

Transit Services	Notes
Fixed-Route Bus Service	58 urban local bus routes
Light-Rail Transit Service	2 light-rail lines (Blue and Green); 37 total stations; combined average of over 60,000 weekday boardings
Commuter Rail Transit Service	Connects Minneapolis with northern suburbs
University Campus Shuttle Service	East Bank, West Bank and St. Paul Campus Connectors and four Separate Campus Circulators
Paratransit Service	Metro Mobility and University Paratransit Service
General Public Dial-a-Ride Service	Transit Link, a Metro Transit former Dial-a-Ride Program for areas not serviced by frequent fix route service
Suburban Transit Service	Transit service to/from Cities – Minnesota Valley Transit, SW Transit, Maple Grove Transit, Plymouth Metrolink, Shakopee, Laker Lines, etc.
Interstate Bus and Rail Service	Jefferson Bus Lines, Badger Bus, Megabus, Greyhound Bus, Amtrak Train
RFID "Go To" Transit Fare Cards	Over 100,00 active cards for tap payment on buses and trains.

Shared-use Mobility Services

Shared-use mobility services are prevalent throughout the Minneapolis and Saint Paul region and, in addition to public transit discussed in the previous section, these include car-sharing services, bike-sharing services, ridesharing services, Transportation Network Companies (TNCs), and taxi and limousine services. A high-level summary of existing shared use mobility services in the region today are presented in the table below.

Shared Use Mobility Services	Notes
Car-Sharing Services	
Car2Go -- https://www.car2go.com/en/minneapolis/	445 Vehicles in the Mpls. / St. Paul Area
HourCar -- http://www.hourcar.org/	Recently integrated with Metro Transit Go-To Cards that utilize RFID tags
Zip Car -- http://www.zipcar.com/	
Bike Sharing Services	
Nice Ride MN -- https://www.niceridemn.org/	Recently expanded to 190 stations in Minneapolis and Saint Paul with over 1,700 bikes to choose from.
ZAP Bike -- https://www.derozap.com/zaptwincities/	Incentive program that provides RFID tags for use on personal bicycles. Potential for integration with other RFID tags / cards, such as Metro Transit and HourCar.
Car-pooling / Van-pooling Services	
Metro Transit -- http://www.metrotransit.org/carpool	Over 7,000 carpool permit holders
TransitLink -- http://www.metrotransit.org/transit-link	Augments regular transit routes and is available in areas that don't have frequent regular transit routes
Metro Vanpool -- http://www.metrotransit.org/vanpool	Over 550 vanpool users in 69 active vanpools
Transportation Network Companies (TNC)	
Uber -- https://www.uber.com/cities/minneapolis	Approved for operation through ordinances from Minneapolis and St. Paul in 2014.
Lyft -- https://www.lyft.com/cities/minneapolis-st-paul	Approved for operation through ordinances from Minneapolis and St. Paul in 2014.
Taxi Services	
Taxi Services, Inc. -- http://www.airporttaximn.com/about-taxi-services-inc/	Accepts taxi reservations and payment from Smartphone applications
iHail -- http://www.ihail.com/	Accepts taxi reservations and payment from Smartphone applications
Multiple vehicle taxi services in the region	
Twin Town PediCabs -- http://www.twintownpedicabs.com/	Short distance taxi service operational in downtown areas

Information and Communications Technology

It is understood that Information and Communications Technology (ICT) consists of unified communications and the integration of telecommunications, computers as well as necessary enterprise software, storage, and visualization systems, which enable users to access, store, transmit, and manipulate information.

As discussed further in the next section, there are multiple control centers installed in the region that utilize various forms of communications infrastructure to communicate with field devices for presenting traveler information to the general public. Integration of communications between these centers is supported through the installation of a fiber-optic communications cable line between the City of Minneapolis TMC and the Metro Transit Transit Control Center (TCC) as well as shared Minneapolis/MnDOT fiber hubs to facilitate information sharing between the centers. Metro Transit has also facilitated integration between its TCC and Light Rail Control Center through

the use of an Emergency Command Center at the TCC facility. MnDOT also shares viewing of CCTV cameras with the City of Minneapolis TMC in areas of interest to the City TMC operations staff. In addition, the City of Minneapolis TMC has links with the Minneapolis Emergency Operations Center and the University of Minnesota to facilitate information exchange.

There are multiple communications methods that could be integrated with the overall unified communications infrastructure. For example, the City of Minneapolis has been operating a city-wide Wi-Fi network that is utilized by City departments to support operations, and is also available to the general public for a monthly fee as an alternative to private internet service providers. Other opportunities also exist for the integration of wired communications infrastructures between the City of Minneapolis, City of Saint Paul, Metro Transit and MnDOT in the region.

ITS, TMCs, Field Equipment

The City of Minneapolis TMC is a state-of-the-art facility that allows operators to communicate with over 800 traffic signals, 40 pedestrian crossings with signal flashers, and over 60 pan-tilt-zoom (PTZ) CCTV cameras for monitoring traffic. The City operates its own communication network which allows staff to communicate in real-time with traffic signal controllers, CCTV cameras, and other ITS devices in the field. Staff can also monitor MnDOT freeway cameras and City of Minneapolis Police cameras this facility. The City of Minneapolis has also installed over 40 Dynamic Message Signs in the downtown area to provide travelers with detailed information on the location of nearby parking facilities, traffic restrictions in place, and other information to facilitate travel in the downtown area.

The City of Saint Paul TMC communicates with over 375 signalized intersections in addition to numerous other ITS devices throughout the City. Similar to Minneapolis, the City of Saint Paul operates its own communication network which allows staff to communicate in real-time with traffic signal controllers, CCTV cameras, and other ITS devices in the field.

Metro Transit operates a Transit Control Center (TCC) in Minneapolis that allows transit dispatchers to monitor the real-time location of all buses throughout the region through the use of AVL system. In addition, the Transit Control Center can serve as an Emergency Command Center that can monitor CCTV cameras installed at light-rail transit stations along the Green Line corridor. Metro Transit can also communicate to all technology devices that present real-time transit arrival information on dynamic message signs, LCD monitors, and audible annunciation devices (for the visually impaired) installed at bus stops throughout in the region. There is also a separate Metro Transit Light-Rail Control Operations Facility in Minneapolis that monitors the locations of all light-rail transit vehicles in operation in the region.

MnDOT operates the Regional Transportation Management Center (RTMC) and communicates with all ITS devices deployed throughout the metro region, including traffic signals, CCTV Cameras, Dynamic Message Signs, and ramp meters among other ITS devices. This facility co-locates the Minnesota State Patrol with RTMC operators to facilitate information sharing and fast incident response to detected incidents. MnDOT also operates its own communication network which allows staff to communicate in real-time with ITS devices deployed in the field. Along the I-94 corridor, CCTV cameras are placed at approximate one-mile spacing to ensure complete video coverage of the entire I-94 corridor. MnDOT also operates active traffic management systems and the dynamically priced MnPASS lanes in the region. A tabular summary of ITS devices installed in the urban center is included below.

Agency	Electronic Message Signs	CCTV Cameras	Notes
City of Minneapolis	40+	60+	Message signs used to indicate location of nearby parking facilities, traffic restrictions, etc.
City of Saint Paul	10+	20+	Message signs include arrow-boards to indicate the proper direction of travel from downtown onto nearby Interstates
Metro Transit	100+	50+	Message signs presenting transit arrival information include LCD monitors as well as annunciation devices for the visually impaired
MnDOT	26	60	Cameras on I-94 spaced at one-mile intervals, message signs on I-94 at multiple locations to present travel time and incident information

Smart Grid Infrastructure including Electrical Vehicle Charging Infrastructure

Electric vehicles are becoming more prevalent in the Minneapolis and Saint Paul region, and there are currently over 60 locations in the cities of Minneapolis and Saint Paul with publicly available electrical charging stations. Some of these locations feature accelerated vehicle charging infrastructure that allows for faster charging than conventional charging stations, to help alleviate vehicle range anxiety concerns associated with electric vehicles. As other wireless, inductive-charging technologies become more prevalent at locations in the region, these will help further address range anxiety concerns associated with electric vehicles. Xcel Energy continues to partner with Minneapolis and Saint Paul to expand the electrical charging sites.

9. Data Currently Collected

Data currently collected by the cities and stakeholders involved in this demonstration is summarized in the table below. The table also identifies additional data that will be generated and collected by various stakeholders that will potentially be integrated and utilized for the demonstration.

Stakeholder	Functions/ Services	Data Collection (Current and *Future*)	
Minneapolis	Transportation	• Traffic volumes • Turning movements • Ped/bike counts • Signal timing data • Transit signal priority logs • CCTV images • Parking counts at city/state facilities	• DMS logs • Snowplow GPS/AVL data • Snowplow spreader data • Pavement condition • *Smart parking system data* • *Connected vehicle data from snowplow*
	Public Safety	• Police vehicle AVL data	• Police cameras
Saint Paul	Transportation	• Traffic volumes • Turning movements • Ped/bike counts • Signal timing data • CCTV images • Snowplow GPS/AVL data	• Snowplow spreader data • Parking counts at city owned facilities • *Smart parking system data* • *Connected vehicle data from snowplow*
	Public Safety	• Police vehicle AVL data	• Police cameras
Metro Transit	Transportation/ Transit	• CAD data • Transit GPS/AVL data • Schedule adherence • APC and fare collection data	• Transit passenger movements and total ridership • *Mobileye sensor data* • *Connected transit vehicle data*
	Public Safety	• Public safety data	

Stakeholder	Functions/ Services	Data Collection (Current and *Future*)	
University of Minnesota	Transportation	•Traffic Observation Lab •Campus transit user counts	•Parking counts •Bicyclist counts
	Public Safety	•Public safety data	
MnDOT	Transportation	•Traffic volumes, speed and occupancy •Travel times •CCTV images •DMS logs •Road weather conditions •Ramp volumes	•Ramp meters data •Freeway service patrol GPS/AVL data •Snowplow GPS/AVL data •Snowplow sensor data •Snowplow spreader data •*ICM data (real-time, prediction, and responses)*
Met Council	Transportation / Land Use	•Travel Demand Model •Land Use Model •Origin Destination data	•Air Quality data •Regional Planning data •*SMART Data Clearinghouse*
Nice Ride Minnesota	Transportation	•Bike station locations •Bike availability data	•Bike rental details (date, time, origin, destination, duration)
ZAP	Transportation	•Bike RFID sensor data and counts	
TNC	Transportation	•*CAD data* •*GPS/AVL data*	•*Service/trip details*
State Patrol Hennepin County, Ramsey County	Public Safety	•Public safety data •GPS/AVL	•Incident reports •Road condition reports
Public Citizens	Transportation Usage	•Real-time observations •*Bike route conditions*	•*Bike use locations* •*Travel choices*

SMART is the center piece of the proposed Smart City Challenge demonstration for the Minneapolis / Saint Paul urban center. The SMART model enables data integration and sharing throughout the proposed demonstration corridor and scalable beyond. The data will initially be integrated and shared through SMART to participating public and private stakeholders. The public portal in the form of mobile apps and websites will make the data available to the traveling public in an organized and useful fashion. This data sharing capability will allow scalability to cover the entirety of the two cities as well as to the metropolitan area.

Public transportation agencies will use the data to monitor the multimodal transportation network. Road operating agencies will utilize the data to assess the roadway performance and make operational adjustments to accommodate increasing traffic flows due to demand, congestion, incidents and special events. The data will allow for maximizing the capacity of roadways and balance the network utilization.

The data will assist Metro Transit to monitor bus, BRT and LRT operations and make service adjustments in real time. Metro Transit can also utilize the data to improve the management and operations of paratransit and other mobility on demand (MOD) services. The improvements in the paratransit and MOD services will enhance the transit user experience and convenience, and thus improve the transit utilization which indirectly reduces the roadway congestion and environmental impacts.

The City recognizes that abundant data on travel patterns has also been collected by non-public agencies. The data, such as biking data and data collected by TNC, can greatly supplement the data needed to provide the enhanced mobility on demand concept proposed for this demonstration. The business model of SMART in our proposal is a public-private partnership which allows private stakeholders to opt in to this travel consumer oriented data clearinghouse and gain access

on travelers' trip demand and patterns. In return, opt-in private partners provided trip data they have already collected so such data can be integrated into the clearinghouse to enhance data richness. Such data provided by the private entities may include service availability, trip origin and destination, duration, time of travel, etc.

A decision support system will be developed to assist in operations and management of the proposed systems and support future planning. The decision support system will utilize the real-time data in the clearinghouse and provide predictive information to support ICM operations, transit management and operations, micro transit, smart parking management, and traveler information, among others. The decision support system will also include data analytic features to assist in smart planning for urban growth, land use, business opportunities, energy consumptions, etc.

Another component of our proposed demonstration is a crowdsourcing mechanism to involve citizens to provide their trip information. Participants of this program can provide data regarding their trip details, including trip purpose, origins and destinations, starting time, mode(s) of transportation taken, trip route(s), etc. Data from this program can also fill data gaps in many areas, such origin-destination data, weather conditions, conditions of bicycle routes or sidewalks, etc.

The data collected by the various public and private agencies will be fused into the SMART Data Clearinghouse. Public agencies will be able to access the data to better manage and operate the transportation system and provide enhanced services to the public. Private sectors will be able to use the data to develop their business and provide consumers with the services at the right time and the right location. The traveling public will be able to utilize the rich transportation-related data to make informed travel decisions and modal choices. The public can use the mobile apps that are powered by SMART to perform functions such as dynamic ridesharing, automated ridematching, trips choices, itineraries, trip costs, and parking availability and pricing.

Policies, Orders, Ordinances, Legislation

The existing Minnesota Government Data Practices Act (MN Statute 13.01) regulates the collection, creation, storage, maintenance, dissemination, and access to government data in government entities. It establishes a presumption that government data are public and are accessible by the public for both inspection and copying unless there is federal law, a state statute, or a temporary classification of data that provides that certain data are not public. As such, the state and local agencies openly provide available transportation data from their existing transportation management systems for retrieval and use by private third parties

Green Line - St. Paul 10th Street with State Capitol

who may further customize services for the public. Data sources are numerous for our region but stored in separate agency or business platforms making it difficult to fully integrate, provide seamless travel options and realize full benefits. Our new integrated Data Clearinghouse will incorporate public, private, business and citizen data sources for those who choose to opt in. Our proposed Mobility Alliance will provide an agnostic governance body that will be further addressing data policies and participation rules as well as the need for new local executive orders, ordinances or legislation.

10. Approach for Using and Documenting Standards, Architectures, Certification Processes for ITS/Connected Vehicles

Minnesota has been at the forefront of ITS research and deployment. Public agencies, in particular MnDOT, Metro Transit and the Cities of Minneapolis and Saint Paul have been aggressively testing and implementing ITS technology for various applications, including traffic management, emergency management, transit management, traveler information, archived data management, and connected vehicles.

The Minnesota Statewide ITS Architecture serves as the singular architecture to cover all ITS planning and deployment for the entire state. The Architecture has been updated regularly, with the latest update in September 2014, to capture the deployment and planning status in the state. The Architecture identifies applicable standards to facilitate interoperability as well as captures future connected vehicle initiatives.

MnDOT is currently leading an effort to implement a programmatic process to fulfill the requirements of 23 CFR 940 Regulations on ITS Architecture and Systems Engineering for ITS projects. This will require agencies using federal and state funds for ITS projects to follow the programmatic process to ensure compliance with 23 CFR 940. The process will require a systems engineering analysis is performed, integration and interoperability issues are addressed, and the needs for updating the Statewide ITS Architecture are appropriately identified. Following this programmatic process, required analyses for the proposed solutions will be performed to facilitate the use of existing ITS standards and the Architecture.

Key stakeholders for this application are experienced with the systems engineering process and have applied it to many technology projects. Following the systems engineering process has ensured the appropriate use of ITS standards and certification processes for ITS technology.

Agencies and partners for this application will follow the systems engineering process to plan, design, test, and implement the proposed systems and components. The systems engineering documentation will provide detailed records and traceability regarding goals, objectives, functionality, testing methods and results, and configuration changes. Experience and lessons learned will be documented to cover technical, policy, and implementation issues.

We will use the National ITS Architecture and the Connected Vehicle Reference Implementation Architecture (CVRIA) as guides to perform planning and design of the proposal systems. Unique aspects of the system design will be identified. We will document and communicate such aspects with the USDOT, the architecture developer, and standards developers to seek for advices and support. We will work closely and support the USDOT in the Connected Vehicle Certification Program and provide input, as appropriate, to certification requirements for equipment, applications, devices, and systems.

Based on the experience and lessons learned through the demonstration, we will provide recommended revisions and enhancements to the National ITS Architecture, CVRIA, ITS and Connected Vehicle Standards, and the certification process. In addition, we will coordinate and support the USDOT, architecture and standards developers, and other private stakeholders involved in the ITS and connected vehicle based technology.

11. Measurable Goals and Objectives

Our proposal shares the vision and achieves the goals of the USDOT Smart City Challenge initiative. The vision statement for the Minneapolis / Saint Paul Smart City Challenge initiative was de-

veloped with the many stakeholders. The vision statement is included in Section 1 of this proposal. Our vision statement reflects current practices, planned improvements, and future scenarios.

Using this vision as a starting point and taking into account the specifics of the proposed demonstration site, the stakeholders developed a potential list of measurable goals and objectives detailed in the following table.

Goals	Objectives	Performance Measures
The multimodal approach with smart technologies shall improve accessibility to travel operations and attain an enhanced level of mobility for travelers	• Increase transit ridership within the demonstration corridor • Reduce the use of single occupancy vehicles • Increase the use of non-motorized transportation • Reduce vehicle miles traveled • Increase transportation options for disabled and seniors • Reduce delay due to parking	• Change in transit ridership • Number of single occupancy vehicles reduced • Number of travelers commuting with non-motorized transportation • Changes in vehicle miles traveled • Number of transportation options for disabled and seniors • Time spent finding parking
The safety record shall be enhanced through smart technologies	• Reduce vehicle crashes and fatalities • Reduce vehicle-pedestrian crashes and fatalities • Reduce vehicle-bicycle crashes and fatalities	• Number of vehicle crashes and fatalities • Number of vehicle-pedestrian crashes and fatalities • Number of vehicle-bicycle crashes and fatalities
The multimodal approach and smart technologies shall have positive impacts on climate change	• Reduce fuel consumption • Reduce air pollution • Increase the use of electric vehicles	• Changes in vehicle miles traveled • Changes in vehicle miles traveled • Number of electric vehicles and miles traveled
Travelers shall have the information tools to make smart travel choices	• Enhance multimodal traveler information tools, including trip planning tools • Increase the number of traveler information mobile apps users • Increase the number of visits to the traveler information mobile apps • Increase the number of visits to the traveler information websites	• Number of tools (mobile apps, websites) providing multi-modal traveler information • Number of downloads of mobile apps • Number of requests made from mobile apps for traveler information • Number of recorded visits to the traveler information websites
Institutional partners shall employ an integrated approach through a city-wide perspective to resolve problems	• Improve the level of institutional coordination among stakeholders • Strengthen existing communication linkages among institutional stakeholders • Establish new communication linkages with additional institutional stakeholders (e.g. business) • Enhance the joint operations concept throughout the demonstration site	• Number of agencies actively participate in committees for planning, management, and operations of the system • Number of committee meetings held • Number of community outreach activities conducted

It is anticipated all data needed to evaluate the performance measures listed above will be available with the implementation of the Smart City initiative. Key Minneapolis / Saint Paul public agencies have already used some of the data elements and established performance management systems to actively monitor and manage the transportation system. They will continue building off the existing traffic management centers, transit control center, and performance monitoring programs to include additional data that will be become available through the Smart City initiative and perform continuous performance monitoring, evaluation and report on the impact of the demonstration on mobility, safety, efficiency, sustainability, and climate change.

The Minneapolis / Saint Paul stakeholders will work with the USDOT Independent Evaluator to conduct the evaluation of the Smart City demonstration. A key to a successful collaboration between the demonstration site and the USDOT contractor is a thorough evaluation plan that clearly identifies the roles and responsibilities of each of the parties involved.

The Minneapolis / Saint Paul stakeholders will collect traffic, transit, traveler information, and other applicable data to support the evaluation. As mentioned previously, all collected data will be stored in the data clearinghouse. The data will be essential for evaluating the system performance. The Minneapolis / Saint Paul site will provide the USDOT Independent Evaluator with the access to the data clearinghouse. In addition, we will support the Independent Evaluator with the access to the stakeholders and staff to conduct evaluation-related experiments, interviews, and surveys. The Minneapolis / Saint Paul region has participated in the USDOT Urban Partnership Agreements Program. We are very familiar with and are committed to provide the support and coordination needed for a meaningful and successful evaluation.

12. Evidence on Capacity to Take on Project

Key stakeholders for the Minneapolis / Saint Paul Smart City initiative are no strangers to complex projects of this magnitude. A prime example of our experience is the UPA project in Minneapolis which included MnDOT, the Twin Cities Metropolitan Council/Metro Transit, and the City of Minneapolis. Stakeholders are committed to dedicate staff resources necessary to the success of the demonstration. The table below summarizes the workforce and capacity of the key stakeholders.

Agency	# of Employees
City of Minneapolis	3,800
City of Saint Paul	3,000
Metro Transit	3,200
MnDOT	5,000
University of Minnesota	23,300

As stated in Section 3, stakeholders have made commitment through letters of support and participation in working group meetings. Official actions and resolutions from the City of Minneapolis Council and Metropolitan Council (see Attachment) further solidify the City and the team's commitment to the project.

Evidence of the site's infrastructure readiness, data and performance management capabilities has been described in Sections 8 and 9. In short, the site has already established very robust systems for real-time data collection, management, and performance monitoring, as well as for data archiving and management for research, planning, and other purposes.

13. Opportunities to Leverage Federal Resources

In preparing our response, the stakeholder agencies have already contributed resources by funding consultant support for the grant application development and through in-kind labor contributions. In-kind donations have occurred through staff involvement in meetings, outreach, consensus building, critical needs identification, vision/concept definition and technology solutions development.

We understand that a fixed cooperative agreement award for $100,000 will be made to five finalists. As part of our effort to further define our concept and plans that will be reflected in our more detailed response to the USDOT's second Smart City solicitation, we expect additional in-kind donations from participating stakeholders. We will seek out and obtain additional private sector partnerships and contributions as we execute our program. Our response to the second solicitation will also detail a strategy to leverage existing and previous federally funded assets and integrate them as appropriate with our proposed solutions. After deployment of our solutions, the stakeholders will strongly consider on-going commitments for operations, maintenance and management of our enhanced systems.