City of St. Louis: The Smart City Challenge Application
Connecting People and Opportunity
Vision Narrative
February 4, 2016

City of St. Louis Application
Mayor Francis G. Slay
City Hall – 1200 Market, Room 200
St. Louis, MO 63103

Contents

smart
St. Louis
a history of innovation

St. Louis Statement of Interest

St. Louis has a vision for a Smart future where transportation works and roads go beyond just moving traffic. The St. Louis Smart City project demonstrates how Smart Transportation Solutions can address our Nation's most pressing need, Connecting People and Opportunity.

St. Louis is the right place for the USDOT to demonstrate how Smart Transportation Solutions can improve quality of life for Americans. With a strong History of Innovation, St. Louis has been a leader in implementing new transportation ideas for more than 250 years. We have recently been recognized as a leading start-up friendly city by both Popular Mechanics and the Business Insider. The ranking demonstrates our ability to lead in the new tech revolution.

Our plan connects our "Central Corridor" jobs district with the HUD designated St. Louis Promise Zone. This federally recognized zone has a poverty rate of 35% and unemployment rate of more than 20%. This proposal provides Smart Transportation Solutions to connect those in the Promise Zone with Opportunity.

In this proposal you will find a holistic, integrated approach to connecting people and opportunity. This application puts forth bold and innovative ideas to use transportation data, technologies, and applications to improve access and mobility, public safety, and quality of life. It is a step toward greater opportunity for all Americans. Specifically, we propose projects in three major areas.

- **Smart Data Systems** that include development of a transportation data fusion center and deployment of smart sensors that will enable agencies and application developers to improve how transportation information is collected, shared, and used.
- **Connected Vehicles** focused on improving safety and security through a Smart Vehicle Fleet (police, fire, EMS, transit, maintenance, bike share) and smart traffic signals.
- **Smart Transit and Bicycle Systems** focused on providing travel choice through self-driving and connected bus demonstrations, the implementation of a bicycle share program, connected bicycle corridor, smart wayfinding system, and smart form-based code.

Transportation systems are complex, and Smart Transportation Systems require a collaborative effort from a host of stakeholders. For this application the City of St. Louis is partnering with the Bi-State Development Transit Agency, Missouri Department of Transportation (MoDOT), East West Gateway Council of Governments Metropolitan Planning Organization, St. Louis County, and Great Rivers Greenway Regional Trail District.

Connecting people and opportunity

The following pages illustrate how St. Louis is an ideal location to demonstrate how Smart Transportation Solutions can connect people and opportunity.

Connecting Community Needs to Opportunity

The City of St. Louis is well positioned to show how cities across America can address their needs through Smart Transportation Solutions. Our project connects people and opportunity. It addresses some of the most pressing needs in our community.

Efficient Infrastructure Use: In its prime, the City of St. Louis was a bustling port city designed for a population of one-million. However, according to the 2010 Census, the City's population is 319,294. Operating an overbuilt road network continues to strain the City, economically and environmentally. Projects proposed for the Smart City Challenge promote a dense urban environment, and support an efficient system that serves our resident population, as well as our daytime population of nearly 500,000. Through the use of Smart technology we have the opportunity to more efficiently work with the infrastructure that we already have, to promote a sustainable system for the future.

Multimodal Transportation System: As an early Midwestern City to embrace light rail, it is evident that St. Louis is forward thinking about mobility. While we have made great strides in promoting alternative modes of transportation, we still have room to grow in the development of a truly multimodal system. We continue to grow our number of bike commuters and implement bicycle friendly roads. As a FHWA designated **Pedestrian Safety Focus City**, we work toward zero pedestrian fatalities. We know a robust multi-modal system addresses climate change, promotes increased public health, and enhances mobility within our City and the St. Louis region, while expanding access to more users of the system.

Public Safety: St. Louis works every day to improve safety, both on our transportation network and within our City. Smart technology can help reduce crashes and promote a more equitable transportation system. Like many other cities, St. Louis has wrestled with crime in recent years. 2015 proved to be challenging for St. Louis as with cities across the US. Smart technology can assist law enforcement in their efforts to make our transportation system safe and secure for all.

Urban Redevelopment: Like many other Cities, St. Louis lost population as residents chose single family homes in the suburbs. To be successful moving forward, we know we need people and development back in our City. This proposal supports dense land use with a high level of access to jobs and education, as well as many recreational and cultural activities. These urban revitalization efforts address climate change and enhance mobility for the City of St. Louis.

Pedestrian Focus City: A FHWA designation that indicates **St. Louis is a high priority City** *to address 'critical safety challenges' with the help of the Federal Government that lead to key safety infrastructure improvements.*

sm**A**rt
St. Louis
a history of innovation

St. Louis Smart Cities Approach

The City of St. Louis and our partners have collaborated extensively to develop our concept of implementation for the Smart City Challenge. Our proposed approach includes 15 projects that focus on the challenge's 12 Vision Elements. This program is structured so that it can be implemented efficiently among partner agencies during the project demonstration period. As identified in the Challenge, the main goals are to increase safety, enhance mobility, and address sustainability. Projects have been grouped into three main areas:

Smart Data System: Smart data projects would create a regional **transportation data fusion center** to facilitate the sharing of transportation data. This system would also include the deployment of technology such as **Smart LED Street Lights** and **Smart Parking Systems**. Enhanced data would help the City and partner agencies operate the system better and more efficiently. The private sector will leverage this new data to enhance or develop **Transportation Applications** for travelers.

Connected Vehicles: Our Connected Vehicle projects will improve public safety and security. **Connected V2V and V2I** technology will be deployed on City police, fire, and maintenance vehicles; a portion of Metro busses; MoDOT maintenance trucks; and private ambulances. This deployment would be supported by **Connected V2I** infrastructure at City and MoDOT traffic signals. This effort would demonstrate connected vehicle safety applications and also provide data to support public safety, traveler information, and enhanced maintenance efforts.

Smart Transit and Bicycle System: Smart transit and bicycle projects would include **autonomous battery-electric buses**, a **connected bus route**, and **connected bicycle facility**. These efforts would be enhanced by the deployment of a **smart wayfinding program**, **bike-share program**, and an expansion of the **form-based code overlay districts** in the City, promoting appropriate development for transit use.

The matrix and annotated site map on pages 14 and 15 provide the location of the proposed projects, and map out how the individual projects outlined within this proposal support the Challenge's 12 Vision Elements. More specific information about the proposed projects is provided in detail further in this document.

St. Louis – a History of Innovation

St. Louis has been a leader in transportation innovation since our founding in 1764. St. Louis was the North American Continent's first inland trading center due to its location at the convergence of the Mississippi, Missouri, and Illinois rivers. Lewis and Clark began their journey of the Louisiana Purchase territory in St. Louis in 1804, highlighting the City's importance as the gateway to the opportunities of the West.

St. Louis pioneered the early use of steam power, first for river traffic, then for railroads. St. Louisan James Buchanan Eads' Mississippi River Bridge was the world's longest arch bridge when it was opened in 1874, and the first significant structure to be made of structural steel. St. Louis strengthened its reputation as a City of Innovation when it hosted the 1904 St. Louis World's Fair, as well as became the first city outside of Europe to host the Olympic Games.
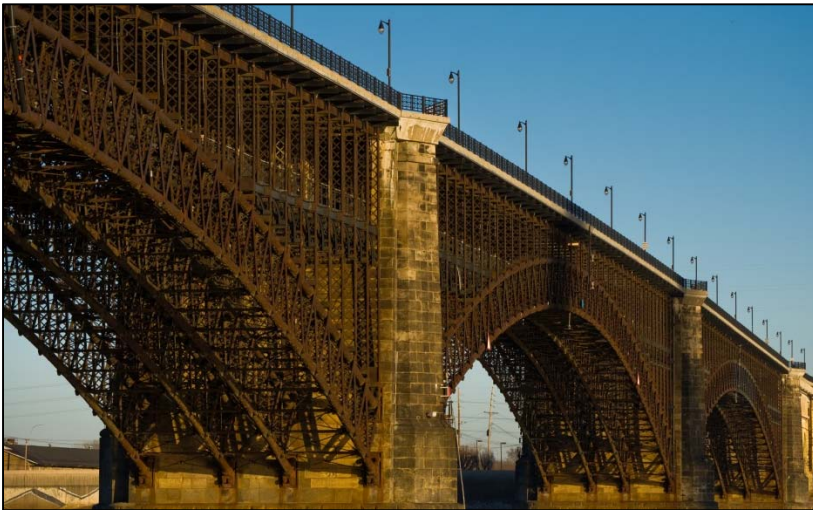
Eads Bridge

St. Louis was an early pioneer in both aviation and highways. Charles Lindbergh flew 'The Spirit of St. Louis' in the first solo flight across the Atlantic in 1927, the same year that Lambert Airport was purchased by the City of St. Louis to become the first municipally-owned airport in the United States. In 1956, the Missouri Highway Commission approved contracts for three of the first interstate projects in America, one-of-which being a segment of I-70 within the city of St. Louis.

The demand for mass transit led to the region's first light-rail in 1993. More than 180,000 rode MetroLink during the three-day introduction. By Labor Day, only a month after beginning regular service, the one-millionth passenger had boarded MetroLink.

270%
Increase in Bike Commuters since 2000

Over the last 20 years, the City of St. Louis has been active in deployment of smart traffic signals and has built a transportation operations center. The City Streets and Police Departments have jointly deployed a vast video camera surveillance system which is linked by a robust fiber optic network. In recent years the City has been aggressive in creating infrastructure for a walkable and bikeable City. The number of bike commuters in the City of St. Louis has increased 270% since 2000, and ranks 17th in share of bike commuters for cities with populations of 300,000 to one million.

St. Louis has been a leader in transportation innovation for 250 years. We pioneered the way for westward expansion. It is fitting for St. Louis to lead the next steps of US transportation innovation through the USDOT Smart City Challenge.

sm(arc)rt
St. Louis
a history of innovation

St. Louis Today

Though the 2010 census lists the population of the City of St. Louis at *319,294*, the daytime population of the City is closer to *500,000* as many commute in to the City for jobs. Revitalization efforts are attracting younger generations. Between 2000 and 2010 St. Louis saw a 138% increase in the number of 25-34 year olds, ranking first on the list of Cities with the greatest growing young adult population (City Observatory). We know that Millennials prefer to live and work in dense, mixed-use neighborhoods, within walking or biking distance to transit, and with access to multiple modes of transportation. The population density within the City of St. Louis is *5,148 per square mile* and includes *14.84%* of the urbanized area's population (with a daytime population closer to *23%* of the urbanized area population).
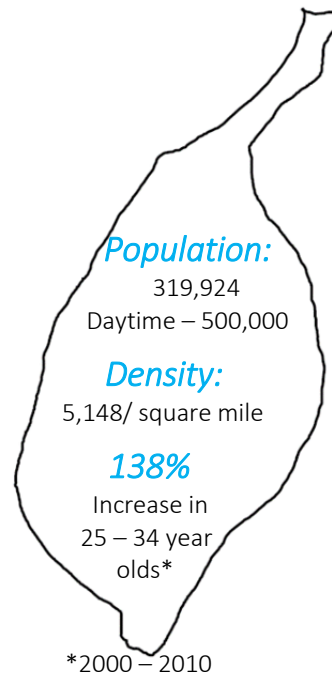
The City is a diverse mix of history, tradition and industry. We continue to define our status as a leader in innovation with its designation as the number one Startup City in 2015 (by Popular Mechanics) and the number one growing startup scene in the United States in 2016 (Business Insider). The ranking demonstrates that our mix of unique neighborhoods, Arch Grant's Program, and low cost of living empower the City of St. Louis to lead the new tech revolution.

Population:
319,924
Daytime – 500,000

Density:
5,148/ square mile

138%
Increase in
25 – 34 year
olds*

*2000 – 2010

In 2015, St. Louis was **one of eight finalists selected to participate in the Brookings Institution Global Cities initiative**. This program was launched in 2012 as a way to help leaders in major metropolitan areas grow their economies, while strengthening internal connections and competitiveness. As a part of this program, St. Louis is participating in research to implement integrated global trade to boost the St. Louis region and grow competitiveness for the 21st Century Economy.

St. Louis was also named in the **100 Resilient Cities program by the Rockefeller Foundation** in 2014, recognizing cities around the world that have made efforts to become more resilient and prepared for the social and economic challenges that come along with the 21st Century. This acknowledgment further-demonstrates the City's resolve to continue looking towards the future of mobility, safety, and climate change.

#1
Fastest Growing Startup Scene in the United States
-Business Insider, January 2016

Our Vision for a Smart St. Louis is a collaboration of local partners, regional stakeholders, multiple agencies, and the public working together to create an updated and fresh transportation network for the City. We envision a system that merges new technology and creative thinking with a history of tradition for an update that is safer, enhances mobility, and addresses climate change. Our vision is for a system that builds upon and strengthens existing relationships, and merges with new partners to support a network that is equitable in moving our region forward.

Diversity, Collaboration and Opportunity

St. Louis is a rich mix of different neighborhoods, ethnicities and industry that make the City a unique place to be, a strong employment center, and a great place to live. The wonderfully diverse, 79 different neighborhoods create a distinct sense of place, and foster community engagement with active and involved participants. Today there is great energy in the City's Central Core, including innovation and technology hubs for start-ups and entrepreneurs.

With multiple locations earning the status of 'Great Places in America' (street, public space and neighborhoods – as designated by the American Planning Association, APA), it is clear the diversity within the City makes it a great place to live, work and play. The City is home to the largest Ethical Culture Society in the United States. With unique pocket parks, a plethora of cultural institutions including theatres and museums, and regional attractions – from sporting events to festivals, it is imperative that St. Louis has a world-class transportation system that works for the everyday commuter, as well as the out of town visitor.

The desire for transportation choices, mixed with the vast diversity among neighborhoods, also means that we must have an accessible, multimodal transportation system. 21.9% of St. Louis households do not have access to a personal vehicle. It is critical that we provide quality transportation choices that connect all people with opportunity.

A key area of our City is part of the **HUD designated Promise Zone**. This Promise Zone designation is intended to support rebuilding certain areas within a City and create partnerships with local leaders to put people back to work. The goals of this program are to: create jobs, leverage private investment, increase economic activity, expand education opportunities and reduce violent crime.

Like other mid-sized U.S. cities, St. Louis experienced suburban sprawl and disinvestment within the Central City after World War II. However, there has been recent revitalization and reinvestment. Regionally, the completion of major projects in the Downtown core – including the City+Arch+River 2015 project, new retail and residential units, the addition of Webster University, TRex Innovation Community, and the upcoming St. Louis Blues Museum – demonstrate a City on the path toward greatness. Nationally, St. Louis has gained attention for programs focusing on economic investment, resiliency, and social equity. As a model Smart City, St. Louis can demonstrate best practices of leveraging current investments with national attention to achieve more than the sum of those parts. The rich mix of diversity present in the City of St. Louis is a key element for beneficial collaboration and can be an asset used in developing innovative technology as the model Smart City.

Existing Transportation System

St. Louis has a strong transportation backbone for the Smart City Challenge. Our system includes 278 lane-miles of interstate freeway and 694 lane-miles of arterial roadways. These roads are tied together with a tight urban street grid established before World War II. As such, the urban fabric within the City is primarily made up of small lots, short blocks, and small set-backs which are the "good bones" necessary for a walkable/bikeable and transit friendly transportation system. As described in the sections below, St. Louis has demonstrated a commitment to smart transportation infrastructure and is eager to continue with this work.

St. Louis Intelligent Transportation Systems

The City of St. Louis has a robust ITS system currently in place, with 92 miles of fiber within the City limits. The City has developed two fiber optic networks: one for traffic control and a second for video surveillance. We use both to operate successful and proven daily, emergency, and special event traffic signal timing strategies with our current Advanced Traffic Management System (ATMS).

Traffic Operations: City traffic operations are run out of the Traffic Operations Centers located at the Police and Street Department Headquarters. We have the current Siemens ATMS software TACTICS with 288 signals online and 200 network switches deployed. The system also has a discrete network hub that serves as a disaster recovery area adding resilience to our system. The City uses vehicle detection at 339 intersections throughout the City and has traffic surveillance cameras at an additional 40 intersections.

Traffic Video Surveillance: The City of St. Louis has a camera network that is shared between the Street and Police Departments. The City was awarded $3 Million by the Congestion Mitigation and Air Quality Improvement Program (CMAQ) in 2015 to update the current system and provide a better traffic management approach within the City. The money will be used to establish a new Real-Time Transportation Intelligence Center (RTIC) to augment current infrastructure and operations. The result will be reduced travel times and lower vehicle emissions. With major construction efforts underway in the Central Business District, this project was necessary mitigate the impact to changing travel patterns and traffic volumes, and demonstrates a forward-thinking approach. The project will be designed in 2016 and includes enhanced fiber optic communications network, the expansion of the video camera surveillance system, downtown traffic signal optimization, a downtown transportation study, and staffing and maintenance for the new RTIC.

Courtesy Sensys
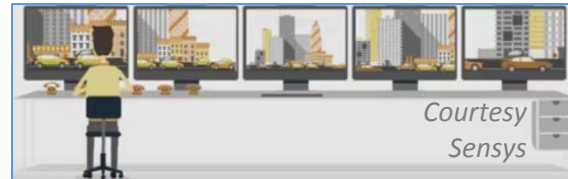
Wireless Traffic Signal Detection: The City currently utilizes Sensys wireless magnetometers for vehicle detection and count stations at approximately 339 signalized intersections. The existing Wi-Fi infrastructure can easily be expanded to detect and count bicycles utilizing MicroRadar sensors. In addition, SensMetrics can be implemented in order to provide various performance measures including turning movement counts, Purdue coordination diagrams, levels of service, and travel time. SensMetrics can also improve safety by identifying red-light and speeding violations.

City Bicycle Infrastructure

St. Louis is committed to promoting biking as a primary mode of transportation. The City of St. Louis has adopted a Sustainability Plan and Action Agenda that identify cycling as a viable component of economic development. As a preferred method of alternative transportation, this plan outlines specific goals related to bicycling. The first phase of Bike St. Louis was implemented in 2005 and we continue to actively grow our bicycle infrastructure. Since 2009 the City of St. Louis has been designated as a bicycle friendly community. The City implemented a Complete Streets policy in 2010 to ensure that we design streets that are safe for all users, including pedestrians and bicyclists.

In 2011 the Downtown Bike Commuter Station opened, and in 2012 a bike parking ordinance was implemented requiring installation of bike lockers with all new developments of greater than $1 million. As an active member of the Gateway Bike Plan, we work to increase the number of people bicycling as a mode of transportation. Bike St. Louis Phase III, a $1.2 million project adding 108 miles of new/improved bikeways was completed in 2015. Within the City we have 97 miles of shared lane markings, 24 miles of bike lanes, 16 miles of buffered bike lanes, implemented lane diets on 8 corridors, 6 bike corrals, and recently installed our first parking protected bike lane in downtown (Chestnut). Through our bike rack program we have installed 180 racks throughout the City (in addition to what local businesses may provide), and are currently planning a velodrome redevelopment. In 2015 the City hired its first ever Bicycle Pedestrian Coordinator, further solidifying our commitment to active modes of transportation.

Smart Parking Systems

In 2014, the City of St. Louis completed a parking study to update the parking management system for both on- and off-street parking. The study completed occupancy surveys and benchmarking, and provided recommendations for meter installation phasing. Areas were identified throughout the City as level 1 and level 2 priorities for phasing out old meters and implementing new technology. Within the past year, the City has installed a total of 704 Smart Parkeon Parking meters. These pay stations are solar powered and serve about 7 – 10 parking stations each. Additionally the City has installed 1059 Parking Meters manufactured by the IPS Group. These meters are connected wirelessly to a cellular network for parking management. The City continues to implement these smart parking systems throughout the identified areas. When complete in 2016, the City will have a total of 7,700 Smart Parking Spaces on this new Smart Parking System.

These parking meters use the ParkMobile application. Users register for the app and download it to their smart phone and have the ability to connect wirelessly to the parking system. Once users find a parking spot, they can log into the parking space and pay via the app. This affords users the ability to extend parking sessions remotely and enhances efficiency for the transfer of money to the City. This application can alert users before their time on the meter expires.
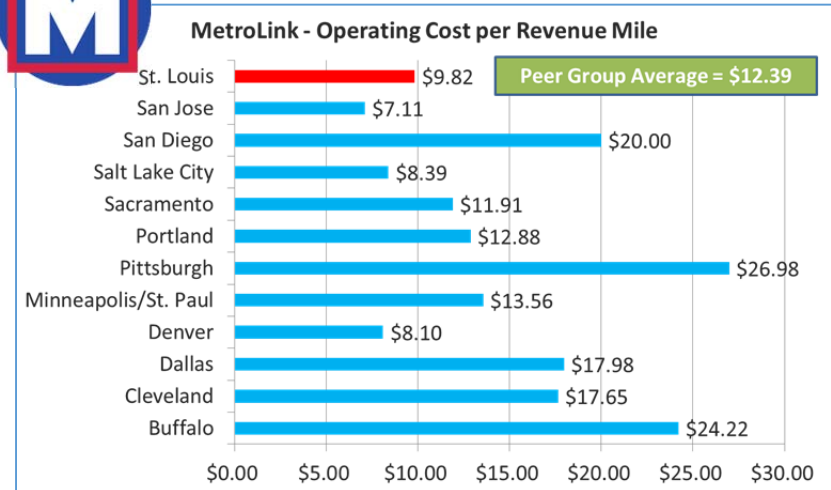
Partner Agencies

Transportation systems are complex and Smart Transportation Systems require collaborative effort from a host of stakeholders. Below are examples of our team member's ability to deliver quality transportation projects.

Bi-State Development Agency – Metro Public Transit

The St. Louis region's public transportation system, Metro, includes MetroBus, MetroLink and Metro Call-A-Ride. As one of the first Midwestern cities to embrace Light Rail, Metro has continued to improve the region's public transit service. Transit supports a stronger economy and Metro is constantly looking for more efficient ways to serve users. **Metro returns $4 in economic activity for every $1 invested, and has helped spur over $2 billion in investment near transit stations.** Metro supports the ongoing regional planning effort to promote transit-oriented development (TOD) toward efficient land use practices.

Metro currently operates 79 bus routes with over 6,000 MetroBus stops, 37 MetroLink Stations, and 45 million annual total boardings (63% MetroBus, 36% MetroLink and 1% Call-A-Ride). Metro operates over 22 Million Annual Service Miles in an efficient manner when compared to peer group cities. The St. Louis Region works to move transit forward by implementing new technology that promotes an efficient system. **Metro uses Automatic Vehicle Location (AVL) technology to monitor and communicate service information to riders. Recently, Metro started operating electric powered busses on some of the most heavily traveled lines in the region and intends to continue expanding on this program.**

$4 return for every $1 invested

MetroLink - Operating Cost per Revenue Mile

St. Louis	$9.82
San Jose	$7.11
San Diego	$20.00
Salt Lake City	$8.39
Sacramento	$11.91
Portland	$12.88
Pittsburgh	$26.98
Minneapolis/St. Paul	$13.56
Denver	$8.10
Dallas	$17.98
Cleveland	$17.65
Buffalo	$24.22

Peer Group Average = $12.39

MoDOT - Partners in ITS

MoDOT maintains a traffic management center (TMC) and extensive ITS network for the Missouri portion of the St. Louis metropolitan region. In the St. Louis City limits, MoDOT has deployed 69 surveillance cameras, 59 data sensors, 16 dynamic message signs, and interconnected signals. **These signals are also connected to the City of St. Louis ATMS to provide interagency control of traffic signal operations and cross-coordination capability.**

Regional ITS Architecture Plan: The East–West Gateway Council of Governments recently completed an ITS Architecture plan outlining ITS Standards for the bi-state St. Louis region. Included is a Regional ITS Strategic Deployment Plan to guide the implementation of Integrated Transportation Systems. The plan highlights the region's commitment to investment in emerging technologies.

Shared-use Mobility Services

The City of St. Louis knows the sharing economy is important to the future of transportation technology and is ready to implement new, and expand upon existing sharing programs within the City and the Region.

Bike Share: In 2014 Great Rivers Greenway concluded a feasibility study for a St. Louis regional bike share program. The study recommended a non-profit 501(c)3 ownership model, with a Board comprised of key political, corporate, institutional and community leaders and organizations. This model offers involvement of numerous stakeholders, neutral governance, the ability to raise sponsorships and donations, and the ability to reinvest profits over time. Comparable examples are Pronto Cycle Share in Seattle, Nice Ride Minnesota in Minneapolis/St. Paul, and San Antonio B-Cycle. The study recommended that implementation begin in the central corridor from Downtown St. Louis to the Washington University Campus.

Enterprise Car Share: As the headquarter for Enterprise Holdings, the St. Louis region has in place the Enterprise Car Share program. This program allows travelers to rent a vehicle by the hour, the day, or longer, providing access to personal transportation 24 hours a day and seven days a week.

Smart Grid Infrastructure: The City of St. Louis is working toward implementation of Smart Grid infrastructure to address climate change concerns, and enhance the sustainability of our transportation network. Within the City limits, there are 12 electric vehicle charging stations, 1 compressed natural gas station, and one propane station, with plans to install more stations in the future.
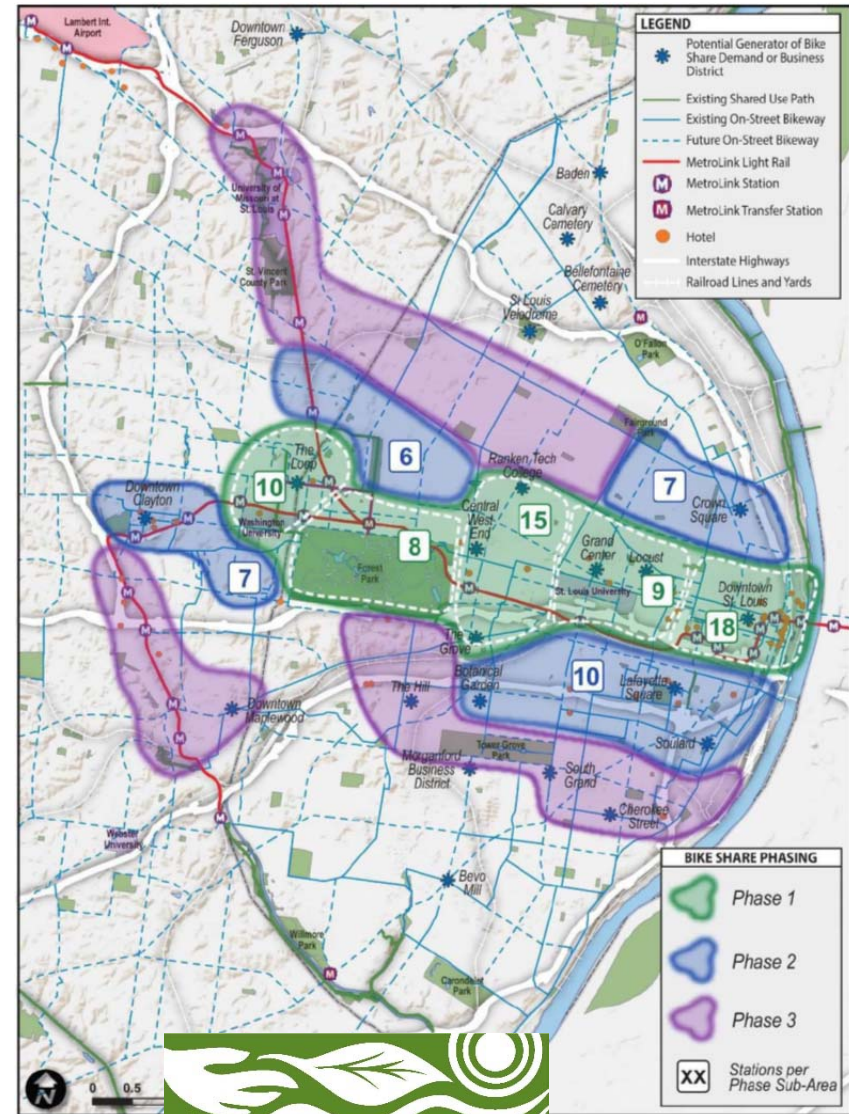
Commitment to Innovation

The City of St. Louis has shown strong leadership for many years, notably, since St. Louis Mayor Francis Slay took office in 2001. **Mayor Slay is the longest serving mayor in St. Louis history. His tenure has proven transformational, and his record reflects his administration's commitment to transit, innovation, and regionalism.** With overbuilt infrastructure and demand on limited resources, the City turns to data to ensure every dollar is used efficiently, and we invest in innovation to make every dollar go further – to expand the realm of the possible.

Innovation is in St. Louis' DNA. World class universities, hospitals, and a vibrant entrepreneurial sector combine to create a nationally-recognized innovation community. Cortex, a 200-acre innovation hub and technology district epitomizes this energy. As a premier innovation hub of bioscience and technology research, development and commercialization, Cortex serves as the anchor to St. Louis' growing ecosystem for innovative startup programs and established companies.

Mayor Slay's commitment delivers results: Securing IKEA within the Cortex footprint and pursuing the retention of the National Geospatial-Intelligence Agency (NGA) in the St. Louis-area are two examples of extraordinarily complex land-acquisition efforts in an urban core. The current administration's capacity to deliver results isn't just targeted at big development projects. Efforts to reduce fuel consumption reflect the same dedication. In 2007, Slay set an ambitious goal: cutting the City fleet's fuel consumption 7% by 2013. Data from more than 500 telematic devices allowed managers to identify and cut down on fuel wasting activities. The City met that goal and is striving to reduce fuel consumption a further 6% by 2018.

Together with St. Louis County, Slay created the St. Louis Economic Development Partnership to better-position the St. Louis region to work together and compete in a global environment. The Partnership works to grow businesses, understanding that **when businesses thrive, so does the community.**

Mayor Slay pledges the same commitment to success for the Smart Cities Challenge. Data sharing is one critical step toward expanded collaboration and informed decisions. Implementing a Connected Vehicles program would expand the operational efficiency of the City's Fleet. A Smart Transit and Bicycle System will help the City serve a population that demands more transportation choices. It is a step forward in Mayor Slay answering Secretary Foxx's Challenge for Safer People, Safer Streets. Together, these efforts advance the City's top priorities for transportation: public safety, efficient use of tax-payer dollars, choice, mobility, environmentally sensitive, innovation and regionalism.

Proven Project Management

The City of St. Louis Board of Public Service is well prepared to oversee a project of this magnitude. Most recently, the City has been a partner in TIGER Grant Funding for two projects totaling over $82 million, demonstrating our ability to manage projects of this size and scale. Specifically, the $69 million City+Arch+River 2015 project received $20 million in TIGER grants and is currently under construction. The new $13 million MetroLink Cortex Station received $10.3 million in TIGER grants and is currently under design.

The City has managed other projects of similar magnitude. The City completed a $20 million project completing major upgrades to the Municipal River Terminal as a part of a $16.5 million Department of Commerce grant. In addition to these efforts, the City recently oversaw the design and construction of a new ARRA funded downtown access point from I-70 to Tucker/12th Street, in conjunction with the Stan Musial Veterans Memorial Bridge over the Mississippi River. Our experience on projects this size, demonstrates our high level of capacity to complete the Smart City Challenge.

Tucker Boulevard

The City of St. Louis has engaged a wide range of stakeholders and community leaders in developing our concept for the Model Smart City. We understand a robust and efficient transportation system involves collaboration and coordination between many key individuals. Our Model Smart City Project involves collaboration with:

- *The City of St. Louis* – Mayor's Office, Board of Public Service, Street Department, Planning and Urban Design Agency, Port Authority, and St. Louis Metropolitan Police Department;
- *Missouri and Illinois Departments of Transportation*;
- *Bi-State Development Transit Agency (aka* Metro);
- *St. Louis Regional Freight District*;
- *St. Louis County* - Transportation and Planning Departments;
- *Great Rivers Greenway (Regional Parks & Trails District)*;
- *East – West Gateway Council of Governments (MPO)*;
- *St. Louis Economic Development Agencies* – St. Louis Development Corporation, St. Louis Economic Development Partnership, and DowntownSTL;
- *Innovation Communities* – Cortex and TRex;
- *University Partners* – Washington University at St. Louis, St. Louis University, University of Missouri at Columbia, Southern Illinois University at Edwardsville, and Southern Illinois University at Carbondale

Project Corridor

Our project area is a strong business corridor that starts at the Gateway Arch, including the downtown T-Rex Innovation Hub, and stretches west through the Central West End, the Cortex Innovation Community and to Forest Park. This includes a wide mix of demographics, multiple regional attractions and destinations, and major employment hubs for the St. Louis Region. It also reaches into the St. Louis HUD designated Promise Zone, providing a connection from this underserved area to opportunity. Connecting these diverse areas connects People and Opportunity.

Downtown

Downtown St. Louis has seen major investment and job creation in recent years. The efforts of local leaders and economic development organizations, including Downtown STL, have led to building rehabilitation for housing units (market rate and affordable), new corporate investment and job centers, and the continued growth in vibrancy and enhanced sense of place for the neighborhood. For example, Washington Ave was named a national Great Street by APA in 2011. Downtown St. Louis is home to about 86,500 employees and has 92% of residential units occupied (2014). The T-Rex hub attracts innovation to downtown, and serves as a co-working space and technology incubator. In addition to a strong workforce and resident population, Downtown St. Louis is home to regional recreation, tourism, and sporting activities including the St. Louis Cardinals Baseball, Blues Hockey, the Gateway Arch, the St. Louis Convention Center, Union Station, and a mix of other theaters and restaurants.

Central West End/Cortex

The Central West End (CWE) neighborhood and Cortex Innovation Community provide access to jobs, education, healthcare and recreation and are located just 5 miles west of the Downtown. The CWE is a busy, mixed-use district located near the popular destination, Forest Park. The neighborhood is walkable, vibrant, and filled with a variety of cultural institutions and St. Louis destinations. Designated as one of the top ten great neighborhoods by APA in 2014, this unique and eclectic environment boasts a strong residential population and opportunity for jobs and entertainment. Located just south of the CWE is the Cortex Innovation Community (CIC), which is home to a vibrant 200-acre hub and technology district. Cortex was formed in 2012 to capture commercial benefits of corporate partnership and research. The result is a successful community, with a master plan for development and new MetroLink station funded through the TIGER Program.

The Promise Zone

Neighborhoods within the City limits north of Delmar Boulevard, stretching into St. Louis County, have been identified by HUD as one of the eight promise zone locations in the United States. This area of the city is vastly different from the jobs center and recreational district identified by the other two destinations within the project area. These parts of St. Louis are the hard-hit areas of the city that were impacted extensively by suburban sprawl, years of disinvestment, and community neglect. St. Louis and the federal government 'promise' to rebuild these communities for a sustainable and equitable future, in part, with this Smart Cities Challenge.

Connecting people and opportunity

PROJECT LOCATIONS

99 = #99 Bus Route - Projects **4,6,10**
 - Connected Traffic Signals
 - Smart LED Street Lights

74 = #74 Bus Route - Projects **4,6,11**
 - Connected Traffic Signals
 - Smart LED Street Lights

■ ■ = Phase 1 Bike Share Program - Project **12**

━━━ = Connected Bike Route - Projects **4,6,13**
 - Connected Traffic Signals
 - Smart LED Street Lights

━━━ = Priority Roadways - Projects **4,6,8,9,14**
 - Connected Traffic Signals
 - Smart LED Street Lights

PROPOSED SMART CITY CHALLENGE PROJECTS

Smart Data Systems
1. Transportation Data Fusion Center
2. Regional Travel App Development
3. Regional Transportation Dashboard
4. Smart LED Street Lights with Sensors
5. Smart Parking System

Connected Vehicles - Safety/Security
6. Connected Traffic Signals
7. Connected Vehicle Deployment
8. Smart Winter Weather System
9. Smart Road Maintenance Systems

Smart Transit and Bicycle Systems
10. Self-Driving Downtown Trolley (Route 99)
11. Connected Bus Route (Route 74)
12. Connected Bike Share Program
13. Connected Bike Route
14. Smart Wayfinding
15. Form Based Code Overlay Districts

St. Louis Promise Zone with #74 Bus Route

METRO NORTH COUNTY TRANSFER STATION

METRO CIVIC CENTER TRANSFER STATION

PUBLIC VENUES
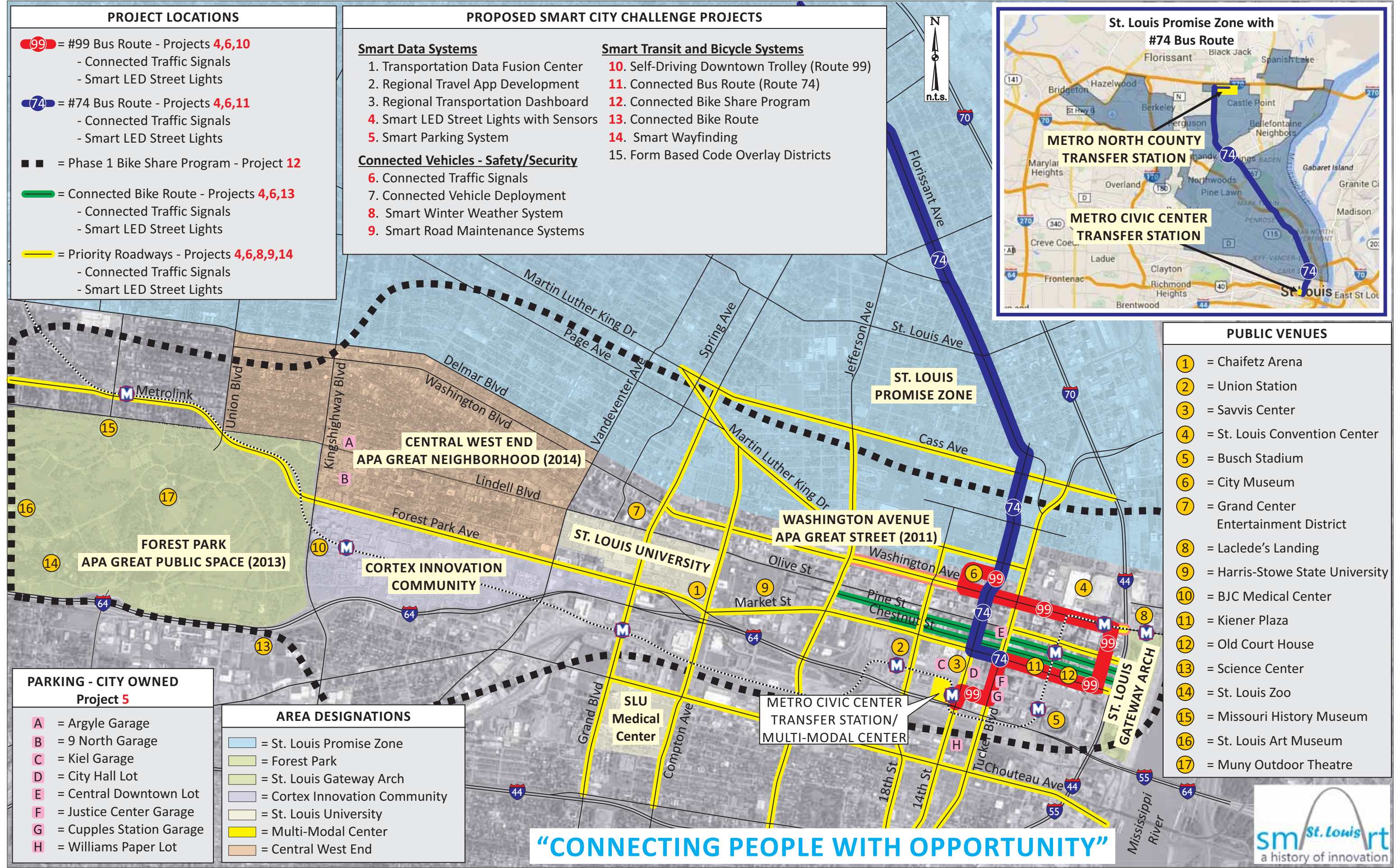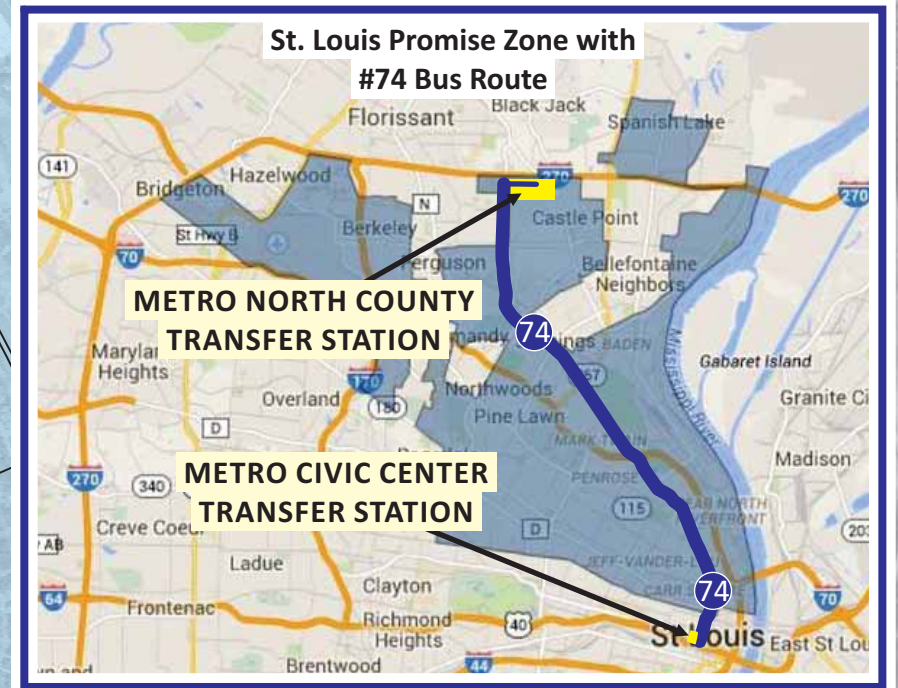
1 = Chaifetz Arena
2 = Union Station
3 = Savvis Center
4 = St. Louis Convention Center
5 = Busch Stadium
6 = City Museum
7 = Grand Center Entertainment District
8 = Laclede's Landing
9 = Harris-Stowe State University
10 = BJC Medical Center
11 = Kiener Plaza
12 = Old Court House
13 = Science Center
14 = St. Louis Zoo
15 = Missouri History Museum
16 = St. Louis Art Museum
17 = Muny Outdoor Theatre

PARKING - CITY OWNED
Project 5

A = Argyle Garage
B = 9 North Garage
C = Kiel Garage
D = City Hall Lot
E = Central Downtown Lot
F = Justice Center Garage
G = Cupples Station Garage
H = Williams Paper Lot

AREA DESIGNATIONS

= St. Louis Promise Zone
= Forest Park
= St. Louis Gateway Arch
= Cortex Innovation Community
= St. Louis University
= Multi-Modal Center
= Central West End

ST. LOUIS PROMISE ZONE

CENTRAL WEST END APA GREAT NEIGHBORHOOD (2014)

FOREST PARK APA GREAT PUBLIC SPACE (2013)

CORTEX INNOVATION COMMUNITY

ST. LOUIS UNIVERSITY

WASHINGTON AVENUE APA GREAT STREET (2011)

SLU Medical Center

METRO CIVIC CENTER TRANSFER STATION/ MULTI-MODAL CENTER

ST. LOUIS GATEWAY ARCH

"CONNECTING PEOPLE WITH OPPORTUNITY"

smArt St. Louis — a history of innovation

Approach – Project Matrix

	Implementing Agency	Urban Automation	Connected Vehicles	Intelligent Sensor Based Infrastructure	Urban Analytics	User-Focused Mobility Services and Choices	Urban Delivery and Logistics	Strategic Business Models and Partnering Opportunities	Smart Grid, Roadway Electrification, and Electric Vehicles	Connected, Involved Citizens	Architecture and Standards	Low-Cost, Efficient, Secure, and Resilient Information and Communications Technology	Smart Land Use
Smart Data Systems for Mobility				X	X	X	X	X		X	X	X	X
1. Regional Transportation Data Fusion Center	East West Gateway			X	X	X	X	X	X	X	X	X	
2. Regional Travel App Development	Private Market			X		X	X	X		X	X	X	X
3. Regional Transportation Dashboard	Partner Agencies			X	X	X	X	X		X	X		
4. Smart LED Lights with Sensors	City of St. Louis			X	X	X	X	X		X	X	X	
5. Smart Parking System	City of St. Louis			X	X	X		X	X	X	X	X	
Connected Vehicles for Safety			X	X	X	X	X	X		X	X	X	
6. Connected-Vehicle Traffic Signals	City of St. Louis/MoDOT		X	X							X	X	
7. Connected Vehicles	City of St. Louis/MoDOT		X	X	X	X		X			X	X	
8. Winter Road Condition Information	City of St. Louis/MoDOT		X	X	X	X	X			X	X	X	
9. Road Maintenance Monitoring	City of St. Louis/MoDOT		X	X	X	X	X			X	X	X	
Smart Transit and Sustainability		X	X	X	X	X		X	X	X	X	X	X
10. Self Driving Downtown Trolley	BSDA (Metro)	X	X	X	X	X		X	X	X	X	X	
11. Connected Bus Route	BSDA (Metro)		X	X	X	X		X	X	X	X	X	
12. Connected Bike Share Program	Regional Partnership		X	X	X	X		X		X	X	X	X
13. Connected Bicycle Facility	City of St. Louis		X	X	X	X		X		X	X	X	X
14. Smart Wayfinding	City of St. Louis			X		X		X		X	X	X	
15. Form Based Code Overlay Districts	City of St. Louis				X	X				X			X

sm(A)rt St. Louis
a history of innovation

Program Area 1: Smart Data Systems

Currently, multiple agencies in the St. Louis region collect data on separate systems. MoDOT, the City of St. Louis, Metro, and several other agencies run Transportation Operations Centers. For example, MoDOT's Gateway Guide System collects and displays travel information on the regional freeway system as well as many arterial roads. Likewise, Metro offers real time bus information through a web application. St. Louis runs a connected traffic signal system through a Traffic Operations Center co-located with the Real Time Crime Center.

The proposed projects will increase the scope of data collected and make the data publically available. These steps are intended to connect people to opportunity, improve mobility, strengthen resilience, and enhance the livability within the Urban Core. Additionally, these projects allow more efficient management of infrastructure.

Our vision is one that supports a highly-mobile transportation network and connections to opportunities including jobs, education and regional attractions. The proposed Regional Transportation Data Fusion Center will connect multiple data sources from agencies to promote efficient travel by real-time signal optimization, incident detection, emergency response, and inter-agency collaboration. Additionally, real-time traveler information will be made machine readable and publically available, supporting a strong freight movement through this major Midwest port-rail-road hub. Using this Center as the nexus, St. Louis can support a travel app, a transportation dashboard, deploy Smart Street Lights, and a Smart Parking System. These projects are intended to provide smarter mobility, connecting underserved populations to opportunity.

http://www.gatewayguide.com

https://tripplanner.metrostlouis.org
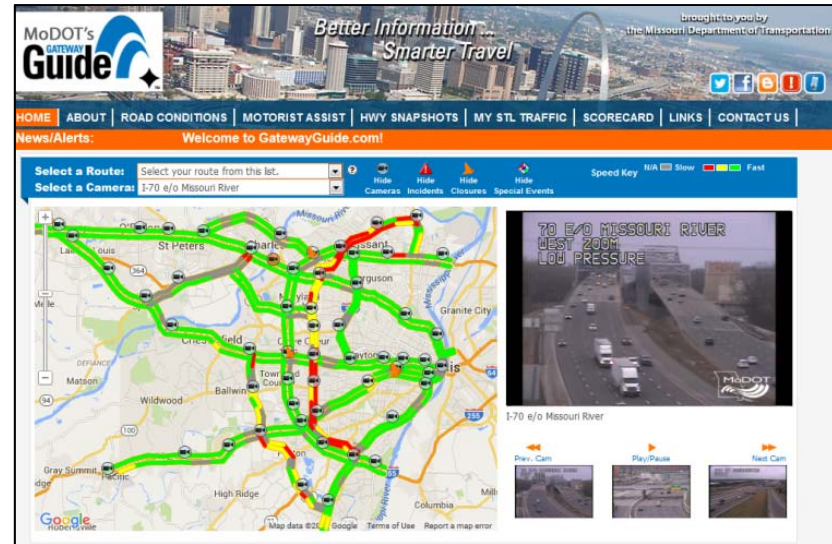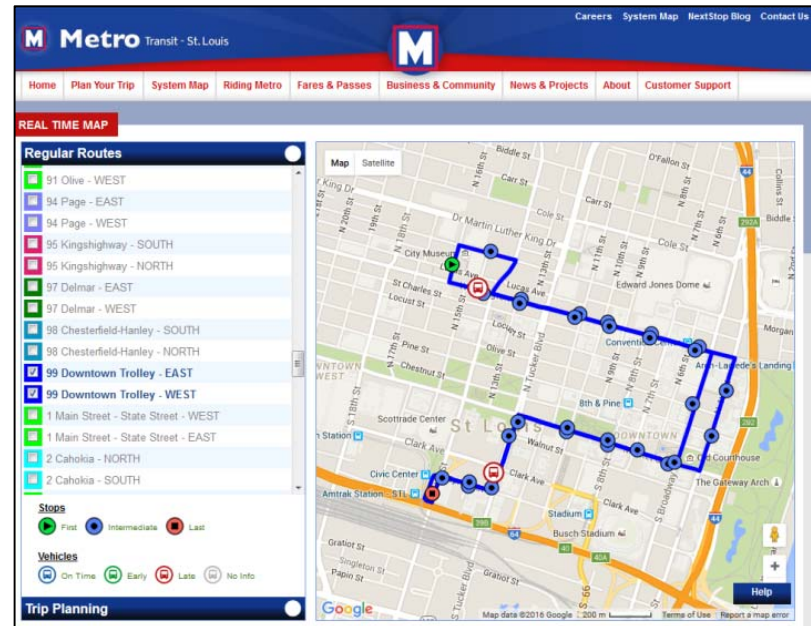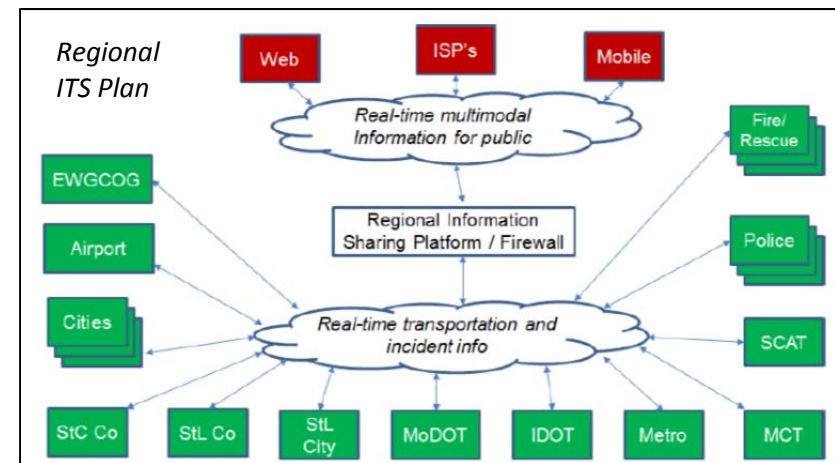
Regional Transportation Data Fusion Center

There is currently no ability for automated sharing of data, other than signal timing, between the City of St. Louis and other agencies. This proposal includes the creation of a Regional Transportation Data Fusion Center. Like a Virtual Transportation Management Center, the proposed Regional Transportation Data Fusion Center would be an unstaffed operation that would monitor, collect, process and fuse transportation system data, increasing the data's value and ability to disseminate between cooperating agencies and outside entities. This center would enable cooperating agencies to better-implement control strategies to react to incidents and emergencies and improve daily operations. It is anticipated that the East West Gateway Council of Governments would host and maintain the Center.

The fusion center would allow each partner to decide what data they would share and with whom when crafting data sharing agreements. For example, the City and Metro may choose to share video feeds for transportation safety and security purposes, but not share those feeds with private operators or the public.

> Creating a Nexus for Mobility Data

As illustrated on the graphic on the following page, it is anticipated that several agencies would be included in the initial deployment including the operator, the East-West Gateway Council of Governments; the City of St. Louis Streets, Traffic, Police, and Parking Operations; Metro; MoDOT and the Missouri State Highway Patrol; and a new regional bike-share operator. Moreover, private operators would likely participate
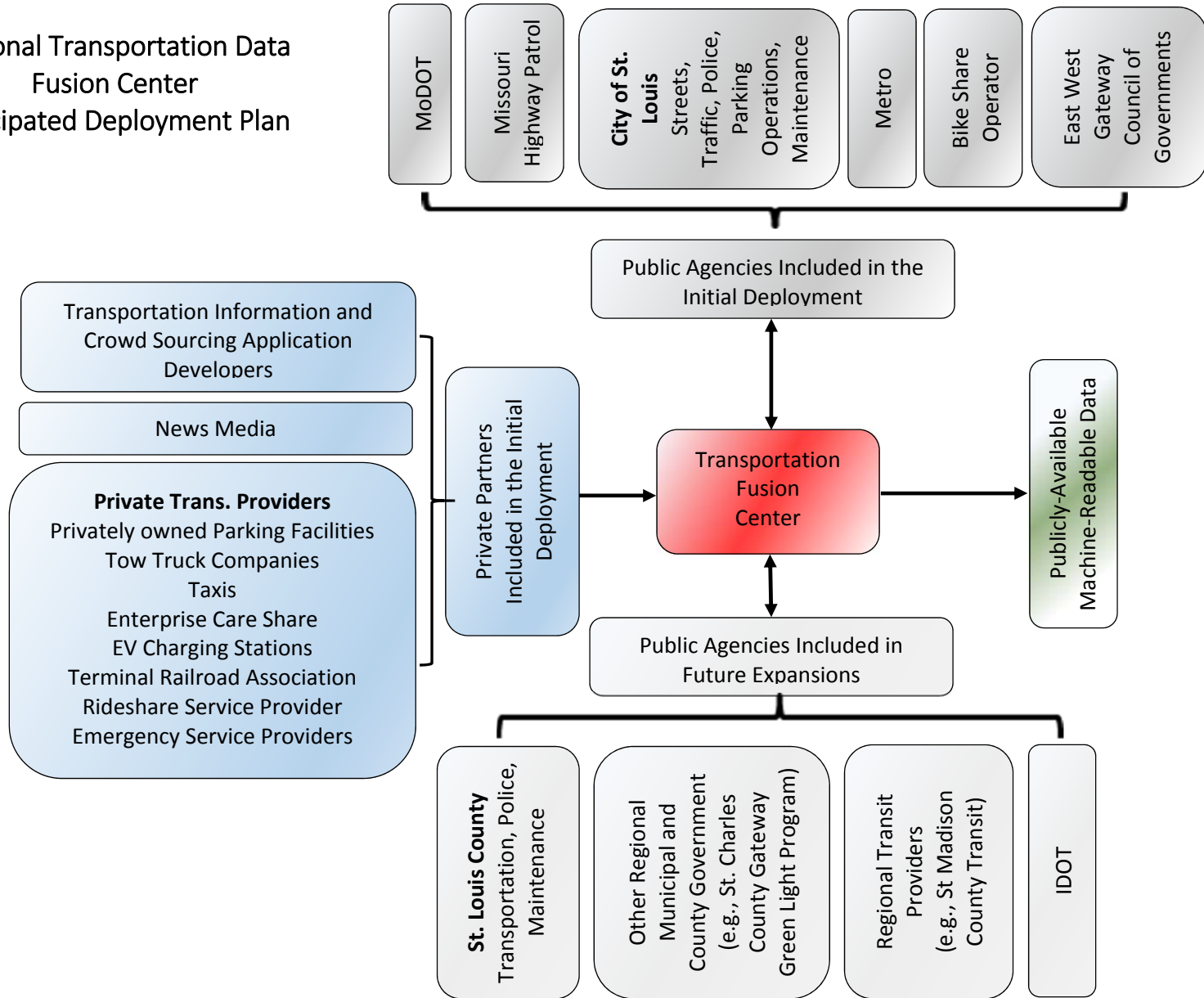
as well. Anticipated private partners include transportation information/crowd-sourcing application developers; news media; and private transportation providers such as privately owned parking facilities, towing companies, taxi and ride sharing companies, electric vehicle charging stations, and ambulance companies. Finally, it is anticipated that other regional public agencies, such as universities and municipal governments, could be included in future expansions.

The Regional Transportation Data Fusion Center would primarily address the vision elements of Intelligent Sensor Based Infrastructure and Urban Analytics through facilitating the sharing of data and User-Focused Mobility Services and Choices through the facilitation of transportation applications.

By facilitating more efficient operations and traveler information the Transportation Data Fusion Center will better connect St. Louis residents, visitors, and businesses to opportunity.

Regional Transportation Data Fusion Center Anticipated Deployment Plan

MoDOT

Missouri Highway Patrol

City of St. Louis Streets, Traffic, Police, Parking Operations, Maintenance

Metro

Bike Share Operator

East West Gateway Council of Governments

Public Agencies Included in the Initial Deployment

Transportation Information and Crowd Sourcing Application Developers

News Media

Private Trans. Providers
Privately owned Parking Facilities
Tow Truck Companies
Taxis
Enterprise Care Share
EV Charging Stations
Terminal Railroad Association
Rideshare Service Provider
Emergency Service Providers

Private Partners Included in the Initial Deployment

Transportation Fusion Center

Publicly-Available Machine-Readable Data

Public Agencies Included in Future Expansions

St. Louis County Transportation, Police, Maintenance

Other Regional Municipal and County Government (e.g., St. Charles County Gateway Green Light Program)

Regional Transit Providers (e.g., St Madison County Transit)

IDOT

sm[Art] St. Louis
a history of innovation

18

Regional Travel App Development

The Regional Transportation Data Fusion Center will provide transportation application developers with access to real-time data. When integrated, this information allows travelers to review and compare travel times and costs for automobile, transit, bus, bike, taxi, car share, rideshare, and walking. This capability would be especially important in downtown St. Louis, where special events are often held at the convention center, sports venues, and other attractions. A regional travel application would help travelers, destined to downtown events, such as Cardinal's baseball games, Blue's hockey games, or other recreational activities, make smart choices about travel modes and parking opportunities. At the same time, such applications could help encourage people to park remotely at a regional park-and-ride lot and take the train into downtown, reducing overall traffic volumes and congestion in the central city as well as regional Greenhouse Gas emissions. Application developers such as RideScout and Google already have partial access to travel data in the St. Louis market, but access to a much fuller data set could be established if St. Louis is selected for this grant. The development of regional travel applications would primarily address the vision elements of Intelligent Sensor Based Infrastructure and User-Focused Mobility Services and Choices, and serve to better connect the everyday commuter as well as the regional tourist.

> Transportation Applications help people make Smart Transportation Decisions

Regional Transportation Dashboard

The development of the Regional Transportation Data Fusion Center will also enhance the collection and processing of data and of transportation performance measures. All of the partner agencies already analyze data to optimize their systems now (e.g., MoDOT Tracker at: modot.org/about/Tracker.htm), but the shared data would help to form a more complete picture of the overall transportation system.

Each participating agency would have the ability to conduct a fuller evaluation of their own performance using this new wealth of data. These metrics will help inform future decisions and plans about the operations of their transportation systems. For example, the City could leverage the Center's data to identify the most congested intersections when prioritizing signal timing projects. The development of a regional transportation dashboard would primarily address the vision elements of Intelligent Sensor Based Infrastructure through facilitating the sharing of available data and Urban Analytics.

Smart LED Lights with Sensors

In order to complement and enhance the data currently being collected, the City would convert street and sidewalk lighting to Smart LED lights with sensor capabilities such as video, light, traffic speeds/counts, pedestrian and bicycle counts, noise, and weather. Smart LED lights are currently available through vendors such as General Electric. This deployment would take advantage of the City's existing 60,000+ street light poles as well as the City's fiber optic backbone. Sensors would enhance the City's ability to provide transportation, law enforcement, and public safety services. They would assist police in their efforts to make the transportation system more secure. Moreover, Smart Street Controllers would be used to maximize the efficiency of the street lighting program. For example, lighting levels may need to be higher on downtown streets during special events, but lower when pedestrian levels decrease. The result of more sophisticated lighting control is a reduction in energy consumption and CO2 emissions. The deployment of Smart LED street and sidewalk lighting would primarily address the vision elements of Intelligent Sensor Based Infrastructure through facilitating the sharing and expanded use of available data and Urban Analytics.

Street lighting depletes a substantial amount of the City's operating budget. Installing and utilizing features of the Smart LED lights would decrease the payback time, so the City would replenish their investment in about six years. Additional costs of manpower and time would be saved by having the ability to monitor the existing infrastructure remotely rather than responding to calls from the public.

Smart LED lights enhance quality of life and *connect* people with their City

Smart Parking System

As identified previously, the City of St. Louis must provide a transportation system that serves the everyday commuter as well as the regional visitor and tourist. Regional attractions include Busch Stadium (MLB), the Scottrade Center (NHL), the St. Louis Convention Center, and Forest Park. The City of St. Louis wants to build upon their existing parking system, strengthen their relation with special event holders, and expand smart parking practices.

The proposed system lets users know when and where parking spots are open

The City would build upon their existing parking system to let users know when and where parking spots are open. People can make better decision about where to park and how to get downtown. The app will also offer patrons the opportunity to reserve spots for certain times, maximizing travel time efficiency, and decrease emissions. Additionally, the City can implement sensors within City garages, as well as surface transportation lots, that in conjunction with enhanced real-time signage, advertises if spots are available and how many. This system will assist for dynamic pricing based on location, with the user closer to the event paying more for convenience. By adding their privately owned spots on the system, the City has the opportunity to implement a parking strategy that creates a smooth transition in the times of increased traffic. This project focuses on intelligent sensor based infrastructure, urban analytics, and user focused mobility and service choices.

Program Area 2: Connected Vehicles

Deploying connected vehicles as a part of this program will improve transportation safety. These deployments are intended to reduce intersection collisions, increase the ability of law enforcement to fight crime, improve winter road condition information, and advance the ability to maintain the pavement on city streets. The infrastructure will also enable private connected vehicles to avoid intersection collisions and improve their efficiency.

With support from this grant, St. Louis will deploy approximately 150 Connected Vehicles: 75 City Police cruisers, 25 City Fire Department vehicles, 30 City maintenance vehicles/snow plows, and 20 MoDOT maintenance vehicles/snow plows stationed in the City. Based on best practices gleaned from this initial deployment, future expansions are envisioned that could include city waste management vehicles.

A safe and efficient transportation network is critical to the health, vitality and economy of a city. Moreover, transportation safety and security are transportation equity issues, as access to opportunity is only realized when all people can travel safely. As a model Smart City, St. Louis will implement several systems that promote safety and accessibility for all users. Autonomous buses and connected vehicles will operate on City streets, reducing crashes due to human errors. Smart technology will disseminate with roadway conditions during inclement weather, promoting smarter traveler decisions and enhancing maintenance operations. Additionally, projects will combine data from multiple sources and agencies in the Regional Transportation Data Fusion Center to identify locations to further-enhance safety and security at public transportation facilities; promoting a robust network for all modes of transportation, and connecting people to opportunity.

> Autonomous buses and connected vehicles will operate on City streets, reducing crashes due to human errors.

As a FHWA Pedestrian Focus City, St. Louis is constantly looking for innovative concepts for improving pedestrian safety. Many of the proposed projects are focused towards deployment in downtown St. Louis where pedestrian safety is a critical need.

> *75 Connected City Police Cruisers*
> *25 City Fire Department Vehicles*
> *30 City Maintenance/Snow Plow*
> *20 MoDOT Maintenance/Snow Plow*

smart St. Louis
a history of innovation

Reducing Intersection Collisions

One of the most impactful Connected Vehicle applications is the Cooperative Intersection Collision Avoidance System (CICAS). Our deployment of this system will addresses the vision element of connected vehicles and its safety performance will be evaluated with crash statistics.

Recent crash statistics indicate that 26% of all crashes occur at signalized intersections (NHTSA, 2011). To reduce intersection collisions, real-time signal timing information will be made available for approximately 150 of the city's busiest signalized intersections. Based on recent crash statistics, police and fire-rescue connected vehicles are of particular interest in regards to intersection collision avoidance. Further, the traveling public with equipped vehicles will benefit from this deployment by reduced crashes, injuries, and fatalities. Overall, a safer city will enhance mobility and connections, and promote a more productive business environment with increased job opportunities.

The CICAS systems in emergency vehicles will be supplemented by a smart signal preemption system. Although traditional signal preemption systems do allow equipped vehicles to interrupt signals at any time, this ability has the ability to be misused. Instead, the proposed smart signal preemption system will leverage the connected vehicle capabilities, logging preemption requests and ignoring those not associated with emergency responses.

> Deployment will occur at 150 of the city's busiest signalized

The CICAS will be based on both sensors on-board vehicles and signal timing information received from roadside devices. On-board systems for collision avoidance are already available from several manufacturers such as General Motors (Cadillac, 2012; Chevy, 2015) and Chrysler. The City expects to purchase fleet vehicles already equipped with CICAS, then have connected vehicle systems installed.

To disseminate the signal timing information, the City will install Designated Short Range Communication (DSRC) devices at approximately 150 traffic signals, transmitting Signal Phase and Timing (SPaT) information at the 5.9 GHz range. The same information from an additional 25 signals will be available online through the proposed Regional Transportation Data Fusion Center. The intersections providing SPaT information through DSRC will represent a distributed method of providing information to connected vehicles and the information provided through the fusion center will exemplify a centralized version of this capability. Local universities, as identified previously, will partner with the City to compare the performance of the two approaches to making SPaT information publically available. The findings of this deployment and its evaluation can help guide continued expansion in St. Louis as well as deployments in other cities.

Further expanding the impact of the connected vehicle infrastructure, the City of St. Louis plans to work with the established Enterprise car sharing program, to phase connected electric vehicles, and the CICAS system, into their downtown fleet.

Improve Winter Road Condition Information

Improving winter road conditions, particularly during snow and ice storms, can lead to better decision by travelers. This implementation addresses the vision elements of connected vehicles, user-focused mobility services and choices, and intelligent, sensor-based infrastructure. The success of this project towards improving safety during winter storms could be evaluated using crash statistics and the penetration rate of the information to the public.

This project will leverage the communication capabilities of connected City and MoDOT maintenance vehicles to provide real-time images of road conditions and, during winter storms, plow locations. Following best practices identified by the Iowa DOT's "Plow Cams" project (Iowa DOT, 2014), the proposed system would use vehicle-mounted cameras to take pictures of winter road conditions at set intervals in time and space. These images can be communicated using DSRC to equipped City traffic signals. The information will flow back to the Regional Transportation Data Fusion Center and made publicly available.

Those planning to travel during winter storms could revise their plans based on real-time information and images of road conditions and predictions of the next plow vehicle for each road segment. Providing this information in a machine-readable format can support the sharing economy by encouraging app developers, to dynamically route traffic based on the clearest routes. Additionally, the freight and delivery industries could leverage this information to improve their efficiency during winter storms.

Advance the Ability to Maintain Roads

The goal of this project is to leverage the City's fleet of connected vehicles to collect information about pavement quality. More specifically, accelerometers on connected vehicles will be used to measure and record the roughness of city streets and identify the presence of pot holes. This implementation addresses the vision elements of connected vehicles, urban analytics, and intelligent, sensor-based infrastructure. Performance measurement should focus on efficiency and sustainability; evaluating if real-time information can improve management efficiency and prioritization, and, in the long-term, result in longer design life.

Accelerometers will find pot holes.

Because of limited budgets, pavement maintenance remains a challenge for many municipalities. If untreated, small holes inevitably enlarge and eventually require the reconstruction of whole sections of street. This project will enable a smarter way to identify, map, and continually update the pavement quality on the roads traveled by the City's vehicle fleet. In addition, partnerships with app developers such as Waze (Waze, 2015) can also provide a more user friendly way for travelers to avoid poor roads or report potholes; crowd sourcing this data and further integrating with the sharing economy.

With the proposed enhancements, the City's fleet vehicles can become the eyes and ears of an integrated information collection effort. These systems can prevent crashes, help motorists avoid snow-covered streets, and continuously update the City about pavement conditions.

Program Area 3: Smart Transit & Sustainability

As part of the proposed work, the City of St. Louis will complete several innovative projects to make it easier for people to take transit, walk, and bicycle. These projects include implementing autonomous battery-electric buses, implementing connected transit vehicles along a key route, deploying a connected bicycle sharing pilot program, improving downtown wayfinding, and expanding their form-based code overlays. Overall, these projects are intended to address the challenges of increasing transit ridership, reducing transit operating costs, reducing crime rates, reducing air pollution, improving traffic signal coordination for bicycle users, enhancing way finding for visitors, and codifying transit-friendly development. The following subsections describe these activities in more detail.

Addressing Climate Change

The St. Louis Smart Cities vision includes the three pillars of sustainability: environment, society, and economy. Our vision addresses environment regarding both protecting it and responding to climate changes. Social sustainability is considered by connecting underserved St. Louis communities with better transportation alternatives, particularly those in the Promise Zone. Last, we consider sustainability as solutions that can address the first two categories while still providing economic vitality.

The City understands the transportation industry is the second largest contributor to Green House gas emissions in our Country. By making a system that is cleaner, more efficient and safer, the Smart City has the opportunity to contribute immensely to our Country. St. Louis will use information from the Regional Transportation Data Fusion Center as well as from connected vehicles, to promote efficiency, a multi modal system and support the goal of addressing climate change by planning a better transportation network for the future.

As a model City, St. Louis will develop a transportation model that is safer, more mobile, and more sustainable for the future generations. Our Midwest location, mixed with new opportunity and innovation, create an atmosphere that will allow this investment to thrive, not only in St. Louis, but throughout the United States as our transportation system continues to transform.

St. Louis will connect people and opportunity by providing a greater range of Smart and Sustainable travel choices.

Autonomous Battery-Electric Connected Buses

Deploying autonomous battery-electric buses along a downtown route is intended to address the key challenges of increasing transit ridership, reducing transit operating costs, and improving air quality. This project addresses the vision elements of urban automation, electric vehicles, and connected vehicles. Performance measurement will focus on safety, transit operating efficiency, user satisfaction, and emissions. The #99 Downtown Trolley Route serves locations where high activity and frequent special events create high ridership for mass transit. These include the St. Louis Gateway Arch; Busch Stadium, Scottrade Center, America's Center Convention Complex, City Museum, and numerous hotels and restaurants. The #99 Downtown Trolley also connects to Amtrak train and Greyhound bus terminals, via the Civic Center Station; Saint Louis City Hall, the Saint Louis Historical Old Courthouse, among others (Metro, 2014). This is a regionally "Marketed" route and thus will be easy for people to identify. It will be easy for St. Louis visitors to access.

> Automated busses reduce transit operating costs, ultimately allowing expanded service.

This route remains on low-speed roads, with a limit of 25 miles-per-hour and a length of approximately 5 miles. To support the operation of these autonomous battery-electric connected buses, plug-in or catenary charging services will be installed at the Civic Center Station. Metro plans to begin reconstruction of this station in 2016 with planned completion in 2017.

Because of the Civic Center Station reconstruction and existing fiber-optic communication link to Metro operations, it was chosen as the hub for future autonomous battery-electric connected buses in downtown St. Louis.

Metro has shown dedicated efforts to the efficient maintenance of their vehicle fleet and has recently been nationally recognized for these efforts. Battery-electric buses are of particular interest because of the expected reduction in maintenance costs.   Initial deployments are proposed to include 3 buses serving the Downtown Trolley route.
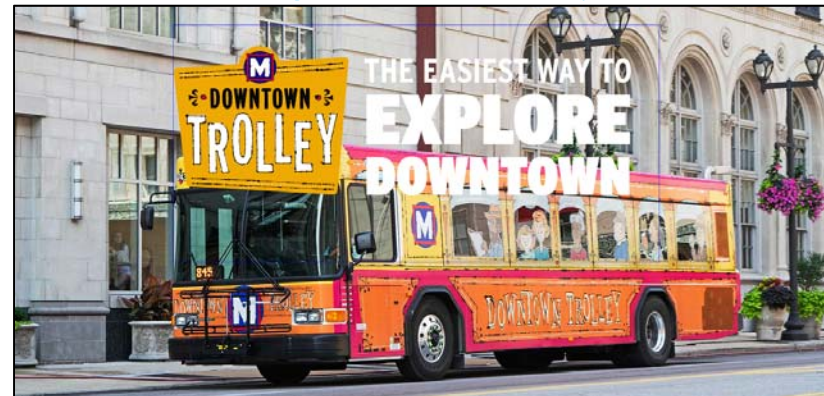
This proposal suggests a phased Level 3 automation deployment along the #99 Downtown Trolley route, eventually accounting for 50% of service. This project will help innovatively solve the critical issues of increasing transit ridership, reducing transit operating costs, and reducing air pollution.

> 3 Connected Busses serving the #99 Downtown Trolley Route

Connected Buses

A second Smart Transit project is a connected bus system along Metro's #74 West Florissant Route. This route is 25 miles round trip with frequent traffic signals under the jurisdiction of the City of St. Louis, St. Louis County, and MoDOT. #74 is one of the most heavily used routes in the Metro system. Based on the high ridership, Route #74 has already been identified as a future Bus Rapid Transit (BRT) corridor (Bi-State Development Agency, 2015) and is included in the region's transportation improvement program. It was selected as a Smart Cities demonstration project because it connects underserved communities to opportunity and it has the ability to leverage ongoing work and potential funding sources. This implementation primarily addresses the vision elements of connected vehicles. The performance of this project should be evaluated for efficiency and climate change. Metrics could include reduced travel time, safety, transit efficiency, rider satisfaction, and emissions.

Route #74 serves many in the HUD Promise Zone

Route #74 Florissant currently serves many citizens in St. Louis' promise zone, connecting them directly to jobs in downtown St. Louis. Specifically, this route serves patrons in Ferguson and Old North St. Louis. The nation has become aware of the struggles faced by those living in and around the City of Ferguson throughout the past two years. Route #74 also serves citizens in Old North St. Louis' Murphy Blair Historic District. In addition to being located within the HUD designated area, this section of the city has struggled for generations.

Connected bus equipment along Route #74 will benefit existing patrons as well as the future BRT line. Operationally, these vehicles are intended to connect with traffic signal infrastructure to obtain priority along their route, place pedestrian crossing calls, and to provide updated security images. In contrast to existing transit signal priority systems that use optical communication spectrums, the proposed project intends to leverage DSRC to allow buses to communicate with traffic signals. Buses would report position and speed information to nearby signals, allowing appropriate response by signal controllers.

This project includes communication with traffic signals adjacent to bus stops to enhance pedestrian safety. If a bus intends to stop, it will automatically actuate the pedestrian crossing calls at nearby traffic signals. Thus, passengers will have pedestrian calls waiting for them, and safer crossing can be encouraged. Busses would also actuate flashing beacons at mid-block stops, when available. Otherwise, the bus would only request priority through approaching signalized intersections.

Actuated transit signals = Enhanced Safety

The #74 Route was selected based on the connecting people with opportunity and the ability to leverage other potential funding sources. This project seeks to address three key challenges: increasing transit ridership, improving pedestrian safety, and improving public safety.

smart St. Louis
a history of innovation

Regional Bike Share Program

This project would fund Phase 1 of the Great River's Greenway proposed Bike Share program. Based on experience from other cities, an initial deployment of **500 bikes** is proposed to attract those with shorter trips in downtown and throughout the central business corridor.

The bike share program could solicit interest from visiting tourists, workers during lunch breaks, or those interested in exercise. It could also **provide for basic transportation for those who live and work downtown and provide the "last mile" for those wishing to take transit** instead of driving into downtown.

All bicycles will all be equipped with transponders readable along the proposed bicycle signal priority routes and be outfitted for the connected vehicle demonstration.
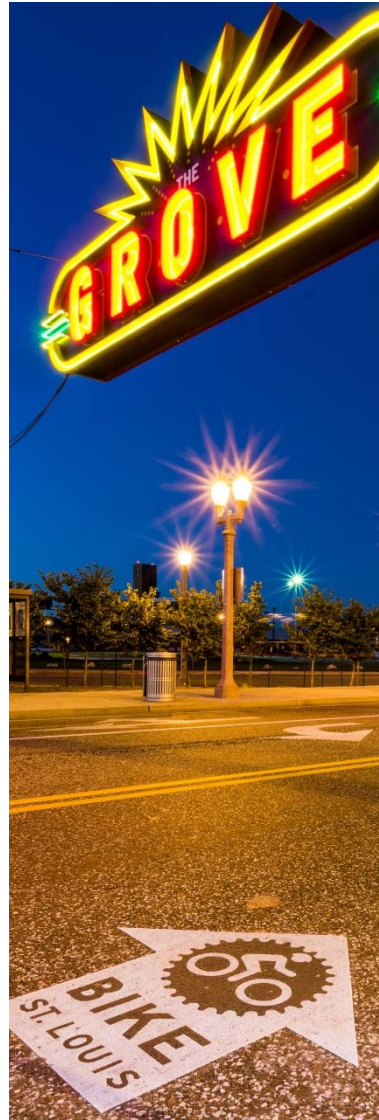
Connected Bicycle Corridor

St. Louis will implement a connected bicycle corridor to **innovatively improve signal coordination for cyclists**. This implementation addresses the vision elements of connected vehicles; intelligent, sensor-based infrastructure; and user-focused mobility services and choices. Performance measures include the number of connected bicycles using the system and their decrease in travel time along the connected bicycle corridor.

Protected Chestnut Bike Lane

Pine and Chestnut Streets are primary bike routes in and out of downtown. However, the network of traffic signals and their timing causes cyclists to stop each block because of the direction of green rest. Particularly during off-peak hours, a Smart system could reduce the need for cyclists to frequently stop at traffic signals. To address these two issues and promote bicycling, this project would **create a bicycle signal priority system** on these routes.

The bicycle signal priority system will identify smart bikes from cyclists with transponders or from bicycles from the proposed bike share program. With this grant, citizens can apply for the transponders. On the roadside, traffic signal infrastructure will be able to detect approaching cyclists and provide an expedited green signal. The vision is to **connect citizens with an efficient bike commute**, or sight-see via bicycle along this corridor. It is proposed that these signals will also be included in those upgraded to communicate with connected vehicles.

Smart Wayfinding

A smart wayfinding system will encourage the use of all Smart Cities infrastructure by ensuring users are informed about the transportation alternatives available. This system will include electronically-updated kiosks throughout downtown and at transit stops in the promise zone. Information can include 3-dimensional maps of the area, locations of key destinations, estimated walking times, and transportation alternatives. The proposed wayfinding system builds on shared information from the public and private sector, and can be continually updated.

Real time travel kiosks CONNECT transit users throughout downtown and at Promise Zone transit stops

Wayfinding information will also be available online, accessible through smart phones and other computing devices. As usage patterns emerge, maps can be focused towards those features of most interest to better connect users.

This project will support the vision elements of user-focused mobility services; connected involved citizens; and smart land use. Specifically, smarter wayfinding is expected to reduce personal vehicle use for short trips, overcoming barriers to walking and transit use by providing localized information and improving confidence about the trip's "last mile". These shifts can improve people's local knowledge, health, and community pride. Performance of this project can be evaluated by tracking the use and mode split over time.

Form Based Code Overlay Districts

Finally, there are many zoning practices that can be implemented to reinforce a sustainable transportation system and address climate change. Current ordinances include a Form-Based District (FBD) that is intended to enhance the vibrancy and atmosphere of a neighborhood/commercial corridor by providing a cohesive urban form. These districts promote dense, mixed-use, walkable, vibrant and connected neighborhoods that encourage residents to get out of their car and enjoy the neighborhood at the pedestrian scale, and are in line with the City's Pedestrian Safety Action Plan. Encouraging this type of development promotes more access to transit, better walking and bicycling infrastructure, and a strong sense of place which will enhance safety and activity.

Form-Based Districts promote dense, mixed-use, walkable, vibrant and CONNECTED neighborhoods

The City of St. Louis was built on a dense grid system and currently has many vacant lots ripe for redevelopment. As a part of the Smart City Challenge, we will advocate implementing new FBDs in support of transit oriented development – particularly near the Downtown Core. These overlay districts help to optimize the land use within the area and ensures our transportation system supports the City's neighborhoods by connecting residents to opportunities. By using FBDs in conjunction with our current bike parking and complete streets ordinance, we can promote strong communities where living a car-optional lifestyle can become a reality.

Outcomes

Performance Measures

Each of the previously-described projects will be evaluated to gauge their performance in at least one of five categories, including mobility, safety, efficiency, sustainability, and climate change. The findings can support best deployment practices in other cities.

	Mobility	Safety	Efficiency	Sustainability	Climate Change
Smart Data Systems					
1. Data Fusion Center	X		X		
2. Travel App Development	X	X	X	X	
3. Transportation Dashboard		X	X	X	
4. Smart LED Lights		X	X	X	X
5. Smart Parking System	X		X	X	X
Connected Vehicles					
6. Connected Traffic Signals	X	X	X		
7. Connected Vehicles	X	X	X		
8. Winter Road Information	X	X	X		
9. Road Maintenance			X	X	
Smarter Transit and Bicycling					
10. Autonomous Bus		X			X
11. Connected Buses			X		X
12. Bike Share Program	X		X	X	X
13. Connected Bike Route	X		X		
14. Smart Wayfinding	X			X	
15. Form Based Code	X			X	X

Risks and Mitigations

The legal issues related to the use of technologies in a smart city are complex because they originate from diverse legal areas, levels of government, and agencies. The technical risks could include autonomous vehicle crashes and cybersecurity of the Fusion Center. To prevent autonomous bus crashes, deployments will include an extensive trial period with drivers still present to take control during an emergency. Cyber security risks could be addressed with tools such as fire walls, 128-bit encryption, and requirements for strong passwords.

Policy risks could include connected vehicle legislation as well as data collection and sharing agreements between stakeholders. The City is prepared to work with the USDOT to obtain required approvals for the proposed connected vehicle deployment. The background work done while creating this proposal has mitigated many of the data sharing risks, but policies or driver consent are required for addressing privacy of connected vehicle drivers.

There also exist certain institutional risks to deploying the infrastructure described. First, tort liability risks are significant with collision avoidance maneuvers of connected City vehicles. Similar crash risks are present with the proposed autonomous buses. Mitigating efforts might limit the speed of these vehicles and/or require agencies to purchase additional insurance coverage for these operations. Additionally, data security should be addressed prior to launching the Fusion Center to mitigate risks of disclosure. Both data and physical security should be considered at the design-level for roadside equipment.

The St. Louis Experience

As your plane touches down at St. Louis Lambert International Airport, you are excited about the journey you are about to embark on. You have finally arrived to explore the Gateway to the West and have a list full of activities, adventures and explorations planned for your 48-hours in the City. From attending a St. Louis Cardinals game, travelling to the top of the arch, taking a stroll in Forest Park, you know these activities will be enjoyable and memorable. But, first you must think about your transportation.

Accessing St. Louis' Smart Cities data is easy and you choose to take the Blue MetroLink rail line and head toward the heart of the City – Downtown. This public transportation experience is your first memory for the City of St. Louis. As you depart the Metrolink at the Downtown Convention Center stop you are immersed in the heart of the City. You take a nice long walk to get the flavor of the City and Downtown St. Louis and asking native residents what the 'must see and do' attractions are. Finally settling in back at the hotel you plan the next day's journey.

The next day, you follow smart wayfinding stations towards the Gateway Arch, check out a bike from the Bikeshare program,

and enjoy the first-of-its-kind bicycle signal priority. You ride an autonomous electric bus to a Cardinals game and finish your day having dinner in Forest Park. Your last day in town, you take Metro bus route #74 to Florissant to meet an old friend for lunch, buy some souvenirs, and head for home; excited to apply what you have learned in St. Louis.

Moving St. Louis Forward

St. Louis provides a unique opportunity for the Smart Cities Challenge that no other mid-size cities offer. Our history is full of transportation firsts; our transportation system is a convergence of water, rail, and road freight; and our downtown project locations provide direct opportunities for those in a HUD Promise Zone.

The existing transportation infrastructure in St. Louis is the ideal framework for demonstrating integration of smart city applications. The present level of ITS investment provides the groundwork to support such an endeavor, and can provide a clear evaluation of the impacts of the proposed Smart Cities projects. While known as the Gateway to the West, this Smart Cities Challenge will reinvent St. Louis to become the Gateway to Smart Urban Transportation. St. Louis is ready and eager to once-again lead the nation in transportation innovation.