

PROPOSAL FOR

Beyond Traffic: The Smart City Challenge

Funding Opportunity Number DTFH6116RA00002

Part I—Vision Narrative

U.S. Department of Transportation

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Submitted by

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February 4, 2016

The Honorable Anthony Foxx
Secretary, United States Department of Transportation (USDOT)
1200 New Jersey Avenue, SE
Washington, D.C. 20590

Secretary Foxx:

Today, the City of Las Vegas, spurred by increased demand on our transportation infrastructure by an expanding diverse population, stands at the threshold of a **safer, more efficient, sustainable, and environmentally sound mobility** revolution. In this context, the City is seeking to partner with the USDOT on its Smart City Challenge Grant initiative. No other mid-sized city makes transportation work for a broader cross section of travelers. No other city serves as a better platform for developing policies, celebrating successes, and broadcasting them worldwide.

Las Vegas, with over 22,000 events and over 5 million attendees, has long been the stage for showcasing innovation. As the host community for such events as the Consumer Electronics Show and Specialty Equipment Market Association, we have provided the backdrop for rolling out the technologies that have improved how we live, work, and commute. Building on our ability to showcase technology, several innovative companies such as Faraday Future, Switch, Local Motors, Hyperloop, and Zappos have already established—or are in the process of establishing—offices and manufacturing facilities in the Las Vegas metropolitan area that will further support and diversify our economy.

Innovation is the foundation for the City's future. We will fully leverage our investments in excess of **\$500 million** to become a Smart City. In fact, as part of our Downtown Master Plan, we established resolution R-3-2016 to transform our downtown urban core into an **Innovation District**, focusing **safe, efficient, sustainable, and environmentally conscious** mobility such as autonomous and connected vehicles, establishing a platform for demonstrating innovation and further paving the way to becoming a Smart City.

Through our partnership with the USDOT, we will continue to address our challenges while highlighting innovation as your **Smart City Showcase**. We have assembled a robust team of public, academic, and private sector partners to help us fulfill our commitment and have developed a quantifiable approach that paves the way for success. We applaud your vision to promote innovation and believe Las Vegas can provide the **ideal environment** and a **global stage** to successfully launch this important initiative.

Warmest regards,

Carolyn G. Goodman
Mayor

Elizabeth N. Fretwell
City Manager

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1	Letters of Interest and Support
2	City Resolution to Establish Downtown Las Vegas as an Innovation District





Smart City Vision

As the host of international technology showcase events such as the Consumer Electronics Show (CES) and the Specialty Equipment Market Association (SEMA), Las Vegas is an epicenter for innovation: there is no bigger stage for rolling out and promoting new ideas capitalizing on Las Vegas' world renowned brand. Perhaps because of this, the City has long had a vision for—and is already on its way to becoming—a Smart City.



AV/CV technologies headlined the 2015 CES

Las Vegas (perhaps surprisingly) is not only a perfect match for the United States Department of Transportation's (USDOT) "typical" mid-sized city, it comes with the infrastructure and built-in audience to showcase the Smart City concept to nearly 42 million visitors each year. Couple that with the fact that the City has already invested \$500 million in "smart" infrastructure, having charted a course to become a Smart City by 2025. Las Vegas was the winner of the **"What Works Cities"** in 2015 from Bloomberg Philanthropies for its progressive use of data and evidence to engage the public, improve services, evaluate progress, and fund new innovative programs. By making Las Vegas its partner, the USDOT would capitalize on that investment, and use it as a springboard to take the "Smart City" concept to a whole new level.

Our charter for becoming a full-fledged Smart City is to provide safe, reliable, and efficient transportation that stimulates further economic growth. To achieve that, we will seek to:

- Provide improved interoperability among all of our public service sectors: transportation, energy, public works, facilities, and public safety/law enforcement through open-source data sharing, real-time data analytics, and decision support
- Keep citizens and tourists safe and connected and provide them with a host of transportation choices and an easy way to pay for those services
- Catalyze economic growth through innovative partnerships that showcase technology to progress forward thinking and create fulfilling jobs for our residents
- Enhance freight mobility to bring goods into our city efficiently
- Provide reliable and energy-efficient transportation options that enhance mobility for all people, including low-income and senior populations
- Support continued acceptance and ultimate ubiquity of electric vehicles (EVs) with unlimited access to smarter, more efficient charging capabilities
- Establish a platform that not only showcases transportation technology, but practically applies those technologies (i.e., innovation) to make our infrastructure smarter

Our Smart City will be a place where transportation works seamlessly with all other public service entities and improves the quality of life for all by, each year, giving our more than 500,000 residents, and nearly 42 million tourists and business travelers an experiential demonstration of what it is like to move about and be a part of a Smart City.

Las Vegas, the region, and the state have developed and promoted policies to further mobility. The City has laid over 123 lane-miles of fiber optic cable, which will allow for the implementation of electric and autonomous vehicles and transit throughout

the heavily traveled urban core. The state has an established program to license autonomous vehicles operating on our roadways.

The key to our recent successes in launching advanced technologies and innovation has been our highly supportive, progressive policymakers and legislators. Recently, city resolution R-3-2016 was passed that identifies our downtown urban area as an **Innovation District**. This Innovation District will provide increased visibility to technologies and complement mobility initiatives already underway in the state and the region.



In the coming months, this Innovation District will provide a stage for pioneering new technologies that will demonstrate how American cities can stitch together regions and achieve prosperities of scale through the combination of new, connected infrastructure, responsive urban design, and advances in energy, telecommunications, mobility, and construction.

Nevada was the first state in the country to pass legislation to legalize autonomous vehicle testing, and the City of Las Vegas recently hosted a policy conference on autonomous vehicles, led by Governor Brian Sandoval, the American Association of State Highway and Transportation Officials (AASHTO) and the Nevada Department of Transportation (NDOT). Through all of these initiatives, our policymakers have been the tip of the spear; providing a protected, but progressive, environment for launching innovation.

Las Vegas is a ready-to-go incubator for mobility technologies, autonomous vehicle policy, and revolutionary and innovative technology. By awarding Las Vegas the Smart City Challenge Grant, the USDOT would gain a unique partner that:

- Makes transportation work for a broad cross section of American travelers—from tourists, businesspeople, residents, technology entrepreneurs, and global citizens. Las Vegas serves as a platform for developing policies, celebrating successes, and broadcasting them across a worldwide stage.
- Has invested in its own infrastructure, indexing its fuel tax to inflation and enacting legislation at the state level to build infrastructure for industrial parks, commercial real estate, and economic development.
- Serves as a magnet to transportation and mobility innovators like Faraday Future, Local Motors, GE Transportation, Uber, and Hyperloop Technologies, all of which have operations in Las Vegas

A community of FIRSTS:



Optical Guidance System

Optical Guidance Striping

First community to deploy an autonomous bus (using optical guidance with paint striping detection technology)

One of the top five bus rapid transit (BRT) systems in the country according to Institute for Transportation and Development Policy

One of the few U.S. cities with a whole network of BRT, as opposed to just a single corridor

First state to license autonomous vehicles for testing on our roadways



First state to receive an autonomous test vehicle

We are primed and ready to become the USDOT's partner city. Our challenges and objectives are real, our vision is plausible, our policymakers are supportive and progressive, and our economy is poised to support innovation. As a partner city, we will transform Las Vegas into a "real-time" exposition of USDOT's ideal "Smart City Showcase."



Las Vegas Challenges Measured and Mitigated Through Smart City Innovations

Rapid Growth: *Forbes* recently identified Las Vegas as the third fastest growing city (2015) and the first fastest growing city in the past decade. Given recently announced partnerships with Faraday Future, Zappos, Hyperloop, and Local Motors, Las Vegas will undergo a period of exponential growth in short order. This growth will increase the strain on the current infrastructure, public transit capacity, and public services.

Increased Tourism: The number of Las Vegas tourists is expected to continue to rise as a result of improved marketing strategies, lower fuel costs, and showcasing of innovative technologies. This mass influx of tourists will also increase the strain on the existing infrastructure.

Constant Infrastructure Demand: Given that much of the current economy is based on the service and entertainment industries, many businesses have 24-hour operations. This ingress and egress of employees and goods puts a constant strain on roads and public transportation. Given the projected growth in tourism and residents, 24/7 infrastructure demand will continue to grow.

Increased Demand for Mobility Choices and Equity: Recent surveys have identified that one of residents' key needs is improved mobility choices and equity. Having more demand-driven choices for mobility and reliable transportation choices are challenges we are addressing to both satisfy our resident demands and reduce the impacts on roadways.

Need to Improve Motorist, Pedestrian, and Bicyclist Safety: Increased demand on infrastructure, coupled with expected population growth, has made ensuring the safety of the City's motorists, pedestrians, and bicyclists a challenge. In 2015, Las Vegas had 13,270 total crashes, which resulted in 125 total fatal crashes. In the City of Las Vegas, there were 42 fatal crashes that included pedestrian and bicyclist incidents and fatalities. Given the anticipated growth, additional prevention means are necessary.

Increased Carbon Emissions: Congestion on Las Vegas highways has led to a significant amount of greenhouse gas (GHG) emissions. In 2009, transportation contributed to 8,842,226 tons of carbon dioxide (CO₂) emissions (29.8% of the total emissions for the City). Without active promotion of low-emission vehicles, transit or non-vehicular use, this number is only expected to increase.

Lack of Economic Diversity: Studies rank Las Vegas in the bottom half of the worst cities for economic diversity (183 of 350). While this ranking is expected to improve with the recent influx of innovative companies, the city must seek out infrastructure solutions that will help diminish inequity amongst residents.

By enhancing Las Vegas' infrastructure through Smart City innovation, we expect to deploy solutions that will enhance mobility, reduce congestion, improve resident safety, reduce our carbon footprint, and stimulate economic growth and diversity. The planning tools that stem from improved data sources and analytics in a Smart City will allow us to not only overcome these challenges, but to also proactively mitigate them for many years to come.



Our Approach

We will use technological innovation, data analysis, real-time and predictive modeling, and information transfer to become a truly integrated and connected Smart City by 2025. We will achieve this through a fully connected series of elements that will enhance mobility, improve safety, reduce GHG emissions, and grow the economy while promoting economic diversity and equitability. The architecture of our Smart City is shown in Figure 1.

Through academic, public-public and public-private partnerships, we will integrate data across our public resources. Data collected from these sources (or “probes”) will be used by City staff to conduct proactive and real-time analysis. A Decision Support System (DSS) will assist City managers in evaluating the overall City health and determine what changes need to be made to maximize operations. Building upon our existing investments, we will undertake a series of steps to become a fully integrated Smart City:

Figure 1. City of Las Vegas Smart City USDOT Showcase Architecture



Las Vegas Smart City Roadmap

1. Deploy a series of **innovative projects** that enhance information and communications technologies (ICT) throughout our infrastructure, develop operational concepts, and identify policy and administrative gaps.
2. Establish a **downtown urban environment** that promotes the use of advanced transportation technologies.
3. Establish a fully interoperable, **open-source data sharing platform** among partners.
4. Conduct **predictive analytics** using the data shared among agencies and private partners.
5. Deploy an **automated decision support system** to measure City performance and change operational parameters based on changes in performance indicators.
6. Enhance our existing **City dashboards, websites, and mobile apps** to show real-time City activities and provide real-time status and information to managers and the public.
7. Augment **planning and City improvement activities**, using robust data to better target areas for economic investment, improved resident and tourist safety, and a fully sustainable environment.



To establish the foundation for our Smart City, we must first make our infrastructure smarter, enhancing the connectivity between our services and our citizens. We have identified 11 demonstration projects that will enhance our current infrastructure investments, providing a litany of data for analysis and communications.

With our innovative infrastructure partners, Bosch, Delphi, and Qualcomm and our public partnerships with NDOT, Regional Transportation Commission of Southern Nevada (RTC), and Nevada Energy (NV Energy), we will augment our infrastructure investments with sensors and communications radios (DSRC, Bluetooth, satellite, and 4G cellular). These enhancements will allow us to collect data from project sources, test autonomous and connected vehicles (AV/CV), pedestrians, bicyclists, emergency response vehicles, transit vehicles, charging stations, wayfinding signs, and public works facilities for processing with our real-time and predictive analytics engine.

The heart of our program is the **Smart City Command and Control**, powered by our “Real-time & Predictive Data Analytics Engine.” This engine, developed and maintained by our university partners: (Desert Research Institute [DRI] and the University of Nevada Las Vegas [UNLV]), and commercial data partners: (Bosch, HERE, INRIX, and Ford), will conduct both real-time analytics and collect historical data for use in analytics. The results will allow us to overlay a DSS that will compare the analysis results against key performance indicators (KPIs) to recommend and implement operational changes.

The results from the analytics engine will be a Real-time City Dashboard displayed over a series of dashboards, apps, and websites to our City managers and the general public. We will expand on RTC’s Bugatti dashboard, to make it a Real-time City Dashboard, which will display information across each of Las Vegas’ infrastructure departments. This dashboard will show the current status and “health” of the City, and provide notifications to managers on DSS analytics. Outputs from the Real-time City Dashboard will also be displayed to tourists and members of the public through our City of Las Vegas (CLV) Mobile App, other relevant apps (i.e., ParkMe), Smart Wayfinding Signs, and AV/CV displays.

By deploying these “building blocks” for our Smart City, we will create a robust, flexible, and easily replicated model for other cities, while providing practical solutions that improve the overall efficiency, livability, and sustainability of Las Vegas.

Demonstration Projects

We are proposing 11 demonstration projects which when connected, will culminate in our Smart City Showcase:



Project 1: AV/CV Test Beds – Deploy two AV/CV test beds: one corridor test bed throughout our urban **Innovation District**, and a second offsite test bed to conduct controlled testing



Project 2: Smart Transit Program – Enhance Las Vegas’ public transit choices through on-demand fleet management, automatic trip planning, and an autonomous mass transit vehicle



Project 3: Vehicle to Pedestrian Safety Improvement Project – Connect urban employees throughout the Innovation District (near the new

Zappos Corporate Headquarters) with priority access, and integrated AV and CV collision avoidance systems



Project 4: Downtown Bike Share Safety Project – Deploy technology to 180 Bike Share bicycles throughout our Innovation District to monitor cyclist and

emissions data, synchronize traffic signals, and integrate with AV and CV collision avoidance systems



Project 5: Smart Wayfinding Signage – Deploy smart wayfinding signs integrated with the CLV Mobile App, and the Smart City Command and

Control system to collect interest data and display relevant information to users



Project 6: Downtown Traffic Monitoring & Measurement –

Collect data to monitor real-time traffic congestion, accidents, and emissions; displayed on the Real-time City Dashboard; integrate into Smart City Command and Control to redirect traffic and minimize congestion





Project 7: ParkMe Real-time Parking

– Transmit real-time commercial and freight parking availability (5,200 City-owned spaces and 500 private spaces) to the CLV ParkMe location and reservation app; navigating drivers to available parking



Project 8: Solar Charging & Smart Monitoring

– Install solar-powered smart charging stations that transfer charging information, power efficiency data to the Smart City Command and Control system. Integrate with the ParkMe app to display and automatically route AV and CV test vehicles to available stations



Project 9: Smart Metering for City Streetlights

– Integrate consumption data from 50,000 streetlights and 3,000

power taps into NV Energy's smart meter network and the Smart City Command and Control



Project 10: Advanced Emergency Response Integration

– Integrate first responder CAD/AVL data into the Smart City Command and Control system to monitor emergency vehicle locations and resynchronize traffic signals when preempted during responses



Project 11: City of Las Vegas Fleet AV/CV Conversion

– Retrofit 50 City of Las Vegas fleet vehicles with AV/CV technologies to promote traffic harmonization, reduce carbon emissions, and promote safety for City workers

As illustrated in Figure 2, the City intends to have these 11 projects implemented by the end of 2019.



Figure 2.
Las Vegas
Smart City
USDOT
Showcase
Project
Deployment
Timeline

Leading up to the launch of these projects, the City will undertake fundamental planning, design, procurement, and public outreach activities, including development of the information necessary to finalize our Smart City application (expected

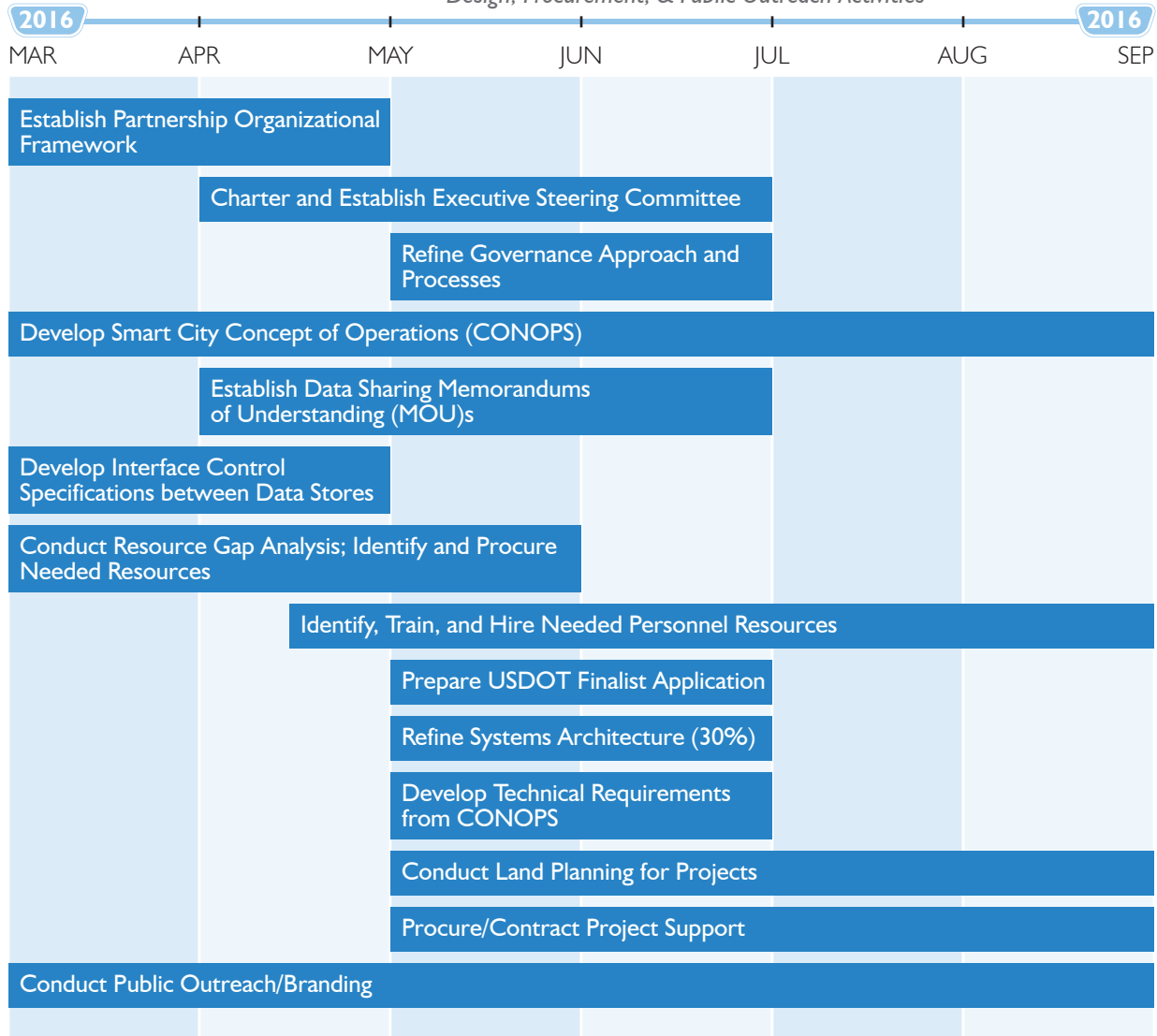
to be March 2016). Figure 3 provides the monthly timeline for these high-level preliminary steps.

Program Management Approach

The City of Las Vegas will serve as the program manager, developing the plans, processes, and policies to guide the successful implementation of these projects. We have a strong history of delivering large-scale, and diverse transportation programs, including over \$412 million in capital improvement projects in 2015.



Figure 3. Timeline for Smart City Preparatory Planning, Design, Procurement, & Public Outreach Activities



Similarly, we've delivered numerous large-scale Federal Transit Administration and Federal Highway Administration-funded projects.

We have a vested interest in this program, given our \$500 million investment to date; and will ensure that both our investment and that of the USDOT is protected and maximized.

We have identified a broad range of partnerships to promote a successful deployment. The City, in conjunction with our core partners, will serve as the lead agency responsible for program management and implementation, with support from public, private, and university partners. City staff will undertake and oversee all Smart City projects,

including the design, planning, procurement, and deployment of the showcase elements.

RTC is the region's metropolitan planning organization overseeing public transportation (RTC Transit system), traffic management system (Freeway and Arterial System of Transportation [FAST]), roadway design, construction funding, and transportation planning for southern Nevada. RTC is a committed partner that will offer expertise in the areas of public transportation/transit and traffic management.

FAST staff will be partners in the deployment of Smart technologies at the traffic signals, including the display of real-time traffic data on its award-



winning FAST Dashboard (Performance Monitoring & Measurement System), termed “Bugatti.” The dashboard provides an intuitive web-based user interface to enable the public to view real-time and historical freeway data. RTC staff are committed to incorporating the data collected through the Smart City Showcase elements into Bugatti and making the information available to the public.

NV Energy will be our core partner in integrating its Smart Grid network into the Smart City Showcase. They will also aid in the deployment of the Smart meters for dynamic monitoring of the City’s street lighting infrastructure.

Additionally, partnerships will be established with regional, state, and federal transportation planning agencies, private sector companies, academic institutions, and foundations. Each partner agency and organization has been chosen on the basis of experience and skills in core competencies related to the innovative projects. Overseeing the program management will be an Executive Steering Committee made up of key stakeholders. The Executive Committee will provide timely, high-level direction, guidance, and senior review. In combination, these partnerships will facilitate opportunities to try out new integrated approaches to solving the transportation challenges facing Las Vegas and other cities across the US.



How Las Vegas Aligns with USDOT Smart City Population Characteristics

Table 1. Population Characteristics of the City of Las Vegas, based on 2010 US Census Values

Las Vegas City, NV – 2010 Census-designated place population	583,756
Las Vegas-Henderson, NV – 2010 Census urbanized area	1,866,011
Percentage of the local urbanized area	31.3%
Urbanized land area (square miles)	416.8
Density (persons per square mile)	4,524.5

As shown in Table 1, the City’s urban population and density meets the USDOT’s Smart City requirements. The city’s population was 583,756, or 31.3% of the local urbanized area population of 1,866,011 in 2010. We have established a long-range plan to increase the residential and commercial capacity of the downtown urban area; and have made considerable investments in technologies, communications, and public works to serve as the foundation for this growth. By 2014, the City’s population was estimated by the US Census to have increased to 613,599, a 5.1% increase from 2010.

Source: US Census Bureau, 2010 Census Data.

<http://www.census.gov/geo/reference/ua/uafacts.html>. Retrieved January 24, 2016



How Las Vegas Aligns with Other USDOT Smart City Characteristics

Las Vegas also fully meets the other characteristics USDOT is looking for in its Smart City Showcase. The 2013-35 regional transportation plan identifies more than \$1.6 billion in public transportation improvements, including funding to build on the success of existing bus rapid transit lines by adding bus lanes in several key corridors, and replacing transit vehicles with an all compressed natural gas vehicle fleet.



The City has made considerable investments into technologies, communications, and public works to serve as the foundation for becoming a Smart City.

The City is also a prime market for several new businesses. Several leading innovation-focused businesses are establishing facilities in Las Vegas.

We have partnered with these companies to further promote Smart City innovations and expand our infrastructure to support this growth. Some of the companies committed to Las Vegas are:

Faraday Future, a global company focused on the development of fully electric and autonomous vehicles, is investing \$1 billion to develop a manufacturing facility in Las Vegas. We are partnering with Faraday Future to further promote EV technologies, establish the AV/CV test beds, and further integrate EVs into a Smart Grid.



Hyperloop Transportation Technologies Inc. (HTT), an industry-leading mass-transportation innovation company, is building a new test track in Las Vegas to support the design, testing, and deployment of a high-speed mass transportation network. HTT will renovate high-speed mass transportation leveraging Las Vegas' infrastructure.



Local Motors Inc., is a transportation innovation company focused on the development and promotion of open-source innovative vehicle designs. Local Motors global co-creation and microfactory manufacturing encourages public innovative collaboration to bring new transportation solutions faster to market. We will work with Local Motors on the continued development and deployment of connected vehicles, placing emphasis on Local Motor's future vision of fully autonomous electric vehicle design.



Zappos America, a subsidiary of Amazon, recently purchased 276,500 square feet to relocate its corporate headquarters, and more than 1,500 employees, to downtown Las Vegas. We are working with Zappos to enhance downtown infrastructure and support pedestrian safety and mobility along the urban corridors surrounding Zappos new headquarters.



One of the major reasons these companies have taken a vested interest in Las Vegas is our **progressive attitude** and **commitment to be at the leading edge of innovation** and sustainability. Over the past several years, the City has received key awards and accolades for our commitment to promoting innovation and sustainability.

The City of Las Vegas and the U.S. Department of Commerce's Economic Development Administration hosted the **Strong Cities, Strong Communities (SC2) Challenge** in 2014-15 to procure highly innovative, creative, and transformational economic development ideas for Las Vegas from multidisciplinary teams throughout the world. The City gave a \$500,000 prize to the plan to turn our Cashman Center into a hub for drone and technology research, establishing

a fly zone for drone testing, and redesigning and enlarging the convention center to turn it into an unmanned aerial robotics resource center.

USDOT 2014 Data Innovation Winner—Our partner RTC-FAST won the 2014 USDOT Data Innovation Challenge. Over the 3-month challenge, RTC-FAST found innovative ways to use apps to improve transportation and reduce congestion by taking advantage of new access to multiple sources of transportation data. RTC-FAST's Bugatti



dashboard was selected for its ability to provide easy-to-understand online user interface and access to real-time and historical freeway and arterial monitoring and performance data.



Program Director Brian Hoeft, USDOT Sec. Anthony Foxx, and Systems Architect Gang Xie

The HUD-DOT-EPA Sustainable Communities Planning Grant was an opportunity for southern Nevada to address complex regional issues, culminating in regional collaboration, expert input, and community engagement (kickoff and summit events, 7,000 surveys social media, focus groups, open houses, visual preference surveys, and targeted mailings to over 40,000 households). This led to the adoption of the Southern Nevada Strong

Regional Plan, which developed a shared vision for integrating good jobs with a wide range of housing options located near transit.

Las Vegas is also at the **forefront of sustainability**, having won numerous sustainability awards.

Additionally, the City is committed to advancing open data, by making data accessible, discoverable, and useable by the public to fuel entrepreneurship and innovation. We have data sharing agreements in place with private companies (Google Waze, Traffic.com) and the general public through GISMO (Geographic Information System Management Office)—cooperation through interoffice agreements—that already support the open, fully interoperable sharing of data. The City is committed to advancing open data by making data accessible, discoverable, and useable.

Our well-established infrastructure, commitment to urban modernization, focus on growth through partnerships with industry-leading innovators, and awards for sustainability and innovation make Las Vegas a prime proving ground for a Smart City.

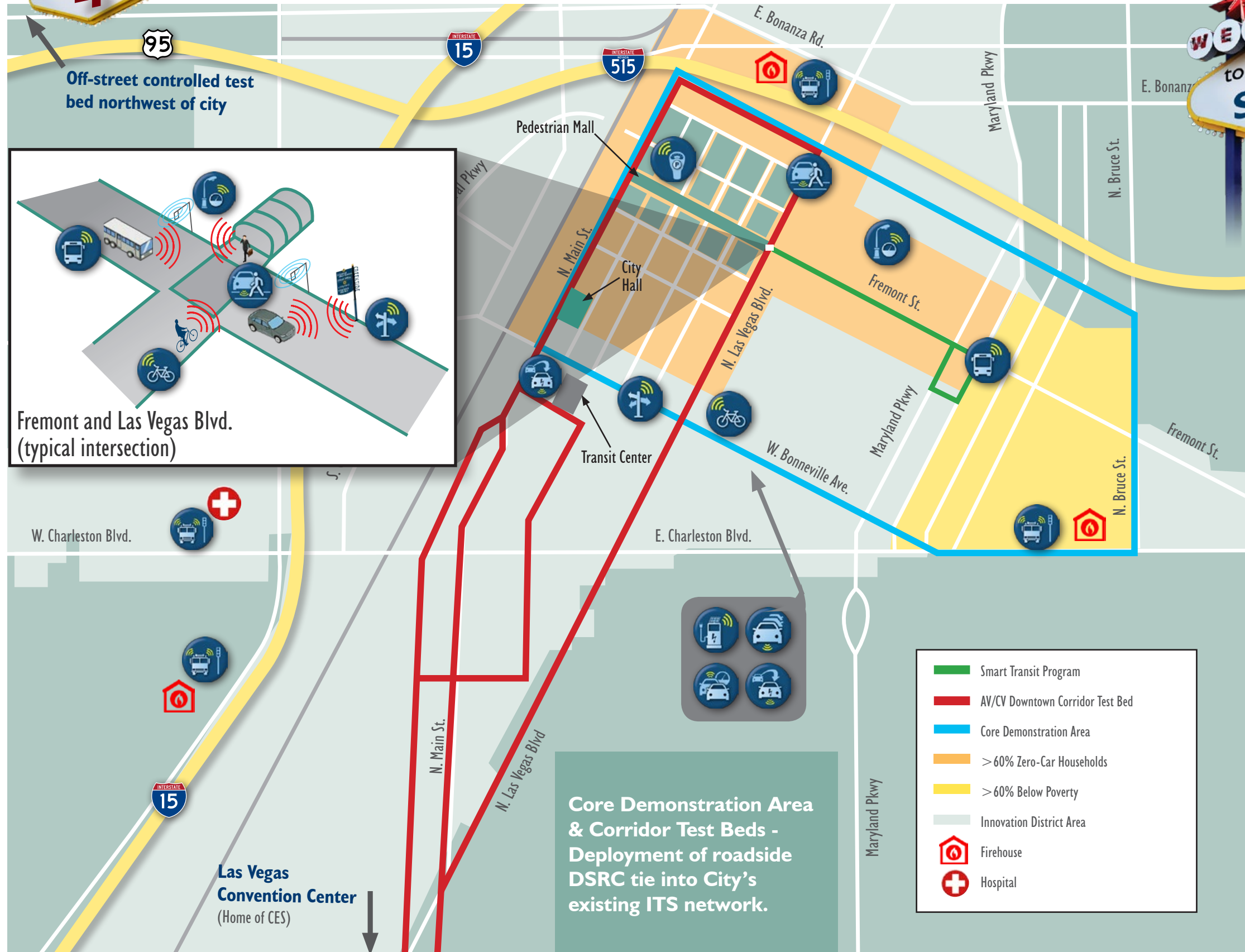
Table 2. *City of Las Vegas: Recent Sustainability Awards*

Award	Organization
2013 Renewable Project of the Year	Association of Energy Engineers
2013 Crown Communities Award	American City and County
2013 Bicycle Friendly Business Award; Bronze	League of American Bicyclists
2013 Outstanding Achievement in Local Government Innovation	Alliance for Innovation
2013 Project of the Year Award: Structures	American Public Works Association
2014 Bicycle Friendly Community Award; Bronze	League of American Bicyclists
2014 Climate Protection Award	U.S. Conference of Mayors
2014 Green Power Leadership Award	U.S. Environmental Protection Agency
2015 STAR Communities	4-STAR National Excellence in Sustainability
2015 Tree City USA	National Arbor Day Foundation
2015 13 Newest What Works Cities	Bloomberg Philanthropies





Las Vegas Smart City Site Map



As a Smart City, Las Vegas will be a place where transportation works seamlessly with all other public service entities and improves the quality of life for all. Nearly 42 million tourists and business travelers will experience what it is like to be part of a Smart City, with safer, more efficient mobility, cleaner air, and a diverse, prosperous community.

These projects are the foundation of our Smart City:

- AV/CV Test Beds
- Smart Transit Program
- Vehicle to Pedestrian Safety Improvement Project
- Downtown Bike Share Safety Project
- Smart Wayfinding Signage
- Downtown Traffic Monitoring & Measurement
- ParkMe Real-time Parking
- Solar Charging & Smart Monitoring
- Smart Metering for City Streetlights
- Advanced Emergency Response Integration
- City of Las Vegas Fleet AV/CV Conversion



How Our Approach Aligns with the 12 Vision Elements

The precursor to making Las Vegas a Smart City will be to deploy and connect a series of innovative projects that will improve mobility; enhance motorist, pedestrian, and bicyclist safety; reduce carbon footprint; and promote economic growth and diversity. We plan to implement 11 innovative projects that will not only meet those objectives, but also establish a solid foundation for making Las Vegas a true Smart City. We have analyzed the proposed projects against the 12 vision elements identified in the Notice of Funding Opportunity and our four key objectives, as shown in Table 3.

Table 3. Our Smart City Foundation Projects Align with USDOT's 12 Vision Elements and Key Objectives

	Objectives				Vision Elements											
	A	B	C	D	1	2	3	4	5	6	7	8	9	10	11	12
	Improve Safety	Improve Mobility	Reduce Carbon Emissions	Increase Economic Vitality	Urban Automation	Connected Vehicles	Intelligent, Sensor-based Infrastructure	Urban Analytics	User-Focused Mobility Services & Choices	Urban Delivery & Logistics	Strategic Business Models & Partnering Opportunities	Smart Grid, Roadway Electrification, & Electric Vehicles	Connected, Involved Citizens	Architecture & Standards	Low-Cost, Efficient, Secure, & Resilient ICT	Smart Land Use
Smart Transit Program	●	●	●	●	●	●	●	●	●		●		●	●	●	●
AV/CV Test Beds	●	●	●	●	●	●	●	●	●		●		●	●	●	
Smart Metering for City Streetlights	●		●	●		●	●	●			●	●		●	●	●
ParkMe Real-time Parking		●	●			●	●	●	●		●		●	●	●	
Advanced Emergency Response Integration	●	●	●	●	●	●	●	●	●					●	●	
Downtown Bike Share Safety Project	●	●	●	●	●	●	●	●	●		●		●	●	●	
Vehicle to Pedestrian Safety Improvement Project	●	●	●	●	●	●	●	●	●		●		●	●	●	●
Downtown Traffic Monitoring & Measurement		●	●	●	●	●	●	●	●		●		●	●	●	
Smart Wayfinding Signage	●	●	●	●		●	●		●		●			●	●	
Solar Charging & Smart Monitoring			●	●		●	●	●			●	●	●	●	●	
CLV Fleet Vehicle AV/CV Conversion	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●



Detailed project descriptions, objectives, and performance metrics for success for each of our 11 proposed projects follow.

I. AV/CV Test Beds



- Downtown Las Vegas corridor AV/CV test bed to test innovations with multiple mobility types (transit, pedestrian, bicycle, freight, and personal vehicle)
- Offsite AV/CV test bed to conduct controlled testing
- Connectivity testing with fully enhanced ICT infrastructure corridors

The City will establish incentives-based public-private partnerships with Bosch, Delphi, Faraday Future, Ford, and Qualcomm to design and deploy two AV/CV test beds within City-controlled property. The downtown corridor test bed will run from the Las Vegas Convention Center, along Paradise Road, Main Street, and Las Vegas Boulevard. A second test bed on a 640-acre parcel in northwest Las Vegas will conduct innovative testing without impeding current traffic operations. The test beds will be used to not only showcase advancements in AV/CVs, but also to test those vehicles and installed connected vehicle applications under several urban conditions:

- AV/CV connectivity and reactions with autonomous transit vehicles as part of the Smart Transit program
- Traveler warnings for pedestrians participating in the Vehicle to Pedestrian Safety Project
- Traveler warnings for bicyclists participating in the Downtown Bike Share Safety Project
- Destination and route updates based on real-time city events
- Automated electric vehicle charging station availability provided by the Solar Charging & Smart Monitoring Project
- Enhanced destination wayfinding from information provided by the Smart Wayfinding Signage Project
- Real-time parking spot identification and automatic reservations and navigation to parking spots participating in the ParkMe Real-time Parking Project

- AV/CV interactions with unmanned aerial vehicles (should licensing from FAA be approved)

The City will design and deploy Smart infrastructure sensors and DSRC radios along these corridors connecting to existing fiber optic backbone for data transfer. Faraday Future and Ford will also provide AV/CV test vehicles. The City will work with other AV/CV vendors through cooperative agreements, CES, and SEMA, to use the test beds to showcase AV/CV technology.

These AV/CV test vehicles will use onboard sensors (camera, infrared, LiDAR, etc.) to collect vehicle location and lane positions relative to other vehicles, bicyclists, and pedestrians. This location information will be refined through analyzing the continually operating reference stations (CORS) global positioning satellite (GPS) data provided by the City and its partner Las Vegas Valley Water District. This GPS data provides real-time kinematic (RTK) georeferenced data sets to improve accuracy to 0.3 meters (11.8 inches), ten times more accurate than commercial GPS data. Onboard vehicle systems will take location measurements and compare them against this CORS data to provide more accurate route navigation and lane determination.

Our offsite facility allows for continued innovative testing. We have committed a 640-acre parcel of land to deploy this simulated urban and rural test. AVs and CVs will be tested under a litany of situations, including pedestrian, bicycle, and freight vehicle interactions, under more aggressive testing in a controlled setting without hindering mobility or endangering motorists.



2. Smart Transit Program



- AV/CV transit vehicle within the Innovation District on Fremont Street
- Deployment of a passenger application with real-time vehicle location data
- Enhanced mobility circulator with CV communications within the Innovation District

This program will deploy a pilot autonomous transit vehicle and a Downtown Circulator with CV technologies within the Innovation District to improve safety, enhance mobility, and reduce GHG.

ICT sensors and DSRC radios, provided by Delphi and Qualcomm, will be installed along Fremont Street, from Las Vegas Boulevard to 15th Street, to provide the information backbone for our pilot autonomous transit vehicle, such as the French CityMobil2 Electric, fully automated bus. This bus will autonomously move passengers along a predetermined route using vehicle to infrastructure (V2I) communications from our Smart infrastructure, vehicle to vehicle (V2V) communications throughout the AV/CV test bed, and vehicle to pedestrian and bicycle (V2P and V2B) communications as part of the Downtown Bike Share and Vehicle to Pedestrian Safety projects.

Additionally, the City is in process of deploying a Downtown Circulator within the Innovation District. The Downtown Circulator will provide mobility options for residents and visitors to downtown Las Vegas. The Smart Transit Program will also outfit the Downtown Circulator with V2I, V2V, V2P, and

V2B communications to increase safety of pedestrians and bicyclists within the downtown.

A passenger app, the USDOT's T-DISP, will be deployed initially to give users real-time location data of the pilot autonomous transit vehicle and the Downtown Circulator. Ultimately, over the long term, it is envisioned it will provide users an enhanced mobility option that includes a transit-on-demand application. A passenger would use the newly developed RTC travel app to not only obtain real-time location information for the nearest transit vehicle, but ultimately, call a vehicle on-demand. The future expansion of the app would be tied to a RTC DSS that takes a passenger's request, their current position, and compares it against collected CAD/AVL data and other mobility information. The DSS would then command a fleet vehicle to hold or reroute a fixed route bus or deploy a paratransit vehicle to pick up the passenger. Available transit options, seat availability, and optimal travel times and fees would then be transmitted to the passenger from the DSS through the app.



3. Vehicle to Pedestrian Safety Project



- Improves safety through the Innovation District by connecting pedestrians to Smart infrastructure (via DSRC and Bluetooth) and AV/CV technologies
- Enhances urban mobility by encouraging connected citizens to walk throughout downtown Las Vegas with an extra layer of awareness
- Partnering with multiple large employers downtown to prove capabilities of this technology with their employees

The relocation of Zappos Corporate Headquarters to downtown Las Vegas has greatly increased the number of pedestrians who use the downtown area. To promote the safety of these employees, as well as the safety of the countless tourists that visit the downtown area, the City is partnering with Zappos, Delphi, and Qualcomm to deploy a vehicle to pedestrian safety project. Using the existing Bluetooth and DSRC radios in their phones, employees who download the CLV Mobile App will receive and transmit enhanced traveler information. The City, in a partnership

with Bosch, Delphi, and Qualcomm, will deploy a series of Bluetooth and DSRC receivers throughout the downtown corridor to collect pedestrian information and support increased pedestrian mobility and safety throughout this urban area.

Additionally, the AV/CV Test Bed (Project #1) will connect with this area and allow AV/CV test vehicles to receive information about pedestrian and bicyclist locations. These improvements will promote walking and bicycling as preferred modes of first and last mile transportation options.



4. Downtown Bike Share Safety Project



- Provides additional mobility options (Bike Share) while improving bicycle safety
- Builds on the City's existing **Bcycle** program to integrate DSRC radios, GPS, and emissions monitors into publicly available bicycles
- Collects bicycle usage and emissions information throughout Innovation District to feed into Smart City
- Consolidated payment (with Mobile Ticketing) for Bcycle

As part of the downtown Las Vegas modernization effort, the RTC is deploying a Bike Share program of 180 bicycles throughout the Innovation District, with a plan to deploy over 500 throughout Las Vegas. This program will allow users to share bicycles from a pickup location, use them for transportation, and return them to another location, enhancing mobility by providing a cleaner, healthier transportation option.

One major concern with any bicycle-centric program is the safety of bicyclists along traffic-heavy corridors. As part of the Smart City program, we will outfit these bicycles with location and collection sensors and DSRC radios that will integrate with other transportation data for analysis, preemptive

signaling at crosswalks, and identification by AV/CV corridor test vehicles. Our partner, Ford, will provide its bicycle-mounted sensor to collect carbon emissions information to be used in GHG reduction analyses. Bike Share users will also be able to automatically reserve and pay for bike reservations through our Consolidated Payment System app (developed under the Smart Transit Program).

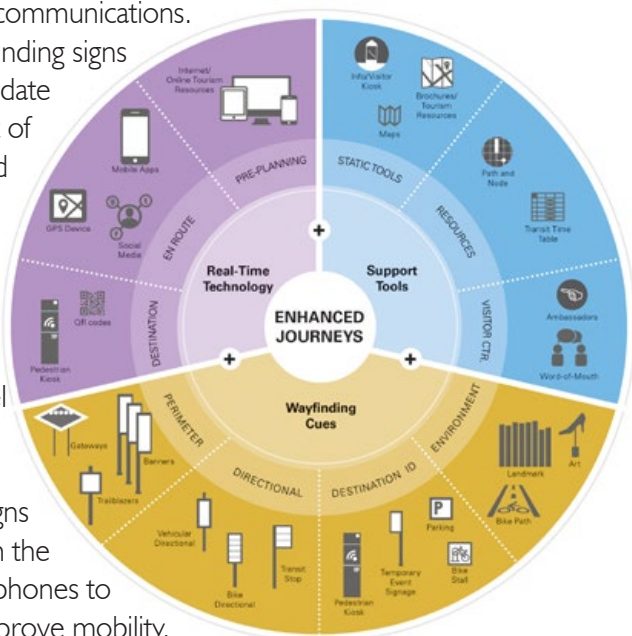
The information collected in this project will pave the way for safer and environmentally friendly corridors for our urban bicyclists. As the program matures, we will also integrate fully connected, electric bicycles (again through Ford), into both the Bcycle and AV/CV test projects.

5. Smart Wayfinding Signage



- Enhances urban mobility and automation by feeding Smart Wayfinding Signage information to connected citizens through the CLV Mobile App and through AVs and CVs
- Builds on the City's Wayfinding Sign Program, making signs "smarter" through dynamic messaging and DSRC communications
- Provides real-time information and city status to users throughout Innovation District

The heart of creating the Innovation District is public communications. To support this effort, the City will deploy Smart wayfinding signs throughout Las Vegas. These signs will provide up-to-date information and navigation assistance to users. As part of the Smart City Showcase, we will integrate DSRC and 4G cellular radios into each wayfinding sign to allow relevant Smart City information to be sent to and broadcast from each wayfinding sign. This will allow users to not only gather information relative to navigating key city locations, but also provide real-time information on City happenings, alternative travel information based on traffic congestion, public events, or other abnormal city circumstances. Based on user preference, information from the Smart wayfinding signs will also be integrated into a user's cell phone through the CLV Mobile App, where users can synchronize their phones to the sign, allowing them to connect to the City and improve mobility.



6. Downtown Traffic Monitoring & Measurement Project



- Web-based and mobile app dashboard to show real-time City health and information
- Promotes connected citizens by displaying information (trip reroutes, city issues, emergency situations, and public announcements)
- Leverages RTC's USDOT Data Integration Award-winning "Bugatti" dashboard

The City, in partnership with Bosch, Delphi, Ford, and Qualcomm, will deploy a series of Smart meters, ITS sensors, DSRC, and Bluetooth radios throughout Las Vegas. These will integrate with the City's ITS investments to capture real-time data for traffic congestion, accidents, carbon emissions, pedestrian concentrations, and public transit route and ridership information. Collected data will then be fed into the City's Real-time and Predictive Analytics Engine, developed and maintained by our partners DRI and UNLV. Analytics performed on these data sets will be displayed in real time to our Real-time City Dashboard. This dashboard will also be integrated with the City's mobile app to allow the general public to view real-time City-related

information to support better mobility decision making.

By further making this data open source and available to the public, the capabilities of this engine and dashboard are endless. RTC has already made considerable advances in the development and use of dashboards, through Bugatti, which provides a sound launching point for one of the key outputs of our Smart City.



7. ParkMe Real-time Parking



- Efficient freight movement and reduced congestion through real-time parking space availability
- Balances parking space supply and demand
- Lays the foundation for future FRATIS (part of the Dynamic Mobility Bundle) integration
- Integrates with consolidated payment
- Builds on the City's ParkMe app to show current occupancy and availability of metered parking spaces, commercial hourly parking spaces, and dedicated freight spaces

Vehicles looking for available parking is one of the leading causes for urban traffic congestion and reduced freight efficiency. The 2015 City of Las Vegas General Population Survey found that 43% of respondents indicated that finding parking in Downtown Las Vegas is at least somewhat difficult with 8 in 10 of those respondents (79.8%) saying that difficulty parking influences their decision to visit downtown.

To mitigate this, the USDOT Smart City Showcase will include a project for motorists to automatically find, reserve (for garages and lots), and route vehicles (both through a mobile app and automatically with AVs and CVs) to available parking spaces. This project will leverage the City's existing "ParkMe" app, powered by INRIX, and expand the parking facilities with sensors to identify whether a parking space is occupied or available.

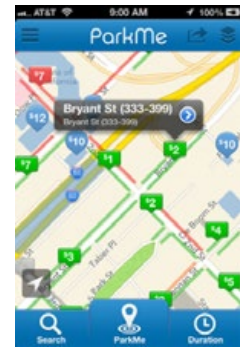
Commercial vehicles are part of the unseen backbone of downtown urban Las Vegas, delivering and receiving hundreds of shipments a day to support the significant entertainment and convention businesses. This project will also integrate the commercial vehicles that need to park in order to make these shipments; using theirs and other vehicle data to enhance traffic congestion analyses for City planning. As part of the fully integrated Smart City, freight vehicle AVL and timestamp data will also be used to determine where specific vehicles are located, how long they will be in a particular area, and when the freight vehicle will be exiting to support better management of traffic signaling and speed harmonization along the delivery corridors.

Infrastructure upgrades for this project will involve public-private partnerships with CivicSmart and



Parkeon and downtown parking vendors, to upgrade parking spaces and payment kiosks with sensors, DSRC, and 4G cellular radios. INRIX, will modify its existing ParkMe app to support the real-time information provided by the newly installed sensors. The ParkMe app will also be integrated into AV/CV navigation systems by our partners Bosch, Delphi, Faraday Future, and Ford to allow motorists to reserve and automatically travel to available parking spaces. We will also integrate this capability with our Solar Charging & Smart

Monitoring Project to display, reserve, and navigate to available EV charging stations. Through the Consolidated Payment Systems app, ParkMe users will also be able to pay for parking with the same method they pay for transit, Bike Share, or EV charging usage.



8. Solar Charging & Smart Monitoring



- Enhances the City's existing investment of 64 charging stations with Smart technologies and deploys an additional 60 solar charging stations throughout the Innovation District
- Integrates with ParkMe app to display, reserve, and automatically route motorists to available charging stations
- Expands Solar Highway Partnership between the City, NDOT, and USDOT by expanding charging stations and connecting them to our Smart Grid

As part of a statewide initiative to deploy an electric highway between Las Vegas and Reno, the City has entered into a partnership with NV Energy to provide a series of DC-based "fast charge" and AC-based Level 2 charging stations. Las Vegas will take this initiative forward and provide solar powered charging stations to further promote electric vehicles in Las Vegas.

The City will take several steps to modernize these charging stations and deploy new, Smart charging stations. We will deploy a series of solar-backup charging stations that will contain consumption sensors, GPS receivers, and communications radios to collect and transfer charging capacity and power consumption information to the Smart City Monitor and Control System. Location data for each of these charging stations will also be integrated into the ParkMe App to show users the location and availability of these charging stations. This information will also be provided to AV/CV test vehicles heads up displays and navigation systems

to display and automatically route the vehicle to a selected charging station. Charging station fees can be paid for simply using the newly developed Consolidated Payment System app; or through a vehicle's existing telematics provider agreement.

Finally, the capacity, power consumption, and other relevant data for each charging station will be sent to the Real-Time and Predictive Analytics Engine for integration into NV Energy's Smart Grid network and our Smart City Command and Control System. This data will be used to more accurately capture and analyze power consumption data for NV Energy's power processing and planning activities.



9. Smart Metering for City Streetlights



- Adaptive lighting with succinct control over streetlights in areas of dynamic urban density
- Performance tied to Smart Grid to balance power efficiency with mobility safety
- Crowdsourcing through phones and vehicles to better inform urban lighting conditions

Las Vegas' street lighting system, while critical for the safe movement of pedestrians, bicyclists, transit users, and drivers of vehicles, is also a major contributor to power consumption costs. We have

converted over 80% of our more than 52,000 streetlights to LED bulbs, reducing annual power costs from \$4.3 million to just under \$2.6 million a year and reducing maintenance costs by nearly



\$370,000. While these investments have greatly improved efficiency, a lack of monitor and control causes inconsistencies in light timing and power consumption wasting taxpayer dollars, and posing safety risks for poorly lit areas.

We will leverage our partnership with NV Energy, to collect power consumption data from each service point and streetlight. This information will be transferred to the Smart City Command and Control System and the Real-time City Dashboard to show lighting conditions at certain times of day (indicating whether a light is erroneously powered on or if a light is not providing adequate light during nighttime). We will also tie pedestrian and vehicle density both automatically and through

user-driven notifications on their phones and vehicles to the system to determine whether or not lighting can be temporarily reduced in low conflict areas – creating an urban density reactive lighting system. This project will greatly improve our pedestrian safety, reduce operational costs, and reduce GHG emissions from our power plants.



10. Advanced Emergency Response Integration



- Make emergency response vehicles “Smart” with DSRC communications and PREEMPT capabilities, thus improving emergency response times, overall safety, and mobility
- Provides motorists, bicyclists, and pedestrians a warning when emergency vehicles are approaching
- Tie CAD/AVL data into Smart City Command and Control to resynchronize traffic signals and maximize speed harmonization after emergency vehicle preemption

Effective and efficient emergency response is a critical element of a coordinated, regional traffic signal system. Typically, a computer-aided dispatch (CAD) system is utilized by first responder’s dispatchers to locate the most optimum response asset for the incident. The City’s first responder vehicles are all integrated with automated vehicle location (AVL) technologies, which identify the real-time location of each of these vehicles to minimize the response time for specific incidents.

Local agencies’ goal to provide motorists, pedestrians, bicyclists, and transit vehicles with the most optimum commute, is challenged by the impact of emergency responders “preempting” the traffic signal’s operation. Whenever an emergency response vehicle with optical preemption emitter travels through a coordinated traffic signal with an optical detector, it desynchronizes the traffic signal with other traffic signals in the area, causing backups and congestion along the City’s major corridors.

For this project, the City, in conjunction with FAST, Las Vegas Fire Department, and Las Vegas Police Department, will integrate the CAD/AVL

data with the City’s traffic monitoring and signal synchronization, establishing a seed to build the DSRC-based connected vehicle application Emergency Vehicle Preemption (PREEMPT). The City will partner with DRI and Trafficware, the CAD/AVL software provider, to establish a common interoperable platform, which seamlessly integrates CAD/AVL and traffic monitoring data. We will also transmit synchronization signals, affected by first responder preemption during an emergency, over our Smart infrastructure to more quickly synchronize traffic signals after a preemption. Light synchronization and first responder locations will also be routed to AV/CV test vehicles for identification and automatic rerouting.

The expectation is this project will reduce first responder response times, improving motorist safety during a response. It will also improve urban automation and reduce traffic corridor congestion, improving mobility and reducing carbon emissions from idling vehicles.



II. CLV Fleet Vehicle AV/CV Conversion



- Retrofit City Fleet vehicles with AV/CV technology
- Enhance City staff mobility, improve safety, and reduce carbon emissions
- Integrate retrofitted vehicles into AV/CV test beds

To further launch Las Vegas into the AV/CV realm, the City will retrofit its fleet vehicles with AV/CV technologies. In partnership with UNLV's world-renowned Transportation Robotics Lab, Bosch, Ford, Delphi, and Qualcomm, the City will deploy a series of sensors, DSRC radios, and robotics into 50 fleet vehicles. By immediately deploying AV/CV technology, the City can further enhance mobility, improve employee safety, and reduce carbon emissions through speed harmonization initiatives.

evolves, the City will also work with Faraday Future, Ford, and Local Motors to address potential CV modifications. Once deployed, data from these fleet vehicles will also feed the Smart City Command and Control system to display real-time fleet information for further Smart City analytics.

Also, UNLV will develop and deploy an AV/CV training simulator. This simulator will be used to train employees whose vehicles have been retrofitted with technology to the operational considerations for using an autonomous or connected vehicle.



These fleet vehicles will also be used as test vehicles in the AV/CV Test Beds. As this project

Risks and Mitigations

The City has undertaken a comprehensive risk analysis to identify the potential technical, policy, and institutional risks to the success of our USDOT Smart City Showcase. Technical, policy, and institutional related risks and their potential mitigations are summarized in Table 4.

Table 4. Las Vegas Smart City USDOT Showcase Technical, Policy, and Institutional Risks

Risk	Mitigation
TECHNICAL RISKS	
Proprietary data platforms among public and private partners pose a risk to seamless data connectivity	Establish open-source based interface control specifications and use as contract and MOU specifications for partners.
Lack of encryption standards for Smart cities poses a risk to network intrusion, data integrity, and user safety	Work with USDOT and other federal and private partners to define encryption standards for DSRC, and Bluetooth networks. Conduct comprehensive testing in controlled environments with certified ethical hackers prior to launch. Assure that the system architecture uses the newly established SCMS concepts.
Lack of available wireless communications bandwidth poses a risk to project deployment and fully interoperable communications	Conduct a comprehensive wireless spectrum needs analysis.
POLICY RISKS	
Varying and conflicting agendas from multiple stakeholders poses a risk to concise objectives and project delays	Establish an Executive Steering Committee, chartered to establish clear and measurable program goals and objectives. Work with this ESC to establish program direction, identify goals and objectives, and maintain a course for program success.
Federal and state legislator changes pose a risk to continued visibility and funding for promoting long-term Smart City initiatives	Establish support within ESC. Provide showcase tours for incoming legislators to review the Smart City program and work to establish a long-term plan for maintenance and improvement.
Short term (3-year) projects may not include a socioeconomic diverse set of participants, thus posing a risk for public acceptance and future Smart City policy support	Develop a public education and outreach plan that will expand initiatives to economically diverse areas of Las Vegas. Implement Smart City expansion initiatives as part of long-term city plans and economic development.



Risk	Mitigation
INSTITUTIONAL RISKS	
Las Vegas year-round climate poses a risk to conducting fully seasonal testing on projects	Upon award, partner with City of Reno and other neighboring key cities that have a more varied climate. Expand test beds and projects to these other cities as part of long-term plan.
Objections from the commercial gaming companies and casino owners may pose a risk to meeting project completion timelines	Partner with key commercial gaming companies, as part of the ESC. Work with them to promote and potentially sponsor Smart City initiatives through public-private partnerships. Focus on the economic and mobility-based benefits seen through the establishment of Las Vegas as a Smart City.
Federal funding changes may prevent the entire allocation to fund the Las Vegas USDOT Smart City Showcase, posing a risk to timely project completion	Leverage existing, and expand public-private partnerships. Solicit sponsorship for key projects. Pursue alternative funding mechanisms to augment Smart City funding.

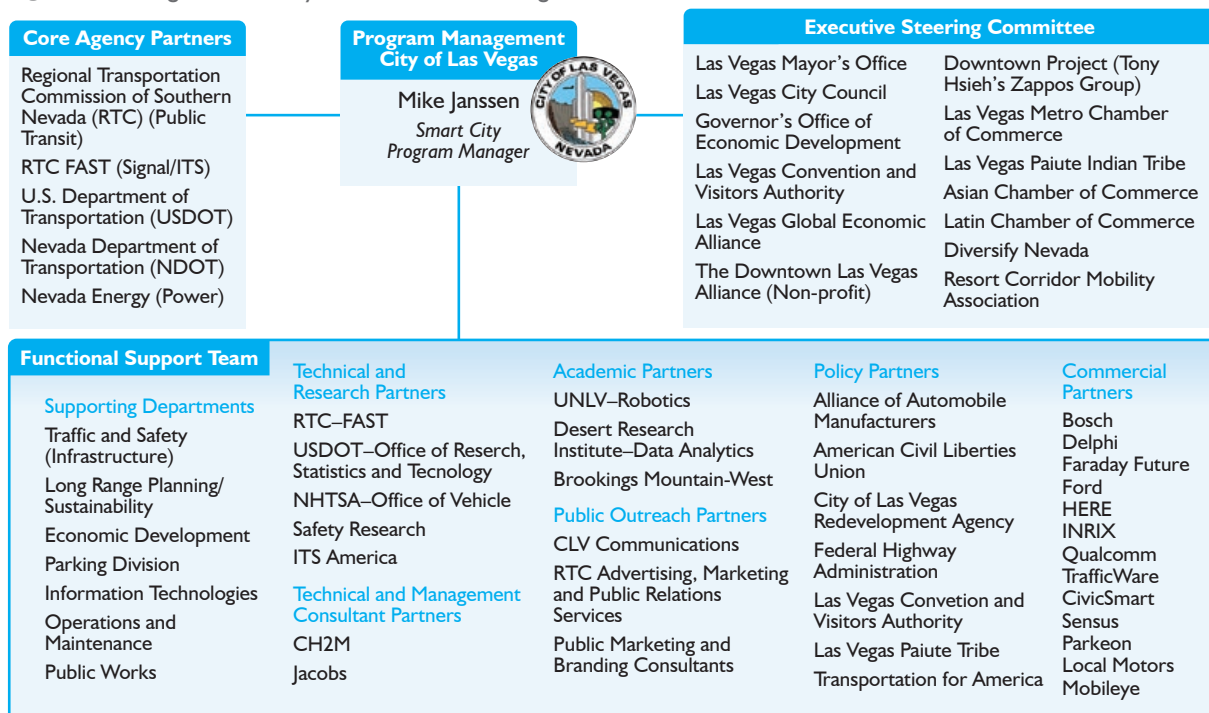


Team Partnerships, Stakeholders, Governance Processes

Team Partners, Key Stakeholders

The City has taken great strides in establishing partnerships with our public sector, private sector, and university partners for promoting our Smart City initiative, as shown in Figure 4.

Figure 4. Las Vegas Smart City USDOT Showcase Organizational Structure



Refer to Attachment I for letters of support

Our approach revolves around the City of Las Vegas City Manager's Office, with its core agency partners. Our proposed program manager, Mike Janssen, will be responsible for the day-to-day

activities of our program. The City will use its existing Program Management Office (PMO) to oversee all project activities. The City and our agency partners will also work with the Executive



Steering Committee (ESC), a group of highly vested partners who will establish the goals, objectives, and guidance for our program team. The ESC will also work directly with other cities, federal agencies, and legislative partners to solidify the vision and

objectives for the longer term Smart City initiative.

Our team also includes functional area partners to plan, design, and implement the needed activities for each of the 11 foundational projects that comprise our Smart City Showcase.

GOVERNANCE PROCESSES

The City has a well-established governance process that will be used as a launching point for deploying and managing the USDOT Smart City Showcase. Our approach to governance is to support innovation and use Las Vegas as an incubator for new ideas. We see this program as constantly evolving and will not let overly structured processes or bureaucracy stifle creativity.



Nevada was the first state to license autonomous vehicles for testing on our roadways

One distinct advantage that Las Vegas has over many other cities is our progressive political support and positive political will for promoting innovation. We have established clearly defined and

accepted roles and responsibilities among City staff, our Core Partners, Functional Support team members, and the ESC.

We have received the full support of both our Governor's and Mayor's Offices (as per the attached cover letter), and our City and state legislators are excited to transform our City into the USDOT Smart City Showcase.

This is also well represented through the partnerships our City has established with key innovation and technology companies. These companies (Faraday Future, Hyperloop Transportation Technologies, Local Motors, Zappos, and others) are at the forefront of advancing technology and are using our City as canvas for demonstrating their creativity. Having strong City-wide political will and a progressive attitude towards innovation has paved the way for these companies to establish centers of excellence throughout Las Vegas. Our City leadership has committed the same level of positivity and rigor to transform Las Vegas, as a whole, into the USDOT's Smart City Showcase.

EXISTING PARTNERSHIPS

The City has established many public-public, public-private, and public-academic partnerships to promote innovation throughout Las Vegas.

Public-Public Partnerships

Emergency Management has a regional partnership with the multi-jurisdictional Shared Computer Operations for Protection & Enforcement (SCOPE). This prime example of shared data usage was originally funded through the US Department of Justice and Department of Homeland Security, with ongoing support from all local emergency responders.

Freeway & Arterial System of Transportation (FAST) is one of the first truly integrated ITS organizations in the country. On July 3, 2004, RTC became the official administrator of FAST. NDOT and the RTC became full-fledged funding partners, contributing to the operations and management of FAST.

FAST is under the jurisdiction of the RTC elected board, which makes policies for FAST. Transportation strategies are set by the Operations Management Committee, comprising RTC, Clark County, NDOT, and the cities of Henderson, Las Vegas, and North Las Vegas. RTC staff is responsible for two major areas that make up the FAST system: the Arterial



Management Section, which includes all arterial streets and roadways; and the Freeway Management Section, which includes the entire freeway network.

FAST is designed to both monitor and control traffic. The traffic control component of the system consists of freeway and arterial management. Traffic control requires detection of traffic conditions through the use of video image detection and inductive loop detection. Visual verification of conditions is possible through closed-circuit television cameras. Traffic control is achieved through the use of traffic signals, ramp meters, dynamic message signs, and lane use control signals.

Project NEON extends 3.7 miles along I-15 from Sahara to the US95/I-15 Interchange. It will consist of a high occupancy vehicle (HOV) connector between US95 and I-15, direct HOV access ramps at Wall Street, reconstruction of the Charleston Blvd Interchange, and Grand Central Parkway connector over Charleston Blvd. The project is being administered by NDOT. Construction will impact local access and local roads during construction, even though it will primarily be reconfiguring the freeway. The City has worked with NDOT to review the design and construction phasing in order to minimize construction impacts and benefit both the freeway and arterial streets. The City is currently partnering with NDOT and City staff are functioning as an extension of NDOT staff to provide design reviews and construction responses. The City has also contributed financially to the project so that NDOT could include complementary arterial roadway projects with the construction of Project NEON. The inclusion of the City's arterial roadway projects will mean that construction within the area will be completed at the same time and in a timely manner. It is beneficial to NDOT and the City to have a contractor mobilized, once within the area, and no conflicts of schedules if there are multiple contractors within the area. Project NEON demonstrates the ability for the City to work with our public sector partners on large scale projects that benefit our residents.

TIM Working Group – NDOT has created a Traffic Incident Management Working Group comprising RTC, NDOT, coroner's office, TV, radio, and social media, NHP, law enforcement personnel, emergency response personnel, fire departments,

local public agencies (including the City of Las Vegas), tow truck companies, and other companies that might be involved with responding to incidents that might occur within the public right of way. The TIM Working Group is an example of the public-public and public-private partnerships that are formed in order to provide an increased level of response to our motoring public. The goal of the TIM Working Group is to better define the incident response methods and lines of communication in order to improve the process for better response. Ultimately, it is desired to optimize the emergency response times to help the crash victims while decreasing the travel time delays due to an incident.

Public-Private Partnership

The Fremont Street Experience, located in our **Innovation District**, is a long-term partnership between the City and over a dozen private businesses to modernize the historic downtown Fremont Street area, improving pedestrian access, enhancing tourism, and improving mobility access and choices.

IKEA Las Vegas has been a strong supporters of public transit and sponsored the launch event of Transit Route 121 – Durango / Buffalo. They have provided right-of-way for bus shelter installations.

Fiesta Henderson Hotel & Casino is a current transit park & ride location, which is serviced by the Henderson & Downtown Express (HDX) transit route linking Henderson with Downtown Las Vegas. Fiesta Henderson provided right-of-way access to install the bus shelter alongside the property, as well as 16 dedicated parking space for park & ride transit riders.

City of Las Vegas Downtown WiFi – The City has a public-private partnership with LV.Net to provide free WiFi to the public within the Innovation District.

Public-Academic Partnerships

We also have a strong relationship with our university partners. The City has several partnerships with the UNLV's Howard R. Hughes School of Engineering and the Department of Civil and Environmental Engineering & Construction. We have used this partnership to spearhead several initiatives.



The UNLV Downtown Design Center is a non-profit community design center located at the City's historic Fifth Street School in downtown Las Vegas. It is administered by the School of Architecture at UNLV. The school uses the Downtown Design Center to directly engage communities and advocate for the best planned and built environments in the state of Nevada and the Great Basin and Mojave Desert Regions. Resources may be used to assist communities and organizations in Las Vegas with research, design, planning, technical assistance, and creative innovation. The Center engages communities through service learning, faculty research, and technical assistance. Service learning is a model where students partner with communities to work upon applied projects, such as the Hundred Plan, which engaged the underserved, historically African-American community that makes up the north western sector of the downtown planning area. The service learning model brings a tremendous amount of enthusiasm to community projects and catalyzes conversations about potential solutions.

Weather Analytics through Applied Innovation Center – DRI has supported the City for the past several years with the processing and visualization of climate and remote sensing products for enhanced weather forecasting and potential environmental impacts from severe weather events. Using its Google-cloud based technology, DRI has provided real-time and

predictive analytics on weather patterns and their potential impacts on City activities.

Regional analytics and EPA air quality compliance for atmospheric particulate matter – Over the past several years, DRI and the City have partnered to conduct regional air quality analyses to remain compliant with the EPA's PM-10 NAAQS Air Quality certification for particulate matter. As part of that study, DRI conducted air quality surveys collecting atmospheric particulate matter and analyzed the collected data against PM-10 NAAQS standards. DRI has also conducted a long-range forecast of the Las Vegas regional atmospheric particulate data and has worked hand-in-hand with Las Vegas staff to ensure the appropriate measures are in place to remain compliant for the future.

Pedestrian Safety Engineering and Intelligent System-Based Countermeasures Program, a cooperative agreement between FHWA and UNLV Transportation Research Center was co-sponsored by five agencies: City of Las Vegas, Clark County Department of Public Works, NDOT, Nevada Office of Traffic Safety, and RTC. The project involved deploying and evaluating countermeasures to improve pedestrian safety and walkability. The intent was to serve as an example of what would lead to implementation of successful pedestrian safety countermeasures across the nation.



Las Vegas Transportation Infrastructure

The City's transportation infrastructure provides a prime environment for becoming the USDOT's Smart City Showcase. Our infrastructure consists of 290 arterial miles and 115 freeway miles. Our public transit partner, RTC, manages a well-established public transit network of 39 fixed routes, 318 paratransit vehicles, and supports more than 244 million trips and over 211 million trip-miles per year. For the 12-month period ending November 30, 2015, total ridership was nearly 66 million, with 46.6 boardings per revenue hour. This represents an annual ridership increase of more than 7%.



Data: Collection, Use, Integration, Policies, Management, Sharing

The collection, sharing, analysis, and exploitation of data for the USDOT Smart City Showcase program will follow many of the practices currently in place with the City and our partners.



Currently, the City and its partners collect data from many different sources including:

Existing Data Agreements

- RTC-FAST traffic data, currently powering Bugatti
- Bluetooth probes
- Las Vegas Public Works Survey, downtown 3D model data
- EUD economic urban planning data
- Highly accurate (0.3 meter resolution) CORS GPS data from Las Vegas Valley Water District
- RTC transit data
- Las Vegas Fire and Police CAD/AVL data
- Regional Flood Control District Flood data
- Commercial mapping data
- GIS and other asset management data
- NDOT and Las Vegas Metropolitan Police crash data
- Strava crowdsourcing athletic data
- Signal preemption data
- Pollutant information

We will augment these data sources with probe data from our project sources (AV/CV test vehicles, pedestrians, bicyclists, Smart charging stations, and Smart wayfinding signs).

DRI, UNLV, and our private sector partners HERE, INRIX, and Ford, will develop a fully interoperable data sharing medium that will take each of these existing and new data sets (many of which are disparate) and standardized them to a common interface standard, as defined in our developed Interface Control Document (ICD).

Once this data is standardized, we will augment it with commercial GIS and telematics data from our private partners to further expand our analytical capabilities. As is common with many other agencies, we will offer this standardized data to subscribed users in the open-source community for further modeling, analysis, and development. We will reach out to the open source developer community using a series of crowdsourcing initiatives and outreach activities where developers can develop apps, analytics models, and decision support systems using open-source platforms.

Oversight of all data collection, sharing, and processing activities will be conducted by the City, with support from DRI, UNLV, and the Technical & Research Committee. This team will develop the ICD, with support from our private partners; require ICD

conformance as a contractual requirement, and then test the integrity of data into the interoperability platform and then gauge and its ability to conform with the ICD.

The oversight activities and policies will also address data and network security. Public access to data will only be provided in non-connected Demilitarized Zone (DMZ) repositories and no access will be given to data or systems that pose a risk to overall city operations (e.g., Smart Grid networks, traffic signals, or CAD/AVL systems). Over the course of the Smart City program, we will work directly with USDOT and our data partners to define any data that could pose threats to the security of Las Vegas; and then work to develop alternate policies and plans for collecting, storing, and sharing this data to the fullest extent possible.

The City has existing data collection and dissemination agreements in place with commercial partners. All data collected from our ITS components are sanitized and aggregated for inclusion through our established data repository by our partners. Our goal with the Smart City will be to further expand those data sets while maintaining the same policies for data sharing, interoperability, privacy, and analysis. We will impose the same data sharing policies with all of our new commercial partners and will not establish proprietary formats or protocols that would infringe on our open data approach.



ITS/Connected Vehicle-based Technology Approach

Our approach hinges on expanding our already robust ITS and communications infrastructure throughout our Core Demonstration Area. Over the past several years, the City and its partners have invested more than \$14 million in ITS and

CV technologies and infrastructure. The foundation of our approach is a robust communications backbone. To date, we have installed more than 123 miles of reliable, redundant (48-pair or greater) armored fiber optic cable along our urban corridors



and metropolitan centers within the City of Las Vegas alone. This communications backbone is also tied to our City's free public WiFi, where we have deployed 42 wireless access points providing reliable, high-speed 802.11g wireless data connectivity for our occupants. We have also deployed a series of ITS sensors and emissions and weather monitoring stations. This currently includes:

- 478 in-ground, infrared, video, side-fire microwave vehicle detectors on City-controlled roads and traffic signals for data collection purposes with hundreds more deployed throughout the region
- 245 of our nearly 600 traffic signals converted to Advanced Transportation Controllers for enhanced performance monitoring capabilities, including 32 intersections currently configured with 24 hour lane-by-lane real-time turning movement count data
- 3 dynamic message signs on City-controlled roads, and another 37 throughout the area
- Bluetooth monitoring on two discreet corridors used for travel time and incident management purposes
- Fixed route Bus Transit Signal Priority and AVL
- 174 owned or shared use incident management Closed-circuit Television (CCTV) cameras, whose images are shared with the local media and streamed in real time to the public; 290 CCTV cameras deployed regionally
- 2 traffic signals fully configured with DSRC radios for V2I communications
- Opticom Management System integrated with nearly 160 traffic signals in the City
- 178 traffic signals with video image detection systems installed and integrated with the central Traffic Operations Center
- 12 fully operational real-time arterial midblock detection stations tied directly to the Traffic Management System used for operational and land use planning purposes

The considerable investment already made by the City and its partners not only illustrates our commitment to becoming a Smart City, but also provides a solid launching point for the deployment of Smart City technologies. We will not need the USDOT grant dollars to build out the ITS infrastructure. Rather we will use the USDOT's investment to augment our already robust infrastructure, ensuring the investment is optimized.

Our Plan for Using and Improving Standards

For the Smart City Showcase, the City will also leverage standards-based approaches to the fullest practical extent. We are including many of these standards in our current programs and will work with USDOT, our university partners, and our Technical & Research Committee to further define and refine standards that will be used for our various projects and the ultimate Smart City Showcase.

Our ongoing standards focus is inclusive of all of the relevant standards related to connected vehicles, including SAE J2945 and J2735, IEEE 1609 WAVE as well as 802.11 for DSRC radio. We are also understanding of all of the NTCIP infrastructure

standards that are impacted by our connected vehicle work.

We will utilize our vast experience in evaluating architecture and standards and working with technology and standards committees to update standards to reflect the best in industry practices. Through our partnership with UNLV, and membership on various professional organizations such as ITS America, ITE, AASHTO, NEMA and USDOT, we have experience with the standards that will be used in our Smart City Showcase. In particular, our work with the NTCIP was necessary in the development of our FAST architecture.

We have also kept up our state and regional ITS architectures in full compliance with 23 CFR 940, which was updated in March 2015.

Many of our private partners also have experience in the development, update, and ratification of architecture and standards. Upon award, we will work collectively with USDOT and its partners, to identify the full complement of standards that will be used in our approach, identify any potential risks or gaps in the standards, and work to ratify any necessary amendments.





Vision Goals, Objectives, and Monitoring Approach

To monitor success for each of our 11 foundational projects and ultimately, the success of the Smart City Showcase, we have identified a series of success criteria and short and long term key performance indicators (KPIs). We will monitor these success criteria and their KPIs over the course of each project and then evaluate the overall success of the program. We will integrate these metrics into our project management tools to determine whether the KPIs have been successfully met. The metrics and associated KPIs for each project are defined in Table 5.

Table 5. Performance Metrics and Associated Key Performance Indicators

Project	Success Criteria	Quantifiable KPIs	
		SHORT TERM (< 3 YEARS)	LONG TERM (5-10 YEARS)
 Autonomous & Connected Vehicle Test Beds	- Development of downtown and offsite AV/CV test beds - Full deployment of smart sensors and DSRC radios along downtown corridors - Open-source integration of AV/CV data into Smart City	- Successful delivery of 3 AV/CV pilot smart corridors > 5% required user intervention during AV/CV testing (at least 100 tests)	> 90% successful AV/CV integration with pedestrians, bicyclists, and other vehicles 100% pass rate of automatic rerouting of AV and CV vehicles based on real-time instances and emergency situations
 Smart Transit Program	- Full upgrade of transit infrastructure (fleet, route, and Bonneville Transit Center) - Integration of transit data into Smart City - Increased mobility with on-demand transit ordering - Fully autonomous transit vehicles along fixed and routes and paratransit service	> 10% improvement in transit route reliability > 15% improvement in transit travel times > 20% ridership increase > 50% increased customer satisfaction	> 90% fixed and paratransit fleet conversion to AV and CV - Transit data and route health fully integrated into Smart City > 95% route efficiency (riders/vehicle w/ < 3 minute deviation in on time service)
 Vehicle to Pedestrian Safety Improvement Project	- Successful deployment of DSRC, and Bluetooth, radios throughout downtown corridor - Integration of pedestrian safety app into CLV Mobile App - Successful synchronization of traffic signals with high pedestrian concentrations - AV/CV collision avoidance when encountering a pedestrian in the same intersection	100% successful preemption of traffic signals with at least 5 pedestrians at an intersection - Implementation of CLV Mobile App for pedestrian safety > 90% reduction in pedestrian and vehicle collisions	- Deployment of pedestrian safety program throughout the City where there are employment centers with more than 1,500 employees > 50% increase in downloading of CLV Mobile App for pedestrian safety
 Downtown Bike Share Safety Project	- Successful deployment of communications radios and emissions sensors into Bike Share bicycles - Successful synchronization of traffic signals with high bicyclist concentrations - More robust emissions data for analysis - AV/CV collision avoidance when encountering a bicycle in the same intersection	100% of 180 Bike Share bicycles outfitted with ICT - Provide bike sensors to bicycle community for collision avoidance - Soft pitch to social bicycle community such as Strava to push out the app > 20% increase in bicycle ridership in downtown > 50% reduction in vehicle and bicycle collisions	- Outfit 100% of 500 bicycles with ICT such as Bike Share bicycles, bicycle interest groups, and employers that support bicycling to work > 30% increase in bicycle ridership throughout Las Vegas > 50% increase in emissions data accuracy > 5% reduction in carbon emissions
 Smart Wayfinding Signage	- Successful deployment of Smart Wayfinding Signs outfitted with DSRC, WiFi, and 4G cellular radios - Integration of Smart wayfinding data to CLV Mobile App and AV/CV vehicles - Automatic multimodal route navigation from Smart wayfinding sign to key areas of interest	100% integration of Smart wayfinding sign information to CLV Mobile App 100% integration of Smart wayfinding sign information to AV/CV test vehicles	100% integration of Smart wayfinding sign information to all AV/CV vehicles - Automatic wayfinding and alternate route navigation during instances of high traffic congestion or emergency situations



Project	Success Criteria	Quantifiable KPIs	
		SHORT TERM (< 3 YEARS)	LONG TERM (5-10 YEARS)
 Downtown Traffic Monitoring & Measurement	• Full ICT deployment along urban corridors • Real-time display of traffic incidents and areas of high concentration to Bugatti app • Traffic signal synchronization to maintain speed harmonization and reduce congestion	• > 20% reduction in traffic congestion • Incident notification on Bugatti app within 3 seconds of occurrence	• > 5% reduction in carbon emissions • > 90% successful automatic rerouting of traffic during peak periods and emergency situations • > 40% reduction in traffic congestion
 ParkMe Real-time Parking	• Full deployment of smart sensors, wireless radios, and GPS to parking spaces • Integration of availability data into ParkMe app • Integration of ParkMe app into CLV Mobile App and AV/CV displays; • Automatic routing of AV/CV test vehicles to available parking spots • Routing of commercial vehicles to enhance goods movement	• > 100% of city-owned or -managed downtown parking spaces will be outfitted with smart sensors • > 75% reduction in CLV residents and visitor complaints in finding parking • Full integration of ParkMe app into CLV Mobile App • Partner with minimum of 3 private garages • Increased satisfaction of freight drivers	• Identification and real-time availability of 100% of all Las Vegas parking spaces • Autonomous routing of AV and CV vehicles to available parking space • Integration into regional and state goods movement plans
 Solar Charging & Smart Monitoring	• Deployment of solar EV charging stations throughout Las Vegas • Retrofit of existing EV charging stations with ICT to monitor power consumption and usage • Integration of charging stations into CLV Mobile App to identify and navigate users to available charging stations • Integration of EV probe information • Integration of EV charging station installation requirements into land development code	• 200% increase in EV charging stations • 90% of new EV charging station will be installed with supplemental solar charging capacity • > 90% existing charging stations tied to CLV Mobile App • Automatic AV/CV routing to available charging stations	• 500% increase in the number of charging stations • > 50% of all charging stations have solar powered backup • > 5% reduction in carbon emissions due to improved charging station efficiency
 Smart Metering of City Streetlights	• Full deployment of smart metering and communications throughout the City's streetlight network • Full integration of streetlight consumption data into Smart grid and Smart City	• > 15% improvement in streetlight power consumption efficiency • > 98% functioning streetlights (tuning on and off when intended) • > 50% reduction in City resident complaints on streetlight inefficiencies within project boundary	• Automatic rerouting of electrical power based on the need for improved lighting performance in highly concentrated areas • Predictive analytics and automatic decision capability for Smart Grid based on streetlight efficiency
 Advanced Emergency Response Integration	• Integration of Fire CAD/AVL data into the analytics engine and Bugatti app • Data integration into traffic signaling network • Integration of DSRC-based emergency signal preemption • Resynchronization of traffic signals upon preemption of emergency vehicles	• 20% improvement in harmonization of intersection operations after preemption of emergency services • Bugatti display of preemptions and emergency situations	• 50% improvement in harmonization of intersection operations after preemption of emergency services • Automatic alternate routing of traffic during emergency situations through DSRC communications
 CLV Fleet Vehicle AV/CV Conversion	• Retrofit all City fleet vehicles with AV/CV technologies • Integration of City fleet vehicles into AV/CV test beds	• Successful retrofit of > 40% of CLV existing fleet vehicles • > 15% required user intervention during AV/CV testing with fleet vehicles (at least 100 tests)	• Successful retrofit of > 80% of City existing fleet vehicles (with more than a 5-year lifespan) • 100% pass rate of automatic rerouting of City fleet AV and CV vehicles based on real-time instances and emergency situations



Project	Success Criteria	Quantifiable KPIs	
		SHORT TERM (< 3 YEARS)	LONG TERM (5-10 YEARS)
USDOT Smart City Showcase Program	• Full open-source data integration across all public service data platforms for transportation • Real-time & predictive data analytics using probe data from project sources • Automated decision support commands to change situations based on certain performance thresholds	• > 50% of public service data platforms integrated • 100% of all integrated data on a standard platform and interoperable • Real-time & predictive analytics available on at least one public service entity • Integrated with Bugatti dashboard to show City health	• 100% of all public service data platforms integrated and interoperable • > 40% reduction in traffic congestion • > 20% reduction in carbon emissions • > 20% reduction in city power consumption • > 50% reduction in safety instances



Evidence of Delivery Capacity, Commitment, and Readiness

The City of Las Vegas is well-equipped to fulfill the USDOT's vision of a Smart City Showcase. We have a robust organization of staff whose primary focus is deploying a Smart City. We are on track to become a Smart City by 2035. Over the past year, even before release of this program from USDOT, we have been ramping up to deploy a series of innovative solutions to become a Smart City. Our capability to deliver is supported by these staff and resources:

- **City of Las Vegas:** Over 2,600 full-time employees
- **RTC:** Approximately 300 employees, including engineers, technicians, operators, technicians, IT, support and management staff
- **Desert Research Institute:** Over 30 faculty and staff with 10 research associates, engineers, and software developers committed to this USDOT Smart City Showcase program
- **UNLV:** Over 50 faculty and staff, with 5 research associates, transportation robotics engineers, software developers, and mathematical modelers committed to this USDOT Smart City Showcase program
- **NV Energy:** Existing communications network and support for Smart grid deployment to serve as the power foundational component for our USDOT Smart City Showcase
- **Bosch:** 360,000 associates
- **CH2M:** 25,000+ full time engineers, managers, and technologists dedicated to Smart Cities and other innovative public infrastructure programs; with nearly 80 employees in the Las Vegas area
- **Faraday Future:** 500+ full time engineers and technologists
- **Ford:** 20,000+ employees dedicated to innovative transport initiatives
- **HERE:** 5,000+ full time staff dedicated to data collection and analysis
- **INRIX:** 200+ full time engineers and data analysts
- **Jacobs:** 65,000+ employees dedicated to innovative public infrastructure programs, with over 50 employees in the Las Vegas area
- **Qualcomm:** 25,000+ employees

We also have several facilities dedicated to supporting our USDOT Smart City Showcase. The City has 4 offices throughout Las Vegas that are used for our Smart City initiatives. We have a newly modernized Traffic Management Center that will serve as the



Executive Support

To show our commitment to becoming a Smart City, the City of Las Vegas has established, through Resolution R-3-2016, that our downtown planning area, identified in our Downtown Las Vegas Master Plan, an **"Innovation District"** focused on the "promotion and adoption of new transportation infrastructure and mobility technologies" and "to create partnerships with autonomous vehicle and mobility technology companies to establish demonstration sites within the Innovation District." We have provided a copy of this resolution in Attachment 2 of our proposal.

We also have a highly supportive, progressive group of state and City legislators fully supporting Las Vegas in becoming a Smart City. This has been made glaringly apparent through the support provided to attract innovative businesses such as Faraday Future, Hyperloop Transportation Technologies, Local Motors, and Zappos into the Las Vegas area. Our legislators have committed people, resources, facilities, land, and investment dollars to promoting innovation, while supporting economic growth. We have included letters of support from both our Governor's and Mayor's offices that further validate their interest and support.

The positive executive support we have received spans every organization. Our legislators and executives have established two strong initiatives to promote our Smart City progress.

At this year's CES, Governor Sandoval announced the establishment of the **Nevada Center for Autonomous Vehicles** to become the nation's leader in the testing and development of "cars that drive themselves." This center

of excellence, part of the Governor's Office of Economic Development, partnered with the City and RTC, will provide a platform for companies to design, manufacture, and test AVs, and provide support for companies wanting to pursue AV initiatives.

In July 2015, the Southern Nevada Tourism Infrastructure Committee was established to identify, prioritize, and report tourism improvement projects in southern Nevada, and explore potential funding mechanisms to support new tourism-related initiatives. To support these endeavors, the committee was chartered to evaluate and recommend tourist transportation infrastructure improvements.

Infrastructure Readiness & Data and Performance Management Capabilities

The City and its partners RTC and NV Energy have well-established performance dashboards that monitor transportation and power consumption capabilities. As part of our USDOT Smart City Showcase program, we will integrate these into the Real-time City Dashboard that will monitor the performance of each of our public service capabilities and report on the "health" of Las Vegas. We will couple this dashboard with our Real-Time & Predictive Analytics Engine (powered by DRI, UNLV, Bosch, Ford, HERE, and INRIX) to perform analysis against all of our collected data sources. The results of this engine will also be tied to a DSS that will automatically control city situations (traffic signaling, power production, water and waste processing) based on Las Vegas' behavior against a series of established performance thresholds.



Partnerships, Roles, & Investments

The City recognizes the importance of building a diverse team comprising public sector, private sector, university representatives, manufacturers, and developers to create a comprehensive team that can develop and implement smart city solutions.



Our partners and their proposed roles are:

Ford will support autonomous, connected and electric vehicle initiatives, as well as data interoperability between the Smart City and their Sync telematics platform.

Bosch will focus on smart infrastructure, automated parking, and data integration across each of our public service data platforms.

Faraday Future will support new EV charging technologies, and AV/CV interactions within the test beds. They will also support the development of these test beds.

CH2M and Jacobs will provide technical and project management consulting expertise to design, develop, and manage the deployment of each of the projects.

HERE will provide commercial GIS and other data repositories for inclusion in the Real-time and Predictive Analytics Engine.

INRIX will modify their ParkMe app for integration into the Smart City and provide commercial GIS and other probe data to the Real-time and Predictive Analytics Engine.

Delphi will provide smart infrastructure solutions for deploying each of our projects.

UNLV will lead the the City Fleet Vehicle Retrofit Project and support the mathematical modeling needed for the Real-time and Predictive Analytic Engine.

RTC-FAST will design and implement smart infrastructure solutions with our private partners; support traffic data integration and analytics; and provide technical representative support to CLV. They will also transform their Bugatti dashboard to the Real-time City Dashboard.

Trafficware will support CAD/AVL data integration into our Smart City.

NV Energy will provide Smart Metering and Smart Grid integration for the Smart Streetlight and Solar Charging & Smart Monitoring projects.

Qualcomm will provide smart infrastructure communications solutions and provide data interoperability expertise for integrating each of the public service data platforms.

CivicSmart will deploy smart parking sensors and infrastructure upgrades to our City and commercially owned parking spaces.

Parkeon will integrate their smart metering data into the ParkMe app for automatic reservation and payment information.

DRI will develop the Real-time and Predictive Analytics Engine, establish data interoperability amongst each data platform, integrate the data into the Smart City Monitor and Control System, and deploy the DSS.

We are proud to partner with these reputable companies and universities that are already at the forefront of developing the intelligent transportation system technologies that will ultimately be used to improve safety, enhance mobility, and reduce fuel use and emissions. Their expertise and services will be leveraged to best utilize the federal funding of the Smart City Challenge grant. In addition to the in-kind donations and cost sharing, the City will provide staff support through in-kind donations. There are also opportunities to utilize local funding sources for ITS to supplement and/or provide a local match to the federal funding.

In addition to the resource matches going forward, the City and its partners have already made considerable investments in preparing the City to become Smart City. These investments were used to augment our technology infrastructure and will provide a jump start/launching point for incorporating ICT in our efforts to become a Smart City. Some of the investment projects and their values (both City and federal) are provided in Table 6.

Table 6. Las Vegas Smart City Investments to Date

Project Description	Investment Value (\$)		
	City	Federal	Total
Downtown Roadway Reconstruction (2008-2015)	\$91.3M	\$174M	\$265.3M
Traffic Signal Controller Upgrades	\$1.8M		\$1.8M
NV Energy Smart Meter Deployment		\$138M	\$138M
Downtown Fiber Optic Communication Network	\$800K	\$1.9M	\$2.7M
Smart Park Meter Deployment	\$2.4M		\$2.4M
Downtown Wi Fi	\$180K		\$180K
RTC FAST Data Management System	\$44M	\$176M	\$220M

