USDOT: Smart City Challenge

"Nashville Connected: Music City's Smart Transportation Vision"

Metropolitan Government of Nashville and Davidson County

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Nashville Connected: Music City's Smart Transportation Vision

Part 1: Vision Narrative

Contents

1 **Nashville's Challenges and Vision for a Smart City** 1
2 **Population Characteristics** 5
3 **Other City Characteristics** 6
4 **Annotated Preliminary Site Map** 9
5 **Vision Elements** 9
6 **Risks of Deployment Vision** 15
7 **Partners and Key Stakeholders** 17
8 **Existing Transportation Infrastructure and System Features** 17
9 **Data** 19
10 **ITS Architectures and Standards** 24
11 **Measurable Goals and Objectives** 25
12 **Nashville's Capacity** 26
13 **Leveraging Resources** 27

Nashville's Challenges and Vision for a Smart City

Nashville's Smart City vision calls for an **inclusive, multi-modal transportation system** with integrated technologies that improve safety, enhance mobility for all, and reduce our city's impact on the environment. Technology use in our transportation system, complemented by ongoing investments in the active modes, will permit a paradigm shift from majority reliance on private, single-occupancy vehicles for most trips.

In pursuit of this vision, Nashville is well-positioned to **embrace emerging technologies** that will influence the transportation landscape throughout the 21st century, including electric and autonomous vehicles. Nashville will work to ensure these technologies are integrated with existing multi-modal mobility goals, utilizing data-driven technology and policy platforms that provide real-time information and decision-support to both residents and implementing organizations through smart applications. This platform will focus on integrating modular technologies and methods, which can be **replicated** in cities around the United States.

Nashville's goal is to **expand access** to social, economic, and cultural activities; **manage growth** and congestion; **provide meaningful transportation options** beyond single-occupancy, private vehicle; and contribute to quality-of-life. Ultimately, smart city technologies will enable all residents to experience not only transportation mobility, but economic mobility, providing ladders to opportunity across Davidson County.

Challenges:

Mid-sized cities like Nashville can lack a robust network of multimodal transportation choices, increasing our region's vulnerability to congestion. Rapidly growing mid-sized cities are facing this problem more, as

traffic congestion has nearly doubled in the last ten years, and Nashville's investment in non-auto modes has not kept pace with this growth. Congestion is expected to more than double by 2040. Nashville must work with its regional partners to align land-use policies and mass-transit investments to manage congestion, while embracing technology to better utilize existing infrastructure to keep people and goods moving.

Population growth and changing demographics are impacting Nashville's housing market and community character. Over the next 25 years, Nashville-Davidson County will add 186,000 residents and 326,000 jobs. An average of 82 people move to Nashville each day, and projections show that the Nashville region will welcome one million millennials, creatives, entrepreneurs, Baby-Boomers, New Americans, and others to our metro area over the next quarter century. Without a smart approach to transportation, accessing jobs, services, and opportunities will become more challenging as our population increases and economic activity expands in Nashville and the surrounding metropolitan area.

Nashville is committed to leveraging its existing transportation assets and expanding access to transportation choices through the use of technology. Nashville will align public and private incentives to promote shared mobility options that reduce personal vehicle trips, as well as continue to invest in transit, and bicycle and pedestrian infrastructure that supports access to mass transit, goods and services.

Nashville's Dynamic and Diverse Transportation Problems

Nashville's street network is mostly built, and rights of way throughout the county are constrained. To allow the region to continue to grow in a harmonious manner, our city must expand access to multimodal transportation options and utilize technology to better manage, operate, and maintain our existing transportation assets. Because Nashville's city limits span urban, suburban, and rural settings, with varying patterns of development, Nashville faces a variety of transportation challenges across the city.

At the intersection of three major interstates (U.S. Interstates 24, 40, and 65), Nashville and the surrounding metropolitan area comprise a complex regional context, with growth occurring not only in the city limits, but also in surrounding counties. More than half of all commuters in the Middle Tennessee region work in a different county from which they live. This places additional stress on Nashville's transportation system, with high quantities of travelers heading both in and out of Nashville during peak travel hours.

It is essential that we use our region's existing resources more efficiently, effectively, and equitably. In the past, our region has invested heavily in traditional highway infrastructure to try to manage congestion. These transportation assets are inaccessible to many residents, preventing some residents from fully participating in social and economic opportunities. At the same time, this infrastructure has influenced commuting behaviors and growth patterns, contributing to worsened congestion. For example, 81.3% of residents commute alone, while 19,255 households have no access to a car in Nashville. Transit ridership has increased by 40 percent in Middle Tennessee since 2005, but our transit ridership is still low, with Nashville ranking 76 out of the top 100 metro areas in terms of ridership. In 2014, the average auto commuter lost 45 hours due to traffic, costing our region more than $800 million. The lack of meaningful transportation options burdens our economy, our residents, and our environment. The Nashville Area MPO traffic models show this amount of time spent on the roadways will double by 2040 due to population growth and worsening congestion. While congestion is a symptom of prosperity, communities must provide alternatives to sitting in traffic, should they wish that prosperity to continue. Accessible, multimodal options and infrastructure will enable enhanced transportation mobility and expand access to enhanced economic mobility.

Like any other urban area, Nashville aims to meet the transportation needs of residents as well as the industries supporting our local economy. As one of the top destinations in the country, Nashville experienced 60 consecutive months of year-over-year growth in hotel rooms sold and hotel tax collections. While the hospitality industry serves as one of the backbones of our economy, bringing in $5.4 billion per year, it also attracts over 13 million visitors each year. From the high volume of visitors traveling in and out of Nashville to the high volume of visitors traveling within the downtown urban core, the tourism industry presents our city with another complex transportation challenge.

The downtown urban core of Nashville is extremely vibrant and successful, but with this success comes unique transportation challenges – particularly related to managing multimodal demand and access during construction and special events. During 2014 and 2015, Metro Parks issued permits for more than 930 special events attended by nearly 2.5 million people. In addition to these special events, construction and maintenance related closures and major events in traditional venues add additional strain to Nashville's transportation network. This particularly impacts transit users like bus riders, pedestrians, and cyclists, as their routes can be severed by special events and construction related closures and detours, creating unfavorable conditions or added time and effort to a trip. By building on existing technologies and creating new platforms that use network level information, we can empower transit users to make smarter transportation choices. Information can also be used for pre-planned selective re-routing of traffic to maintain flow and prevent bottle-necks, thus improving safety and mobility for all transit users. This data can improve transportation now, and contribute to successful connected and autonomous vehicle technology in the future.

As Nashville's downtown and walkable inner neighborhoods have redeveloped, many residents –especially people with limited mobility access– are moving further away from the core to obtain affordable housing. While planned investments and land-uses will ultimately help these areas to become walk/bike- and transit-friendly, innovative technologies and partnerships *must* provide for underserved residents with transportation *today* that allows access to destinations essential to economic mobility, physical and mental health. For example, Transportation for America's *Aging in Place: Stuck without Options* (2015) showed that 85% of Nashville residents aged 65-79 had poor transit access. Only Atlanta, Kansas City, Oklahoma City fared worse off.

Safety and Public Health

Nashville's legacy transportation infrastructure lacks basic features like sidewalks, crosswalks, transit-stop amenities, and bike lanes. As Nashville's urban core continues to develop and grow, more trips are being taken on foot and bicycle. This combination of increasing active-trip demand with limited supporting infrastructure correlates with an alarming number of bicycle and pedestrian injuries and crashes. According to a recent 2014 Pedestrian and Bicycle Safety Pilot Project, more than 1,200 bicycle and pedestrian injuries and crashes were observed in a three-year period. Smart Growth America's 2014 *Dangerous by Design* report ranked Nashville as **the nation's 15th most dangerous metro for pedestrians**. Nashville has taken a data-driven approach to addressing these safety issues, using GIS software to identify 50 high-pedestrian crash locations and 25 high-bicycle crash locations. Cost-effective, easily-implementable safety countermeasures –designed to be employed in a short time frame– were identified at each crash location.

As a part of Nashville's Smart City vision, Nashville will use technology and to both analyze *and* react to data on serious injuries and fatalities, as well as provide decision-support for infrastructure investments to prevent injuries and fatalities even as travel behaviors and development patterns change over time. Nashville will develop a model system that combines demographics, transportation asset data, land use policies,

and advanced projection and modeling techniques to identify potential high-crash spots *before* they claim a life. Cities around the country will be able to better protect their citizens using the tools developed here.

In 2014, Nashville MPO's planning area experienced 53,531 vehicular crashes, 164 fatal crashes, and 13,882 injury crashes. While the frequency of total crashes and crash-related injuries/fatalities has declined over the past four years, it's critical that Nashville move toward a Vision Zero scenario for fatal collisions.

In addition, Nashville recognizes that our traditional sprawling development patterns and reliance on the single occupancy private vehicles for the majority of our trips has led to a sedentary lifestyle that is a real threat to our regional public health. Nashville's daily vehicle miles traveled is a whopping 34.7 miles and the region's obesity rates in 2011 (the last time they were assessed) were 66.2%, up from 60.6% in 2010. This particularly impacts our more vulnerable populations, including children and low-income populations. The research clearly shows a high correlation between poverty and higher mortality rates. As Nashville's regional planning efforts shift to encourage more compact, walkable, and bicycle-friendly communities, emerging technologies and data-driven technology platforms should support the city's public health goals.

Climate Change

2015 was the hottest year on record, confirming the challenge for cities worldwide to take responsibility for tackling addressing a changing climate. Cities are the future of global development. Already more than 50% of the global population lives in urban areas (expected rise to 66% by mid-century). While cities are currently more energy-intensive than rural areas, they have tremendous potential to become the beacon of green, sustainable living. In addition, the drivers of emissions in cities are usually the same, including inefficient heating and cooling in buildings, methane emissions from landfills, heavy traffic congestion, and inefficient water systems and outdoor lighting. In Nashville, 32.6% of the city's carbon emissions are estimated to originate with the transportation sector. A 2013 analysis of Tennessee's statewide CO2 emissions showed a 27.9% attribution to the transportation sector. Identifying low-carbon transportation solutions is essential to the city's and the state's continued growth and success.

Nashville's Vision for the Next Generation Transportation Services:

Despite our long list of challenges that are mostly inherited from half a century of building a metropolitan area around cars, Nashville is uniquely poised for a paradigm shift towards more compact development patterns and a multimodal transportation network. Nashville recently completed a three-year process called *NashvilleNext*, the city's comprehensive growth, development, and preservation plan for the next 25 years. Residents voiced concerns about how difficult it is to get around the city without a car, and they are seeking solutions that go beyond building new roads. They want their communities to be walkable and bicycle friendly, and they want to be connected to mass transit options.

Given the dynamic nature of these transportation problems across Nashville-Davidson County, a holistic solution is needed that integrates emerging technological elements with the planned available transportation options and policy initiatives proposed in *NashvilleNext* to help Nashville better use its infrastructure. In particular, we must ensure that Nashville becomes a smart and connected community where transportation improves access and is a ladder to opportunity, not a barrier.

Smart and connected communities are examples of dynamic human cyber-physical systems, which are characterized by rich integration between computational elements, physical elements, and human elements in a city. This integration should provide a continuous feedback loop of "sense, analyze, and actuate" that enables autonomic control capabilities for managing physical elements, such as traffic lights and driverless

cars. Moreover, smart and connected communities can also provide contextual information to humans as part of a dynamic decision support system, thereby helping them make informed choices.

This system must constantly generate feedback to help residents and visitors use it optimally. For example, a smart citywide shared mobility system will help commuters find the best trip option(s) based on multi-attribute optimization criteria (cost, time, predicted availability), while managing global constraints for congestion, public-transit service alerts, and emissions. Data gathered from this system can help city planners introduce new transit routes or modify existing transit routes to account for dynamic demand, and/or meet policy goals around greenhouse-gas emissions-reductions.

While there is Intelligent Traffic System (ITS) infrastructure in Davidson County, Nashville lacks many ITS technologies found elsewhere in the region and throughout the county on non-Interstate routes. While Nashville lags behind peer-cities in a few key transportation and ITS-related areas, the goal is not to catch up with other peers, but to leapfrog into the next generation of ITS applications and data-sharing, so that Nashville becomes a proving-ground or "laboratory" for promising technological solutions.

As previously stated, Nashville's vision for the next generation of transportation services is an inclusive multi-modal transportation system with integrated technologies that allow us to not only have "complete streets," but complete trips, moving us further away from our reliance on private single-occupancy vehicles. To link residents to opportunities as envisioned, technology needs to be interwoven into the following Strategic Transportation Initiatives, as identified in *NashvilleNext*:

• Develop an exceptional walking environment • Create a robust biking network • Create dedicated mass transit lanes • Manage travel lanes	• Complete strategic connections • Maintain infrastructure • Achieve zero traffic-related deaths

Project implementation builds on the work of Nashville's 25-year general plan, *NashvilleNext*, and its Strategic Transportation Initiative. This involves developing a framework for collaboration across Metro departments and external decision-makers in land-use and transportation. The framework will develop a multi-modal transportation program of project-priorities from *NashvilleNext*, update policies, ensure funding for infrastructure maintenance/operations, and explore dedicated funding source(s) for transportation/transit.

Nashville's Smart City program management approach includes leadership from Mayor Megan Barry's infrastructure, transportation and sustainability team in concert with Metro's Chief Information Officer/Director of IT Services and Chief Data Officer; convening of the proposed Smart City Advisory Council and additional, relevant community partners and elected officials; and an integrated public outreach effort by the Mayor's Office of Neighborhoods & Community Engagement, Metro Councilmembers, and potentially a consulting firm. Find additional information on program management in Section 12: Nashville's Capacity.

Ultimately, our vision is to make Nashville a smart and connected community that is inclusive, accessible, safe, and low-carbon. Nashville's smart transportation system will utilize technology and data to create a seamless, multimodal transportation experience for residents, tourists, and employees and serve as a model for other cities to pursue and implement smart city technologies and transportation systems.

1 Population Characteristics

Nashville is a vibrant, creative community at a critical moment for managing growth and development.

Census 2010 Total Population: Davidson County, TN: 626,681 Urban Services District: 429,776 2014 Census Estimate of Davidson County Population: 668,347	**Nashville-Davidson--Murfreesboro--Franklin, TN MSA Total Population:** • 2010: 1,589,934 (US Census Bureau 2010 Decennial Census). • 2014: 1,792,649 (U.S. Census Bureau 2014 estimates).	• Davidson Co. total population (2010): 626,681 • Nashville-Davidson, TN UA population: 605,250 • 605,250/969,584 = **62.4%** = Davidson Co. portion of Nashville-Davidson UA

2 Other City Characteristics

Existing Transportation System

Greater-Nashville is at a crossroads for planning and investing in its area transportation system to sustain a vibrant, growing economy accompanied by rapid job increases. The city is actively working toward mitigating stresses put on local/regional transportation systems, across all agencies and levels of government.

In mid-2015, Nashville's Metropolitan Transit Authority (MTA) and Regional Transit Authority (RTA) began a strategic master-planning process to develop a 20-year comprehensive transit plan for both the city-county and the region (with associated, specific project recommendations). The process, branded as *nMotion* and scheduled for adoption by summer 2016, will evaluate the state of Nashville's transit system, identify opportunities for system improvement and ridership/service increases, and meet growing transit needs.

Similarly, the Nashville Area Metropolitan Planning Organization's Regional Transportation Plan, scheduled for adoption in February 2016, aims to improve connections between transportation plans/investments, and area land use, urban design, economic development. *Middle Tennessee Connected* will identify the region's most important transportation priorities for anticipated federal, state, and local funding through 2040.

Additionally, the Nashville Area Chamber of Commerce recently began its Moving Forward initiative to engage community and business leaders in the creation of regional transportation solutions. By convening partners and conducting an annual review of the Nashville region's progress toward implementing a regional transportation system, Moving Forward seeks to support the completion of an RTA and MTA strategic plan update by 2016; support the identification and passage of state and federal government revenue enhancements for transit by 2017; support the engagement of at least 30,000 unique individuals in transit discussion by 2017; identify and secure local dedicated funding source for regional transit by 2018; and support breaking ground on the first rapid transit project in our region by 2020.

Mayor Megan Barry and the City of Nashville are engaged in transportation planning and policy efforts on regional and state levels. Mayor Barry currently serves as a co- Vice-Chair of the Middle Tennessee Mayors Caucus. Projected transportation infrastructure needs far outpace funding sources, but the Mayor's Caucus has committed to making increased funding a legislative priority. Governor Haslam has also toured the region to discuss methods for generating additional revenue for transportation infrastructure.

Nashville is poised for major transportation investment as residents are asking elected leaders for improved service and infrastructure, and the responsible authorities are responding through comprehensive planning exercises. Combining these already-underway efforts with a Smart Cities initiative allows Nashville to potentially leapfrog other metros toward implementing a true 21st-century transportation system and network.

Committed Leadership and City-County Government
As Nashville Mayor Megan Barry's first four-year term began in September 2015, **a new mayoral administration** with committed, enthusiastic leadership –supported by in-office and departmental teams with deep subject-matter expertise– creates an ideal environment to pursue smart-city strategies. The future of Nashville's transportation system is a top priority for Mayor Barry, the 40-member Metro Council, and the community at-large. The Smart City Challenge is ideally and appropriately timed in synch with the community's long-term commitment and dedication to innovation in both the technology and transportation sectors.

Mayor Barry has prioritized transportation with a **Mayor's Office team** dedicated exclusively to leadership on transportation, infrastructure, and sustainability within and outside of Metro Government. This three-member team has been tasked with eliminating procedural and communication silos to facilitate sustained coordination and cooperation across departments and organizations, and will work with Metro IT Services, a Smart City Advisory Council, and partner organizations to carry out program activities. Finally, as a consolidated city-county government, Nashville-Davidson County represents 526 square miles of the greater-Nashville region efficiently, and with consideration for a diverse array of populations and communities.

Smart City Advisory Council: Mayor Megan Barry is currently pursuing the creation of a **Smart Cities Advisory Council** to improve livability, efficiency, sustainability, and resiliency by overseeing the integration of emerging technologies into Metro government operations. As *NashvilleNext* recommends, this Council will inventory existing tech assets, needs, and overlapping technologies; seek strategies to better leverage existing smart-city technology investments; pragmatically assets commercially-available technologies to meet needs; research and address emerging trends and technologies. This Council will include subcommittees on smart-city issues:

- Smart Transportation (parking, transit, traffic management, connected/autonomous vehicles)
- Smart Water (waterway management, storm-water, wastewater, and freshwater supply)
- Smart Public Safety
- Smart Energy (Supply-side: electric and natural gas utilities, renewable energy policies)
- IT and Connectivity
- City-wide Integration of Smart City Initiatives

Mayor Megan Barry is considering a retained consultancy for facilitating Metro's Smart City Strategic Plan, involving Smart City Advisory Council members and community stakeholders. Nashville has already convened a robust multi-stakeholder group that made detailed recommendations around sustainability (Mayor Karl Dean's Green Ribbon Committee), and will build on that work with the Smart City Advisory Council.

Commitment to Sharing Economy: Nashville has been specifically recognized at a national level for its commitment to a hospitable regulatory environment for businesses that promote the sharing economy – particularly Transportation Network Companies. According to R Street's 2015 *Ridescore* report, Nashville scored highest in America for TNC-friendliness. This legal climate is demonstrated by recent passage of commonsense ridesharing legislation. Nashville has also prioritized welcoming sharing-economy businesses and their associated talent: Lyft is bringing a new local corporate presence for customer service–a $5.1 million investment with 400 new jobs. And Uber has a fully-staffed local office in Nashville's downtown area.

Strong and Diverse Economy: As Tennessee's main economic driver, Nashville's prosperity is rooted in economic diversity; leading industries include healthcare, technology, hospitality, music/entertainment, manufacturing, and higher education.

- Nashville MSA's gross metropolitan product is $100,841 billion (top-3rd of 100 leading U.S. metros).
- Over the previous five years, the region's businesses have experienced a 14%-growth average.
- According to the U.S. Bureau of Labor Statistics, Nashville was the #1 American market for job creation (among metros with one-million-plus residents) in 2012, #2 in 2013, and #8 in 2014.
- In 2015, the Brookings Institute ranked Nashville as the No. 1 metro for advanced manufacturing job growth, and by *Fortune* as the No. 2 fastest-growing city for tech jobs.
- Nashville approved $2,437,788,885 of building permits in FY2014-15, **a 30% leap** over the prior year, setting a record $1.87 billion worth of permits for new buildings, renovations, development activity.

Major employers include: Vanderbilt University (22,105), NISSAN North America (10,050), HCA Holdings, Inc. (7,000), Community Health Systems (3,092), GM (2,139), UPS (2,012), Amazon (2,000), and Bridgestone Americas (1,855). Automotive manufacturing companies located in the Nashville area include General Motors and NISSAN. Bridgestone Americas recently announced plans to relocate its corporate headquarters to downtown Nashville – a $232 million investment bringing 600 new jobs and 1,100 existing jobs.

As a city with burgeoning technology, creative, entrepreneurial industries, Nashville is now an established **innovation hub** in the Sunbelt, strengthening its ability to leverage relationships with companies like Google. Nashville was one of seven inaugural cities in the 2013 Google for Entrepreneurs Tech Hub Network, bringing new ideas, initiatives, and investments in the technology and startup sectors. And along with other major telecommunications providers, Google is installing Fiber infrastructure throughout the city.

Higher Education: Further strengthening Nashville's environment of research, innovation, and creativity are its 21 reputable higher-education institutions, including Vanderbilt University, Lipscomb University, Belmont University, Fisk University, Tennessee State University, and Meharry Medical College. While the city already has experience in partnering with local universities, partnerships with academia will be foundational for planning and implementation of the Smart City vision. As mentioned later in this proposal, Metro recently established a more formal partnership with Vanderbilt University. Additionally, the City will partner with the University of Tennessee's Center for Transportation Research (see attached letter of support).

Spirit of Collaboration: Nashville is reputed for utilizing community-wide efforts and strategic public-private-university partnerships for addressing pressing issues. This spirit of collaboration is often noted in the city-wide emergency and recovery response to May 2010's 1,000-year flood event. A spirit of collaboration is also evident in the formation and continued efforts of Partnership 2000/2010/2020 and Cumberland Region Tomorrow, two of America's oldest, most sustained and collaborative, regional economic-development and quality-growth initiatives. Regional collaboration also occurs around transportation/transit and other issues (tourism, education, air/water quality) through the work of the Nashville Area Metropolitan Planning Organization and the Middle Tennessee Mayors Caucus.

Nashville and its surrounding communities are also actively working to strengthen relationships with State-level agencies and policymakers to ensure support for a local environment conducive to project completion and other forthcoming smart city initiatives. Since taking office in September 2015, Mayor Megan Barry has begun working in a bipartisan manner to generate support for transportation and smart city efforts: Tennessee State Senator Mark Green has filed Senate Bill 1561 to establish safety and registration policies for the

manufacturing and testing of autonomous vehicles. In addition, Mayor Barry has engaged Tennessee State Senator Bill Ketron on legislation to facilitate Bus Rapid Transit along Interstate right-of-way.

Open Data: Mayor Megan Barry's Administration has convened a diverse constituency of relevant mobility and innovation partners, in conjunction with **Metro Government's existing open-data initiative**. Engaged partners willing to **open and cross-platform share mobility-related data** sources include: the Nashville Metropolitan Transit Authority and Regional Transportation Authority, the Tennessee Dept. of Transportation, Lyft, Nissan, and all Metro departments, among others. As Nashville advances its Smart City Challenge work, the Mayor Office and its partners will facilitate, solidify details of open-data agreements, recruit additional partners/sources as needed, and staff/resource any outlying back-end data management needs, as appropriate. An ethic of partnership and collaboration has framed Nashville's approaches in the past, lending this community a track-record for cultivating an environment uniquely prepared for and conducive to carrying out Smart City strategies—across city-regional-state levels and/or public-private-university entities.

3 Annotated Preliminary Site Map

*See map attached.

4 Vision Elements

For the region to continue to grow, the city must move away from a reliance on private vehicles and expand access to multimodal transportation options, while simultaneously using technology to better utilize existing assets. This multimodal system will work to integrate data from various sources, including transit vehicles, traffic flow sensors, interstate cameras, and weather conditions, to provide end users with travel options that take into account the individual's profile and time constraints, along with providing cost parameters for each option to help citizens make more informed travel decisions. In addition, Metro Government's data and technology platform will help us achieve our regional goals, such as reduction in congestion and total fuel consumption. Multimodal travel options include public transit, personal vehicles, shared rides, bicycles, and walking. With these goals in mind, Nashville proposes to focus on the following five Smart City pilot projects: 1) Parking reform, 2) Municipal fleet conversion to EVs, 3) Ridesharing pilots with electric vehicles, 4) Autonomous Vehicle (AV) pilot, and 5) IT infrastructure, open data and transparency.

1) Parking Reform

Addressing parking reform now as part of the Smart City Challenge will better position Nashville for greater transit ridership in the future, when parking is appropriately priced, and for greater integration of Autonomous Vehicles (AVs), when fewer parking spaces will be needed. Nashville proposes implementing a pilot program at the Main Downtown Nashville Public Library Garage, which will consist of 1,361 spaces after completion of a current expansion, that will feature: 1) Metered parking that can be paid by credit cards, by SmartCity ID cards (see details below), or by phone, 2) Parking sensors that identify where open spots are located and drastically reduce CO2 emissions resulting from circling in search of parking, 3) Surge pricing that adjusts parking costs according to demand, and 4) A potential pilot for self-parking, autonomous cars. There are numerous other garages downtown that would also be potential candidates for a pilot program. Metro Government would work with the Downtown Partnership to identify the most promising locations.

Smart Parking Sensors at garages and meters enable the use of data to better communicate to drivers by directing them to available spaces; manage parking demand; and regulate special event related congestion. This information may be integrated with turn-by-turn directions for travel; a centralized system to adjust parking prices based on events, traffic, and congestion; real-time displays (physical and online) on availa-

bility and prices of spaces; and enforcement tools that alert users and enforcement officers when time is nearly up, allowing for increased control of extending hours or issuing fines.

Parking policies will have major impacts on the future of Nashville's multimodal transportation network. In order to prepare for increased transit investments, the growth of ridesharing, and the future of autonomous vehicles, Nashville will utilize emerging data-driven technology to experiment and pilot new parking policies that will set the city up for success in the future.

2) Municipal Fleet Conversion to Electric Vehicles (EVs)

Nashville is very interested in exploring opportunities to convert Metro Nashville's municipal fleets, totaling over 3,400 vehicles, to electric vehicles. In addition to the numerous environmental benefits associated with electric fleets, conversion of light-duty vehicle fleets can result in 50% lower fuel and maintenance costs than traditional internal combustion engine fleets. While the city will focus on Metro's light-duty fleets, it still needs to conduct an assessment of the use characteristics and fuel consumption of the over 50 departments' fleets to determine which vehicles classes would most benefit from conversion. Based on experiences from other cities, most notably Indianapolis, city leaders believe that numerous fleets would benefit from conversion, including vehicles from Metro Public Works, Metro Water Department, Metro Public Schools, or other agencies and departments with light-duty vehicles. The city is considering partnering with Nissan for EV conversions, given Nissan's expertise in EV technology and manufacturing. Nissan's corporate headquarters are located in Nashville and the production of the Nissan Leaf occurs in nearby Smyrna, TN, making the Leafs a "local product". Metro is exploring a partnership with VisionFleet (visionfleet.com) due to their extensive experience in converting municipal fleets to EV in cities like Indianapolis.

Electric vehicles are well-positioned to contribute to the city's goal for smart transportation infrastructure. EVs can communicate with the electric grid to receive a charge from the grid, store energy from the grid, or give energy back when it is needed. EVs can also be equipped with sophisticated telematics that analyze the travel patterns of the vehicle and report data back to a central data system, allowing the fleet operator to more efficiently manage that vehicle and the fleet as a whole.

There are numerous reasons for Metro-Nashville to consider converting its municipal fleets to electric vehicles. First and foremost, as previously mentioned, fleet conversion is often a cost-savings measure. In addition, relying on our energy grid to power municipal vehicles means that Metro Government is achieving energy independence and no longer needs to rely on changing gas prices controlled by volatile foreign countries. Electric vehicles also have zero tailpipe emissions which provide clean air benefits when looking at local air pollution. Since many of our vehicles operate in parts of Nashville that impact low-income communities and neighborhoods with children, this is of utmost importance. Metro Nashville is also committed to working with Nashville Electric Service and the Tennessee Valley Authority to "green" our region's and the state's energy grid, so that electric vehicles have both global GHG and local air quality benefits.

3) Ridesharing with Electric Vehicles (EVs)

Nashville is considering a partnership with Lyft and/or Uber, as well as major automakers to implement an electric-vehicle ridesharing pilot downtown and in identified *NashvilleNext* Tier1 (priority development and growth) centers within the demonstration site. Ideas considered will build off of conversations already underway between MTA and local ridesharing partners, and TDOT and FTA:

- **First/Last Mile Ride Pilot**: Offer subsidized access to Lyft and/or Uber rides for MTA riders in areas where bus lines don't have enough ridership. The subsidy can be custom-structured for the MTA with

geofences on pickup/drop-off locations within specific zones or to/from trunk line transit stops. The operators can set conditions on time of day, a capped dollar amount or % subsidy. It can also provide a web-based tool so call center dispatchers can book on-demand rides for people without smart phones/credit cards. The Metro Arts Commission can commission local artists to use low cost and low impact treatments to visually define drop-off zones and leverage urban creative placemaking.

- **Expand MTA's Availability of Paratransit Service for Ambulatory Passengers by Integrating with Uber and/or Lyft:** Integrate MTA's paratransit dispatching system with Lyft's and/or Uber's APIs, allowing MTA to send Lyft and/or Uber vehicles to pick up ambulatory passengers. Lyft and/or Uber would integrate their software with MTA's dispatch system (Trapeze, etc.), and bill MTA monthly for the cost of all rides provided through that dispatch account. All customer booking and payment would be handled by MTA using existing systems. MTA could also allow direct booking by paratransit passengers via the Lyft and/or Uber apps or an MTA mobile application.
- **Mobile Ticketing**: Integrate the Lyft and/or Uber APIs into a forthcoming MTA mobile ticketing app, to show real-time wait times, prices, and allow people to book and pay for rides inside the app. Mobile ticketing can be combined with the first/last mile ride pilot and/or paratransit pilot to allow users to redeem and book rides right through MTA's mobile ticketing app. This could also later be transformed to use in Nashville's proposed app that integrates all modes and transport options, public and private.
- **Expand Availability of Wheelchair-Accessible Vehicles to Uber and/or Lyft through FTA-Funded Vehicles:** Uber, Lyft and similar networks have been facing legal challenges across the country for alleged ADA violations since wheelchair users are generally not able to request a ride in a wheelchair-accessible vehicle. MTA, TDOT, and sub-recipients of FTA funds (rural transit agencies and non-profit agencies serving the elderly and people with disabilities) will work together to identify opportunities where utilization of FTA-funded vehicles could enable Uber and/or Lyft to provide trips in accessible vehicles. For example, there are instances where rural vehicles are idle mid-day in Nashville while waiting for a passenger, and there are instances where non-profit agencies have vehicles only used on certain days of the week or during certain hours of the day. These situations present an opportunity to maximize use of existing FTA-funded assets through new technologies. TDOT has discussed such an arrangement with FTA Region IV as well as FTA Headquarters staff, and FTA has been receptive to finding ways for creative practices to work within the current regulatory framework.

Paratransit opportunities: Smart City partnerships focused on improving Nashville's ability to serve the city's disabled residents through paratransit services will build off the success of MTA's existing AccessRide program, which is a publically funded paratransit service operating specialized van services for persons with disabilities who are unable to use regular fixed-route buses. Other projects in the works include the launch of UberAssist in Nashville in the very near future. UberAssist is a new service offering for Uber that specifically targets elderly and mobility-challenged riders. Uber will use specialized vehicles and has provided specific training for their drivers to assist people with disabilities and other mobility challenges. Nashville will work closely with Mayor's Committee on People with Disabilities and other local partners, such as the Council on Aging and the Senior Transportation Coalition, to develop innovative, efficient, and cost-effective paratransit solutions.

New fleet conversion opportunities: In addition to a partnership between MTA and Lyft and/or Uber, the city has had initial conversations with VisionFleet about bringing their Evercar model to Nashville. The Evercar model uses 100% Nissan Leafs to provide EV ridesharing. Usually about 50% of users rent the Evercars for personal use, but the remaining users rent Leafs by the hour for use as commercial drivers for service, such as with Uber, Lyft or Postmates. As with usual ridesharing services, the driver doesn't need to

pay for insurance or gas, so it is often an extremely economical decision for drivers to engage Evercare in lieu of owning their own car. As services like Uber, Lyft, and Postmates continue to skyrocket here in Nashville, city leaders believe Evercar could be an extremely beneficial service for both residents and the ridesharing workforce, as well as a way to encourage EV adoption in Nashville. The Metro Arts Commission can work with MTA and private-sector partners to produce an artist call to specially wrap vehicles or produce other artistic and unique visual branding that identifies this fleet.

The above examples highlight the myriad opportunities for ridesharing services to complement Nashville's existing transit service in a more cost-effective manner than Metro or MTA/RTA could achieve. In addition, as mentioned in the section on municipal EV-fleet conversion, the opportunity to convert rideshare fleets to electric vehicles can provide residents exposure to electric vehicles and increase the size of the EV-driver constituency that can advocate for a cleaner local and regional electric grid. Finally, the Smart Cities Challenge provides an opportunity for Nashville to work closely with the city's ridesharing providers to ensure that their services support (instead of undermine) our region's goals for a multimodal transportation network that improves mobility access for all Nashville residents – particularly vulnerable, underserved populations.

4) Partnership with Automotive and Tech Industry Leaders to Test Autonomous Vehicles (AVs)

One of the most exciting, yet still somewhat unknown, emerging technologies within the transportation field is autonomous vehicle technology or self-driving cars. Many people have heard about Google testing out their AV technology on regular city streets in Silicon Valley and Austin, but few have actually passed one on the street. Car companies are also enhancing their vehicles with numerous connected vehicle technologies and automated mechanisms, such as parallel parking-assist or freeway lane-assist, but few drivers can imagine letting their car take over driving for an entire ride. Autonomous vehicle experts predict that certain types of AVs will be street-ready in 2-3 years. In particular, there are two types of autonomous vehicles that could be ready in the next two years: 1) low-speed vehicles traveling under 30 mph in urban contexts on fixed routes, and 2) higher speed vehicles traveling over 30 mph, but only on low distraction routes, such as highways. Nashville is intent on piloting the first category of AVs in downtown Nashville. Nashville is extremely interested in providing a context in which to test the aspects of AVs beyond the actual onboard technology, including regulatory environment, customer interactions, and integration with other transportation systems. To better engage the local community and increase AV usage, Metro Government will leverage the Metro Arts Commission's local-artist network to assist in designing fleet wraps to attract customers.

A first phase of such a pilot, in collaboration with The Nashville Convention & Visitors Corporation and the Downtown Partnership, could involve a demonstration ride in downtown Nashville to expose residents and tourists to AVs. This could be a tour of downtown sights narrated by country music stars to make it uniquely "Nashville". The goal of this initial pilot would be to expose the general public to the safety and usability of AVs and improve their level of acceptance for them over time.

A second phase pilot could involve partnering with a private sector partner to pilot autonomous and electric vehicle ridesharing in downtown Nashville. The city could designate select streets within downtown Nashville where AVs can operate under 35 mph. The partner company would then house the AVs in a nearby parking garage. When a user requests a ride within the pilot test area, an AV would leave the garage and meet the user, take them to their destination, and then return to the garage when not in use. There could also be an opportunity to enable trip chaining-efficient use of vehicles so they are idle for as short a time as possible. Automation of trip-chaining requires extremely complex algorithms, so the city would need to evaluate available technologies at the time of pilot deployment.

The main goals of the USDOT's Smart Cities Challenge are to improve safety, mobility, and to address climate change. Nashville is interested in piloting AVs, because this emerging technology has the potential to meet all three of these goals. Firstly, autonomous vehicle experts predict that AVs will eventually be much safer than human-operated vehicles, and they imagine downtown sections where human-operated vehicles are actually prohibited for safety concerns. Secondly, AVs can help serve the mobility needs of people that need it most: low-income residents that cannot afford a car, elderly and disabled residents that are unable to drive, and youth who cannot drive yet. AVs can supplement the city's public transportation network to provide mobility solutions to these residents efficiently and cost-effectively. Finally, many of the experts with whom Metro staff consulted are confident that AVs and EVs have complimentary utility. As ridesharing services continue to increase, and the majority of vehicles become part of ridesharing fleets, it will make more sense from a cost perspective to electrify vehicle-fleets, leading to significant carbon-emissions savings. Metro Government is excited to pilot this emerging technology in Nashville and work to improve safety, mobility, and to reduce emissions within the region's transportation sector.

5) IT Infrastructure, Open Data, and Transparency

By integrating an expanded IT infrastructure and open data initiatives, Metro Government will support both research into devising innovative solutions and support applications to alleviate problems with mobility and access, while enabling Nashville's growing entrepreneur and startup community to scale up research and prototype solutions to widely disseminate applications. For all of the city's Smart City partnerships, Metro Government will ask the city's corporate partners to share all relevant data.

- **Open Data Specification:** Pilots will augment the existing Open Data platform by driving inclusion of additional high value datasets managed in silos by Metro Government departments and agencies, with a short-term focus on an open data feed of known transit, street, sidewalk, and bike lane closures and detours. This will specifically be helpful in the urban core and downtown, where lane closures and detours often occur due to construction and special events.
- **Shared Data Management System with Integrated Payment System:** Develop a secure shared data management system that would build upon the success of StrIDe (a partnership between MTA and MNPS to provide middle and high school students free bus rides with their school ID) and provide the means to share information about clients across transit services and providers. This will include a Smart CityID card and be integrated into a kiosk system, allowing individuals who are unbanked to use the card as a prepaid debit card and re-load at kiosks. This will further form the basis for use of the card for other Metro Government services, such as utility payments.
- **Transit Kiosks**: Develop and install internet-connected smart kiosks initially in the downtown area and transform existing kiosks (such as the city's 30 BCycle station kiosks) to allow users to plan trips, queue rides, crowdsource data on transit conditions, and re-load Smart City cards with cash for transportation. These kiosks can also serve the public as free mobile WiFi hotspots. Designed in conjunction with the Metro Arts Commission, kiosks will serve as both practical-ticketing and trip-planning centers, as well as public-art street furniture increasing use and placemaking in the urban core.
- **User-friendly Mobile App, Web, and Kiosk Suite:** Create a user-friendly mobile application and engaging website, which would be extended to online transit kiosk application services.
- **Software Suite that Reads Existing Data**: Create a software suite that reads existing crash data, transportation facility data, roadway geometric data, existing and planned land uses and other relevant information to provide decision support for infrastructure investments. By reading existing data, Metro Government will not only be able to provide real-time data, but also enhance our ability to build archives for future predictive analytics and mining for evaluation of current system optimization and decision support for future investment.

- **Push for Rideshare button:** Develop a push-for-rideshare button in *NashvilleNext* Tier 1 centers (demonstration sites), allowing residents, including those without access to smartphones, to request a first/last mile ride between their trip origin/destination and nearby transit service.

Smart customer-oriented apps may provide additional customization options that are more user-friendly and can generate solutions that customers find more acceptable. For example, the app may combine use of a customer's profile-data from their personal device with transit options presented by the multimodal transportation system to customize the options presented to the customer (e.g., the option presented to a young millennial versus those presented to a senior citizen). The app can be easily customized to meet a user's specific requirements. The Nashville Metro and surrounding areas support a diverse population, so providing flexibility and customization may be important factors in acceptability of the apps, and, by extension the use of the multi-modal transportation network. A unique element about this proposed solution will be its ability to adapt. We expect that over time the system will be able to adapt to individual needs and parameters, and can leverage the latest advances in big data analytics and machine learning algorithms.

For commuters without smart phones, the system will provide access through smart kiosks. Kiosk Systems offers direct and barrier-free access to city-life related information and services. The company integrates real-time, contextual, event-aware, and localized content from various domains. They can themselves serve as an information source using modular extendable sensors and usage feedback. If a traveler is looking for a small, independent café that is located at a nearby location, a Kiosk can provide directions. Over time, Metro will tie this information system into existing 311 services, making it easier for residents to crowdsource information about potholes, cracked sidewalks, debris in bike lanes, or safety issues at transit stops, for example. Crowdsourcing this information through a smart phone suite, kiosk suite, or Web-suite would allow Metro to be more responsive and strategic in maintaining transportation infrastructure.

Another unique aspect of our proposed vision is the creation of an integrated citywide computation platform used as the base architecture for deploying and managing smart sensors, distributed analytics, and smart services. Metro-Nashville will partner with Vanderbilt University's VISOR group to create and pilot this architecture. The city will pay special attention to interoperability and modularity, and reuse existing standard information architectures, such as Connected Vehicle Reference Implementation Architecture (CVRIA) and the Internet of Things reference architecture being developed by the National Institute of Standards.

Metro's Open Data Initiative, led by Metro ITS, will also provide two additional advantages worth mentioning: 1) Allowing different segments of Metro (e.g. MTA, RTA, MPO, MDHA, Fire, and Police, etc.) coming together to find common approaches to solving short- and longer-term inter-related problems of transportation, safety, and housing; and 2) Opening up an innovation ecosystem where private enterprises, especially startups (private-public partnerships) have access to information and data for finding innovative solutions to existing and anticipated future problems.

Vision Elements/Nashville Pilot Programs	Vision Element #1: Urban Automation	Vision Element #2: Connected Vehicles	Vision Element #3: Intelligent, Sensor-Based Infrastructure	Vision Element #4: Urban Analytics	Vision Element #5: User-Focused Mobility Services and Choices	Vision Element #6: Urban Delivery and Logistics
Parking Reform			●	●	●	
Municipal Fleet Conversion to Electric Vehicles (EVs)						
Ride-Sharing with Electric Vehicles					●	
Partnerships to Test Autonomous Vehicles (AVs)	●	●			●	
IT Infrastructure, Open Data, and Transparency			●	●	●	

Vision Elements/Nashville Pilot Programs	Vision Element #7: Strategic Business Models and Partnering Opportunities	Vision Element #8: Smart Grid, Roadway Electrification, and Electric Vehicles	Vision Element #9: Connected, Involved Citizens	Vision Element #10: Architecture and Standards	Vision Element #11: Low-Cost Efficent, Secure, and Resilient Information and Communications Technology	Vision Element #12: Smart Land Use
Parking Reform			●			●
Municipal Fleet Conversion to Electric Vehicles (EVs)		●				
Ride-Sharing with Electric Vehicles	●	●				●
Partnerships to Test Autonomous Vehicles (AVs)	●					●
IT Infrastructure, Open Data, and Transparency	●		●	●	●	●

6 Risks of Deployment Vision

Any new infrastructure introduces risk(s). Given the criticality of the infrastructures and solutions involved, a risk management framework will be identified during project initiation in order to identify, assess, evaluate, and mitigate risk across all partners. While Metro Government has not had the opportunity to thoroughly evaluate the risks that will need to be mitigated, Metro Government plans to address the following risks and others:

Security Vulnerabilities (MEDIUM RISK): Security vulnerabilities are key technology risks, potentially resulting in loss of data or disruption/loss of service. To address this risk, Metro Government will use a methodical risk assessment process that includes careful documentation of all components (including both hardware elements as well as data elements) of the infrastructure involved and an assessment of the security concerns for each of those components, with a determination of the level of risk introduced and mitiga-

tion strategies for addressing risks. Metro Government's Chief Information Security Officer will provide oversight for this process to be completed at all phased of the project.

Technology Standardization (MEDIUM RISK): One deployment challenge is the lack of standardization required to integrate various citywide information sources to enable a smart and dynamic transportation network. Nashville will mitigate this risk by specifically focusing on cross-cutting information architecture to dynamically adapt and integrate services with varying API and behaviors. Grounded in fundamental research, this work will leverage upon innovative research in smart city and Internet of Things platforms, carried out at Vanderbilt University (e.g. www.chariot.isis.vanderbilt.edu). Nashville can also leverage open source technologies such as city-hub sdk (http://github.com/siemens/cityhub-sdk).

Managing Complex Data (MEDIUM RISK): Other challenges include creating filters that provide real-time security and privacy guarantees and manage data-collection that is heterogeneous, high volume, high velocity, and with variability. Moreover, data will be collected at different rates. Therefore, synchronizing and aligning data will be a challenge. While the technological solutions to this challenge will be based on Nashville's open data platform, the policy challenges associated with the security and privacy issues will be handled through the open data initiative of Metro ITS.

Cross-Departmental Management (MEDIUM RISK): Historically, one challenge and risk with deployment of any project in Metro Government is effective coordination of departments and agencies that have long lived in silos. Aligning these departments and agencies is a priority of Mayor Megan Barry's administration, and the Mayor has already enacted several policies and organizational infrastructure to address this challenge. For example, newly hired Mayor's Office staff members are tasked with coordinating departments across silos to ensure a unified vision and increased cooperation and communication. Furthermore, the Mayor recently released a challenge to departments to collaborate in Metro's budget process by collectively proposing initiatives that reflect several of the Mayor's priorities. Effective organizational infrastructure that supports cross-departmental management will be critical to the success of this project, and the Mayor's political will and budget process reforms will support this effort. This will be facilitated through the establishment of a Smart Cities Program Management Office.

Community Engagement (LOW RISK): One key deployment risk is Nashville's ability to reach residents and galvanize community buy-in to program elements. To create an optimal solution where both individual constraints and choices and city-wide goals are met, we will ensure that residents are reached through community engagement efforts. Community engagement and buy-in will require Metro Government to leverage community outreach and partnerships, targeted incentives, and an improved choice architecture where participation is user-friendly and accessible for all residents. The Mayor's Office of Neighborhoods and Community Engagement will be one of the key leaders in this effort.

Nashville will use established community engagement efforts to make emerging technologies and strategies accessible to all parts of our community, including residents who may not currently have access to internet, devices, or training. For example, Nashville's recently launched ConnectHome initiative in public housing units may be leveraged for training and community engagement. In addition, Metro Government will prioritize user-friendly design of elements of our strategy to ensure that the system is accessible to residents. Examples of this include our proposed kiosk and Smart City ID card systems for residents without access to smart phones and/or bank accounts and first/last mile and paratransit programs designed to meet mobility needs of aging residents and residents with disabilities.

Incorporating Smart City Initiatives with Existing Planning Efforts (LOW RISK): Many of the proposed Smart City initiatives involve partnerships with external partners. Public-private partnerships are crucial to fostering economic growth and providing services to residents in an efficient and cost-effective manner. At the same time, emerging technologies are extremely dynamic and when deployed. As mentioned previously, Nashville is at a unique juncture point as we launch and finalize numerous regional strategic planning efforts related to our urban development and transportation networks. Strong coordination by the Mayor's Office, Metro Departments, and the Smart City Advisory Council will ensure that all of the proposed Smart City initiatives will support the city's overall vision for increased transit investments, improved active transportation options, and accessibility for all Nashville residents, including our most vulnerable residents.

7 Partners and Key Stakeholders

In order to facilitate the proposed project, Nashville will leverage strategic citywide partnerships. While Metro expects to add additional partnerships, the city has already received support from the following elected officials, regional agencies, companies, higher education institutions, and non-profit agencies.

Elected Officials	**Private Sector**	**Other**
• U.S. Sen. Lamar Alexander • U.S. Sen. Bob Corker • U.S. Rep. Jim Cooper • Metro Councilman Freddie O'Connell (District 19 - Downtown area)	• Nashville Area Chamber of Commerce • Lyft • Uber • NISSAN North America • General Motors • Ford • car2go • Urban Land Institute • Nashville Technology Council • Esri • Socrata	• Transportation 4 America • 1776 • Middle Tennessee Mayors' Caucus • Nashville Civic Design Center • Nashville Downtown Partnership • Nashville Convention and Visitors Corporation • Walk/Bike Nashville • Senior Transportation Coalition • Southern Environmental Law Center
Regional Agencies	**Universities**	*All departments of the Metropolitan Government of Nashville-Davidson County will also serve as partners.
• TN Dept. of Transportation • Nashville Area MPO • Metropolitan Transit Authority / Regional Transit Authority • Nashville Electric Service	• Vanderbilt University • University of Tennessee – Center for Transportation Research • Lipscomb University – Institute for Sustainable Practice	

8 Existing Transportation Infrastructure and System Features

a. **Arterial Miles**: 2014 (federal functional classification) • 1,321 lane miles • 426 centerline miles	b. **Freeway Miles**: 2014 (federal functional classification) • 739 lane miles • 118 centerline miles

c. **Transit Services**: FY 2015 data for Nashville MTA
• 0.69 service hours per capita
• 9.5 million annual ridership (9.7 million including MTA-operated service to Rutherford County)
• 142 peak buses
	d. **Shared-Use Mobility Services**
	• B-Cycle (bikeshare): 30 stations, 250 bikes, 33,762 daily & 941 annual, monthly, and weekly users, 56,857 checkouts, 318,822 miles ridden
	• Car Share: 11 locations, Enterprise and ZipCar
	• Peer2Peer Rideshare:
	  ○ Lyft
	  ○ Uber (4 million Nashville-area trips since December 2013)

e. **Information and Communication technology (ICT)**

Metro Information Technology Services maintains a strong wired and wireless network that supports departments and agencies of Metro Government, including MTA and Metro Nashville Police Department (MNPD), in a robust, resilient manner. Comprised of leased and owned fiber as well as lesser capacity bandwidth paths, the Metro Government Communications Network coverage encompasses 270 physical sites within Nashville-Davidson County and includes well over one thousand network devices.

Metro Government plans to expand upon current owned fiber capacity to provide a much larger footprint. This will allow for expansion of many different technologies including MNPD video surveillance, MTA connectivity, many other specific departmental capabilities and diversification of existing leased fiber routes for increased fault tolerance.

A new network backbone project for the Metro Government Communications Network was completed in December 2015, replacing an end-of-life system that was installed 15 years ago. This new backbone provides for a significant amount of growth looking forward while at the same time increasing the current usable capacity anywhere up to 40 Gigabits, depending upon the specific point in the network.

The Metro Government Wireless Communications Network includes coverage internal to many Metro government facilities but also extends into many Metro Parks locations as well as supporting many MNPD video surveillance cameras throughout Nashville. Separately, the Metro Public WiFi network is a free citizen and visitor focused service provided over this wireless infrastructure to all libraries, Metro Parks locations including all community centers, Metro Government offices, and public gathering locations throughout Nashville. This service is currently available at over 80 locations.

Metro IT Services also provides MNPD with a robust and secure wireless mesh network. While currently only used for public safety purposes, the network is available for use by other departments and agencies and consists of 49 nodes which provide connectivity for over 50 MNPD safety cameras. The network coverage is based upon the desired camera views of MNPD for the purposes of crowd/traffic control and investigative work for crime-solving. Viewing locations exist primarily within the inner interstate loop of Nashville, along the Cumberland River waterway near downtown, and along major corridors extending out of downtown. There are also several Skycops mobile trailers populated with cameras, which can be setup in specifically targeted locations due to events in and around a particular area. These are then wirelessly connected for video transmission to the intended destination for remote viewing.

f. **Intelligent Transportation Systems**

- Transportation Management Centers: currently 0 true TMC. There is some connectivity to field devices but not a TMC as defined.
- Field Equipment: 0 cameras; approximately 650 signals with communication capabilities to office; 0VMS; 0 miles fiber (currently all copper).
- Metro Public Works Intelligent Traffic System (ITS): This new ITS system, the pilot of which has just begun, is intended to provide an enhanced level of traffic control for traffic engineers. It will have capabilities targeting prioritization of public safety vehicles. When completed, this ITS system will encompass over 800 traffic signals across Nashville-Davidson County with TSP and EVP programming capabilities. The current status of the ITS pilot includes five traffic signals along Church Street in downtown Nashville. This enables testing of many new components for the purposes of

adjusting various parameters of use and will also provide valuable feedback that will be required for the overall design of the project.

- ITS System/MTA Bus Routing System Connection: A pilot is currently underway to interconnect the ITS system with MTA bus routing systems for the allowance of buses that have fallen behind on their route to gain a higher priority within the traffic signal network. This pilot is being implemented on Murfreesboro Road in Nashville.
- Nashville Fire Department Fleet Technology: The Nashville Fire Department (NFD) and Metro IT Services Department launched new vehicle fleet connectivity technology within the NFD vehicle fleet for ambulances, fire engines and other NFD vehicles. It provides vehicle connectivity in the form of a constant cellular link, as well as traditional wireless coverage to support medical devices to communicate with the vehicle while they are in use in near proximity to the vehicle, such as a defibrillator taken into a residence. Data is uploaded to the vehicle over this wireless connection and, when appropriate, on to a destination hospital for an effective transfer of the patient and patient information between caregivers. Equipped vehicles are also tracked via a third radio using GPS. This allows for a centralized system to better manage these resources and improve response times. Lastly this system tracks many standard and customized vehicle parameters which are then automatically uploaded for review by the NFD. Information gathered includes advance notification of many vehicle maintenance items allowing proactive vehicle service, reducing vehicle service time and all costs associated with a heavy fleet vehicle being out of service. MNPD is currently testing this same technology for use in its even larger fleet of vehicles. For MNPD, this technology not only updates the physical hardware used for connectivity and GPS tracking, but provides vast capabilities for collecting and reporting data from and about MNPD vehicles.

G. **Smart Grid Infrastructure**

- Electric Vehicle Charging Stations
  - Metro General Services: 25 charging stations
  - Blink (Metro-contracted): 27 charging stations

9 Data

Data Currently Collected

Metro departments and agencies collect and manage a wealth of data in structured electronic format pursuant to their service to the public. In most cases, this data is held and managed by the individual department or agency. Data held in structured electronic form by departments and agencies includes but is not limited to the table below. In 2014, former Nashville Mayor Karl Dean established an open data program for Metro Government via Executive Order. This executive order is in the process of legal review for reestablishment under the administration of Mayor Megan Barry. Various departments and agencies have contributed data to Metro's Open Data portal (hosted at data.nashville.gov). While listed below, not all data sets qualify for upload to the Open Data portal, according to the definition of Open Data per Executive Order.

Departmental Owner	Dataset	Open Data
Metro Arts Commission	Public art	Yes
Metro Arts Commission	Metro owned art	Yes
Metro Emergency Communications	911 call data	
Metro General Services	Metro Fleet Vehicle detail	
Metro Historic Commission	Historic Marker locations	Yes
Mayor's Office	Bike share program kiosks	Yes

Departmental Owner	Dataset	Open Data
Metro Development & Housing Agency	Resident home location	
Metro Codes	Street closure and work permits	
Metro Codes	Special event permits	
Metro Codes	Building permits	Yes
Metro Codes	Permit complaints and/or violations	
Metro IT Services	Owned and leased network resources	
Metro IT Services	Metro Public WIFI sites	Yes
Metro Health Department	Air Quality	
Metro Parks	Parks Special Events Permits	
Metro Planning	Sidewalk locations GIS files	
Metro Planning	Sidewalk Master Plan locations GIS files	
Metro Planning	Bike trails/Bike lane locations GIS files	
Metro Planning	Street and Roadway GIS files	
Metro Planning	Property parcels including land use, zoning, ownership, assessed value, etc.	
Metro Planning	Development permit applications	Yes
Metro Public Works	Street closures	
Metro Public Works	Planned Public Works projects for roads and right of way	
Metro Public Works	Sanitation vehicle routes	
Metro Public Works	Public Works-owned fiber	
Metro Water	Planned projects	
Metro Water	Stormwater maintenance	
Metro Water	Street sweeping schedule	Yes
Metro Nashville Police Department	Vehicle accident reports	
Metro Nashville Police Department	Safety camera feeds	
Metro Nashville Police Department	MNPD vehicle AVL data	
Metro Nashville Police Department	Special Events	
Metro Nashville Public Schools	School bus Transit routes	
Metro Nashville Public Schools	School bus vehicle locator records	
Metro Nashville Public Schools	Student home location	
Metro Nashville Public Schools	Davidson County school district boundaries	Yes
Metro Nashville Public Schools	School zones/crosswalks locations	
Metropolitan Transit Authority	Transit routes	
Metropolitan Transit Authority	Bus vehicle locator records	
Metropolitan Transit Authority	Ridership per route	
Metropolitan Transit Authority	Metro Transit Authority bus stop Locations	
Nashville Electric Service	Inventory of right of way properties	
Nashville Electric Service	NES-owned fiber network	
Nashville Electric Service	Tree Trimming Schedule	

Departmental Owner	Dataset	Open Data
Nashville Fire Department	NFD vehicle AVL data	
Nashville Fire Department	Incident Response Locations	
Office of Emergency Management	Special Events	
Tennessee Department Of Transportation	State street closures	
Tennessee Department Of Transportation	Planned projects for interstates, roads and state right of way	
Tennessee Department Of Transportation	Emergency alert notifications	
Tennessee Department Of Transportation	State route camera feeds	

Using Data to Further Address City Challenges: Nashville expects a three faceted use of data: (1) bringing together a number of Metro departments and agencies to share data and pool their expertise in developing predictive analytics and mining schemes that provide the framework for predictive and 'what-if' analyses as well as decision support to improve day to day operations by recognizing and removing bottlenecks and distributing resources on an as-needed basis; (2) the ability to enhance existing and develop customer or citizen-facing apps that provide multi-modal transportation and parking options customized to user profiles and their conditions (e.g., young adults versus seniors); (3) allowing organizations external to Metro Government like private enterprises, especially startups, to access relevant information and data to construct innovations that provide, improve services.

In this work, the Metro Government will be aided by collaboration with Vanderbilt faculty members who work on a number of core research areas related to smart city operations. VISOR, the Vanderbilt Initiative for Smart City Operations Research, will be described in more detail later in this document.

The Open Data platform seeks to provide the computational and analytic capabilities at scale to augment and enhance the citizen-friendly presentation, analysis, and visualization tools offered through Metro Government's Socrata-based portal at http://data.nashville.gov. Data sets provided at this open data site run the gamut of data types generated and managed by Metro Government. In years past, Metro Government has also teamed with the Nashville Code for America Civic Brigade through sponsorship of two hack-a-thons in association with the Annual Day of Civic Hacking as well as providing connections between the Brigade and Metro Government data required for project work.

The Metro Public Works Department is currently coordinating with the Tennessee Department of Transportation (TDOT) to provide live roadway closure data on Nashville streets. TDOT has provided a Geographic Information System (GIS) layer tool for the further coordinated development of a seamless data interface that can be used with other municipalities across the state. Road closure data will be fed to the TN SmartWay website, and other public and private partners through the Metro Government and the Tennessee State Government Open Data platforms.

Integrating Transportation Data with Other City Functions: Transportation data can be used to develop computational infrastructures at scale for collecting heterogeneous data citywide with real-time and predictive data analytics and mining to develop decision support systems for city planners and city residents. Transportation data can be integrated within a larger decision support system for public transit that will enable dynamic optimization of maintenance schedules and resources using data-driven prognostics that integrate predictive maintenance (at the individual vehicle, as well as the fleet level) with route planning and

resource allocation. Prognostic systems monitor critical systems, predict degradation rates, and correspond to time-to-failure measures, which enable timely condition-based maintenance activities to reduce down-time while ensuring safe operations. Nashville will develop algorithms for maintenance scheduling that incorporate prognostic information to produce improved condition-based schedules.

Similar data, when received from the extensive Metro Government fleet beyond public transit, can be used in the same manner to improve operations within those departments and agencies. This includes the Metro Nashville Police Department, the Davidson County Sheriff's Office, the Nashville Fire Department, Metro Public Works, and general government vehicles managed by the Department of General Services.

Traffic patterns, combined with weather conditions and the occurrence of special events, can be used to study accident occurrences, and use data-driven methods to access root causes for the breach in safety. Knowledge of root causes may lead to better real-time control, as well as the ability to plan and place resources that significantly reduce the likelihood of adverse events.

Integrating Other Data to Improve Transportation Operations: Integrating other data (road closures, construction projects, weather alerts, traffic accidents, etc.) into a consolidated repository with transportation data will enable a distributed multilevel optimization approach. The goal of such an approach is to find and offer the best integrated multi-modal transportation solution for residents, optimizing their trip options based on multiple criteria, including cost, time, and availability. A person driving from one of the adjoining counties to the Nashville can use the decision support system optimizing the trip options based on predicted parking costs and availability. Such systems can also balance against global criteria, such as a need to reduce congestion or reduce trips during air-quality alerts.

Existing Data Policies

In 2014, Mayor Karl Dean established an open data program for Metro Government via Executive Order (http://www.nashville.gov/Metro-Clerk/Legal-Resources/Executive-Orders/Mayor-Karl-Dean/kd043.aspx)

Collecting, Managing, Sharing Data Across Sectors & The Public: In December 2015, Metro's Chief Information Officer and department heads of Metro Transit Authority (MTA), Metro Development and Housing Authority (MDHA), Metropolitan Planning Organization (MPO), Nashville Fire Department (NFD) each wrote letters of support for VISOR, the Vanderbilt Initiative for Smart City Operations Research.

To be established during Q1 of 2016 by Vanderbilt University, VISOR seeks to "yield a trans-institutional center focused on multi-disciplinary research for formulating, developing, and deploying "smart city" applications." Furthermore, per the VISOR application to the Vanderbilt governing body VISOR will:

- *Work with Metro-Nashville governmental agencies to develop a technical and policy platform that enables living city labs in which to study, research, develop solutions to challenges and problems faced by the city and by extension other cities around the world. In particular, the proposed center will conduct research that combines the development of computational infrastructures at scale for collecting and analyzing heterogeneous data across the city, with a focus on social and policy impact. Real-time and predictive data analytics and mining techniques applied to this data will yield decision support systems that (1) support city planners and residents and (2) addresses challenges to improving mobility, increasing safety, supporting sustainable, affordable housing developments.*
- *At the core of the proposed effort, we will undertake three cross-cutting research initiatives: (1) designing a software platform that integrates networked sensors and computational element; (2) cre-*

ating a data analytics toolbox to serve multiple smart city applications; (3) developing human-facing decision support systems that make tech innovations readily available to city residents and visitors.

Metro and VISOR anticipate applying for membership in the Metro Labs coalition in Q1 2016. Nashville also anticipates onboarding corporate partners with interest in this space. One identified partner that has worked with Vanderbilt University staff is Siemens. Vanderbilt faculty and Siemens have been conducting research together in a number of areas related to distributed systems and platforms for over two decades. Siemens is exploring smart transportation technologies in Aspern and Bavaria, and they are interested in piloting emerging smart city technologies in US. Nashville would be a good target given the partnership between Vanderbilt University and Siemens.

Information collected in the Metro Public Works-TDOT collaboration will be consumed specifically by WAZE (owned by Google), with which TDOT has signed a data-exchange MOU agreement. The Nashville Smart City Challenge pilot will build upon and leverage these ongoing efforts among city and state resources.

Data Expected to be Shared and Used: Please see the first response of this Data for details on potential datasets available within Metropolitan Government to share either with partners or the public.

Terms and Conditions in Partnership Agreements
Beyond Metro Government's Open Data program described above, data sharing opportunities within Metro Government are handled on a case-by-case basis between the Metro department or agency and potential partners and facilitated through the Metro Legal Department and/or equivalent agency legal counsel. Examples of situations include between the Metro Nashville Police Department (MNPD) and crime reporting companies; Metro Nashville Public Schools (MNPS) and a variety of non-profit education research companies; and MNPD and MNPS for analysis of truancy and crime prevention opportunities.

Metro Government recognizes the fundamental role that data plays in any Smart City initiative, and understands that it is critical that this data is managed appropriately. Therefore, Metro Government has begun the process of recruiting a Chief Data Officer. The primary job responsibilities for this position, to report to Metro's Chief Information Officer, are as follows:

1. Ownership/Management of Metro's Open Data initiative, a key element of any Smart City strategy;
2. Creation and oversight of standardized data sharing and use agreements, and working with departments and partners to implement as necessary;
3. Creation of a plan to drive publication of Metro department and agency-owned high value open data sets based on national recommendations and supporting Metro initiatives including Smart City strategy;
4. Identify and drive opportunities for department and agency data analysis to proactively identity areas of concern and affect outcomes.

Cross-cutting initiatives and specific projects identified in Nashville's Smart City vision cover a broad spectrum of research, development, and deployment capabilities in the smart cities area. Metro Government will use experience with the open data program and with the Vanderbilt University VISOR collaboration (described previously) to formally establish a data governance program.

Per Metro's Information Security program, initiated through Mayor Karl Dean's Executive Order #5 and expected to be reissued as an executive order by new Mayor Megan Barry, all information to be shared must be categorized and handled per Metro Government policy. All data sets are examined for inclusion on Metro's Open Data portal, http://data.nashville.gov (terms at http://www.nashville.gov/Terms-of-Service.aspx).

In addition to improving conditions in the city, collecting data and analyzing problems relevant to Nashville creates opportunities for using these scenarios for authentic, challenge-based problems for STEM education in high school and undergraduate programs. Nashville will work with Metro Public Schools to introduce students to open data repositories and data analytics, as well as with educators to link city-related problems and their research solutions to increase the relevance and improve engagement in K-12 STEM curricula.

10 ITS Architectures and Standards

Throughout the region, the existing transportation network is equipped with various forms of Intelligent Transportation Systems (ITS). In the Nashville area, TDOT uses dynamic message signs along interstates to provide important traffic-related messages to motorists. Similarly, radar detectors and video cameras on the Interstates alert transportation officials to slow-downs that indicate when incidents have occurred. Faster response and clearance of these incidents reduces traffic congestion and helps prevent secondary incidents from occurring when motorists slow down to look or swerve to avoid a stopped vehicle. Local jurisdictions use ITS to improve signal coordination along important arterial routes and to establish traffic management centers where data is collected and analyzed.

Over the long term, the local and state efforts are coordinated through a plan known as the ITS Regional Architecture, which was developed by the Nashville Area MPO in 2010 in partnership with TDOT, local governments, and agencies involved in transportation, public safety, law enforcement, and communications. This plan spells out what types of data are being collected by each agency, what will be shared, and the compatibility needs for equipment. The regional architecture is continuously updated.

The Tennessee Department of Transportation's Traffic Operations Division is currently evaluating DSRC technology, with plans to co-locate RSUs within its existing ITS infrastructure. This would mean installing CV technologies at current and future CCTV cameras, Dynamic Message Boards, Radar Detection Systems, and other locations were TDOT has the needed power and communication capabilities. TDOT is also currently re-writing its specifications for other ITS technologies to insure compatibility with DRSC communications. Along with TDOT's fixed infrastructure, the Division is currently evaluating installing CV technologies in TDOT vehicles – which could include all vehicles used for operations.

Upcoming Regional Smart Cities Assessment and Evaluation: The MPO will seek consultant assistance to evaluate current intelligent transportation systems across the region to develop recommendations for how to upgrade existing systems and prepare for emerging technologies such as connected vehicles, urban automation, and integrated communications systems. Specifically, the scope will include:

- Conduct an inventory of all ITS equipment and facilities across the region to document the location, condition, ownership, and type of asset deployed to manage traffic, assist in incident response, collect transportation-related data, or communicate conditions. This will inventory equipment, including traffic signal controllers and lights, pedestrian signalization, active lane management systems (reversible lanes), dynamic message boards, WiFi antennas, communications cables/ fiber optics, etc., environmental sensors, vehicle counters, etc.).
- Engage the public and stakeholders in a conversation about community issues that could be improved through the use of technology; evaluate how well existing technologies meet those needs.
- Evaluate the applicability of best practices and emerging products that could be deployed across the region to position technology as a solution to community based challenges.

- Identify opportunities to broaden use of transportation technologies beyond traffic management, i.e., distribution of real-time data to customers, collection of data to aid in monitoring system performance over time (vehicles, pedestrian, cyclist counts), and collection of environmental quality data.
- Identify revenue sources and prioritize corridors and centers for upgrades.
- Update the ITS architecture and standards to ensure proper deployment.

5 Measurable Goals and Objectives

Measurable Goals/Nashville Pilot Programs	Safety and Public Health	Mobility for all	Climate Change
Parking Reform	Objective: Utilize parking reform policies to appropriately price parking to incentivize more active transportation 1) Reduce both adult and childhood obesity rates 2) Increase physical activity	Objective: Utilize parking reform policies to appropriately price and locate parking to decrease SOV trips 1) Reduce surplus parking inventory; convert surplus parking to other uses (e.g. drop-off zones, parklets) 2) Reduce the amount of unnecessary traffic circulation downtown that is inefficiently looking for parking 2) Increase revenue from parking to fund investments for other modes	Objective: Utilize parking reform policies to appropriate price parking and increase alternative mode share Increase the share of workers traveling to work by transit, bicycle, or walking
Municipal Fleet Conversion to Electric Vehicles (EVs)	Objective: Deploy electric vehicles to lower criteria pollutants from transportation sector 1) Improve regional air quality 2) Reduce number of days that exceed national ozone standards	Objective: Increase the number of Evs in Nashville 1) Increase exposure to all Nashville residents to the ease and cost-effectiveness of electric vehicles	Objective: Deploy electric vehicles to reduce GHGs within the transportation sector 1) Reduce carbon emissions from municipal fleet
Ride-Sharing with Electric Vehicles	Objective: Increase adoption of ride-sharing services to make people less dependent on car ownership 1) Reduce percentage of household income spent on transportation costs 2) Reduce the number of high-risk trips (such as DUIs, distracted driving, elderly drivers) by shifting to ride-share	Objective: Increase adoption of ride-sharing services to shorten wait times for rides for Nashville's most vulnerable residents 1) Improve access to mobility to our most vulnerable residents, such as low-income, disabled, seniors, and children. 2) Increase electric vehicle charging infrastructure	Objective: Increase adoption of ride-sharing services to reduce the number of cars on the road, while simultaneously greening the ride-sharing vehicle fleet 1) Reduce percentage of people commuting alone in SOVs 2) Reduce carbon emissions within the transportation sector

Measurable Goals/Nashville Pilot Programs	Safety and Public Health	Mobility for all	Climate Change
Partnerships to Test Autonomous Vehicles (AVs)	Objective: Provide a new testing environment to contribute to the development of AV safety features, while also reducing roadway fatalities/injuries 1) Reduce vehicle crashes and fatalities 2) Reduce pedestrian and cyclist fatalities/injuries 3) Eliminate fatal crashes within high-crash sites within the pilot study area	Objective: Use AV technology to expand access to transportation options 1) Increase transit ridership for seniors through first/last mile connections 2) Increase access to transportation for low-income residents without a car	Objective: Encourage the deployment of Avs in urban environments that lower the reliance on private vehicles 1) Reduce percentage of people commuting alone in SOVs
IT Infrastructure, Open Data, and Transparency	Objective: Use advanced technology and data to proactively identify and address safety and public health issues 1) Achieve zero deaths on Nashville streets 2) Increase communication of transportation options 3) Develop technologies to communicate potential hazards and delays to commuters	Objective: Provide better information about transportation options to all residents of Nashville 1) Utilize advanced technology and data to optimize transportation services 2) Improve access to mobility to our most vulnerable residents 3) Decrease congestion on regional roadways	Objective: Use advanced data and technology to mitigate and adapt to climate change 1) Reduce VMT per capita 2) Utilize technology to monitor and project infrastructure needs in a changed climate

12 Nashville's Capacity

Executive commitment to pursue Nashville's smart city vision and this project is in place as this addresses one of the primary focal areas identified through *NashvilleNext*. A three year process involving community input from 18,500 residents, *NashvilleNext* serves as our community's direction for Metro government's planning over the next 25 years (details at http://NashvilleNext.nashville.gov). Nashville has significant experience in and the financial capacity for managing and implementing ongoing, large-scale capital projects. Agencies within Metro Government, including General Services and Metro IT Services, have existing relationships with program management vendors that have a track record of success. Metro routinely engages such partners for construction projects. As previously mentioned, Metro IT Services just completed a major update to the Metro Government network backbone – a $5 million, 4-year project that came in on time and under budget with minimized disruption to Metro departments and agencies.

Metro's Chief Information Officer (CIO) has recently been tasked with the responsibility of Smart Cities strategy and execution, and will work with all departments, partners, and community stakeholders to develop and document a strategy for Metro Government. The Mayor's Office will provide additional capacity support to this project, working across departments and the community, and engaging resources from the following, among others: the Mayor's Infrastructure Team (three staff), the Mayor's Director of Infrastructure, the Mayor's Office of Special Events, the Mayor's Office of Economic & Community Development

(three staff), the Mayor's Communications team (three staff), the Mayor's Office of Economic Opportunity and Empowerment (five staff), the Mayor's Education Liaison (one), the Mayor's Office of New Americans (one), and the Mayor's Office of Neighborhoods and Community Engagement (four staff). Members of our 40-individual Metro Council will also assist in community engagement efforts.

Regarding performance management, Metro's Finance Department is responsible for the city's performance management program. Under the new administration of Mayor Megan Barry, the Finance Department is currently investigating opportunities to renovate and modernize Metro's performance management program to align with the budget process, transparency of services, and accountability to the public.

Our infrastructure readiness for smart city initiatives involves Nashville's ITS deployment status and a variety of citywide plans. Metro Public Works is currently updating 600 traffic signals for synchronization. While this update does not currently incorporate smart infrastructure technologies, it has the capacity to do so in future. Public Works is also currently working with Metro ITS to discern policies and procedures for small-cell providers to connect to utilities (which may include the capability to add WiFi). Additionally, there are several fiber networks within the city, most notably Google Fiber, and Comcast and AT&T are upgrading fiber systems. Additional infrastructure readiness exists through the Tennessee Department of Transportation's deployments on Interstates and significant routes in Nashville. TDOT's SmartWay Information System consists of 71 dynamic message boards, 180 CCTV cameras, 512 radar detection systems, 14 highway advisory radios, and 213 miles of fiber optic infrastructure creating a redundant loop around the city.

13 Leveraging Resources

The Metropolitan Government of Nashville and Davidson County's response to the Smart City Challenge is an excellent example of collaborative efforts that occur on a regular basis in Middle Tennessee around transportation. Nashville has received bipartisan support from U.S. Senators Corker and Alexander, U.S. Congressman Jim Cooper, and TDOT's Commissioner Schroer for our Smart City programs. Political collaboration and coordination is a crucial first step to ensure that US DOT's investment in Nashville would have numerous opportunities to be leveraged by other federal, state, corporate, and non-profit entities.

Federal: There are numerous on-going federally funded programs that Nashville can leverage as part of the city's Smart City programs. A few notable examples include:

- In September 2013, Nashville received $10 million from the **US DOT's TIGER grant program** for the Nashville Transit Signal Priority System upgrade. The project, which totaled $13.8 million, includes the installation of upgraded traffic signal equipment and safety enhancements that will improve on-time bus service and provide a more comfortable trip for thousands of transit riders.
- The **Federal Highway Administration's (FHWA)** local office provides training and professional development to transit professionals working in the Middle Tennessee region. The FHWA also conducts road safety audits which are crucial for ensuring the region's roadways are safe.
- The **Center for Transportation Research (CTR)** within the College of Engineering at the University of Tennessee, Knoxville is the state's leading research entity on transportation issues. The Center is a federally supported technical assistance program and currently has over $10 million in sponsored research under contract. Nashville will work closely with the Center in implementing the city's Smart City programs and studying their successes and failures for future replication in other cities.
- The **Nashville MPO** is the federally-designated transportation planning agency for more than 3,000 square miles and more than 1.5 million people throughout Davidson, Maury, Robertson, Rutherford, Sumner, Williamson, and Wilson counties. The MPO has multiple ongoing projects Metro can leverage

as part of the city's Smart City programs. The MPO is utilizing its FHWA Metropolitan Planning grant funds to fund a regional ITS and Smart City Assessment & Deployment plan. The MPO's Regional Technology Fund reserves 20% of the annual suballocation of FHWA-STP to the MPO for transportation technology projects and programs. Metro will also scope any surface-transportation projects submitted to the MPO for federal funding for consideration/incorporation in the city's Smart City programs.

- In 2013, the **US Department of Energy** funded the Tennessee EV project, which included a total public-private investment of $230 million to install Blink EV charging stations throughout the state.
- In July 2015, President Obama announced **HUD's new ConnectHome initiative** to expand high-speed broadband to low-income families. The pilot program launched in 27 cities, including Nashville, TN. As a result, all Nashville public housing units connected to Google Fiber will receive free gigabit speed Internet. Free high-speed Internet will be offered in all Google Fiber cities, with Google Fiber absorbing the cost. "Making Internet more affordable and accessible can fundamentally move entire communities forward," said Google Fiber CEO Dennis Kish on a conference call. "For families in affordable housing, fast broadband can mean the difference between keeping up or falling behind."

Metro can leverage federal resources by submitting joint federal grants for proposals like the National Science Foundation's CPS (Cyper-Physical Systems) and CRISP (Critical Resilient Interdependent Infrastructure Systems) grants. Access to these additional federal grants can provide a mechanism where the core fundamental research on important issues facing Nashville is developed in university labs and tested in the city. Successful results can then be amplified and scaled later by partner companies.

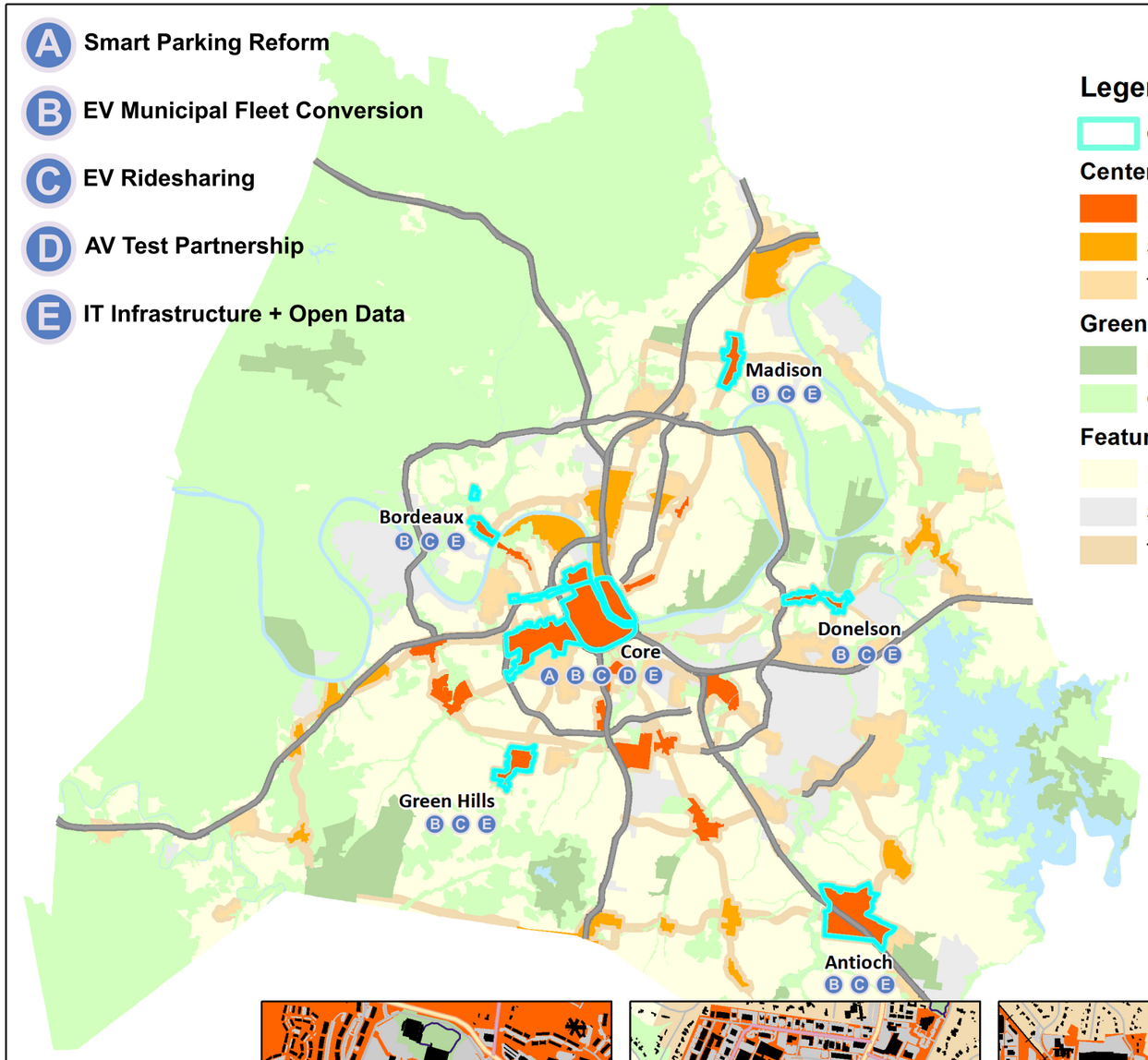
State: As evidenced by **TDOT's** Commissioner Schroer's letter of support, Nashville has a strong relationship with TDOT and will be able to leverage TDOT's staff, programs, and resources. For example, TDOT's SmartWay system relied on federal money and can now be used as a backbone for Smart City Challenge implementation. TDOT also provides a great deal of training for local governments on transportation issues.

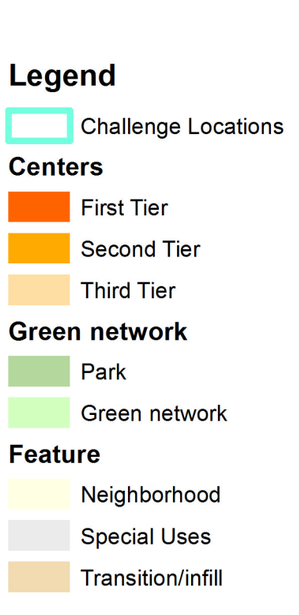
Private and Non-Profit: In addition, as previously mentioned, Metro Government may be able to leverage **Vanderbilt University's** partnership with **Siemens**. Vanderbilt University faculty and Siemens Corporate Technology have been conducting research together in a number of areas related to distributed systems and platforms over two decades. Metro Government can also partner with Vanderbilt University and industries in the Global City Challenge to demonstrate concepts and solutions, and use that exposure to leverage additional federal and private funding.

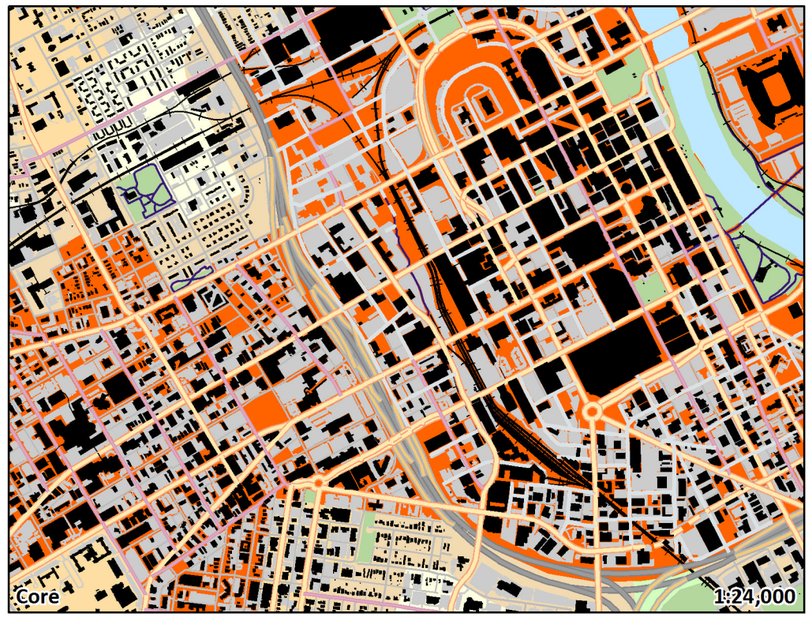
In January 2013, the **Transit Alliance of Middle Tennessee** and **IBM** released the results of an IBM study that identified short-term and long-term ways that the Nashville region could improve transportation and relieve congestion. A major component of the assessment included recommendations on open data and connected infrastructure. Nashville can leverage IBM's past engagement here and potentially work with them in the future on additional assessments and smart-city implementation projects.

Area non-profits are also eager to work with Metro-Nashville on Smart City programs. **Communities Putting Prevention to Work** brought BCycle to Nashville, which is now housed in the **Nashville Downtown Partnership**. The Senior Transportation Coalition, a local nonprofit filling the gap on seniors' mobility needs, is prepared to be leveraged as an outlet, in partnership with Uber and Lyft. The Nashville region also has a wealth of health-related foundations affiliated with or derived from its prosperous healthcare business sector, such as **HCA, Frist, Memorial, and Baptist Healing Trust,** that could be leveraged.

Metropolitan Government of Nashville and Davidson County







As a consolidated city/county metropolitan government, Nashville-Davidson County offers a unique opportunity to concurrently pilot advanced connected technologies in several distinct environments with interrelated transportation challenges. Nashville uses a transect model to define a range of land uses that protect sensitive environmental areas and direct growth onto high capacity transit corridors and into walkable centers. This land use plan was developed over three years as part of NashvilleNext, a general plan for Nashville/Davidson County. NashvilleNext has been widely celebrated for setting new precedents in community engagement, involving more than 18,500 participants.

As part of NashvilleNext, the community identified Tier 1 centers- areas that will receive coordinated public and private investment to accommodate the most growth in jobs and housing over the next 25 years. A subset of these Tier 1 centers has been selected as specific project locations for the Smart City Challenge. The centers were selected to demonstrate a range of distinct but interrelated transportation challenges including parking issues, event related congestion, first/last mile connections, transit oriented development, retrofitting suburbia, and more. The centers were also selected because they are inhabited by a broad and diverse cross section of Nashvillians. The range of contexts exhibited in the project areas will ensure that lessons learned in Nashville's Smart City trials will have applications in communities across the United States.