



# CHATTANOOGA SMART CITY PLAN

Notice of Funding Opportunity Number DTFH6116RA00002  
Amendment 1



CITY OF CHATTANOOGA

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# 1. Vision Overview

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## The Challenge

Similar to many cities its size, Chattanooga's aging transportation infrastructure provides few viable options for other than automobile travel. Additionally, the system is unsafe; vehicle accidents account for an annual average of 55 fatalities and 331 serious injuries in addition to the financial costs of increased delays and damaged vehicles. Land-use contributes to a lack of resiliency in transportation: homes, schools, stores, and workplaces are spread across suburbs putting great distances between daily needs.

The transportation system is vital to every Chattanooga citizen, employee, student, and visitor. From the moment a business opens its doors or a citizen steps out of their home, they engage with the transportation system.

To ensure people and goods can travel within and through Chattanooga efficiently and safely, to effectively invest our limited resources and maximize their impact, and to respond to and limit climate change, Chattanooga is aggressively pursuing non-traditional transportation planning and infrastructure and an integration of smart land-use and freight transport to become the future Smart City.

## The Vision

The Smart City plans for, implements, assesses, and shares the results of an adaptive, efficient transportation system to increase the mobility of people and goods, improve safety for all users, and respond to and limit climate change. Chattanooga's vision for the Smart City works toward these three goals by pursuing our five interconnected priority areas:

- Safer Streets
- Stronger Neighborhoods
- Smarter Students, Stronger Families
- High Performing Government
- Growing Economy

In pursuit of those priority areas, Chattanooga is uniquely prepared to leverage existing transportation infrastructure and implement specific solutions (detailed in Sections 3-5). Beyond specific technologies and infrastructure however, the Smart City must respond to and grow with the needs of its population. The Smart City must engage its citizens, private businesses, and public institutions in a feedback loop of input, goal setting, planning, measurement, and assessment that responds to and works toward the overarching goals. Additionally the Smart City:

- Leverages public and private partnerships to maximize investment;
- Responds to the diverse needs, abilities, and strengths of all people;
- Models proactive planning, technology, and policy implementation for other cities;
- Shares results of Smart City implementation broadly.

## Why Chattanooga?

Chattanooga is the Smart City: we have a big vision, a history of innovation, active government, existing smart infrastructure, long-lasting, extensive partnerships, and the ability and willingness to share our results.

**Vision** – Chattanooga’s vision for the Smart City is rooted in the five priority areas (Safer Streets, Stronger Neighborhoods, Smarter Students, Stronger Families, High Performing Government, and Growing Economy) that orient our planning and implementation toward our overarching goals to increase the mobility of people and goods, improve safety for all users, and respond to and limit climate change. Developed as part of our Budgeting for Outcomes (BFO) process, the priority areas serve as a platform to measure progress. Priority area-specific goals (e.g. reduce unemployment by 25% by September 30, 2015<sup>1</sup>) are developed, programs and policies implemented, and results measured to ensure continuous refinement and improvement of the goals, programs, and policies.

The three goals of the Smart City align with Chattanooga’s existing priority areas, which allows us to leverage existing projects, plans, and policies to best realize the Smart City. This alignment acknowledges that our vision of the Smart City requires solutions that can meet the challenge of the complex, interrelated goals. Increasing redundancy of transportation options allows citizens to travel between home, school, work, and daily trips more efficiently and reduces congestion on our roadways. Decreasing our reliance on fossil fuels reduces greenhouse gas emissions and allows citizens to invest more money locally. Policies regarding data collection and performance measurement are detailed in Section 9.

**History** Chattanooga has a history of developing solutions to complex challenges. The public-private partnerships formed through Chattanooga’s precedent-setting downtown revitalization continue to transform the urban core, are replicated in other areas of the city, and are studied by cities around the world.

**Active Government** – In addition to the integral role the city plays in the Chattanooga Area Regional Transportation Authority (CARTA) and EPB (detailed in Section 7), the Chattanooga Department of Transportation (CDOT) was created in May 2013 and charged with creating an efficient, multimodal transportation system that reflects the changing needs of all users while enhancing multi-use public spaces for all people. The City has developed resources to spur new

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<sup>1</sup> See priority area-specific goals and measurements at: <https://performance.chattanooga.gov/dashboard/y4sb-89dw#>

innovation through the Innovation District, the Enterprise Center, and other collaborations and policies that encourage start-ups and local creativity (detailed in Section 3).

**Infrastructure** – Sections 3-5 detail Chattanooga’s infrastructural preparedness, that includes EPB’s 10 Gig network, the Intelligent Transportation Systems (ITS), and Advanced Transportation Management System (ATMS).

**Partnerships** – The partnerships detailed in Section 7 demonstrate willingness to share resources, develop collaborative processes, assess and mitigate risk, and share results.

**Data** – In addition to our research partners, Chattanooga’s open data policies and portal and data sharing capabilities, detailed in Sections 9-10, will enable other cities, businesses, and individuals to utilize, learn from, and innovate further with the lessons we learn and the data we collect.

### Next Steps

Building from this preparedness, Chattanooga will implement the Smart City by adapting our BFO process to bring forward a suite of Smart City projects. The Smart City Implementation Team (detailed in Section 7) will solicit project proposals related to the 12 Vision Elements (detailed in Section 5) from the broad range of Smart City public and private partners as well as Chattanooga’s burgeoning entrepreneurial environment. Each project will need to address one of the five priority areas, with an understanding of how the project moves toward the three overarching goals, and they will be required to include:

- **Clear and measurable goals:** The Implementation Team will track these benchmarks to ensure long-term success of the funded initiatives.
- **Multi-agency and/or multi-department collaboration:** To leverage federal funding effectively, the Implementation Team will give preference to multi-agency or multidepartmental collaboration.
- **Mechanisms for citizen involvement and feedback:** To ensure effectiveness, citizen input will be encouraged during program development and implementation. Projects will have plans that use citizen input for constant iteration and improvement of service delivery.
- **Sustainable practices:** Projects that harness environmental sustainability will be given extra consideration. These projects will detail the environmental and fiscal return on the investment.
- **Research/Evidence based best practices:** All funded projects must employ documented best practices or thorough research.

Chattanooga is unique among mid-size cities for its preparedness for implementing the Smart City Challenge. In addition to the preparedness detailed above, the existing structure, transparency, and measurable results of the BFO system will enable Chattanooga to begin

implementation quickly and with the confidence that implemented projects will bring forward transformative results to the transportation system that can be shared and replicated in other cities. This process as well as the realized projects will be models for cities nation- and world-wide.

## 2. Population Characteristics

Chattanooga is a growing, mid-sized city, with a resurgent downtown city center blessed with thirty years of award-winning revitalization efforts, and newer geographic centers that are very automobile dependent, some built around regional shopping destinations and one built around a major job center (Enterprise South). Chattanooga is the ideal location to develop a model Smart City because it is growing, mid-size city experiencing increased urbanization and density development.

### Chattanooga is a Growing, Mid-Size City

The total population of Chattanooga, including Red Bank, TN and East Ridge, TN, is 200,304 people (see Table 1). This population total is inclusive of Red Bank and East Ridge because these areas are enclaves surrounded by the City of Chattanooga, contain current ITS that were installed and continue to be operated through CDOT, and contain populations that regularly move in the City of Chattanooga proper. The precedence for the relationship between Chattanooga, Red Bank and East Ridge has existed since 2011, when the City of Chattanooga entered into local agreements with both municipalities to operate and manage the Intelligent Transportation Systems (ITS) infrastructure for both smaller areas. These local agreements continue to be in effect today. Excluding Red Bank and East Ridge from Smart City Challenge implementation creates “holes” in the system and defeats the concepts of interoperability. With the total population and land area, Chattanooga meets the USDOT’s characteristic for a mid-sized city as defined in the NOFO. The map of Chattanooga can be seen in Section 4.

Table 1: Population Characteristics

Geographic area	Population	Land area (sq mi)	Population Density (per sq mi of land area)	Percent of Population in UZA
Chattanooga city, Hamilton County	167,674	137.15	1,222.5	43.31
East Ridge city, Hamilton County	20,979	8.28	2,533.9	5.50
Red Bank city, Hamilton County	11,651	6.52	1,788.3	3.05
<b>Chattanooga, East Ridge, &amp; Red Bank Total</b>	<b>200,304</b>	<b>151.95</b>	<b>1318.2</b>	<b>51.86</b>

Chattanooga is a growing city, with significant growth for over a decade and indications of the trend continuing. In 2010, Chattanooga was the fastest growing city in the state beating out Nashville and Knoxville at a 1.46% increase from the previous year. Since the Census of 2000, Chattanooga’s total population has risen 11.72%.

Population in the region is anticipated to grow by 25.8% by the year 2040 according to the Regional Planning Agency’s 2015 Comprehensive Plan Update. This growth is driven by a number of factors, including cost of living, job and industry growth, and available opportunities through new innovation initiatives. (Chattanooga-Hamilton County Regional Planning Agency, 2015) The employment rate is expected to grow by 38.7% by the same year. With growth rates at these anticipated levels, capacity on the roadway network will present new challenges that the City will need to address.

### **Chattanooga has a Dense Urban Population**

Chattanooga exemplifies the challenges in many mid-size cities with a dense urban population. The U.S. Census Bureau defines “urban” as a territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC), which has: a) a population density of at least 1,000 people per square mile; and b) surrounding census blocks with an overall density of at least 500 people per square mile. As seen in Table 1, the City of Chattanooga, as well as Red Bank and East Ridge, are all classified as urban under this definition, with densities ranging from 1,222 to 2,533 people per square mile and an average of 1,318 people per square mile. With increasing population and fixed land area, this means that this density has been and will continue to increase as the city population increases, putting additional pressure on transportation networks.

### **Chattanooga has a Significant Portion of the Population in Urbanized Areas**

Table 1 indicates nearly 52% of Chattanooga’s population is within the urbanized area. Like many mid-sized cities, Chattanooga has developed across a large area. Downtown Chattanooga contains the majority of office buildings, entertainment, and industry development while major employment centers are located miles away and homes are spread throughout the city. Connecting people in neighborhoods to jobs as well as serving business needs will require a versatile, adaptive transportation network.

## **3. Characteristics of a Smart City**

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The City of Chattanooga is an ideal candidate to be a Smart City because of its public transportation system with CARTA, its collaborative environment that has implemented transformational projects, a history of commitment to community improvement through federal programs and local partnerships, integration with the sharing economy, and a strong public commitment to data sharing and innovation.

### **Public Transportation**

The public transportation system in Chattanooga includes the Chattanooga Area Regional Transportation Authority (CARTA) bus system including downtown electric shuttles. The Chattanooga Area Regional Transportation Authority (CARTA) was established by the City of Chattanooga in 1973 and is funded from the federal government, the state of Tennessee, Hamilton County and other generated revenue. CARTA also coordinates its door-to-door

paratransit service, Care-A-Van with the Southeast Tennessee Human Resource Agency's (SETHRA) regional paratransit service from a shared space in Chattanooga.

CARTA currently provides fixed-route mass transit service in the Chattanooga area, operating 59 vehicles on 17 routes, including the very popular, free downtown electric shuttle. CARTA operates over 200,000 vehicle revenue hours, providing over three million unlinked passenger trips annually. This service is showing continued growth and posted a three percent increase over last year despite fuel prices being much lower than in the recent past. For 24 years, the CARTA downtown shuttle system has been a pioneer in operating as a "Living Laboratory" for our global transportation community. The shuttle has reduced congestion, improved air quality reduced the need for parking, and been an integral component of downtown revitalization. Based on the popularity of the electric shuttle system, in the next fifteen months, CARTA will add three all-electric fixed route vehicles that will use in-ground inductive technology to extend the range of the electric vehicles beyond downtown.

For the past ten years, CARTA has implemented an extensive Intelligent Transportation System (ITS) program in Chattanooga, including of free WiFi on buses, BusTracker (<http://bustracker.gocarta.org>), dynamic message signs throughout the service area; and the implementation of Computer Aided Dispatch (CAD)/Automatic Vehicle Location (AVL) systems providing real time information to CARTA's dispatchers. Through aggressive deployment of technology and communications, CARTA offers multiple tools for trip planning, including the BusTracker, the Transit App, Google Transit, or CARTAText, which provides real time bus information for customers who have SMS-texting capability on their phone.

### **An Environment Conducive to Demonstrating Proposed Strategies and Committed Leadership**

In 2013, newly elected Chattanooga Mayor Andy Berke through a community-visioning initiative called Chattanooga Forward, tasked two dozen Chattanooga residents with determining how to maximize the EPB gigabit network opportunity. A few months later, Mayor Berke, Hamilton County Mayor Jim Coppinger, and Congressman Chuck Fleischmann responded to the task force's recommendations by forming a new entity focused solely on guiding those efforts: The Enterprise Center.

The Enterprise Center is establishing Chattanooga as a hub of innovation, improving people's lives by leveraging the city's digital technology to create, demonstrate, test and apply solutions for the 21<sup>st</sup> century. They are working in the following areas:

- The Chattanooga Innovation District is a newly designated area of Chattanooga's dense and walkable urban core that contains a catalytic mix of start-up businesses, incubators, accelerators and other innovation economy generators and amenities.
- Tech Goes Home Chattanooga is a new digital inclusion program helping residents across Hamilton County gain access to the skills, hardware, and Internet connectivity required for 21st century success.
- Having all parts of a healthy entrepreneurship ecosystem in place is crucial to be able to develop, attract, and keep talent necessary to the new economy. The Enterprise Center is ensuring that this ecosystem is strong, flexible and growing in Chattanooga.

The basis for these efforts comes on the heels of the City's 10 Gig fiber optic network. A non-profit agency of the City of Chattanooga, EPB was established in 1935 for the sole purpose of providing electric power to the people of the greater Chattanooga area.

Today, EPB is still one of the largest publicly owned providers of electric power in the country as well as the provider of a fiber optic communications network delivering some of the nation's fastest Internet speeds. The 6,450 miles of high speed fiber optic cable of which 2,300 are steel lashed provides a 6-7 millisecond average round trip time to devices across the network and enables one of the most advanced electric distribution systems in the world; intelligent, interactive and self-healing. The company currently supports communication services to over 78,000 residential and business customers in the area.

The City of Chattanooga is relentlessly focused on the priorities of our residents (safer streets, stronger neighborhoods, growing economy, smarter students & stronger families and a high performing government) and communicating the progress toward and effectiveness in those five priority areas. Through our Budgeting for Outcomes approach, each dollar must be justified based on how it delivers results to constituents in these key areas. ChattaData is the performance management tool that tracks, monitors, and makes public our efforts, holding us accountable and helping us achieve our goals. Details about ChattaData can be found at: <http://data.chattlibrary.org> and <https://performance.chattanooga.gov/>

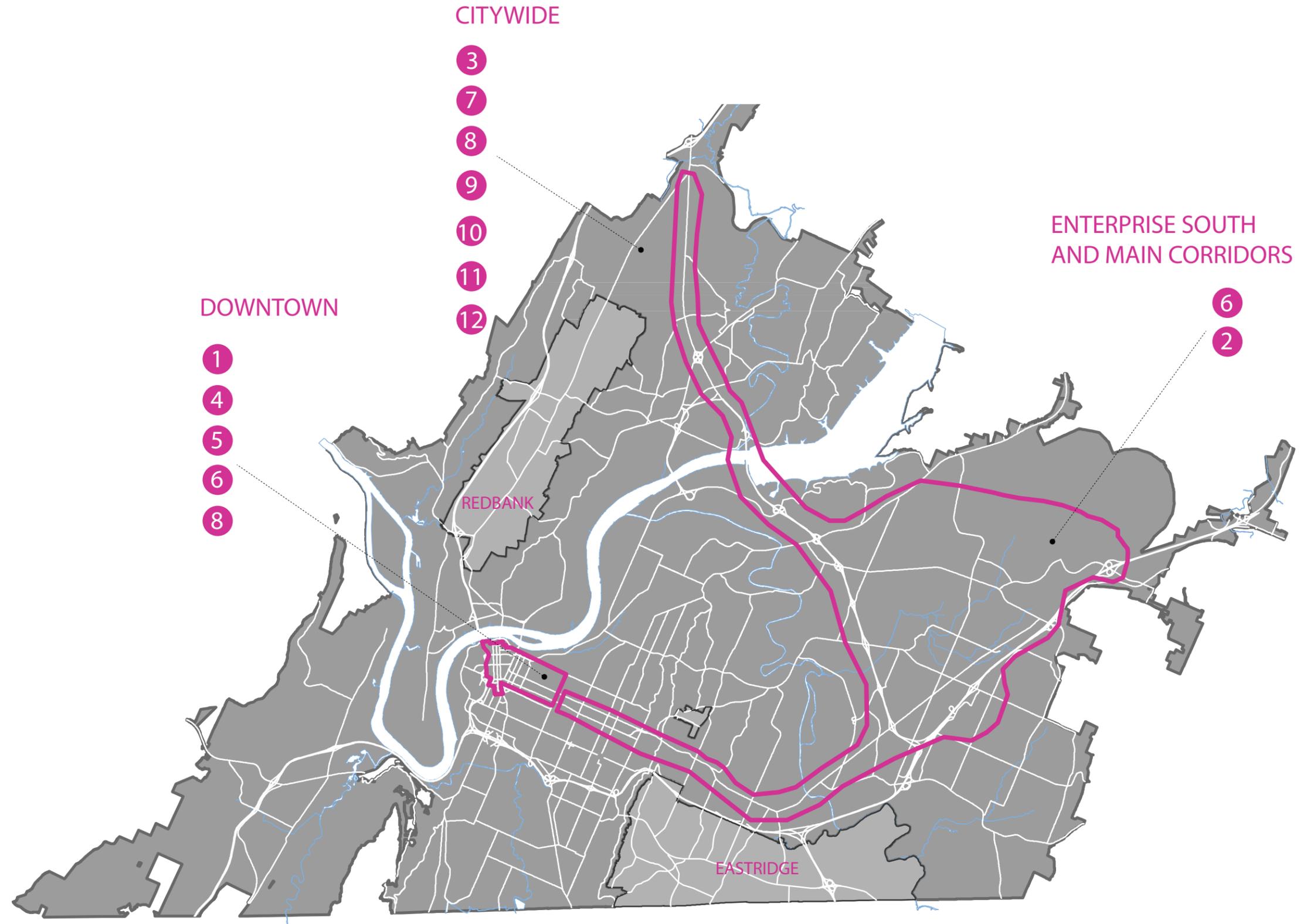
Chattanooga is committed to setting goals, sharing results, and being held accountable through ChattaData, similar platforms, and public and stakeholder engagement throughout Smart City implementation.

## 4. Vision Element Deployment Map

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# CHATTANOOGA VISION ELEMENT DEPLOYMENT MAP

- 1 URBAN AUTOMATION
- 2 CONNECTED VEHICLES
- 3 INTELLIGENT SENSOR-BASED TECHNOLOGY
- 4 URBAN ANALYTICS
- 5 USER-FOCUSED MOBILITY SERVICES AND CHOICES
- 6 URBAN DELIVERY AND LOGISTICS
- 7 STRATEGIC BUSINESS MODEL AND PARTNERING OPPORTUNITIES
- 8 SMART GRID, ROADWAY ELECTRIFICATION, ELECTRIC VEHICLES
- 9 CONNECTED, INVOLVED CITIZENS
- 10 ARCHITECTURE AND STANDARDS
- 11 LOW-COST, EFFICIENT, SECURE, AND RESILIENT INFORMATION AND COMMUNICATIONS TECHNOLOGY
- 12 SMART LAND USE



## 5. Integrated Implementation of a Smart City Transportation System

The City of Chattanooga understands the value of advanced infrastructure and the rippling effects it creates in our community. Most recently, we have witnessed the transformative changes that have transpired as a direct consequence of the advanced fiber-to-the-premise network EPB launched in 2009. Through Smart City implementation, we will focus on an advanced, integrated infrastructure approach to transportation that will support the same level of transformative changes throughout the city. By ensuring all of our transportation systems are interoperable and providing a unified interface for users and applications to interact with the transportation network, we will foster innovation beyond our ability to imagine today. Technology is changing faster than ever, by demanding and ensuring open architecture and interoperability of our systems, we will maintain our ability to innovate in an iterative, low cost process. Assuring that our investments will continue to bring value to our citizens well into the future.

Table 2: Vision Elements

12 Vision Elements	SMART CITY CHALLENGE			CITY OF CHATTANOOGA			CORE VALUES	
	Improved Safety	Enhanced Mobility	Addresses Climate Change	Safer Streets	Growing Economy	Stronger Neighborhoods	Smarter Students & Stronger	High Performing Government
1 Urban Automation	X	X	X	X	X			X
2 Connected Vehicles	X	X	X	X	X			X
3 Intelligent Sensor-Based Infrastructure	X	X	X	X	X	X		X
4 Urban Analytics	X	X	X	X	X	X	X	X
5 User-Focused Mobility Services & Choices		X		X	X	X	X	X
6 Urban Delivery and Logistics	X			X	X			X
7 Strategic Business Models & Partnering		X			X		X	X
8 Smart Grid, Roadway Electrification & Electric Vehicles			X		X		X	X
9 Connected, Involved Citizens		X		X	X	X	X	X
10 Architecture & Standards	X	X	X	X		X	X	X
11 Low-Cost, Efficient, Secure & Resilient Information & Communications Technology	X	X	X	X	X		X	X
12 Smart Land Use	X	X	X	X	X	X	X	X

### **Urban Automation**

- Autonomous car share enables accessibility
- Autonomous Fixed route shuttle lowers operating cost for key urban core transit
- Autonomous dedicated lane express transit to serve as interim solution to light-rail need for inter-city transit
- Autonomous airport shuttle from Multimodal Transit Center to Chattanooga Airport
- Autonomous freight delivery reduces urban core congestion
- Automation of data collection and processing by the Adaptive Traffic Signal Control system allows the infrastructure to respond to real-time network conditions for conventional traffic.
- Automatic pedestrian signal operation through smart device integration to enhance accessibility
- Automated activation of dedicated bicycle signals only when bike traffic is present
- Mobile-Eye crash avoidance system for transit.

### **Connected Vehicles**

The vision for connected vehicles is to provide the technologies required for robust Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications throughout the urban core. This infrastructure will enable Emergency Vehicles, Transit and Freight prioritization throughout the City in the short-term, and have the capacity to handle additional Connected Vehicle (CV) applications in the future.

- Vehicle-to-Infrastructure data flow is bidirectional. Provides data on vehicle metrics and is capable of pushing data to vehicle.
  - Adaptive Traffic Signal Control can utilize the data for speed harmonization or truck platooning.
  - Safer driver operation by providing instructions during traffic affecting events.
  - Dedicated Short Range Communication provide speed and positioning data for signal prioritization.
  - Status updates for at grade railroad crossings and draw-bridge openings.
- Vehicle-to-Vehicle data flow is bidirectional. Provides data between vehicles for spatial information for roadway positioning and vehicular platooning. Speed harmonization, collision avoidance and red-light running.

Chattanooga is already implementing a pilot connected vehicle application with an existing Transit Signal Prioritization project Congestion Management and Air Quality (CMAQ) grant awarded by the Federal Highway Administration and the Tennessee Department of Transportation in April of 2015. That project will impact the busiest CARTA that connects dense residential neighborhoods to jobs, schools, medical care, and daily needs.

The DSRC 5.9 GHz technology has been identified by USDOT as the preferred platform for V2I communications. The City of Chattanooga and its partners at ORNL deployed a “proof-of-concept” test of DSRC in the summer of 2014 utilizing test units provided by ORNL and their

test vehicle and the traffic signal communications (Wireless Mesh) network maintained and operated by the City. That test proved the feasibility of our existing communications infrastructure handling the connected vehicle data flows.

- Eco-Signal Prioritization
- Eco-Traffic Signal Timing
- Incident Pre-Arrival Staging for Emergency Responders
- Incident Scene Work Zone Alerts
- Low Emission Zone Management

### **Intelligent, Sensor-Based Infrastructure**

The use of Intelligent, sensor-based infrastructure in the Eco-Signal Timing and Prioritization will complement these activities. Devices that monitor vehicle plumes against count and classification detectors can trigger specific timing plans based on those signatures as they begin to develop.

- Chattanooga operates 211 existing traffic signal installations with data on occupancy, signal measures of effectiveness (MOE). Speed, and bike/vehicle/pedestrian counts.
- Emission monitoring units can provide real-time data on vehicle plumes. Adaptive Traffic Signal Control system will utilize that information to adjust for increases in certain pollutants.
- Video Detection will provide real-time data on traffic volume, vehicle classifications and will provide video confirmation of traffic congestion for incident recognition, reporting and verification. Linking the video through data analytics can produce diversion plans to mitigate congestion. The City of Chattanooga has 41 Video Detection units being installed in March 2016.
- Permanent Count Stations provide real-time data on vehicle counts by roadway segment. Occupancy and speed data will be collected. These are the basic building blocks for traffic management and modeling.
- Bluetooth and Wifi passive tracking will be utilized in an Accessible Transportation Technology Research Initiative (ATTRI) application for pedestrian actuation.
- Railroad crossing pre-emption circuitry at traffic signal locations can provide crossing status.
- Adaptive Traffic Signal Control throughout the urban core will utilize the passive tracking, bicycle, transit prioritization and vehicular sensors in its operation.
- Parking availability status reporting.

Use of real time video processing to model vehicular movement across the transportation network enables smart autonomous vehicles including route based freight and passenger traffic as well as ad-hoc point to point personal transit that provide enhanced accessibility. This transportation system model is not limited to vehicular traffic, by using bluetooth and wi-fi passive tracking as well as opt-in app-based GPS locators we will enable applications that are aware of all transportation options available to the user at any time. This system model will be available in real time to external applications as well as the vehicles themselves through a robust implementation of DSRC (Dedicated Short Range Communications) infrastructure.

Additional technologies include audible pedestrian push buttons and countdown pedestrian signals at signalized intersections which are now required by TDOT and the City of Chattanooga. Through the existing network, modification and monitoring of those devices can be achieved.

### **Urban Analytics**

The proposed Urban Analytics team will be made up of members of Chattanooga Department of Transportation (CDOT), Chattanooga/Hamilton County/North Georgia Transportation Planning Organization, University of Tennessee at Chattanooga, and Oak Ridge National Laboratory. The team will develop an analytical platform that will integrate and analyze transportation data from the unified system model as well as external sources such as cellular data, crowd-sourced data and social media data with weather information and traffic incident data in order to address urban challenges such as traffic congestion, safety and mobility issues, network deficiency and unreliability, and air pollution.

The real time and near real time data such as speed, travel times, turning movement, counts by bike, vehicle class and street classification will complement the historical data from National Performance Management Research Data Set (NPMRDS) data and third party cellular data with more robust data for both the National Highway System (NHS) and non-NHS networks. For evaluation of proposed transportation improvement projects, the analytics will result in more accurate performance metrics which were identified in the 2040 Regional Transportation Plan (RTP) and aligned with the RTP objectives, such as vehicle mile traveled (VMT), annual congestion cost, average commute trip time, vehicle-hours delay within half-mile buffer of project facility, emergency response time, and access to jobs and services.

Another application includes better and more accurate data for travel demand model calibration which resulted in improved traffic projections and more effective transportation planning. The analytics will also develop from behavioral sciences perspective to improve safety and modify transportation choices.

Results will be shared with citizens, service providers and employers through multi-modal data fusion and large scale interactive data visualization to support multi-modal transportation policies, congestion management process and travel demand management. Efficient communication channels, including web and mobile apps, will be set up to distribute real-time information for transportation-related/location-based incentives and to recommend alternative routes and mode of transportation to the public.

Urban analytics will play a major role in helping the city develop more cost-effective and data driven decisions to help tackle urban challenges ranging from traffic congestion, air pollution and diminishing funding resources to aging facilities. Development of an Infrastructure Health Calculator will be one of the outcomes from the Urban Analytics process. The result will be a more efficient and sustainable city. Transportation health impact will be assessed using the Transportation and Health Tool developed by U.S. DOT and the Centers for Disease Control and

Prevention. Disease-specific public health will also be analyzed based on cross-agency data and customized analytics process.

UTC working with EPB, US Ignite and The Enterprise Center is now the home for a GENI (Global Environment for Network Innovation) computing node. GENI provides a high-speed, distributed, virtual environment for development and research of next generation technologies. GENI will be leveraged to partner with researchers in the 60+ top tier research universities that are connected develop and pilot next generation technologies on the transportation network. This same GENI environment will allow the sharing of successful application pilots with the many other US Ignite cities with a common architecture for rapid deployment of these applications.

### **User-Focused Mobility Services and Choices**

The City of Chattanooga has addressed significant mobility mode choices within its 2040 Regional Transportation Plan. Smart city implementation will consider the opportunities that lie outside of that plan. Detailed below are existing projects that address user access to integrated transportation system data.

- A 2014 Congestion Management and Air Quality Grant will provide an Advanced Transportation Management System that provides the user with traveler information to make a data driven decision on mode choice. Implementation to begin in March 2016.
  - Real-time incident management data
  - Real-time transit system status
  - Real-time Bike-share and Car-share status
  - Real-time construction or special event areas
  - Center-to-Center coordination with the Region 2 of Tennessee Department of Transportation

The City of Chattanooga has enacted policies for the open access to data by the public.

- Internal Data Access
  - City has current open data portals for public use in development of opt-in applications
  - Bike Chattanooga, CARTA and the City have opt-in applications for use regarding the their services.
- Tennessee Department has the Smartway App regarding the Interstate and State Route system within the region.
- A solution that the City has developed is the award winning GreenTrips program. This free program provides incentives and educational resources for walking, biking, carpooling, transit, and telecommuting. GreenTrips also offers a ridesharing application to match compatible users for carpooling, biking, walking, and transit trips.

### **Urban Delivery and Logistics**

Logistics-dependent businesses are particularly dependent on the efficient, reliable movement of goods for both inbound and outbound supply chains. More than three quarters (76.3%) of Chattanooga's freight by weight moved by truck in 2007, and trucks are expected to grow their market share to 79.9% of the total by 2035. Therefore, the 2010 Regional Freight Study indicates that the full development of the Volkswagen (VW) Chattanooga Assembly Plant will likely necessitate the need for additional capacity enhancements to ensure the smooth flow of cargo to and from the Enterprise South Industrial Park area. High-accident locations on interstates contribute to supply chain inefficiencies for area shippers, which are closely related to a lack of alternate routes that can effectively handle trucks.

- Connected Vehicle programs that include Vehicle-to-Infrastructure and Vehicle-to-Vehicle will provide a safer, more efficient and a more environmentally friendly freight system.
- Autonomous Delivery and Logistics in the urban core reduces congestion.
- Shared use Facilities such as the Autonomous Airport Shuttle can deliver some packages in lieu of a separate delivery vehicle.
- Time-sensitive deliveries or correspondence can consider alternate modes for pickup and delivery options including autonomous vehicles
- Several private retail outlets are offering shopping online with delivery services. These services would benefit from autonomous delivery platforms.

The impact of this freight traffic is congested roadways and with few identified truck routes through the city core, it leads to additional congestion in areas unable to support truck traffic.

### **Strategic Business Models and Partnering Opportunities**

The City of Chattanooga has developed a list of partners that will frame the City's future, detailed in Section 7. Specific initiatives arising from these partnerships include.

- The City and EPB have built a relationship with ORNL. ORNL has worked with the City on numerous other projects including the 2015 CV Pilot Deployment Wave 1 and an exploratory project on the ATTRI program in May of 2015.
- EPB and ORNL have entered into an agreement for U.S, Department of Energy to assist with analysis of the Smart Grid System at EPB.
- The City of Chattanooga has a long standing relationship with the University of Tennessee Chattanooga. UTC has been a key partner in Big Data initiatives in the City and hosts the GENI node.
- The City established the transit authority CARTA in 1973. CARTA operates 17 fixed route transit lines, the Electric Shuttle, the Incline Railway, Chattanooga's Parking Authority, and the Care-A-Van paratransit system.
- An "Infrastructure-Health Calculator" will be developed by UTC's Office of Research and Sponsored Programs and Department of Computer Science and Engineering.
- The Enterprise Center and its Innovation District partners will work on initiatives to build dynamic relationships with business, private sector and special interest groups to improve quality of life and build a more conducive environment for the economy.

### **Smart Grid, Roadway Electrification, and Electric Vehicles**

EPB in Chattanooga has the Smart Grid technologies and is working with ORNL to further develop the technology. According to a recent report, “The smart grid is estimated to have avoided 124.7 million customer minutes of interruptions by better detection of power failures and better methods of rerouting service more quickly than in the past.”<sup>2</sup>

- EPB will explore the technologies involved with the Electric Vehicle to Grid (EVTG) role in the Pure DC Circuit.
- CARTA, through funding and partnership with the Tennessee Valley Authority (TVA), will add a minimum of 40 solar-assisted Electric Vehicle charging stations to the existing network throughout the greater Chattanooga area.
- Car-Share objectives,
  - development and implementation of a solar assisted EV/PHEV charging infrastructure,
  - support the launch and adoption of a shared car program,
  - expand the current system of electric vehicle charging infrastructure,
  - provision of solar power generation to approximately equal or “offset” the power consumption of the charging system by adding renewable energy to the grid, and
  - reduction of local vehicle emissions through the use of EV/PHEVs.
- ORNL is working in the dynamic or in-motion charging technologies. The City and CARTA will explore air-gap charging in select locations within the City’s Parking Authority properties and on-street locations. These spaces will provide data to the Parking Authority and to the City’s ATMS.
- Currently the City has over 50 EV charging stations across town with others being installed by private entities such as “Whole Foods.” Links to those data sources will also be published through the ATMS.

### **Connected, Involved Citizens**

The City of Chattanooga prides itself on open and transparent government. This transparency is accomplished in part through the use of the City of Chattanooga and Chattanooga Public Library’s open data portal. The City of Chattanooga has established the position of Director of Performance Management and Open Data to address specifically these tasks. The City will utilize advanced technologies to enhance overall mobility for all citizens including people with disabilities, older adults, and young millennials who will act as an important engine of the future economy.

- Crowdsourced data provides communication conduits through mobile technologies to connect citizens with city operators about a myriad of topics. In a successful Smart City, citizens would provide user-generated content to cities.

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<sup>2</sup> Flessner, Dave, Chattanooga Times Free-Press, “Chattanooga Utility’s Smart Grid Generates Over \$865 Million for ‘Gig City’.” 15 Sept. 2015.  
<http://www.timesfreepress.com/news/business/aroundregion/story/2015/sep/15/study-finds-epb-fiber-optics-generates-over-865-million-benefits-chattanooga/325235/>

- Those individuals of limited mobility or visual impairment are will need specialized technology to provide them with the real-time information produced by these data sources.
- Leveraging broad access to open government data providing a platform for citizens to serve as co-creators and co-producers of new and innovative transportation services.
- Open architecture for further app development by others.

### **Architecture and Standards**

It is the goal of the City of Chattanooga to develop a replicable model for use in other agencies nationally. Documentation, coding and all data will be made available to the USDOT and other related agencies.

- The City of Chattanooga and the CHCNG TPO revised the ITS Architecture for the region in December of 2013, which will require updates to address autonomous and connected vehicle technologies.
- The USDOT's Systems Engineering Tool - Intelligent Transportation software application and it will be utilized by the team to develop the architecture and standard required by this project.

### **Low-Cost, Efficient, Secure and Resilient Information and Communications Technology**

The City of Chattanooga and EPB have the premier network in the country to provide communications infrastructure necessary to perform the BIG DATA collaboration required by this project.

- The City of Chattanooga and its partners will work with the USDOT on other developing protocols such as the security credential management system for use with the DSRC-based portion of the communications network.
- The Smart City project will develop a Privacy and Security Management Operating Concept as a companion document to the ConOps in which the underlying needs of the Smart City Deployment to protect the privacy of users, ensure secure operations, and outline a concept that illustrates these needs will be addressed.
- The Privacy and Security Management Operating Concept will describe the concepts to be implemented to ensure privacy is protected and all required Personal Identifiable Information (PII) is handled appropriately.
- During this team's experiment during the summer of 2014, the team interacted with a Security and Credentials Management System (SCMS) and, based on what was learned then, the team will incorporate with SCMS in this project.
- Accordingly, security by design will be a guiding principle and one of the foundational concepts behind the goals and overall design of this Smart City Deployment.
- We will interface with national SCMS to make ensure interoperability.
- Smart City implementation will utilize the SCMS as a tool to support general deployment communication security and address physical security of the elements that make up the installation as well.

- Smart City implementation will deliver a draft version of the Privacy and Security Management Operating Concept and work with the USDOT for its review and approval.

### **Smart Land Use**

Before such efforts were commonplace in all cities across the country, Chattanooga began to incorporate public input, student participation, and strong place-making and urban design principles in the revitalization of its downtown core. The Urban Design studio has been modeled and copied by communities all over the world, the recent studio retrospective reflects principles that were a generation ahead of their time. The City is making policies to assure an “energy-smart” community at our core, including:

- Compact development, which conserves open space in communities.
- Mixed land use combining residential, commercial, job centers, schools, social services, public institutions, etc.
- Infrastructure design (i.e. Complete Streets) practices, which enhance travel between destinations by all modes and users—including transit riders, bicyclists, pedestrians and vehicles.
- Form-based code, scheduled for City Council action in Spring 2016, replaces an archaic Euclidean zoning system, and establishes a basis for building a city based on what we can do with three-dimensional form rather than what we can’t do with use and restrictions.

Building in “energy smart” ways can also provide benefits to communities aside from reducing carbon emissions. Smart infrastructure in land use planning and community design can build strong local economies and attract business while also supporting healthier and safer communities.

## **6. Risk Assessment and Mitigation**

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Chattanooga understands the technical, policy, and institutional risks associated with implementing a new and visionary system, but we are establishing policies, procedures, and partnerships to mitigate those risks. Chattanooga has demonstrated its ability to implement large-scale, collaborative projects that have transformed the city regardless of the associated risks.

### **Technical Risk**

Technical challenges may result from our Smart City vision in cybersecurity, hacking, and privacy issues. With a smart system or any technology-based system, cybersecurity and hacking threats are a concern to the overall operation. A successful operation will need to remain dependable and secure as well as able to integrate changes as new threats and vulnerabilities arise. A partnership with ORNL in cybersecurity will assist in developing and maintaining an adaptable and secure system. This security will also be important to privacy concerns, especially for sensitive payment information. The city has experience maintaining privacy in other areas and operates a centralized IT department that will be involved in the implementation of the

system. Additionally, data that is available in the open portal must comply with policy to be presented anonymized, without any identifying information.

### **Policy Risk**

There may be policy risks if federal or state laws are passed that preempt the collection or use of data related to the vision. In order to mitigate these risks before they develop, it will be important for the city to communicate the vision, develop strong supporters, and maintain contact with legislators on progress. The application includes the vision, as well as letters of support from local, state, and federal representatives. A review of comparable open data platforms in other cities indicates that Chattanooga's existing open data portal policy is in line with current best practices.<sup>3</sup>

It is important to note that many perceived risks with open transit data (such as legal liability) did not materialize after implementation. In fact, a comprehensive survey and study of the use of open data for transit planning and related policies concluded that there were a number of benefits to open transit data, while the major challenge to internal agencies was ensuring the resources to maintain the open data policy.<sup>4</sup>

In addition to comparable policies and contact with legislators, the City of Chattanooga is also supported in this effort by the Innovation District and the Enterprise Center, which represents business interest in open data and related applications.

### **Institutional Risk**

Although there are institutional risks in implementing a vision that requires coordinating with multiple departments and partners and addressing issues such as the digital divide, the City will mitigate these risks with its existing open data platform, a clear governance structure, and experience in large, visionary projects in the city.

The vision for transportation networks in the city will require coordination from multiple departments and institutions to be effectively implemented. This includes internal expertise from CDOT, IT, Sustainability, Planning, RPA, and other departments, as well as The Enterprise Center, EPB, and other partners listed below. Additionally, the City will also need to address the digital divide, as there are members in the community with limited access to smartphones, computers, and internet service.

Chattanooga has the resources to mitigate these risks through existing structures, relationships, and history. The open data platform is currently operational and, as shown in the past, brings together internal and external groups to collaborate on projects. The City also actively uses

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<sup>3</sup> American Public Transportation Association, Public Transportation Embracing Open Data, <https://www.apta.com/resources/reportsandpublications/Documents/APTA-Embracing-Open-Data.pdf>

<sup>4</sup> Transit Cooperative Research Program, TCRP Synthesis 115: Open Data: Challenges and Opportunities for Transit Agencies, Transportation Research Board, 2015: Washington, D.C., *available at* [http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp\\_syn\\_115.pdf](http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_syn_115.pdf)

Google Docs and other systems to coordinate large projects among different groups. With a clear governance structure headed by the CDOT, the vision will be implemented with direction from the department that will be primarily responsible for continued maintenance and upkeep while being supported at the executive level by the Mayor’s Office and related officers.

## 7. Partners, Stakeholders and Governance

Chattanooga’s Smart City vision arises from the long-term strategic partnerships demonstrated in the figure below and detailed in Table 3 & 4.

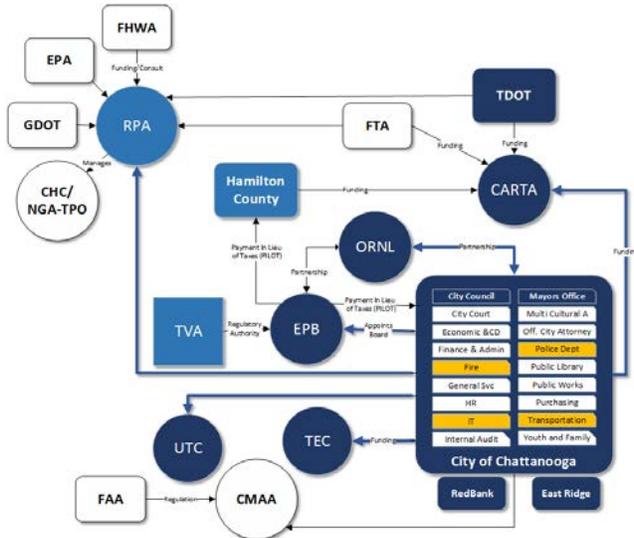


Figure 1: Relationships of Partners and Stakeholders

Table 3: Core Partners

Organization	Description
<b>City of Chattanooga</b>	Includes the Mayor of Chattanooga, City Council, and different departments/agencies
<b>City of Red Bank, City of East Ridge</b>	The City of Chattanooga has existing local agreements with the Cities of Red Bank and East Ridge to operate the traffic signal, ITS and communications network within those jurisdictions. Those agreements are inclusive of the proposed Smart City implementation.
<b>Oak Ridge National Laboratory</b>	Research scientists in transportation technologies. They are assisting in the areas of data collection and analytics. ORNL is also working on electric vehicle charging technologies which includes charging in motion. Additionally, ORNL has established a partnership with EPB to support national efforts in Grid Modernization.
<b>University of Tennessee at Chattanooga</b>	Researchers from the school will assist with Big Data measurement, analytics, and innovations. They are working with Georgia Tech and Virginia Tech through the NSF’s Big Data Hub and Spokes program on replicable data based applications from our systems transferable to other markets + GENI.
<b>The Enterprise Center</b>	Chartered by the City and County Governments to focus on developing the Innovation Economy in Chattanooga. The first of its three key initiatives is developing the recently announced Innovation District, the first such district declared in a mid-sized city in the

	U.S. Secondly, it supports and fosters research and application development projects that leverage the city’s Innovation Economy Assets, including the deployed 10gbps network and our strong entrepreneurial ecosystem. Its third key initiative seeks to narrow the digital divide and enable access to the Innovation Economy to all Chattanoogaans, regardless of social or economic status.
<b>Chattanooga Area Regional Transit Authority</b>	CARTA has been instrumental in innovative application to promote multimodal public transportation. From deployment of electric buses in 1992, to early adoption of on board WiFi and GPS tracking, to support of public bike and car sharing operations, CARTA has established itself as a key partner for this Smart City Challenge.
<b>EPB</b>	A non-profit agency of the City of Chattanooga, EPB was established in 1935 for the sole purpose of providing electric power to the people of the greater Chattanooga area. Today, it is one of the largest publicly owned providers of electric power in the country serving more than 170,000 customers in a 600 square mile area that includes greater Chattanooga, as well as parts of surrounding counties and areas of North Georgia. Beginning in 2009, EPB became a provider of a fiber optic communications services delivering television, voice and some of the nation’s fastest Internet speeds (10 GB).
<b>Tennessee Department of Transportation</b>	Freight and data come together with TDOT. Their systems control many limited access roadways in the region that are essential arteries and provide interface between other freight movement modes such as river, rail, and airport traffic. Chattanooga is a hub of activity with the transfer of freight from one mode to others. TDOT is the oversight agency for all modes of transportation in the state.

**Table 4 Key Stakeholders & Potential Collaborators**

<b>Name</b>	<b>Type</b>	<b>Description</b>
Open Chattanooga	PPP	Open Chattanooga is a collaboration between City of Chattanooga, Chattanooga Public Library, Open Chattanooga Brigade. It empowers citizens with City data to tell stories, solve problems, and better interact with government. It was involved in the development of the open data platform and has hosted past civic hackathons and would likely be a partner in future application development and open data initiatives.
Foundations	Non-profit	A number of initiatives (including the Chattanooga Open Data Portal) have been funded in part by local foundations interested in improving the community, including the Benwood Foundation, McKenzie Foundation, Knight Foundation, and Lyndhurst Foundation. These foundations will be instrumental in implementing the vision, especially to mitigate risks associated with the digital divide and ensure access to all citizens.
Chattanooga State Community College	Public	Chattanooga State is a public community college that has partnerships with industry partners, particularly in the STEM fields. It will likely be involved in workforce development and implementation of the vision.
Chattanooga Chamber of Commerce	Non-Profit	The Chamber of Commerce is a local business association that is involved in workforce development and economic growth

		initiatives in Chattanooga. It would likely partner in events linking business opportunities to vision deployment.
Tennessee Valley Authority	Public	TVA is a federally owned corporation in the United States that serves 154 power companies representing 9 million people in parts of seven states EPB Chattanooga is a local distributor of power on behalf of TVA. With its three-fold focus of service in the fields of energy, environment and economic development, TVA has long been a fundamental force in the prosperity of the Tennessee Valley. TVA will likely be a partner, especially on EV/PHEV expansion
Businesses (Amazon, Volkswagon, Coca-Cola, Blue Cross Blue Shield and others)	Private	Large corporations in the area have an interest in economic growth in the area, employee quality of life, and transportation as it relates to their products. These businesses have also been involved in the past in supporting initiatives that will improve the community and government services, and they will likely be interested in collaborating on vision deployment.
Incubator/Innovation Groups	Private/ Non-Profit	Entities that support start-up development will be an important part of the application development and vision deployment. There are a few different incubators that could bring worldwide talent to develop revolutionary applications and Smart City ideas. Co.LAB is expanding its accelerator program, which invites innovators from across the globe to leverage the city's advanced broadband infrastructure and robust entrepreneurial resources to launch next-generation businesses. Lamp Post Group, a venture incubator, has supported logistics startups in the past and is expanding its presence and operation in downtown Chattanooga. There are opportunities to partner with these groups in Smart City implementation, bringing talent to problem-solve challenges, and supporting start-ups and developers in vision deployment. Additionally, these groups could partner to approach private entities for funds to crowdsource for truly innovative applications.
Chattanooga Citizens	-	Chattanooga citizens are a key stakeholder as users of the transportation network. They will be a collaborator on developing specific projects for the next application through public brainstorming and input meetings as well as hackathons.

**Demonstration Governance Process**

The Phase II Application development will be led by:

- Blythe Bailey, City of Chattanooga, Department of Transportation, Administrator
- Erik Schmidt, City of Chattanooga, Director of Sustainability
- Kevin Comstock, City of Chattanooga, Department of Transportation, Traffic Signal Systems Engineer
- Andrew Rodgers, The Enterprise Center
- Annie Powell, CARTA, Director of Grants, Technology, and Research

- Dr. Mina Sartipi, University of Tennessee at Chattanooga
- Dr. Jan-Mou Li, Oak Ridge National Laboratory

The Smart City Implementation Team will be led by the Phase II development team along with a coalition of representatives from the partners and stakeholders detailed above and appointed members of the public.

## 8. Current Transportation Infrastructure and System

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The City of Chattanooga has made significant investments in its current infrastructure on the path to the transportation network of its future. Features of the current system include:

- Arterial miles: 1,255 centerline miles of roadway, 490.709 miles of sidewalk, and 112.48 miles of bike facilities and trails.
- Freeway miles: 64.31 miles of roadway

### **Transit Services**

As identified in Section 3, CARTA operates the public transit system within the City of Chattanooga and the surrounding region, providing approximately 3.1 million passenger trips per year. CARTA is comprised of four divisions:

1. Fixed Bus Route service within the City of Chattanooga/Neighborhood Bus Routes
2. Complementary demand response paratransit service (Care-A-Van) for citizens with disabilities within the city of Chattanooga
3. Downtown Electric Shuttle/Northshore Shuttle and parking system
4. Lookout Mountain Incline Railway

In addition, CARTA provides oversight, maintenance, and enforcement for approximately 4,200 surface, on-street, and garage parking spaces.

### **Shared-Use Mobility Services**

In addition to traditional public transit services, other shared-use mobility services in the City of Chattanooga include a bike sharing program and ride-sourcing. CDOT's Bike Chattanooga Bicycle Transit System includes 33 stations and over 300 bicycles in downtown Chattanooga. Ride-sourcing is available with Uber operating in Chattanooga.

Shared-use mobility services in the city are in development as well. CARTA, in partnership with TVA, is working to develop a corresponding turnkey car share rental service that is largely comprised of electric and/or plug-in electric hybrid vehicles.

### **Information and Communication Technology (ICT)**

The City of Chattanooga has developed a solid ICT foundation for future development through its broadband network, plans for wi-fi connectivity, and open government data initiatives (which are discussed in Section 9).

EPB's fiber optic network (further described in Section 3) throughout the entire electric service territory is the foundational component of the community's communication technology and includes a state of the art fiber optic network throughout the entire electric service territory built by EPB. The speed (6-7 millisecond average round trip time to devices) and extensive reach (6,450 miles of cables to over 78,000 customers) of this network enables wireless backhaul, business virtual local area networks, and electric system automation.

The City of Chattanooga is partnering with EPB to bring public Wi-Fi connectivity to public spaces in strategic locations throughout the city through its NoogaNet initiative. A part of this effort includes plans to rewire and update the City's network infrastructure within the next few years.

With this foundation, Chattanooga is prepared to take the next steps in Smart City ICT development.

### **Intelligent Transportation Systems (ITS)**

Through the use of Congestion Management and Air Quality (CMAQ) Grants, the City has built an impressive ITS network that spans the Cities of Chattanooga, Red Bank and East Ridge.

Currently there are 329 signalized intersections in the City of Chattanooga, 13 in the City of Red Bank, and 17 in the City of East Ridge. The City of Chattanooga Transportation Management Center maintains communications with 211 of these locations through a fiber optic network. That communications network is a mix of direct connection fiber and wireless mesh. Future phases of these ITS projects will bring the communications network to the remaining 148 intersections within the region. Additionally the City of Chattanooga has installed 70 permanent count stations across the region and a network of cameras to monitor and count traffic. Each of these technologies provides data in which to develop models, and metrics on system performance. It is important to note that Chattanooga has the first Adaptive Traffic Signal Control system in the state of Tennessee.

### **Smart Grid Infrastructure**

Chattanooga has begun to build its smart grid infrastructure through EPB's network technologies and partnerships with EPB and TVA to implement and expand on electric vehicle usage and infrastructure.

EPB manages 3,900 circuit miles of the most advanced electric distribution in the world. High levels of system reliability are a result of a gigabit passive optical network (GPON), automated breaker technology on both the 46kv and 12kv systems and AMI (Advanced Meter Infrastructure). Together these technologies create a system that is interactive, intelligent and self healing. Additionally, the fiber optic network equips the community to incorporate distributed energy resources like solar and storage, sensors and electric vehicles.

EPB and the City of Chattanooga have partnered with TVA to introduce plug in hybrid fleet vehicles like medium duty trouble trucks, vans and shuttle buses. Currently, CARTA, the City of Chattanooga and TVA are partnering in the installation of 40 public solar PV assisted electric

vehicle charging stations. Additionally, the City of Chattanooga, EPB and TVA will continue to collaborate in efforts that support Executive Order, 13693 “Planning for Federal Sustainability in the Next Decade”, issued in March 2015 by the president, addressing federal sustainability. Executive departments and agencies have been called upon to demonstrate leadership in energy, environmental water, fleet, buildings, and acquisition management to drive national greenhouse gas reductions and support preparations for the impacts of climate change. Specifically, a section within the order looks to increase “Zero Emission Vehicles” or plug in hybrid vehicles (electric vehicles) and support the planning for fleet charging infrastructure, and opportunities for ancillary services to support vehicle-to-grid technology. Goals for EVs should account for 20% of all new agency passenger vehicle acquisitions in an agency's fleet by 2020, and 50% by December 31, 2025.

Chattanooga’s current infrastructure and transportation system investments are further strengthened with open data platforms and other policy.

## 9. Data Management and Policy

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Chattanooga’s data management program and related data and transportation policies at the local and state level support infrastructure and other investments and add to our foundation as a Smart City.

### **Data Collection**

The city currently collects and publishes a number of existing datasets from its departments and agencies. Much of this data is relevant to the city’s five priority areas and subgoals, which are defined with specific and measurable performance metrics. This data currently available public includes: crime data, Chattanooga.gov website analytics, traffic citations by location, CARTA GTFS (General Transit Feed Specification of bus routes), bicycle parking locations, maps with railroad locations and parking surfaces, map with Bike Parking Locator, CARTA bus ridership, potholes filled, funding amounts for traffic engineering and other transportation-related costs, and Bike Chattanooga user trip data. CARTA also has a system to collect additional information on the bus system, including a real-time automatic vehicle locator (AVL) feed.

### **Data Sharing**

Chattanooga is already using data-sharing platforms in ways that benefit the community, including publishing publicly through its open data platform as well as through Twitter and Facebook. Data sharing will continue to be an important part of building a Smart City, using existing and new platforms with adequate security measures. Current data as well as new data that could be collected will be useful for models and planning; departments including RPA are actively analyzing and collecting data sets to use in future planning efforts.

Existing data will be collected by CDOT and made available on the open data portal working with the Chattanooga Public Library and Open Chattanooga. Data will be published on the Open Chattanooga data platform as well as incorporated into priority area tracking when applies. It

will also be available to the partners (potentially before being published) to expedite analysis and planning. It may be published in other platforms, including Twitter, Facebook, and newly developed applications. In a recent example, the City of Chattanooga tweeted locations of road closures from flooding.

As identified in Sections 5 and 6, data security, especially for information acquired by project partners or consultants, will be an important part of future projects, both for cybersecurity and privacy concerns. To address these issues, the team will develop a Privacy and Security Management Operating Concept, drawing from best practices to ensure that PII is protected. Currently, the City has successfully managed data with the published, anonymized data sets on its open platform from different departments.

CDOT has the ability to get new data with improved connectivity to existing infrastructure as well, including arterial count data, vehicle counts, and vehicle occupancy rates. With new cameras, CDOT can classify vehicles and evaluate how the road is being used and measure speed and delay averages. Origin and travel time studies could also be done by collecting information on vehicles with bluetooth and wifi signatures. The city is planning to invest more into traffic incident management and will be able to calculate the costs of a crash, delay, etc. It is acquiring software applications to make calculations and working with TDOT to get and share information. There are potential data collection opportunities associated with the smart grid as well; with more electric vehicles in the system, there could be evaluations of load bearing capabilities and the use of vehicle batteries. Some data is available but may be inaccurate or skewed, which may require coordination to acquire accurate data. For example, crash data is collected but may contain inaccuracies associated with imprecise geocoding that need to be corrected for accurate analysis.

The data will be relevant to planning in other departments, such as RPA, as well as provide justifications for future CDOT budget offers. RPA also collects transportation network data for regional planning. In 2014, the agency analyzed its data sources, needs, and recommendations. The recommended high priority data elements included: vendor travel time data, cell phone data, truck GPS data, truck roadside intercept survey, roadway volumes and classification counts, transit state-preference survey, transit performance measures, and bike/ped demand and facilities data.<sup>5</sup> Although this data will need to be collected from a variety of sources and can be costly, there is opportunity for collaboration or cost-sharing, as well as benefits to RPA if some of this data will be available through proprietary systems in the near future. With this new information, RPA could update travel demand models and combine with their transit surveys and information from public meetings. With an accurate model that simulates the population moving around, better decisions can be made to aid in transportation patterns and investment at the regional planning level. The budget process in Chattanooga is also a data-

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<sup>5</sup> *Chattanooga-Hamilton County/North Georgia Data Collection Process and Schedule*, Cambridge Systematics, Inc., April 17, 2014, available at [http://www.chcrpa.org/TPO\\_reorganized/Data\\_Collection/FR1\\_CHCRPA%20Pln12\\_DtaCllPln\\_Process-Schedule-4-17-14clean.pdf](http://www.chcrpa.org/TPO_reorganized/Data_Collection/FR1_CHCRPA%20Pln12_DtaCllPln_Process-Schedule-4-17-14clean.pdf)

driven, one-year planning process; data supporting effective CDOT investments will contribute to stronger budget and capital proposals. Those offer applications now require performance management metrics.

Data could also be used to procure additional funding for technology acquisitions. Since the information will be public, it will be available for businesses and the startup community to develop potential applications and solutions. Other grants, such as CMAQ funds, require standards for measuring related performance metrics before, during, and after fund receipt.

**Transportation Data Integration in Other City Functions**

There are significant opportunities for improved city functions through transportation data integration, as well as external factors that affect transportation. For example, emergency services could get to incidents faster with information on traffic conditions while en route. School delays could be reduced with traffic information and adaptable routing for school buses.

External factors will affect transportation and decision-making as well, including weather data, emergency response location information on spills, etc., days of the week, and other factors. These can provide for better tools to plan transportation routes and improve decision-making, for both individuals and departments such as CDOT. For example, with emergency response information data, CDOT can change traffic light patterns to quickly route traffic away from problem areas. Other information that may be useful would include bridge testing days and locations, information on river traffic, construction and utility work areas, information on school release times, 211 database information, and other sources. With anonymized information from hospitals and schools on likely sources of service users, CDOT may be able to anticipate traffic patterns and alter traffic lights to improve flow.

**Policy**

The City of Chattanooga has been involved in setting and supporting policy at the local, state, and federal level to redefine transportation initiatives, improve energy efficiency, allow new technology, and promote open data.

**Table 5: Policies**

Policy	Date	Description
<i>USDOT Mayors’ Challenge for Safer People and Safer Streets</i>	Accepted May 23, 2015	This local policy from the Mayor’s Office included public acceptance of the federal challenge and a call for action. The CDOT created 3 action teams focusing on neighborhood, results, and safety.
<i>Tennessee Senate Bill No. 598</i>	Passed March 12, 2015	This state bill defines “autonomous technology” as technology that allows for motor vehicles to drive without physical control or monitoring by a human operator and prohibits governments from prohibiting the use of vehicles with autonomous technology on Tennessee roadways.
<i>Chattanooga Passenger Vehicles for Hire Ordinance</i>	Passed January 6, 2015	The Chattanooga City Council passed an ordinance that reorganized the existing transportation board, reduced regulations on taxi companies, and allowed for rideshare programs with guidelines for operation.

<i>City of Chattanooga Open Data Policy: Executive Order by Mayor Andy Berke (No. 2014-04)</i>	Issued 2014	This policy set the tone for open data access and sharing in Chattanooga. It included establishing an open web portal for data publicly and freely available in machine readable format, requiring published datasets from each department and agency on data frequently requested by the public, establishing an Open Data Advisory Group chaired by Chief Information Officer, appointing an open data coordinator in each agency, and submitting an annual open data compliance report to be published online.
<i>Chattanooga Complete Streets Ordinance</i>	Passed 2014	This policy defined “complete streets” as streets that are designed, built and operated to enable safe access for all users.

In addition to these policies, there are a number of reports and studies that inform policy and gather and analyze data. These are conducted by CDOT, RPA and other groups and include the 2040 Regional Transportation Plan, Long Range Transportation Plan, and mobility studies. In addition to these studies, the City of Chattanooga has received awards, including Outside Magazine’s Best Town Ever Award (2011, 2015).

**Collaborations/Partnerships and Data Management**

The City of Chattanooga has been involved in partnerships and networks that have and will contribute to its success as a Smart City.

**Table 6: Key Community Networks and Partnerships**

Open Chattanooga	A collaboration between City of Chattanooga, Chattanooga Public Library, Open Chattanooga Brigade. As a partner in the Chattanooga Open Data Portal, they will be involved with data added to the portal and accessed by the community. Since this partnership currently exists, there likely won’t be a need for additional parameters to current agreements.
National Resource Network Topic Group on Broadband Access and Digital Literacy	This network group includes the National Resource Network, National Telecommunications and Information Admin (NTIA), and seven cities (including Chattanooga). It’s goal is to create a practical resource guide for local governments around the country interested in improving broadband access and digital literacy in their communities and provide an opportunity for participating cities to connect and learn with each other.
US Ignite	An independent organization and innovation initiative promoting next-generation internet applications by leveraging investments in advanced networks, jumpstarting public sector gigabit applications and services, and bringing together private and public sector partners. It will leverage the National Science Foundation’s GENI (housed at UTC and defined in Section 5) as well as other networks.

There are a number of other potential areas of collaboration, such as frequent hackathons.

**Other Data Management Terms**

Consistent with other existing policies and practices, publicly available data will be anonymized and scrubbed of any PII. Other partners that collect or use data will also be subject to agreements with similar terms. If the data contains more sensitive information, the organization might need to agree to a Memorandum of Understanding with the City to address HIPAA or other concerns. Any agreements will follow best practices in this area. Some partners, such as UTC, provide standard Data Use Agreements for partnerships involving data sharing and analysis. These agreements do not include language on proprietary use of the data, in part

because of the open data policies in the public that set the precedent for sharing for mutual benefit in both the public and private sector.

## 10. ITS Standards, Architecture, and Certifications

The Chattanooga Smart City Challenge will follow the guidelines for format and content in IEEE Standard 1362-1998 to develop a ConOps to describe the proposed Smart City Deployment. The Connected Vehicle Reference Implementation Architecture (CVRIA) and the valuable Systems Engineering Tool for Intelligent Transportation (SET-IT) will be used to develop the proposed ConOps.

- **Data Sharing** – Our plan develops a UTC/ORNL Joint Institute of Computer Services (JICS) use agreement for access to the GENI computing node where we will upload all data to the Research Data Exchange (RDE), as appropriate.
- **Open Source Requirements** – We will follow the requirements of Open Source Application Development Portal (OSADP). Systems engineering documentation, source code, and code documentation will be shared with the USDOT and the community via the [www.itsforge.net](http://www.itsforge.net) website.
- **Interaction with Other CV Pilot Program Efforts** – The Smart City Deployment will be replicable for other Smart City Deployment Program efforts, as articulated by the USDOT.

## 11. Performance Metrics

	SMART CITY CHALLENGE			CITY OF CHATTANOOGA CORE VALUES				
	Improved Safety	Enhanced Mobility	Addresses Climate Change	Safer Streets	Growing Economy	Stronger Neighborhoods	Smarter Students, Stronger Families	High Performing Government
Miles of Accessible Sidewalks	X	X	X	X		X		
Miles Traveled/Trips Taken by Individuals with Disabilities in Non-Private Vehicles (by mode)	X	X		X		X		
Miles of Road Lanes		X		X		X		
Miles of Bicycle Facilities	X	X	X	X		X		
Number of Miles with Multiple Mode Options	X	X	X			X		X
Number of vehicle crashes	X			X				
Number of freight crashes	X			X				
Number of bicycle crashes	X			X				
Number of pedestrian accidents	X			X				

Number of traffic-related fatalities	X			X			
Number of traffic-related injuries	X			X			
Crash severity	X			X			
Average Commute Time		X	X		X		
Total Daily Vehicle Delay		X	X		X		
Transit Vehicle Delay		X	X		X		
Number of on-schedule Transit Vehicles		X			X		X
Freight Transit Time		X	X		X		
Intermodal Connections		X			X		
Freight Arrival Time		X					
Number of Flight Delays		X	X		X		X
Number of Transportation Datasets online		X					X
Average Crash severity	X			X			
Pedestrian count			X			X	
Bicycle count			X			X	
Transit Count			X			X	
Annual VMT/Capita			X			X	
Rate of Telecommuting			X		X		
Percentage of Employees with Delayed Start			X		X		X
Percentage of Local Transportation Funding Allocated to Strategic Maintenance			X		X	X	X
Percentage of Local Transportation Funding Allocated to multimodal infrastructure			X		X	X	X
Private Investment in transportation technology			X		X		X
Average Pedometer Count			X				X
Incidence rate of chronic illness			X				X
Private Investment in Health Care			X		X		X
Public Investment in Health Care			X		X		X
Amount of Fossil Fuel Use			X		X		X
Vehicle Emissions			X				X
Response time to extreme weather events			X	X			X

## 12. Project Capacity

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Chattanooga has the capacity to implement this project due to existing support, infrastructure, and technology.

### **Executive Commitment & Workforce Capacity**

As can be seen from the attachments, there are a number of supporters from various levels of government, including local, state, and federal representatives.

Additionally, the City of Chattanooga is committed to implementing this initiative, led by the Chattanooga Department of Transportation. This grant resulted in visionary thinking from the department from the very staff that will be responsible for implementing the project, and the City of Chattanooga will also provide support from other specialists in the organization.

### **Infrastructure Readiness**

The City of Chattanooga currently has the field infrastructure in place to provide significant data towards this effort; this infrastructure has been built through local agreements, grants, and the EPB Fiber Optic network. Through this grant, the City will be able to expand acquisition efforts and ensure system connectivity to collect and analyze data.

Since the award of an American Recovery and Reinvestment Act of 2009 (ARRA), Chattanooga has also been in the process of acquiring the technology to build an Intelligent Transportation System in the city. This process includes:

- Local Agreements with Red Bank and East Ridge – we operate ITS in Red Bank and East Ridge and occasionally perform maintenance.
- The City of Chattanooga has been awarded \$12.4 million in public and private grants for transportation planning and infrastructure.
- Building on the success of the 1 Gig network, EPB Fiber Optic has updated it to a 10 Gig Network in 2015 with an estimated \$550 million investment.

### **Data and Performance Management Capabilities**

The City of Chattanooga has existing open data and performance management programs housed in the Office of Performance Management and Open Data that are well situated to support this effort.

The open data program has the following characteristics:

- An Open Data Executive Order (see Section 9 for more information);
- Established data workflows and data governance through the city's Open Data Advisory Committee;
- Trained Open Data Coordinators in each city department;
- Established extract, transform and load (ETL) data automation workflows for opening data, ETL software, trained IT staff, and dedicated server for ETL services;

- Best-in-class open data portal for hosting city and local partners data; and
- A dedicated staff position for maintenance and improvement of the open data portal in the Open Data Specialist position.

This robust program ensures that the City is consistently collecting, reviewing, and publishing data on its online platform.

The performance management program has the following characteristics:

- External and internal performance management dashboards;
- Monthly performance data meeting with Mayor and department heads;
- Performance measures integrated into the budgeting for outcomes (BFO) budget process;
- Regular performance roundtable meetings to assist departments with incorporating performance management into their operations; and
- Performance management training for department and division heads.

### 13. Leveraging Opportunities

There are strong opportunities to leverage this federal grant with other grants that the city has received, city investment in infrastructure, and networks, donations, and awards from incubators and companies in the innovation space. The community in Chattanooga has a proven ability to implement transformational projects by bringing together public, private, and nonprofit sector resources.

**Transportation Grants Table**

Project Title and Description	Amount	Status
Chattanooga Regional ITS ARRA- Infrastructure Upgrades in the CBD	\$1.5 Million	Project Completed
Chattanooga Regional ITS Phase 1 - Infrastructure Upgrades on 14 corridors	\$7.4 million Budgeted \$6.3 million Actual	Project Completed
Chattanooga Regional ITS Phase 1A - CCTV installation in the CBD	\$1.1 million saving from Phase 1	Under Construction
Chattanooga Regional ITS Phase 2 - Advanced Transportation Management System	\$1.0 Million	In Project Development
Chattanooga Regional ITS - Transit Signal Prioritization	\$2.5 Million budgeted	FY 2017 (July 1 2016)
Pilot Deployment of Connected Vehicle Environment	\$32.5 million estimated	Applied, not awarded
City of Chattanooga Rail Transit Implementation Plan TIGER Grant	\$400,000 (+ matching funding)	In development