Capital District Transportation Committee

Smart Mobility Toolbox: Smart Community Solutions for the Capital Region

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Final Report

Prepared by

and

River Street Planning and Development

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All illustrations and graphics presented in this report are conceptual and may need to be investigated in more detail before any funding commitment is made.

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Appendix

Appendix 1 Summary of Community Engagement for the Smart Mobility Toolbox

1 Setting the Context for Smart Communities

A "smart community" is a term used to describe a community that applies technologically enabled devices or systems to help the city perform more efficiently. The "smart city" framework is an extensive strategy that can address the needs of a city by leveraging different technologies. Today, most cities and many smaller municipalities use smart strategies or communicate with the public through web-based applications. More advanced smart technology can build on previous technology. In considering expanding the capabilities of the municipalities within the Capital Region, several considerations will drive the direction of the development of "smart technology."

> "A Smart City is a designation given to a city that incorporates information and communication technologies to enhance the quality and performance of urban services such as energy, transportation and utilities in order to reduce resource consumption, wastage and overall costs. The overarching aim of a Smart City is to enhance the quality of living for its citizens through smart technology."
>
> -Techopedia

BIG DATA

"Big data" refers to data that is so large in scale, diversity, and complexity that it is difficult or impossible to process manually or through traditional methods. Big data requires new systems, architectures, techniques, algorithms, and analytics to access, store, and analyze. The process of big data preparation consists of the following: collection, processing, cleansing, and analysis. This process creates information from which value can be drawn. The value of big data is not how much data there is, but how, in combination with high-performance analytics, the data can create information and/or make decisions. The components of big data are:

VOLUME

Volume indicates the **amount of data** generated. This could be data generated from websites, smartphones, virtual assistants, smartwatches—essentially from anything.

VELOCITY

Velocity is the **speed of the data that is generated**. It specifies the growth of data and profoundly affects how we see data. It also affects the improvement of the technologies employed to utilize data.

VARIETY

Variety refers to the **diverse types of data** that can make up a data set (e.g., images, audio and video recordings, numbers, text, and sensor data).

INTERNET OF THINGS

The Internet of Things (IoT) refers to a system of connected technologies that is equipped with sensors or software that enables them to collect and exchange data with other devices or systems over a network such as the internet.

WHY SMART COMMUNITIES?

The implementation of smart city solutions seeks to improve the quality of life for residents and improve opportunities for sustainable economic growth within a community. The specific outcomes of

smart technology will vary, depending on how the technology is enabled. For example, current iterations of smart streetlight programs incorporate smart city technologies that can be outfitted to perform a variety of functions, from collecting weather and air quality information, and gunshot detection, to sewer and stormwater monitoring, parking management, and digital kiosks. In addition to area-specific benefits, an investment in smart city technologies could have the following benefits:

INCREASED EFFICIENCY OF SYSTEM OPERATIONS

- Improved communication and integration of systems
- Reduced redundant processes through automation
- Connected different public-sector organizations together to increase communication and collaboration

ENHANCED HUMAN SERVICES

- Improved communication among public agencies and the public through real-time data sharing
- Better transit availability and/or options
- Intuitive applications and websites

IMPROVED DATA MANAGEMENT

- A communication and data management framework to organize and manage data from various sources
- Automated data input, processing, and sharing

CLIMATE CHANGE AND THE ENVIRONMENT

- Improved traffic flows, installation of electric vehicle (EV) infrastructure, and conversion of conventionally powered vehicle fleets to EVs

EQUITY

- Greater access to opportunities by making technology more accessible and affordable

HEALTH AND SAFETY

- Improved traffic safety, emergency response, and support of active modes

OPEN GOVERNMENT

- New pathways and platforms for citizen engagement

SMART COMMUNITY FOCUS AREAS

The development of this "toolbox" focuses on the following smart community strategies that were selected in consultation with an advisory committee:

- Non-Vehicular Mobility
- Traffic Management
- Energy & Infrastructure
- Parking Management
- Smart Transit
- Connected/Autonomous/Electric Vehicles

2 Peer City Case Studies

This section acts as a summation of key findings derived from a review of peer city best practices, highlighting examples of municipalities where smart city strategies and technologies have been, or are being, adopted. Further, this section describes how examples can be adapted for the Capital Region Smart Communities Toolbox. The examples provided herein are based on input from members of the steering committee regarding the priorities for smart city elements. Advancements in Smart Community technology in recent years have expanded the application and accessibility of advanced technology for many cities. Programs and services that might be applicable to the Capital Region are shown below.

BUFFALO, NY

Buffalo, the second-largest city in New York, has a population of 278,349. The Rust Belt city has had an infusion of development and innovation over the past decade due to Buffalo Billion funding and ongoing collaboration with the many colleges and institutions in the area. Buffalo can serve as a unique example of how a city in New York can implement smart city technologies while also working with State of New York agencies and funding opportunities.

Non-vehicular Mobility

Buffalo, NY

Buffalo Niagara Medical Campus Main Street Smart Corridor (2020)

Buffalo smart community applications are proposed as assistive technology to make streets and intersections more accessible and navigable for people with disabilities such as mobility impairments. Beacon devices mounted to infrastructure—such as pedestrian crossing lights—can communicate with smartphones or other devices to audibly aid the visually impaired to safely cross the street.

The same application can be used to aid the visually impaired to use the bus and transit system. As a pilot project, the intersection of Main Street and Summer Street/Best Street would be a high-profile site to implement a universally designed intersection due to the proximity of the Olmsted Center for Sight (just 300 feet from the intersection on Main Street). The intersection would require installation of communication boxes that can communicate real-time audible directions to a smart device held by someone approaching the intersection.

Traffic Management

Buffalo-Niagara Region

Niagara International Transportation Technology Coalition NITTEC (2018)

The Niagara International Transportation Technology Coalition (NITTEC) is a local coalition of agencies developed to improve traffic congestion and roadway safety in the Buffalo-Niagara region. NITTEC and NYSDOT were recently awarded a $7.8 million Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program grant from the U.S. Department of Transportation, Federal Highway Administration. The grant is aimed at reducing traffic congestion at border crossings and key corridors within the City of Buffalo by deploying new technologies and promoting "smart mobility" within the region. The grant proposal includes plans to improve vehicle-to-infrastructure (V2I) applications, create a real-time parking application, create a data platform with real-time data interfaces and interactive traffic signals, roll out a real-time incident management system, a real-time weather advisory and dissemination system, and promote overall smart mobility in the region. The grant program is seeking pilot projects to test the deployment of these smart community elements and gain performance measures to build upon.

Energy and Infrastructure

Buffalo, NY

Buffalo Niagara Medical Campus BNMC Main Street Smart Corridor (2020)

The City of Buffalo is partnering with AT&T, Smart City Capital, and the New York Power Authority (NYPA) to develop a business plan for acquiring all streetlights from the National Grid and deploying smart sensors. Purchase of the streetlights will allow for the deployment of smart community sensors in select areas, allowing the City of Buffalo to retrofit light poles and fixtures to begin building a network of sensors needed to capture data for smart community applications. If desirable, the City of Buffalo would then develop a Request for Proposal for vendors to respond to for the deployment of smart community sensors and networks.

MINNEAPOLIS, MN

Minneapolis is a major city in Minnesota with a population of 420,324. Together with the neighboring state capital of St. Paul, Minneapolis forms the "Twin Cities." Minneapolis has a vast multimodal transportation system that includes roads, rail lines, airports, ports, waterways, pipelines, and transit systems. Minnesota has similar seasonality and weather to Upstate New York.

Smart Transit/Non-vehicular Mobility

Minneapolis, MN

Smart Mobility Hubs (2019)

In 2019, Minneapolis implemented a mobility hub pilot to increase access to convenient, low- or no-carbon transportation options, including transit, shared scooters, and "Nice Ride" bicycles. This pilot was intended to introduce the concept of mobility hubs to the public and help inform a long-term approach to implementing a larger mobility hub network in Minneapolis. Throughout the program, the project team conducted events and intervention surveys to collect community feedback to improve the service.

Mobility hub locations in 2020 have built upon the 2019 network, with an additional 13 hubs to total 25 locations, including seven locations from 2019. Mobility hubs are now located in 14 neighborhoods, throughout North, Northeast, South, downtown, and the West Bank of Minneapolis.

Traffic Management

Minneapolis, MN

Highway 55 Connected Corridor (2019)

This project includes vehicle-to-infrastructure technology, which helps vehicles "talk" to infrastructure to improve the safety and efficiency of roadway users. The Minnesota Department of Transportation initially selected the Highway 55 corridor between downtown Minneapolis and Interstate 494 to pilot this technology. The objective of this connected corridor project is to broadcast signal phase and timing (SPaT) information to vehicles directly from traffic signal controllers on the corridor to vehicles that connect to this technology. The connected vehicle infrastructure and data management systems support existing and future technologies and applications that aim to improve the safety and efficiency of roadway users. For example, the project uses connected vehicle infrastructure and signaling systems to give priority to snowplows during the winter for more efficient road clearance.

COLUMBUS, OH

Ohio's capital city, Columbus has a population of 878,553 and is a university town with some manufacturing history as well. The character of the city is similar to the Capital Region with a strong knowledge economy. Additionally, Columbus is a significant smart city because it was the first winner of the U.S. Department of Transportation's (USDOT) Smart City Challenge and was awarded $50 million to invest in and develop smart city strategies and programs. In the six years since winning this grant funding, the City of Columbus has launched electric fleets, smart mobility hubs, and connected corridors. Columbus is seen as a leader in the smart city landscape and offers guidance on implementing these novel solutions.

Smart Transit/Non-vehicular Mobility

Columbus, OH

Smart Mobility Hubs (2019)

The Smart Columbus Smart Mobility Hubs (SMH) project is one of eight projects in the Smart Columbus Program and is designed to foster a community of connections and accessibility with increased mobility options and free, easy-to-use trip-planning tools. As the winner of the USDOT's first-ever Smart City Challenge, Columbus was awarded $50 million in grant funding ($40 million from the USDOT and $10 million from the Paul G. Allen Family Foundation) and the designation as America's Smart City. These dollars provided the seed funding for Smart Columbus—a regionwide Smart Community initiative co-led by the City of Columbus and the Columbus Partnership.

The SMH project corridor is served in a variety of ways, including traditional fixed-bus service, park-and-ride and transit facilities, the city's bus rapid transit (BRT) line, and public Wi-Fi provided at transit centers and on CMAX buses. There are no comprehensive mobility or multimodal transportation facilities along the corridor. Getting to and from bus stops when it is too far to walk creates first-mile and last-mile challenges for many riders.

Energy and Infrastructure

Columbus, OH

Columbus Operating System (2015)

The Smart Columbus Operating System (SCOS) is a web-based smart city data management and open-data platform that integrates data and data services from multiple sources and tenants to enable better decision-making and problem-solving for all users to support a replicable, extensible, and sustainable platform for data ingestion and dissemination. The SCOS will "ingest, aggregate, fuse, and disseminate" mobility data from a multitude of sensors and other sources across the city. Data collection will be monitored in an open-source information portal to serve the needs of internal and external users. The SCOS will be used to generate metrics on the Smart Columbus project's success. Metrics are first developed and shared with stakeholders, then made available to the public.

Energy and Infrastructure

Columbus, OH

Smart Columbus (2015-2020)

Columbus is the recipient of a $40 million grant from the U.S. Department of Transportation after winning the Smart Cities competition in 2016. The City of Columbus has since leveraged the original $40 million in grant funding into a current $510 million in both private and public funding, including $10 million from Vulcan Inc., $93 million for research from The Ohio State University, and $367 million investment from local and national businesses and partners in the government, financial, tourism and economic development, energy, mobility, academic, technology and research, manufacturing, and philanthropic sectors.

Traffic Management

Columbus, OH

Columbus Connected Transportation Network (2015)

Columbus Connected Transportation Network consists of dedicated short-range communications placement along 50 miles of roadway, at 175 traffic signals, and on 3,000 vehicles. Additionally, the entire Central Ohio Transit Authority (COTA) bus fleet will be equipped with technology that will provide visual collision avoidance and roadway condition data, autonomous vehicles will be deployed on three routes in the Eastern Commercial District, and active parking management will be deployed. The communication devices will be monitored and controlled through a new advanced Traffic Management Center, operated jointly by the City of Columbus and the Ohio Department of Transportation in what is known as the Columbus Traffic Management Group. The Traffic Management Center provides traffic management and emergency management, and interfaces with multiple city, county, and state departments, COTA, freight rail operators, local 911 call centers and emergency responders, local maintenance and construction contractors, the Mid-Ohio Regional Planning Commission, the National Weather Service, Ohio State University, private traveler information systems, and regional event promoters.

OTHER COMMUNITIES

Energy and Infrastructure

Atlanta, GA

North Avenue Corridor (2017)

Partnering with The Georgia Institute of Technology, the City of Atlanta has deployed smart technology along a 2.3-mile stretch of roadway — North Avenue. The City of Atlanta was looking to create a public demonstration and "living lab" for smart technology deployment. The project includes installing hundreds of Internet of Things (IoT) sensors along with 26 signalized intersections to serve an array of applications ranging from adaptive signal timing to the framework for connected/autonomous vehicle rollout. The sensors serve to make North Avenue a Complete Street in coordination with the Travel Safely App. The innovative app allows users to sign in as a pedestrian, cyclist, or driver to connect the user to a mobility network that sends real-time traffic updates and safety messages using the information of the IoT sensors.

Parking Management

Boston, MA

Park Boston App (2015)

The Park Boston app utilizes smartphone technology to provide interactive payment options for on-street parking. After the user downloads the app and creates an account, they may utilize the smart metering system to pay for parking. Once the car is parked, the user then locates the Park Boston Street sign or decal on the parking meter indicating the zone number of their location. The app will prompt the user for the zone number, license plate of the vehicle, and the length of time desired (as allowed). Once confirmed, the parking session begins. When there are 10 minutes remaining, the app will notify the user and, if allowable, provide the option to extend the meter time.

The Performance Parking initiative seeks to increase the number of available on-street parking spaces in some of Boston's busiest neighborhoods. It also aims to reduce the time spent on finding a parking spot, thus reducing traffic and congestion. With flexible meter pricing, the parking fee may increase or decrease depending on the availability of spaces. As the number of spaces decreases, the price will increase within a set limit. This will encourage parkers to seek other areas with lower rates. As the number of spaces increases, the price will decrease within a set limit, thus encouraging more spaces to be utilized. The use of flexible meter pricing has been known to direct motorists from congested areas to less busy streets where parking is more readily available. In addition, the number of double-parking violations is likely to be reduced. By using an ArcGIS application, users can view a map in real time that indicates the current pricing of parking areas.

Traffic Management

Boston, MA

Smart Communities/Vision Zero Pilot Agreement (2016)

Verizon provided its Internet of Things based smart communities solutions (the "Services") for the Vision Zero Boston Program, an initiative for the City of Boston to prevent traffic crashes and resulting injuries and fatalities. The Services will be deployed at the intersection of Massachusetts Avenue and Beacon Street.

Energy and Infrastructure

Chicago, IL

Smart Lighting Program (2021)

Streetlights automatically dim during periods when they are not needed, water sensors have been installed along riverbanks to monitor flooding, and sophisticated software combined with security camera footage can help determine the location of a gunshot to quickly respond to incidents.

Energy and Infrastructure

Chicago, IL

Array of Things (2016)

The Array of Things is a modular, open-source, network of interactive sensor boxes (nodes), collecting and returning urban data in real-time to citizens, scientists, and policymakers. Nodes were installed on traffic light piles in several neighborhoods throughout Chicago to collect data on air quality, climate, traffic, and other urban features. These pilot nodes were designed as a "fitness tracker" for the city, collecting new streams of data on Chicago's environment, infrastructure, and activity. This local, open data can help researchers, city officials, and software developers study and address critical city challenges, such as preventing urban flooding, improving traffic safety and air quality, and assessing the nature and impact of climate change.

Energy and Infrastructure/Smart Transit

Kansas City, MO

RUBICON Smart City (2017)

The city's 2.2-mile-long streetcar line has been outfitted with new mobility technology, including free public Wi-Fi, smart streetlights, smart traffic signals, and interactive kiosks. The city made a private-public partnership with Cisco and Sprint to complete the $15.7 million project. The data collection is sourced from video cameras that capture traffic and pedestrian activity. The data collected is anonymous, and all video captured is processed and overwritten. The data collected is used to source a public data portal that allows anyone to view real-time traffic data, streetcar location, and open parking spots. A series of 25 interactive kiosks have been placed along the corridor for accessing services, current events, transportation, business information, public digital art, local history, and entertainment. As part of the Smart network, each kiosk will have content specific to its location and can dynamically change content based on the needs of the users. Transactions made on the kiosks can also be linked to a smart device. In addition to these amenities, LED streetlights are placed along the corridor to increase

energy efficiency. The LED lights have sensors and will automatically adjust light based on activity.

Parking Management

Las Vegas, NV

Smart Curbside Management Corridor (2018)

Cox Communications initiated a pilot partnership with the City of Las Vegas to trial its smart curbside management solution from Cox2M, aimed at reducing downtown traffic congestion. Over the span of six parking spots along the sidewalk adjacent to the 100 block of Main Street, Cox placed two digital kiosks that utilize video analytics and smart parking technology to better manage active curb loading zones for taxis and rideshares, making conditions safer for visitors and pedestrians.

Cox developed two curbside management kiosks that create a smarter ecosystem for visitors and their residents. Video analytics from devices along the curb capture the vehicle and license plate information that will then send utilization data to the kiosk that will trigger a countdown timer. If a vehicle remains in the loading zone after the countdown ends, the system reports the incident directly to the city. The cloud processes traffic flow information, an on-screen interface to display vehicle information and provides an online portal to report traffic flows and pedestrian counts.

Smart Transit

King County, WA

Seattle Sandbox Program (2017)

King County Metro is participating in a research project to test the use of Transportation Network Companies (TNC) as a Mobility-on-Demand tool. The King County will partner with Via, a TNC, to create an on-demand system that takes passengers heading in the same direction and books them in the same shared vehicle. This is especially targeted to workers traveling to and from park-and-rides of the fixed transit line as a means of first/last mile travel. The project serves as an example of private-public partnership to implement new mobility options, policies, and promotion.

Energy and Infrastructure

San Diego, CA

Smart Streetlights (2012)

The City of San Diego (City) has rolled out a network of 4,000 smart streetlights in what is reported as the world's largest network of Internet of Things sensors on city streetlights. In 2014, the City started working with GE and AT&T to install streetlights with wireless network connections. By networking the lights, the City was able to remotely control and monitor streetlighting, saving the city $2.8 million a year in electricity and maintenance costs. Thousands of these smart streetlights are equipped with complex sensors that can monitor parking spots, criminal activity, and temperature and air quality. Some of the more advanced lights include Intel processors, video cameras, microphones, Wi-Fi, Bluetooth, and

sensors that capture temperature, pressure, humidity, vibration, and magnetic fields. The smart streetlights can optimize parking by guiding patrons to open parking spots, optimize traffic operations by sensing peak traffic volumes and incidents and subsequently timing traffic signals accordingly, and improving citizen safety by communicating when pedestrians are in a crosswalk or when drivers are speeding, parked illegally, or not obeying traffic controls. Law enforcement could also use the sensors to detect gunshots and to decrease police response time.

Energy and Infrastructure

Syracuse, NY

Smart Street Lighting NY (2020)

Syracuse, through a partnership with the New York Power Authority, replaced all of its streetlights with smart LED fixtures, improving lighting quality and neighborhood safety while saving energy and maintenance costs, saving the City of Syracuse $3.3 million annually and reducing greenhouse gas emissions by nearly 8,500 tons a year. The streetlights are now outfitted with smart controls that provide programmed dimming ability, energy metering, fault monitoring, and additional tools for emergency services through on-demand lighting levels.

Energy and Infrastructure

Coral Gables, FL

Smart City Pole (2021)

The "Smart City Pole" pilot project includes installation of the Ekin Spotter on a median in downtown Coral Gables. The Ekin Spotter provides live video and real-time analytics to the Community Intelligence Center and the Emergency Operations Center. The Ekin Spotter has also been integrated to the City's Urban Analytics artificial intelligence platform, which provides sensor data and actionable information to citizens and city employees on the smart community hub platform. Ekin Spotter's modular design provides local governments with the ability to customize each device and collect and analyze the data needed to make informed policy changes to promote a safer, healthier living environment. The Ekin Spotter is a self-contained unit that requires no additional hardware or infrastructure.

Energy and Infrastructure

Vaughan, Ontario, Canada

Salt Optimization with AI (2018)

Using sensors, this tool takes numerous factors into account—weather models, Vaughan's micro-climates, traffic volumes, and road temperatures, moisture, and conditions—to inform road winter maintenance decisions. This innovative approach will keep the road network safe, while maintaining fiscal prudence and environmental consciousness. The tool allows visibility into road treatments up to 24 hours in advance to facilitate a consensus on treatment strategy. For major snow events, it can also advise stakeholders with greater certainty on how the snow removal program will work. The City

started using the tool in the 2018-2019 winter season, which has led to an average reduction of 100 tons of salt per snow event.

Parking Management

Rochester, MN

ParkMobile (2018)

The ParkMobile app is available to download for free on Apple and Android devices. Users can also pay online at parkmobile.io. Pay zones appear on the app and are also printed on a green ParkMobile decal placed on eligible meters. All parking rules, such as maximum time limits, will be unchanged and remain in effect. Users will gain several conveniences, including text or push notifications when purchased time is about to expire.

Energy and Infrastructure

Stafford County, VA

The Stafford Testbed (2020)

The testbed is a living laboratory in Stafford County, Virginia, that conducts pilot projects, tests new smart technologies, and generates researched solutions that can be used across Virginia. The program is the result of a public-private partnership and is currently focusing on the following use cases: Drone application and systems for public safety and emergency management; cybersecurity and training; economic development and tourism; 5G technology and broadband expansion (e.g., 6G network); smoke, particulate matter, and forest fire sensing; and flood sensors. The Stafford Testbed program activities have started two pilot projects with the use of drones and an intelligent video management system: the pilot for the Onclave Zero Trust device security system and Verizon Skyward's public safety pilot.

Energy and Infrastructure

Burlington, VT

Energy Engage (2013)

Energy Engage is a consumer portal that shows electricity consumption and cost and provides energy efficiency tips using existing smart meter infrastructure. The portal is a part of Burlington's wider Net Zero goal. The data collected and shared is an asset and is intended to improve consumer decisions on energy consumption. In the future, Burlington's plans include a proactive messaging system (texts, tweets, blogs, emails) to alert customers on critical events, such as outages, peak periods, and threshold exceptions, enabling individuals to plan and manage their load (washer, dryer, dishwasher, electric hot water), as well as to allow utility providers to take appropriate action.

Energy and Infrastructure

Cincinnati, OH

CincyInsights (2019)

In addition to the Office of Performance & Data Analytics (OPDA) Open Data Portal—which shares citywide data to monitor performance, improve service delivery, promote transparency, drive innovation, and creatively problem solve—OPDA created CincyInsights, an interactive dashboard, to make city data visual, conveniently accessible, and user-friendly for all members of the Cincinnati community. CincyInsights promotes government accountability and transparency by providing open, online access to government data. The goal of this initiative is to increase data accessibility and encourage development of creative tools to engage, serve, and improve Cincinnati neighborhoods and residents' quality of life.

Energy and Infrastructure

Louisville, KY

LouieLab (2017)

The LouieLab is Louisville Metro Government's civic innovation hub for public-private collaboration, and co-working space that features a co-working room, training room, large and small conference room. This space is available to the public for events and co-working. Events held at the LouieLab must have a public benefit in order to preserve the space for free.

Electric/Connected/Autonomous Vehicles

Ann Arbor, MI

MCity (2016)

The MCity Driverless Shuttle research project launched in June 2018 on the public roads of University of Michigan's North Campus. This project enabled the collection of Level 4 autonomous vehicle data. At its conclusion in December 2019, data had been collected from more than 16,000 trips and 500 riders has been surveyed. Engineering data captured the behavior of pedestrians, cyclists, and drivers on the road, as well as dynamic motion of the shuttles. The data will allow the analysis of manual takeovers by the safety conductors, unexpected brakes/stops, interactions at crosswalks, onboard rider behavior, and more. The pilot project has been a success in basic safety message signaling and a template for connected vehicle infrastructure deployment and management. Data from the pilot program is kept internal for researchers to study and analyze. Eventually, this type of data can be made available to third parties. The data and infrastructure are being transitioned to the Ann Arbor Connected Vehicle Test Environment for further pilot testing.

Electric/Connected/Autonomous Vehicles

Arlington, TX

RAPID (Rideshare, Automation and Payment

In March 2021, Arlington launched RAPID, an autonomous vehicle rideshare option for passengers traveling around downtown or at The University of Texas at Arlington campus. The service builds

Integration Demonstration) (2021)	*upon Via Rideshare (launched in 2017), which is a public transportation system built solely upon a rideshare service. Through a public-private partnership with Via Transportation, Inc., the City of Arlington launched an on-demand rideshare service to meet the community's public transit needs.*

Electric/Connected/Autonomous Vehicles

Boulder, CO

Vehicle-to-grid EV pilot (2021)	*The City of Boulder and Fermata Energy have installed a charging station that enables two-way electricity to and from the car or building. This vehicle-to-building technology allows vehicle batteries to transfer energy from the battery back to the North Boulder Recreation Center in order to support the building's electric loads and to reduce peak demand. In the future, this technology can provide the city with new ways to manage its energy load and reduce energy costs.*

3 Smart Community Tools

This section outlines smart community tools and strategies that are applicable to the Capital Region. These tools and strategies are derived from examples taken from peer city case studies, interviews with stakeholders, and input from focus groups, and are continuously evolving. The smart community tools and strategies are grouped into related categories based on priorities identified by the community. A Smart Community Toolbox, summarizing feasible tools and strategies, is provided following this section.

3.1 NON-VEHICULAR MOBILITY

MICROMOBILITY (SCOOTERS, BIKES)

Micromobility services use small, fully, or partially human-powered vehicles such as bikes, e-bikes, and e-scooters. Access to these devices is generally facilitated by mobile app or kiosk where the vehicles can be rented. These vehicles are picked up and dropped off in the public right-of-way and are meant for short trips of less than 10 minutes.

SMART MOBILITY HUB

A smart mobility hub is a physical location that integrates access to several modes of transportation to encourage the use of transit and other mobility services. Smart mobility hubs are typically located at key points on the regional transit system to encourage shared modes of mobility.

UNIVERSALLY DESIGNED INTERSECTIONS

Universally designed intersections are intersections designed to increase safety for pedestrians with special consideration for differently abled populations. In the context of smart city solutions, the intersections are equipped with sensors that facilitate vehicle-to-infrastructure communication. These sensors then connect to an app on the pedestrian's phone that informs them that it is safe to cross.

SMART CYCLE TRACK

A smart cycle track utilizes connected infrastructure technology that contains sensors to detect bicyclists and trigger traffic signals to respond to the presence of bicyclists and gives them priority to navigate the intersection through bicycle signals that turn green before vehicle signals.

3.2 TRAFFIC MANAGEMENT

CURBSIDE MANAGEMENT

Curbside management is a strategy that inventories on-street parking to optimize, allocate, and manage curb space to maximize mobility, safety, and access for the wide variety of curb demands. Curbside management prioritizes transit and bicycling infrastructure first, followed by other important uses of the curb like deliveries, passenger pickups, green stormwater infrastructure, and small public spaces—then managed parking spaces.

Alternative uses for on-street parking will limit vehicle congestion and reserving parking for shared transit modes could also decrease parking demand.

LANE MANAGEMENT (USING DYNAMIC FLOW)

Dynamic lane management enables the number of lanes in one direction at a given point of the network to vary. Dynamic lane management techniques include the use of static signing, dynamic message signing, overhead lane control signals to indicate whether the lane is open or closed (that display in both directions), and lane-specific traffic signals at intersections (that display in both directions).

Dynamic lane management can be activated at fixed times or conditions of heavy volumes of traffic, usually by means of -overhead lane control signals. The lane management system can be centrally monitored and controlled from a traffic management center, or it can be autonomous.

Dynamic lane management and shoulder use are active traffic management (ATM) strategies and are typically used in conjunction with other ATM strategies. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls.

TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS

Transportation Systems Management and Operations (TSMO) is an integrated approach to addressing mobility and safety issues on the transportation network. TSMO differs from traditional management of the transportation network in that the actions address immediate and near-term needs in system operations rather than longer-term expansion. TSMO focuses on optimizing the performance of existing and planned infrastructure by implementing systems, services, and projects that preserve capacity and improve the security, safety, and reliability of the multimodal transportation system.

3.3 ENERGY & INFRASTRUCTURE

LED STREETLIGHT CONVERSIONS AND SMART TECHNOLOGY-ENABLED LED STREETLIGHTS

Replacing traditional streetlights with LED lights provides improved energy savings, better quality light, and cost savings. Additionally, they can incorporate smart, connected technologies through sensors within the streetlights. The capabilities of smart technology withing the streetlights can vary from basic capabilities like dimming lights to more complex tasks such as photographing speeding cars to assist with traffic enforcement.

SMART SENSORS

Smart sensors—either affixed to roadside objects such as traffic light poles or street light poles, embedded in pavement, or used on board vehicles—has enhanced the ability to deploy smart city applications and corridors. Smart sensors are the component part of many smart city solutions that allow the system to collect data. The development and use of an app with multiple modes of travel available is recommended to fully utilize capabilities of the sensors.

Overhead sensors can facilitate:

- Parking management
- Vibration analysis
- Noise and acoustics
- Smartphone detection
- Electromagnetic fields
- Traffic congestion
- Waste management
- Forest fires/smoke detection
- Air pollution monitoring
- Snow level and snow melt
- Earthquake detection
- Stormwater monitoring
- Chemical-leak detection
- Flood-level detection
- Energy consumption monitoring
-
- Radiation levels
- Safety/security monitors

Underground sensors can measure:

- Parking availability
- Ground moisture
- Water pressure
- Ground temperature

COMMUNITY WI-FI/ BROADBAND EXPANSION

High-speed wireless networks and optical fiber are necessary infrastructure for municipalities and residents alike.

3.4 PARKING MANAGEMENT

PARKING MANAGEMENT APPLICATION

Parking management applications are tools that can be used to manage on-street and garage parking. The functions of parking apps vary and can range from navigation only, which locates only vacant parking; online booking, which allows you to pay for parking via the app and often includes the ability to extend time remotely, and to send alerts to the user when time is running low; pre-book, which allows you to find and reserve parking before reaching the spot or garage; and on the spot booking, which facilitates booking at a parking meter.

DYNAMIC PARKING

Dynamic parking is a strategy that sets parking prices based on demand and availability to balance supply and demand. This strategy also aims to discourage drivers from increasing congestion by searching for parking when there is limited parking availability.

3.5 SMART TRANSIT

ENHANCED PUBLIC TRANSIT WEBSITE

Public transit websites serve as the primary source for information to commuters, visitors, and other local agencies. The principle features necessary to facilitate improved dissemination of information and ease of use are:

- Trip-planning tools and time-sensitive updates are featured prominently.
- Easy access to schedules, maps, fare information, system improvement projects and connection to airports and regional transit.
- Designing for compatibility across device types (computer, smartphone, tablet, etc.)

ASSET MANAGEMENT AND MAINTENANCE APPLICATIONS/SOFTWARE

Municipalities and cities can use the Internet of Things to improve their productivity, public safety, general efficiency, and reporting. Software can connect various public services to provide an overview of what is going on in real time through a network of connected devices.

MOBILITY AS A SERVICE

Mobility as a Service integrates existing fixed transit services along with other local on-demand transit services. These integrations are advancing Mobility as a Service (MaaS) by helping customers see all their transit options on one platform and subsequently plan multimodal trips.

MICROTRANSIT SERVICES / FLEXIBLE ON-DEMAND TRANSIT

Flexible on-demand transit typically takes the form of a small bus or van that serves passengers by using dynamically generated routes. This service differs from typical transit services with fixed routes in that it provides flexible routes that serve a targeted geographic area. Furthermore, this service may be more accessible for some users who cannot benefit from other shared modes that are more physically demanding, such as bike, scooter, or moped share systems. For example, this service may be particularly useful for older communities.

3.6 ELECTRIC/CONNECTED/AUTONOMOUS VEHICLES

CONNECTED VEHICLES

Connected vehicles and the infrastructure that supports them are a way in which cities are "future-proofing" their streets. The establishment of a smart corridor network requires the implementation of communication between vehicles and traffic management devices. The on-street communication can be facilitated through dedicated short-range communication devices that are placed in traffic signal cabinets and other roadside structures along the corridor or via a dedicated cellular network. The data exchange between devices can be vehicle-to-vehicle, vehicle-to-infrastructure, or vehicle-to-everything. The data that is broadcast from both vehicles and roadside infrastructure goes to a cloud-based data management system that can evaluate real-time traffic conditions, broadcast safety messages, display parking opportunities, and offer a wide range of applications.

AUTONOMOUS SHUTTLES

Autonomous vehicles (AVs) are an emerging technology, yet already a highly influential facet of smart cities. Though much of the AV technology is established and efficient, the policy and road adaptation still face many barriers. Public acceptance is a major inhibiting factor for AVs because many have indicated that they are uncomfortable with the thought of driverless vehicles' ability to travel without human intervention. There is a large push from automotive companies in self-driving technology, which in turn has pushed cities from Austin, Texas, to Detroit, Michigan, to run pilot tests to see how the vehicles operate in real road conditions. The implementation of connected vehicle infrastructure along smart corridors increases the communicative ability of AVs. By implementing such infrastructure, cities are addressing the current need of connected data while preparing for the likely future of an AV-dominated transit network.

CHARGING STATIONS AND ON-STREET ELECTRIC VEHICLE SUPPLY EQUIPMENT

Electric vehicle supply equipment supplies electricity to an electric vehicle. Commonly called charging stations or charging docks, they provide electric power to the vehicle and use that to recharge a vehicle's batteries. Electric vehicle supply equipment systems include electrical conductors, software,

and communications protocols that deliver energy efficiently and safely to the vehicle. To prepare for anticipated electrification, municipalities should work with state agencies like the New York State Energy Research and Development Authority and the New York Power Authority, as well as local businesses to install charging stations where they are most needed.

ELECTRIC VEHICLE FLEETS

Electrification of fleets encompasses investments into facility upgrades, infrastructure, and the purchase of electric vehicles. Transit agencies are gradually changing to zero-emissions buses to reach ambitious zero-emissions goals. The electrification of public transportation has dedicated support from utility partners and national and statewide policy. In New York State, Governor Hochul issued a $1 billion investment for electric vehicles, particularly school buses.

POLICY AND REGULATION

A wide span of laws and policies must be considered when planning a smart city. From project management and planning perspectives, financial regulations and procurement rules must be considered. Policy and regulation can also be put into place in preparation of smart city initiatives to ensure that desired technology is supported through measures such as compliance with energy regulation, environmental legislation, intellectual property regulation, and the regulation of technologies.

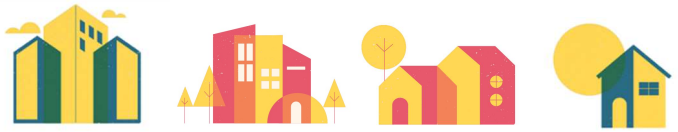
3.7 IMPLEMENTATION MATRIX

Based on the existing conditions, peer case studies, focus groups, and interviews, the following underutilized and evolving technologies that could be applicable to the Capital Region was developed. A preliminary analysis shows the type of community that it best applies to (medium-sized city, small city, village, and rural area), its tier of complexity (1 - simple, 2 - advanced, and 3 - dynamic), and its relative cost ($ - low cost, $$ - medium cost, $$$ - high cost).

Community Typologies

Medium-Sized City	Small City	Village	Rural Areas

Focus Area	Smart Community Element	Implementation Locally	Community Applicability	Tier of Complexity	Cost
Non-Vehicular Mobility	Micromobility (Scooters, Bikes)	Capital District Transportation Committee (CDTA) has implemented bike share, scooter and car share are in development.		1	$
	Smart Mobility Hub	CDTA is in process of implementing mobility hub in Schenectady		1	$$
	Universally Designed Intersections			3	$$$

Focus Area	Smart Community Element	Implementation Locally	Community Applicability	Tier of Complexity	Cost
	Smart Sensors			1	$
	Smart Cycle Track			2	$$
Traffic Management	Curbside Management			3	$$
	Dynamic Lane Management (using dynamic flow)			3	$$
	Transportation Systems Management and Operations (TSMO)			3	$$
Energy & Infrastructure	LED light conversions and smart technology-enabled LED lights	Implemented in Schenectady, Saratoga Springs, Albany, and Colonie		1	$
	Community Wi-Fi/ Broadband Expansion			2	$$

Focus Area	Smart Community Element	Implementation Locally	Community Applicability	Tier of Complexity	Cost
Parking Management	Parking Management Application	Smart parking meters have been implemented by the City of Troy and Albany Parking Authority		2	$$
	Dynamic parking			3	$$
Smart Transit	Asset Management and Maintenance Applications			2	$$
	Mobility as a Service (MaaS)			3	$
	Microtransit Services / Flexible Routing System	CDTA operates FLEX service in the region		2	$$
	Quality Public Transit Website			2	$$

Focus Area	Smart Community Element	Implementation Locally	Community Applicability	Tier of Complexity	Cost
Connected and Autonomous Vehicles	Autonomous Shuttles	Currently piloting is geared to controlled environments		3	$$$
	Deploy Roadside Units to Prepare Corridors for Connected Vehicles			1	$$$
	Electric Vehicle Fleets			1	$$
	Electric Vehicle Charging Equipment/Stations			1	$
Policies and Regulations	Influence Future Transit Services	Existing, need to be revised		1	$

4 Implementation Roadmap for the Capital Region

4.1 OVERVIEW

In developing smart community solutions, strategies should integrate innovative principles and processes to facilitate sustainable, equitable, and appropriate solutions. This section will discuss the smart community strategies suitable for the Capital Region and present a roadmap for their implementation. Because the Capital District Transportation Committee (CDTC) covers four counties with a wide variety of characteristics, the recommendations are organized by the type and size of the municipality.

Implementing various smart community solutions will be based on the municipality's capacity, existing resources, and funding/agency partnerships. These recommendations will be discussed by the complexity or integration level and divided into three tiers described below.

LEVELS OF COMPLEXITY

SIMPLE

The first tier of strategies can be implemented in under two years and includes physical additions to the cityscape, such as installing initial hardware and applications (sensors, parking management applications, real-time info sharing). These can also involve piloting technology such as shared mobility, charging stations, or free Wi-Fi infrastructure. The simple strategies are:

- Micromobility (e.g., scooters, bikes)
- Smart mobility hub
- Smart sensors
- LED street light conversions and smart technology-enabled LED streetlights
- Electric vehicle (EV) charging stations
- EV transit fleets
- Influence future transit services

ADVANCED

The second tier of technological integration are strategies that build the communications infrastructure that helps manage data from sensors, the cloud, and databases. This tier is often unseen by the public because it involves the systems architecture of managing big data and does not result in one visible product for the general public. Instead, it allows agencies to coordinate and program the system to perform various functions that improve the lives of residents. The advanced strategies are:

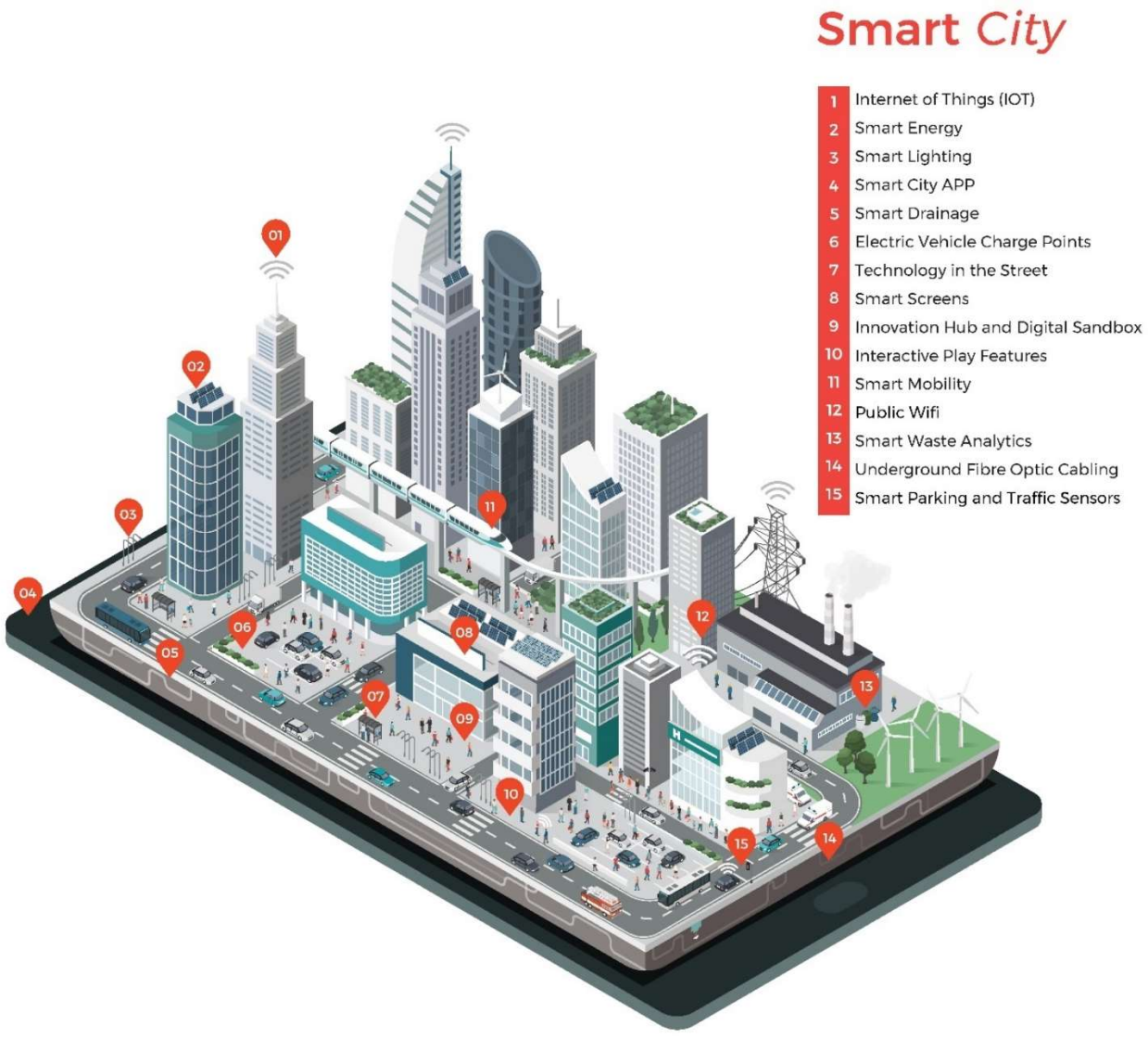
- Microtransit services / flexible on-demand transit
- Community Wi-Fi/broadband expansion
- Parking management application
- Enhanced Public Transit Website
- Asset management and maintenance applications or software
- Smart cycle track

- Universally designed intersections

DYNAMIC

Third-tier strategies are fully integrated physical and communications systems that perform data gathering, processing, and sharing. We often think of these strategies when we think of smart cities that employ technology to create predictive, connected, and autonomous services. The dynamic strategies are:

- Curbside management
- Dynamic lane management (using dynamic flow)
- Transportation systems management operations
- Mobility as a Service (MaaS)
- Deploy roadside units to prepare corridors for Connected Vehicles
- Autonomous shuttles
- Dynamic parking



KEY IMPLEMENTATION CONSIDERATIONS

The toolbox will consider several factors and issues related to implementation for each recommendation. The elements were selected with input from the steering committee and include the most appropriate organizational level for implementation, such as size and type of municipality, cooperative efforts including more than one municipality, regional agencies and authorities, state agencies, and the private sector, for-profit, and non-profit organizations. Areas considered include:

- **Coordination and Partnerships** – The level of coordination required for launching and maintaining innovative or technologically enabled strategies is the most significant concern when implementing solutions in the public realm. All solutions, such as electric charging stations, require coordination between private-sector suppliers and, ideally, regional or state political support to incentivize EV use. As in that example, there is often the required coordination and additional partnerships that strengthen the success of these programs. Municipalities should consider the internal capacity to support programs requiring coordination between other agencies, academic institutions, or private-sector partners.
- **Cost and Maintenance** – The maintenance and operating costs of the strategies, programs, or technical interventions determine when municipalities consider introducing smart-city technology. This area details the implementation costs of setting up a system and the typical costs associated with running and repairing issues.
- **Equity** – Equitable mobility seeks to distribute the benefits and costs of transportation resources equally across people of different economic means, races, and educational attainment. Moreover, equity aims to address the needs of underserved members of a community to improve conditions and remove barriers. In stakeholder and focus group conversations, the issues of accessibility and food deserts were emphasized as areas for increased attention when considering equity. When discussing accessibility, we will be referring to the ease of access for differently abled populations.

4.2 SIMPLE STRATEGIES

MICROMOBILITY (SCOOTERS, BIKES)

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LOCAL IMPLEMENTATION

CDTA launched its bike-share program (Cycle!) in 2017 and now has bike hubs in Albany, Cohoes, Saratoga Springs, Schenectady, Troy, and recently Warren County in 2021.

CDTA launched a pilot program in the summer of 2021 for their new electric scooter program (SCOOT) in Albany, Troy, and Schenectady.

It is beneficial to launch innovative programs in phases. Phase 1 typically consists of the initial launch in the core service area and allows customers to acclimate to the presence of other bikes in their area. Phase 2 is considered the bike-share expansion phase. If Phase 1 is successful and there is more demand, Phase 2 outlines new locations for implementation.

Coordination and Partnerships

The current *Cycle*! program is a publicly owned and privately operated model. The CDTA owns and is financially responsible for the system. The bike and scooter operations are contracted out through a third party. This is a favorable model because third parties often have more experience and resources to run and facilitate a program. Additionally, public ownership offers more state and federal funding opportunities and may subsidize these programs.

Cost and Maintenance

On average, an 8 to 10 bike-docking station costs can vary from about $20,000 to $55,000. Factors influencing prices include manufacturing costs, site constraints, engineering costs, permitting, the total size of the system, and electrical and computing requirements. Maintenance and operation may consist of bike rebalancing, bike repair, system and software maintenance, and bike replacement, typically costing $1,000 to $2,000 per bike. Additionally, scooters have significant maintenance difficulties and are common targets of theft or vandalism. **Section 5, Resources, includes potential funding sources.**

Equity

To expand the benefits of bike-sharing to users with mobility impairments, adaptive bikes for people with limited mobility could be added to the program. Additionally, these bikes can include upright handcycles, recumbent handcycles, recumbent leg trikes, recumbent trike tandems, and side-by-side. It is good practice to schedule demonstrations or pop-up events for adaptive bikes; additional press leading up to and following the launch is also recommended. Accepting cash payments or alternative payment sources such as cash-purchased ride cards or tickets shared with transit systems can facilitate more equitable access to the bike-share programs in the Capital Region

Source: FerrizFrames

Figure 1 Electric Lime Scooters Docked on Sidewalk

SMART MOBILITY HUB

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LOCAL IMPLEMENTATION

The first mobility hub in the region is in development in Schenectady and will serve as a gateway mobility hub with bus bays, heated sidewalks, electric charging, *Cycle*! Bike rack, and SCOOT rack, and will feature the CDTA DRIVE car-sharing service. The hub will also include intercity bus service provided by Greyhound and Adirondack Trailways.

Schenectady's Gateway Mobility Hub could benefit from integrating more "smart" elements. A smart mobility hub is a central node, usually a kiosk, that allows for real-time identification, scheduling, and payment of mobility options. With that feature, an LED screen display can be synchronized with GPS units on public-transit buses to display real-time location and to inform transit users of arrival times. If implemented in the Capital Region, the kiosks can be used to order FLEX rides, *Cycle!* bikes, and

SCOOT scooters, to place emergency calls, to pay for transportation, and to promote businesses and restaurants in the area. Additionally, these kiosks can offer smart device charging and Wi-Fi and can share news and events in the area to help generate revenue.

Coordination and Partnerships

The city will be the lead agency in implementing a smart mobility hub. It may partner with a range of agencies, including transit agencies, internet providers, ride-sharing companies, MaaS providers, and more, to integrate as many capabilities and services as beneficial. The mobility hub features would act independently and not be optimized until a smart-city communications and data management framework is in place (Phase 2). A system must be designed to interface and utilize all these features within the kiosk, which will likely require a third-party provider to design the interface and systems architecture.

Source: Getty Images/iStockphoto

Figure 2 Smart City Kiosk with Interactive Map

Cost and Maintenance

Installing a smart mobility hub as part of the project can range from $4,000 for the more basic hubs to over $20,000 for more complex hubs. Additionally, the cost of installing an EV charging station can range from $3,000 to $12,000. Smart Mobility Hubs are likely to attract vandalism; when designing the hub, consider measures that will deter opportunistic vandalism, such as materials, lighting, emergency dispatch integration, and CCTV. **Section 5, Resources, includes potential funding sources.**

Equity

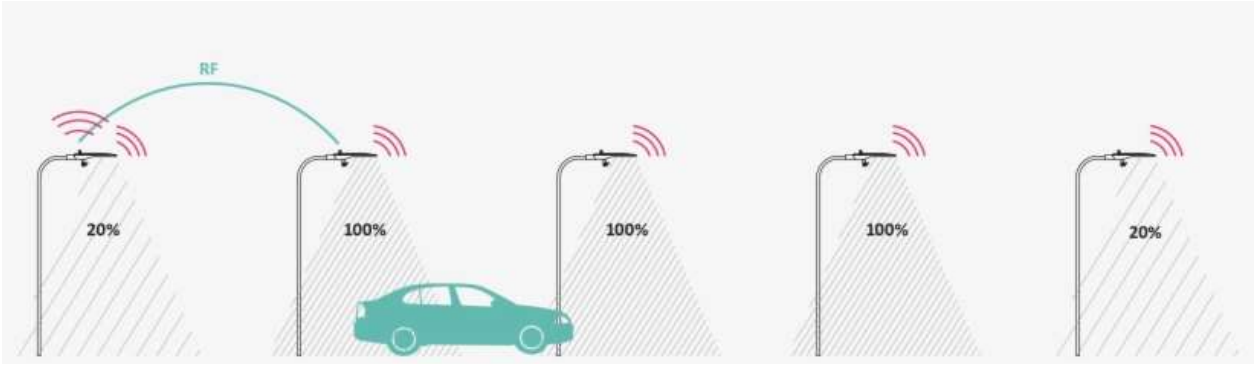
Mobility hubs have the potential to increase equity by centralizing access to potential transportation options that residents may have access to as alternatives to the single-occupancy vehicle. To offer the most access to vulnerable populations, planners should consider providing the following:

- Mobility hub locations near low-income or disadvantaged communities
- Alternative payment methods for those without bank accounts or with no or little transit access
- Multilanguage options and accessible language
- Universally designed hubs to accommodate wheelchairs and other mobility aids

SMART SENSORS

Sensors and communication devices establish the backbone of a smart-city network and maximize the potential for innovative city applications. These sensors collect data on anything from temperature to car movement. The implementation of such sensors dictates the ability to develop and operate smart-city applications. Sensors can be integrated into existing infrastructure such as light poles or traffic signals, within the Capital Region. Sensors can also be implemented in combination with infrastructure improvements, such as combining the installation of queue detection devices along a pavement resurfacing project. Additionally, environmental monitoring sensors such as stormwater sensors can be embedded in the pavement to monitor the volume of water diverted from the storm sewer system or inform transit advisories. The integration of multiple sensors provides safety and efficiency for various modes of transportation. Sensors can be placed on lines on the road meant for future use as guidance for autonomous vehicles (AVs). The development and use of an app for multiple modes of travel are recommended to fully utilize the capabilities of the sensors. Once the infrastructures and operational structures are in place, myriads of smart-city applications can facilitate Phase 2 and 3 strategies.

Figure 3 Smart sensor installed in street pavement



Source: pngkey

Figure 4 Motion Sensor Street Lighting Control System Illustration

Coordination and Partnerships

CDTC could coordinate with cities on their ongoing smart-city efforts (purchasing city streetlights from National Grid; selecting a vendor for the deployment of smart-city sensors on streetlights; and future deployment of sensors). It would also be helpful to encourage the integration of sensor technology into infrastructure improvement projects within municipalities. Municipalities can also request information from vendors on smart-city sensor solutions.

Cost and Maintenance

The cost to add Intelligent Transportation Systems depends on the specific system or device. Device costs range from $15,000 for cameras and sensors to $1,000,000 for virtual weigh stations.[1] **Section 5, Resources, includes potential funding sources.**

Equity

Data privacy should protect individuals by default, and sensitive information should be kept confidential, sanitized, or encrypted and not sold by any users.

LED STREETLIGHT CONVERSIONS AND SMART TECHNOLOGY-ENABLED LED STREETLIGHTS

LOCAL IMPLEMENTATION

Albany, Schenectady, and Saratoga Springs in partnership with New York Power Authority have replaced high-intensity discharge lighting with LED lights, which were retrofit with smart technologies and wireless network to deploy smart-city technology and services.

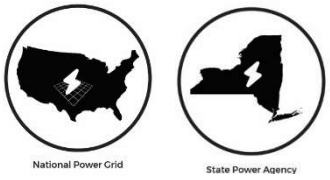
CDTC published the *Municipal Smart City Streetlight Conversion & Evolving Technology Guidebook* in 2020 to provide an overview of LED smart-city capabilities, implementation regionally, and ways to deploy this smart infrastructure. The toolkit educates Capital Region municipalities so they can strategize their smart-lighting needs and start identifying the appropriate smart-streetlight infrastructure for their community. The experiences of Albany, Schenectady, and Saratoga Springs are all in the process or have completed LED light conversion and have the following experiences with the implementation process.

Figure 5 Smart streetlight

Regionally multiple methods have been used to implement LED conversions and smart-city technologies. These include working with National Grid, the New York Power Authority (NYPA), or a private vendor, whenever possible. The City of Schenectady installed LED streetlights through the National Grid REV (Renewable Energy Ventures) Demo Project; the utility company owns and operates the streetlights. In addition to the light installation, Phase 1 of the project's intelligent network lighting controls and communication networks in two zones of the city. Phases 2 and 3 then expanded this installation, including the installation of smart-city sensor nodes and smart-city attachments in other regions. The City of Albany purchased its streetlights from the National Grid in 2019 and began working with NYPA to install LED streetlights throughout the city. NYPA is financing and implementing the project, which will provide the city with an asset management system that automatically reports outages, and features power sources for future smart-city attachments and upgrades.

[1] Traveler Information Service Layer Plan, Iowa DOT

Coordination and Partnerships



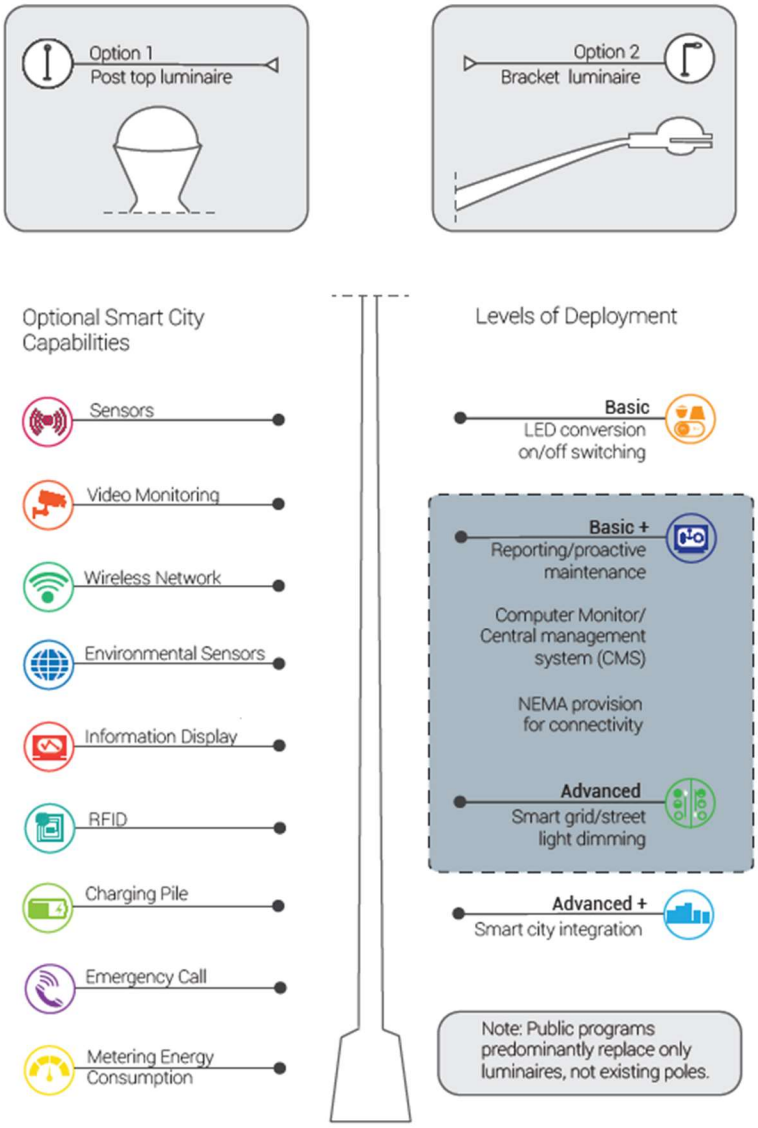
NYPA is leading Smart Street Lighting NY, a statewide program that calls for at least 500,000 streetlights throughout the state to be replaced with LED technology by 2025. Secondly, a municipality can choose to purchase the streetlight infrastructure from the utility company to have control of the cost.

Cost and Maintenance

Funding is available nationally and across New York to facilitate LED light conversion. New York State Energy Research and Development Authority's (NYSERDA) Clean Energy Communities program provides grants, coordinator support, and a clear path forward to local governments that demonstrate leadership by completing NYSERDA-selected high-impact actions. **Section 5, Resources, includes potential funding sources.**

Equity

Data privacy should protect individuals by default, and sensitive information should be kept confidential, sanitized, or encrypted and not sold by any users.



Source: *Municipal Smart City Street Light Conversion & Evolving Technology Guidebook*

Figure 6 Smart Lighting Capabilities

ELECTRIC CHARGING STATIONS AND ON-STREET ELECTRIC VEHICLE SUPPLY EQUIPMENT

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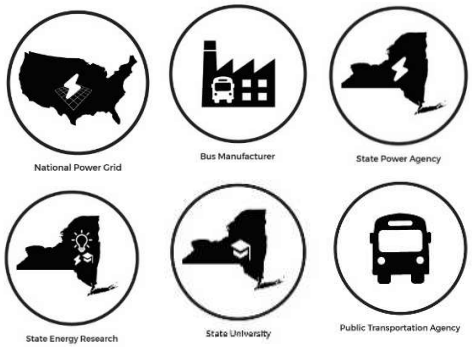
LOCAL IMPLEMENTATION

Schenectady purchased Electric Vehicle Supply Equipment (EVSE) and installed four public facing EVSEs in locations throughout the designated "EV Destination."

Albany has launched three electric charging stations at their Downtown Albany parking garages.

Municipalities should install charging stations based on population size to prepare for anticipated electrification. Charging stations should first be installed in larger urban areas, and as the population increases, they should be installed in suburban or rural areas. The installation of EV charging stations can be combined with pilot curbside management flex zones to control different uses of parking spaces for specific times of the day. EVs use three categories of EV supply equipment classified according to power levels and circuit requirements. Public EV stations use either Level 2 or DC fast charging, with DC fast charging becoming more popular as it allows for much faster charging, freeing up stations for more turnover.

Coordination and Partnerships



EV adoption requires access to EV charging devices across the region and in areas where they are most needed such as in housing complexes, institutions, and the public realm. It is beneficial for public and private sectors to collaborate and provide resources to build the overall EV infrastructure in an area. Some power companies have taken the lead by offering incentives for both private- and public-sector installations. Technical adoption of EV charging stations should follow the Society of Automotive Engineers J-1772 or CHAdeMO standard for EV charging plug connector dimensions and operational requirements.

Cost and Maintenance

Level 3 EV charging station costs start at $50,000 per unit. **Section 5, Resources, includes potential funding sources.**

Equity

Though it is recommended that electrification be driven by population size, planners should give additional precautions to locating electric charging access strategically in underinvested areas. The investments have the potential to promote EVs instead of being driven solely on the current need. Additionally, it is recommended that the chargers are equipped with Americans with Disabilities Act accessible buttons and components.

Source: fottoo

Figure 7 Electric Charging Station

ELECTRIC-VEHICLE TRANSIT FLEETS

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LOCAL IMPLEMENTATION

Schenectady purchased partial hybrid electric vehicles (PHEVs) and CDTA has launched 100% electric buses and the DRIVE rideshare program that utilizes electric vehicles.

The Capital District Transportation Authority's (CDTA) has made significant investments in electrifying its bus fleet. In 2020, the agency piloted four Xcelsior CHARGE 40-foot buses built by New Flyer Industries. CDTA also installed four Siemens direct current depot chargers at its Albany garage. Additionally, CDTA is about to launch an EV sharing program, DRIVE. The program offers a 24/7 green alternative to traditional car-sharing companies like Zipcar. Smart Columbus emphasizes the importance of creating EV utilization standards, engaging with employees, providing them with the necessary EV training, monitoring, and tracking performance metrics, and lastly, exploring policies that facilitate financially sustainable EV adoption systemwide

Source: Los Angeles Metropolitan Transportation Authority

Figure 8 Rendering shows the proposed overhead charging system for the Metro Orange Line Electric Bus Program

Coordination and Partnerships

Necessary partnerships for EV adoption are electric bus companies such as New Flyer. In launching the electric bus pilot, CDTA worked with National Grid to design appropriate upgrades to the electrical capacity at its Albany garage.

Cost and Maintenance

Each Xcelsior CHARGE bus costs $900,000, each charger costs $121,000. Training and tools needed for maintenance cost $200,000. **Section 5, Resources, includes potential funding sources.**

Equity

Advances in electrification are beneficial to society and will improve the health of people of color whom the negative impacts of transit have disproportionately impacted. The CDTA estimates that the introduction of electric buses will eliminate up to 175 tons of greenhouse gas emissions annually, which supports its mission to improve accessibility and mobility. Electrifying vehicles will also help the state reach its goal of transitioning to 100% renewable energy by 2035.

INFLUENCE FUTURE TRANSIT SERVICES

IMPLEMENTATION

In 2021 the Smart Cities Communities Act was introduced in Congress. If passed the bill will establish programs for Smart City implementation such as grant programs, a cybersecurity working group, establish tech related workforce training and development.

On a regional level, municipalities should create legal and regulatory foundations to promote desired smart-city technologies in their communities. This process will be ongoing to ensure fair use and account for emerging opportunities and risks. These technical regulatory measures can fall into several categories including but not limited to oversight, innovation and Data and Cyber Security as shown below.

Oversight

- Set standards and procedures for smart city deployments that include the processes for working with city infrastructure owners.
- Establish a device review process with agency stakeholders.

Innovation

- Establish data sharing mechanisms such as an open data platform for agencies and the public.
- Establish a testbed location where new technologies can be piloted in real-world situations.

Data and Cyber Security

- Create cybersecurity policies and standards that all public agencies, contractors, and vendors are required to follow.
- Clearly define ownership and rights of transit system providers.

Coordination and Partnerships

Planning for future smart transit services requires collaboration between transit agencies, educational and research institutions, private sector, and related city infrastructure owners. In addition to these cross-sector partnerships transparent and open data between agencies and the public is encouraged to create transparency and offer opportunities for innovation from the community,

Cost and Maintenance

The costs associated with influencing future transit service are providing staffing to help establish these policies and assist in the coordination dialogue between state and federal officials to promote smart-city adoption.

Equity

With legislation and policy, equitable standards can become requirements of smart-city implementation, review processes, and ongoing engagement formats. This can be done by introducing requirements such as the Racial Equity Impact Assessment in the design process, setting high standards for Minority and Women-owned Business Enterprises product sourcing in Request for Proposals, and establishing structure for communication between public agencies and community groups to continue community knowledge and help build the capacity of local community groups.

4.3 ADVANCED STRATEGIES

MICROTRANSIT SERVICES / FLEXIBLE ON-DEMAND TRANSIT

LOCAL IMPLEMENTATION

CDTA launched the FLEX on-demand service in 2020 and operates the curb-to-curb service in Colonie, Guilderland, Latham and at the UAlbany Uptown Campus, Albany Medical Center, Albany International Airport, University at Albany and recently Southern Saratoga County.

The CDTA's FLEX provides flexible on-demand service in the Capital Region in real time. Users can request rides through the Transloc mobile application. Flexible service has traditionally taken one of three route forms:

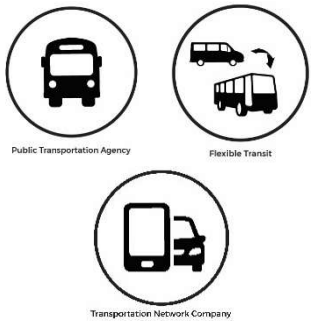
- Completely on-demand service (CDTA's FLEX)
- On-demand transit for specific uses/locations (such as to grocery stores or shopping centers)
- Flexible shuttles running on a schedule and providing various pick up/drop-offs within or near the geographic route area

The FLEX model of public-transit agency ownership and operation is also a best practice for operating a flexible on-demand service. As microtransit service expands, it is often beneficial to incentivize multiple-person pickups to reduce mileage or to expand operation hours to provide more opportunities for nontraditional work hours.

Source CDTA

Figure 9 CDTA FLEX On-Demand Service

Coordination and Partnerships



Operating a flexible transit system within a public-transit agency requires minimal coordination with other agencies beyond the New York State Department of Transportation. Additional partnership opportunities exist if the transit agency chooses to partner with a private Transportation Network Company (TNC), such as Uber, Lyft, or Via. In this partnership, the public agency primarily handles the public-facing aspects and special programs, while the TNC provides travel data and manages the fleet.

Cost and Maintenance

Several federal grant programs are available with eligibility for flexible on-demand transit. The program facilitates integration with the existing transit network by planning and developing business models, obtaining equipment, acquiring, and developing software and hardware interfaces to implement the project, and beginning operations. Several cities that launched flexible on-demand programs were recipients of grants, which fund activities leading to an innovative on-demand service launch. Around the country, many agencies can fund their on-demand transit service using funds raised from local taxes and fees. **Section 5, Resources, includes potential funding sources.**

Equity

On-demand services can help to provide equitable geographic access to transit for riders with limited or no transit options. These services also often offer extended service hours for riders who work nontraditional hours and would otherwise be unable to use transit for their entire commute. The current FLEX system offers customers multiple methods for payment, such as the Pay as You Go option on their Navigator smart card or mobile app, because FLEX rides are not included with a Frequent Rider monthly pass. The service could offer reduced/free fares for riders with disabilities to increase access.

COMMUNITY WI-FI/ BROADBAND EXPANSION

High-speed wireless networks and optical fiber are necessary infrastructure for municipalities and residents alike. Despite this, there are gaps in broadband access in the Capital Region. The National Telecommunications and Information Administration identified that 37% of census tracts within the Central Region lack adequate broadband service. This issue can be addressed through increased investment in broadband access and through offering community or free Wi-Fi access within public locations. Additionally, simple strategies like installing infrastructure needed for smart-city communications (underground conduit and hand boxes; Wi-Fi enabled communications within traffic-signal control boxes; public Wi-Fi routers) can help facilitate community Wi-Fi.

Coordination and Partnerships

Broadband expansion is a national priority and the backbone of smart-city solutions that require immense data exchanges. New York State has supported the expansion of broadband and fiber optic recently, with the Communications Backbone Initiative launched in 2017 and continues to improve connectivity in rural Upstate New York. In 2022, New York State established the ConnectALL Initiative plan to assist with the delivery of affordable broadband to millions of New Yorkers through grants and public programs. There is available funding for infrastructure upgrades and broadband expansion through the following programs:

CHICAGO CONNECTED

Chicago Connected is a program that provides free high-speed internet service to Chicago Public School students and their families. After 1 year of the Chicago Connected Program:

- 93% designated as economically disadvantaged
- 29% are English language learners
- 75% of families had an annual household income less than $35,000

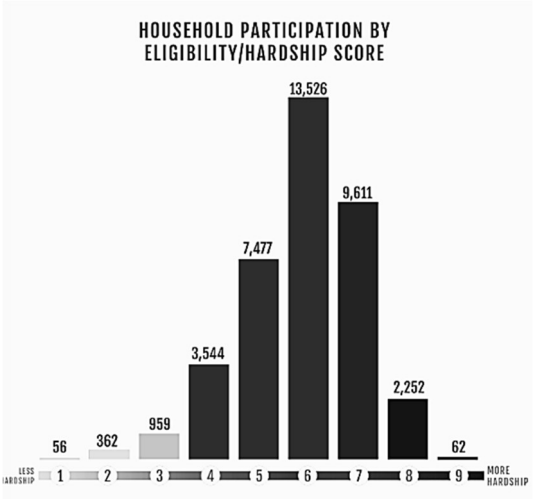
- Local Connectivity Planning and 21st Century Municipal Infrastructure
- Rural Broadband
- Connectivity Innovation

Cost and Maintenance

The cost and delivery of free Wi-Fi vary, depending on the existing broadband infrastructure within a municipality. Cities can offer free Wi-Fi through partnerships with service providers in exchange for advertising space. **Section 5, Resources, includes potential funding sources.**

Equity

The inequity in digital access coexists with other vulnerability metrics such as poverty and lower educational attainment. In smart technology integration, investments in Wi-Fi and broadband should prioritize vulnerable populations and improve access. Investments should prioritize low-income and rural communities.



Source: Chicago Connected 2021 Program Impact

Figure 10 Participation by Household Income

PARKING MANAGEMENT APPLICATION

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LOCAL IMPLEMENTATION

In 2017, ParkAlbany launched new meters and a parking mobile application, which allows users to pay for parking on their smart phones.

In recent years, many cities like Albany have improved their street parking management by implementing a parking management application. Albany's system allows users to extend parking time, to pay using a credit card, and to receive alerts and an electronic receipt. Features that could be integrated to improve the system include providing improved parking availability information to users and reducing their need to circulate city streets in search of parking. Agencies can facilitate parking management through a coordinated system that monitors the capacity of all participating parking facilities and reports real-time information to help users quickly find and navigate to the most appropriate parking facility. The range of applications includes:

- Navigation Only: facilitates locating vacant parking
- Online booking: allows the user to pay for parking via the app and often includes the ability to extend time remotely, and send alerts to notify the user when time is running low
- Pre-book: allows the user to find and reserve parking before reaching the spot or garage
- On the spot booking: allows the user to book a parking spot by entering a zone or meter number

Coordination and Partnerships

Municipalities can help mitigate the parking constraints within downtown areas by partnering with existing parking management application providers. Parking providers provide municipalities with parking application systems and related support for many cities within the United States. This dynamic parking application requires partnership with the municipalities and the implementation of smart sensors frequent enough to cover the on-street and off-street parking.

Cost and Maintenance

These services, at minimum, include capital costs such as signage, application development and maintenance, and gateway and merchant processing. The main cost is associated with contracting a parking management application provider, which costs $20,000 to $40,000 for launching and designing, $10,000 to $15,000 for hosting the digital platform, and a minimum of $2,000 monthly for ongoing maintenance and upgrades. These services, at minimum, include capital costs such as signage, application development and maintenance, and gateway and merchant processing. **Section 5, Resources, includes potential funding sources.**

Source: SFCTA

Figure 11 San Francisco Mobile Parking App

Equity

The application can expand its capability by implementing real-time data to display available parking spaces and eventually create dynamic pricing that fluctuates throughout the day based on parking demand. The update can be phased in through a pilot program where parking demand is most significant and where supply is available.

ENHANCED PUBLIC-TRANSIT WEBSITE

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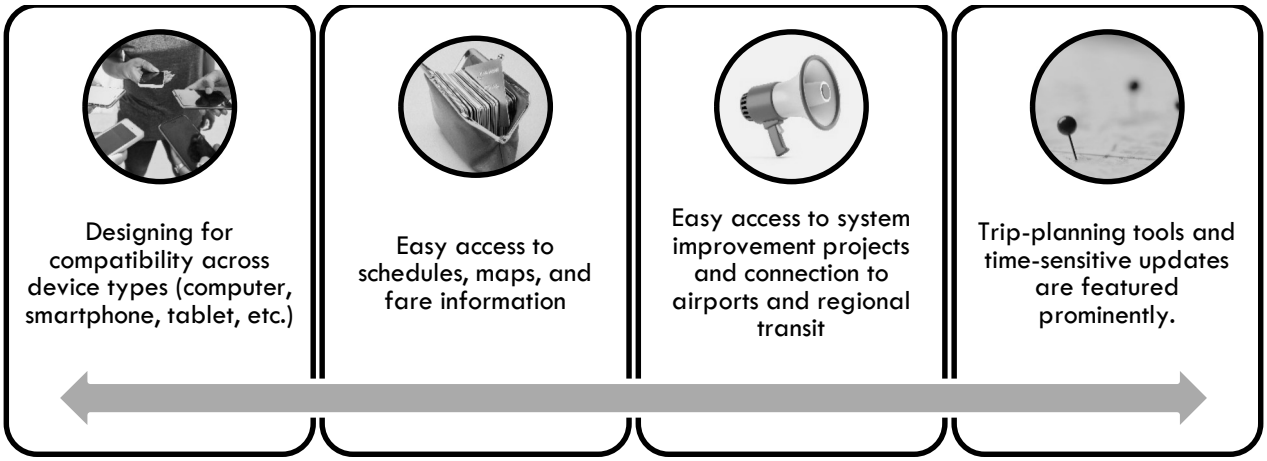
Public-transit websites serve as the primary source of information for commuters, visitors, and other local agencies. The CDTA's website features transit routes and schedules, service advisories, a trip planner tool, and the Navigator transit card information. To improve the dissemination of information and ease of use, the following concept can be helpful:



Coordination and Partnerships

Connecting and collaborating with regional institutions, attractions, and private transit options expands the usefulness of public-transit websites.

Cost and Maintenance

Funding for website improvements is minimal. The cost to support the website can be included in the agency's professional services or maintenance services budgets. **Section 5, Resources, includes potential funding sources.**

Equity

The primary equity concern in a public-facing website is accessibility. The CDTA's current website is accessible for visually impaired users and features customer service contact information for users who are more comfortable speaking to an operator. Websites can also benefit from full compatibility with smartphones to increase functionality for those who do not have access to a computer.

ASSET MANAGEMENT AND MAINTENANCE APPLICATIONS OR SOFTWARE

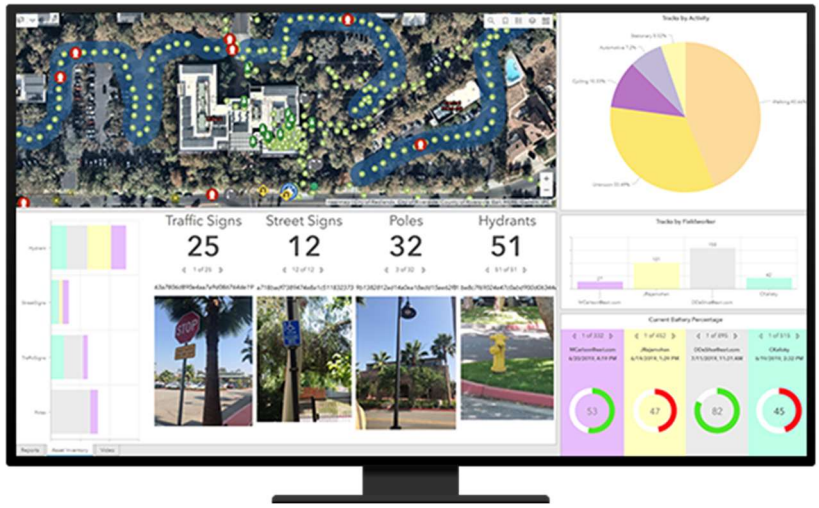
All municipalities, transit agencies, utility providers, and other agencies monitor assets and performance. Municipalities and cities can use the Internet of Things (IoT) to improve the productivity, public safety, general efficiency, and reporting of these metrics and assets. It is recommended that the monitored information be collected through smart sensors and processed through software that automates asset management in real-time through a network of connected devices. With sensors and place, the organization will need to analyze the existing workflows and define what metrics need to be identified.

Coordination and Partnerships

Automated asset tracking for public agencies means implementing a control system to monitor vehicles, facilities, IT, and other equipment used to carry out operations. The coordination would continue between existing partnering agencies, but there would be an added layer of organization at the onset of implementing this system or application. Following implementation, with the help of an automated government tracking system, the administration can easily control asset movement and monitor utilization to optimize resources.

Cost and Maintenance

The costs of IoT asset management software vary depending on the model chosen, and several types include building your own model/software (requires most capital cost), subscribing to an existing asset management model/software (least capital costs), and, lastly, a public-private partnership to create the model/software (nominal capital costs). **Section 5, Resources, includes potential funding sources.**



Source: ESRI Public Works and Engineering

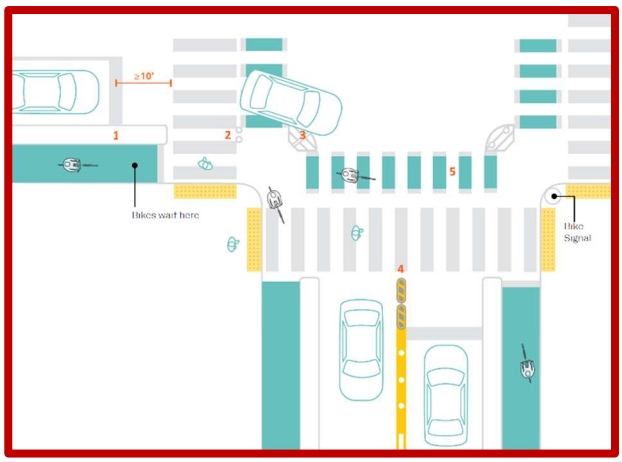
Figure 12 Asset Management Software

Equity

Agencies should enforce their data collection standards on any software provider to help maintain the privacy of individuals. In implementing an internally facing asset management application there is limited direct impact on the public. Equity concerns are related to the processes of creating the system. It is recommended that when sending out a Request for Proposal or Request for Qualifications for software, the agency should have high Minority and Women-owned Business Enterprises utilization rates.

SMART-CYCLE TRACK

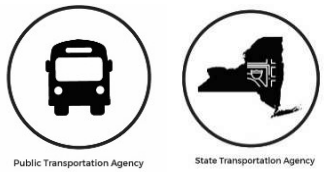
A smart-cycle track utilizes connected infrastructure technology that includes sensors to detect bicycles and trigger traffic signals to respond to the presence of bicyclists. It gives bicyclists priority to navigate the intersection using bicycle signals that turn green before vehicle signals. It is recommended that smart-cycle track features are piloted utilizing existing sensor technology that gives intersection priority to cyclists and micromobility users. Another element that could be employed in the near term is a real-time bike totem counter. The totem counter is a system that counts bicycle traffic, displays real-time bicycle counts, and stores it within accompanying software for analytics. The system can be connected to a smart-city operating system to bolster the data collection period and inform other applications.



Source: NACTO

Figure 13 Intersection diagram with protected bike signal phasing and Smart Bike Lane

Coordination and Partnerships



Smart-cycle track requires collaboration from state agencies, local governments, and all owners and operators of the transportation system. Logistically the cycle-track system will integrate signal timings for the surrounding areas, and the totem will integrate data from bicycle counter sensors.

Cost and Maintenance

To minimize the cost of the cycle-track construction, a city can coordinate the work to coincide with a resurfacing project and upgrades to traffic signals, rendering the actual cost of the cycle track and infrastructure to about $250,000. The first track can function as a pilot project to see if installation could use the technology and infrastructure in other areas of the city. **Section 5, Resources, includes potential funding sources.**

Source: VTT Studio

Figure 14 Intersection diagram with protected bike signal phasing and smart-bike lane

Equity

Planning considerations to improve the equity of the smart-cycle track should prioritize proximity to low-income or no-car households. Design configurations should include wide bike lanes and protected lanes for cyclists. Additionally, during the implementation phase, public outreach and education are

recommended to demonstrate how different user groups, cyclists, people with mobility impairments, low vision, motorists, and pedestrians should interact with the new facility.

UNIVERSALLY DESIGNED INTERSECTIONS

Currently, sensors have not been used to facilitate universal intersections within the Capital Region. Once Phase 1 installation of sensors within the street networks is complete, the sensors can be used as assistive technology to make streets and intersections more accessible and navigable for people with mobility or physical impairments or vision impairments. In this scenario, beacon devices mounted to infrastructures, such as pedestrian crossing lights or buses, can communicate with smartphones or other devices to effectively aid people with disabilities safely cross the street. These intersections are recommended for more dense municipalities in areas with a greater population of people with disabilities or surrounding centers for hearing or sight. The same application can aid the visually impaired in using the bus and transit system if the transit system is equipped with real-time monitoring.

Source: WSP

Figure 15 Buffalo Niagara Medical Campus Main Street Smart Corridor

Coordination and Partnerships

The technology of connected and autonomous vehicles relies on short-range communications devices (DSRCs) placed in traffic-signal cabinets and other roadside structures. Data exchange can be vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), or vehicle-to-everything (V2X), with data broadcast between vehicles and roadside units going to a cloud-based data management system. The V2X system is used in creating smart intersections and specifically universally designed intersections.

Cost and Maintenance

The cost to retrofit an intersection to accommodate elements for universally designed intersections is around $30,000-$50,000 per intersection**. Section 5, Resources, includes potential funding sources.**

Equity

In considering equity concerns in implementing universal intersections, a key consideration is the distribution of these assets among different socioeconomic neighborhoods. Additionally, the prioritization is based on need; some potential concerns might be the density of people with disabilities,

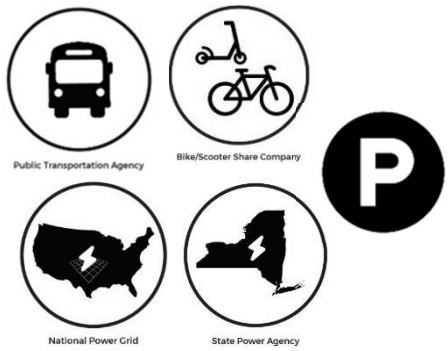
the number of pedestrian-related accidents, or proximity to institutions that support visually impaired people or people with accessibility issues.

4.4 DYNAMIC STRATEGIES

CURBSIDE MANAGEMENT

Curb management will be most impactful in the larger cities and areas surrounding universities, stadiums, or other attractions with competing uses. Uses of the curb generally fall into one of the following categories: pedestrian access, freight access, multimodal travel, parking, and public space. Depending on the street configuration, the curb will prioritize the uses that make the most of the limited curb space. Potential use for curbs includes an allocation to rideshare vehicles—such as CDTA's DRIVE car share program—or as public space when street access is limited, and many more uses that consider the functionality of the street. The earlier smart-city solutions such as smart sensors, parking management applications, asset management, and maintenance strategies facilitate the success of curb management because they facilitate the collection and management of data. Sharing this data between agencies will streamline improved processes to manage curbs, such as dynamic allocation of loading zones based on changing needs, the creation of digital profiles through the aggregation of data, and digitally enforcing parking and traffic rules using cameras and sensors.

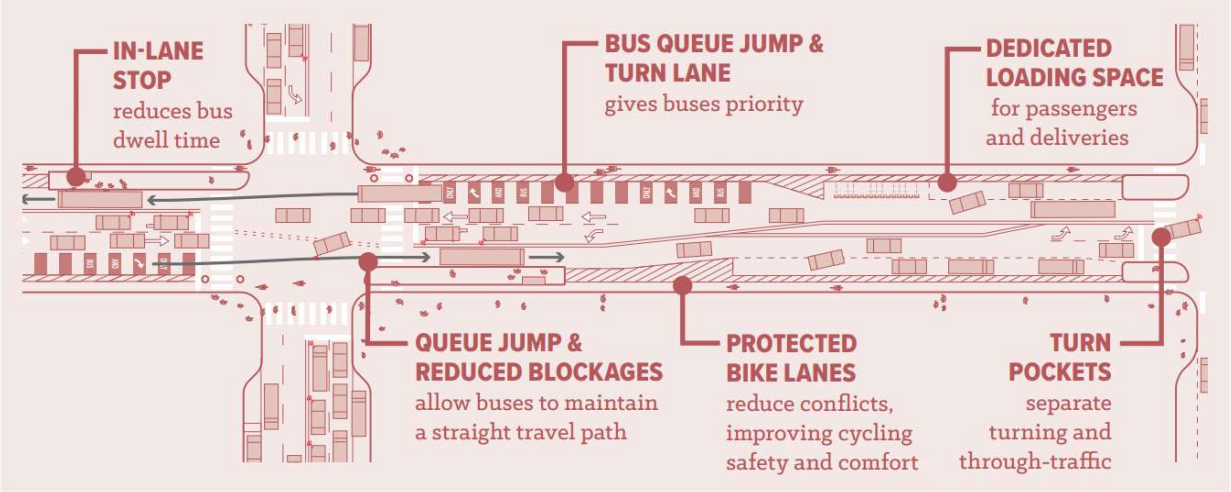
Coordination and Partnerships



Due to the multitude of current and potential uses of the curb, interagency cooperation is necessary to manage and coordinate flexible uses efficiently. More so, a variety of operators are within the streets that traditionally work separately, such as parking authorities, municipal public works departments, CDTA, NYSDOT, National Grid, local sanitation collection, and many others. Coordination between agencies is necessary to share data that may facilitate advanced curb systems such as demand-based pricing or automated enforcement. In the same vein, agencies should work closely with legislative bodies to monitor new enforcement methods and curbside usage.

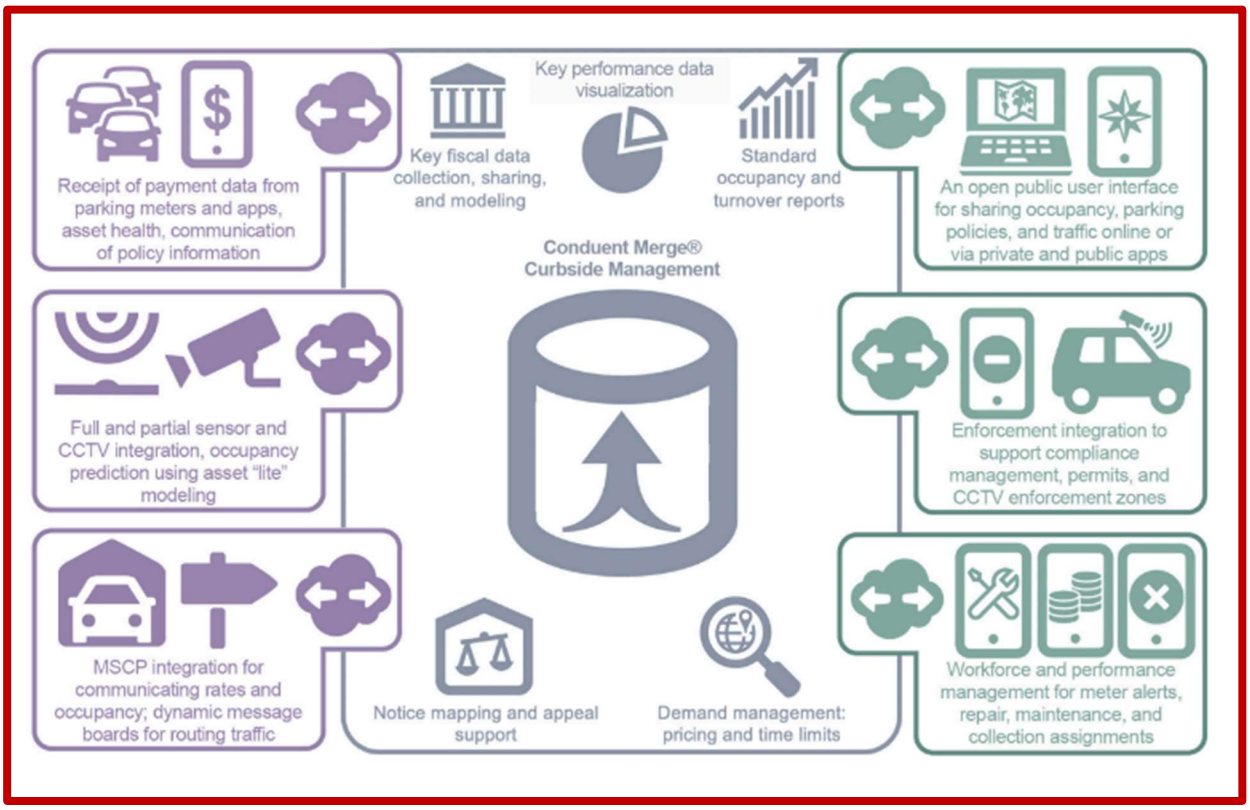
Cost and Maintenance

The cost of curbside management varies significantly because the strategies employed in curbside management vary by street type and technological integration. Additionally, curbside management often integrates existing data sources into a central cloud and within these systems can perform various functions that require varying levels of complexity, such as calculating performance measures, automating actions, and displaying information on an interface. Because applications of curbside management are so vast, many funding opportunities can assist in funding different elements of this strategy. **Section 5, Resources, includes potential funding sources.**



Source NACTO

Figure 16 Possible Applications of Curbside Management



Source: Conduent Transportation

Figure 17 Illustration of Curbside Management Functions

Equity

Curb management strategies aim to reduce congestion of vehicles and facilitate faster and more efficient bus travel, both increasing the quality of life for drivers, transit passengers, and pedestrians in the area. Additionally, management strategies have the potential to reprioritize the needs of more vulnerable populations within curb space if the coordinating agencies agree to renegotiate that space.

DYNAMIC LANE MANAGEMENT (USING DYNAMIC FLOW)

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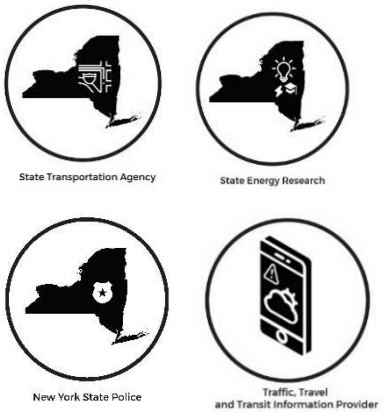
Dynamic lane management and shoulder use is an active traffic management (ATM) strategy typically used in conjunction with other ATM strategies. Dynamic lane management can be activated at fixed times or in conditions of particularly heavy traffic volumes, usually utilizing variable message signs. The lane management system can be centrally monitored and controlled by a traffic management center or autonomously through the system's architecture. Dynamic lane management is best used on roads with significant and regular imbalances in traffic demand by direction. In these conditions, dynamic lane management could balance the excess in demand traffic by using a lane usually used in the opposite direction. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls. Implementing a dynamic lane management system requires many planning stages to determine if this solution could address traffic concerns. The process will likely include operational analysis, operational design, system engineering, system architecture design, and right-of-way acquisitions, if required.

Coordination and Partnerships



Interagency coordination is necessary to develop policy, operating procedures, and communication systems across data-sharing and jurisdictions. The coordination requires partnerships between agency roadway owners and traffic operators, emergency service providers, law enforcement, and media or real-time traffic information providers.

Cost and Maintenance

The capital cost involved in implementing dynamic lane management is high because the cost typically includes new overhead sign structures, electronic signs, sensors, monitoring cameras, and, most importantly, a well-designed central software to manage the data and application. Compared to significant roadway widening projects that might be considered an alternative, this solution is less costly. **Section 5, Resources, includes potential funding sources.**

Equity

Dynamic lane management will best benefit drivers with typical traffic demands because it will respond to significant shifts in traffic. The strategy will not positively or negatively impact non-peak users, though there should be additional equity analysis during the operational analysis phase.

Source: WSP

Figure 18 Dynamic Lane Rendering

TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS (TSMO)

Transportation Systems Management and Operations (TSMO) is an integrated approach to addressing mobility and safety issues on the transportation network. TSMO differs from traditional management of the transportation network in that the actions address immediate and near-term needs in system operations rather than longer-term expansion. TSMO focuses on optimizing the performance of existing and planned infrastructure through the implementation of systems, services, and projects that preserve capacity and improve the security, safety, and reliability of the multimodal transportation system.

Coordination and Partnerships

TSMO includes efforts to operate the multimodal transportation system and activities to manage travel demand, thus crossing over political, modal, and jurisdictional boundaries. It emphasizes door-to-door travel, regardless of the modes of travel. TSMO encourages transportation agencies to look beyond single projects or corridors and to consider the impacts of the entire transportation system. This involves coordination and collaboration among multiple stakeholders, such as federal, state, and local agencies, the first responder community, and the private sector to achieve seamless interoperability.

TSMO is a collaborative effort between traffic operators/agencies and local planning authorities. In addition to a metropolitan planning organization, the member agencies can include the regional traffic operators, NYSDOT, local transit agencies, and other related organizations. These agencies collaborate to implement a broad array of TSMO tools to improve the regional transportation system. These tools include work zone management, road weather management, traffic incident management, and traveler information.

Cost and Maintenance

TSMO is intended to make the provision of transportation services and infrastructure more efficient. Generally, TSMO can be implemented using existing funding sources, except for some strategies that have longer payback periods, such as access management, integrated corridor management, and traffic-signal coordination. The cost can vary, depending on the scale of the project and the type of technology implemented. A new funding program, Strengthening Mobility & Revolutionizing Transportation (SMART), is a source for future funding for TSMO. **Section 5, Resources, includes potential funding sources.**

Source: WSP

Figure 19 NYSDOT INFORM Transportation Management System

Equity

The goals of TSMO initiatives are to improve the efficiency of transportation networks, improve safety, reduce transportation-related emissions, provide public access to real-time travel information, improve access to employment centers, and increase transportation options. These goals align with equity principles. To encourage more equitable investment into TSMO, many Federal Highway Administration grants for 2022 funding include racial equity, environmental justice, and access to opportunity. Some programs can also support electric vehicle charging and other technologies that help reduce emissions.

MOBILITY AS A SERVICE (MAAS)

With the launch of many micromobility services recently, there is a greater need for Mobility as a Service (MaaS) to integrate that service information with existing fixed-route services. Integrating all travel modes advances MaaS by helping customers see all their transit options on one platform and subsequently plan multimodal trips. Within the Capital Region, a MaaS application could integrate many services under one platform: services could include regular bus routes, bus rapid transit, seasonal trolleys, *Cycle!* Bikeshare, FLEX on-demand transit, DRIVE car-sharing, SCOOT scooter sharing program, ride-hailing services, parking, and toll payments.

Coordination and Partnerships

The coordination of these agencies relies on existing smart infrastructure such as widespread 4G/5G, dynamic and up-to-date travel data, and cashless payment systems. In addition to the technological foundation, the built form and spatial relationships between different mobility services should be considered and configured to promote easier mobility modes transfer. When those foundational aspects are set up, the partnering transit agencies; municipal planning authorities, CDTA, municipal parking authorities, New York Thruway Authority, transportation network companies (such as Uber, Lyft, and Via), and others can collaborate on integrating services and designing or choosing a platform for the services to exist on. Only a few companies offer MaaS services. The current landscape of companies that provide MaaS is limited. Still, if available, these providers use third-party aggregators (like Moovit or Transit) that link services from private and public mobility providers and allow planning booking through a single gateway.

Cost and Maintenance

There is a lack of standards and uniformity in launching MaaS across cities; most pilots have been in Europe. Within the United States, there have been several MaaS pilot programs that integrate public and private services. There has been only one end-to-end MaaS initiative—the Move PGH program in Pittsburg, PA. Move PGH was funded partially by a $600,000 two-year grant and through the mobility provider's revenue. There is limited public funding to launch MaaS, and public-private partnerships

are the most feasible way to fund MaaS. **Section 5, Resources, includes potential funding sources.**

Equity

MaaS is early in its adoption, partly due to technological access disparities between cities and among people. MaaS requires users to access the application through an internet-enabled phone or website, which may not be accessible for many people. Some cities have used internet-enabled kiosks to provide travel times. The Capital Region could utilize a similar strategy if MaaS was integrated into kiosks around the city or in areas with limited access to internet-enabled devices. The aggregation of all transit modes in an area under one platform allows users to choose mobility options that are most cost-effective or efficient for their needs.

Figure 20 Illustration of Mobility as a Service applications connected to transit, active mobility, parking, and ride share

DEPLOY ROADSIDE UNITS TO PREPARE CORRIDORS FOR CONNECTED VEHICLES (CV)

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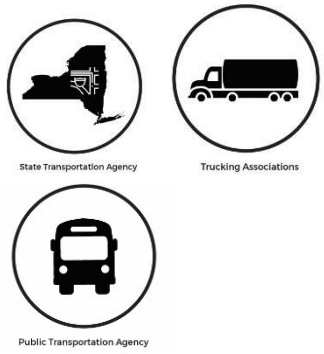
CVs are one of the products of smart infrastructure investments, CV can only be launched in the Capital Region when the region has invested in smart-city hardware and software. More so, to successfully launch CV deployment, roadside units (RSUs) or other CV-compatible devices should be deployed at all the signalized intersections within the deployment area. These investments will collect transportation-related data (through RSUs or similar devices) and will be managed and integrated (using software such as equipment interfaces) to deliver real-time safety and mobility services. In preparation for CV launch, an inventory of existing traffic light capabilities and fiber optic networks will be necessary.

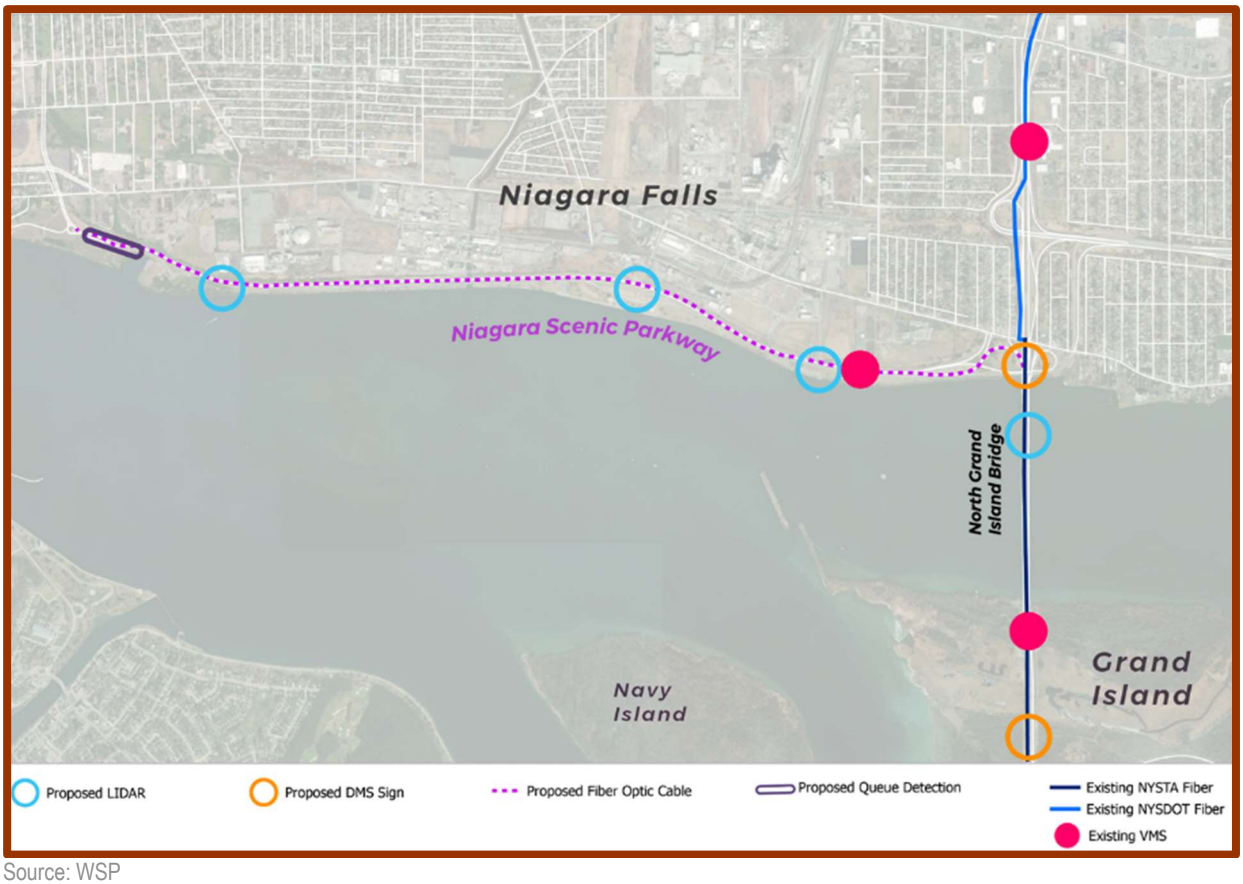
Coordination and Partnerships



Launching and operating a CV network will require partnership and data-sharing between a variety of agencies and organizations including NYSDOT, CDTA, municipalities, the Trucking Association of New York, and emergency management agencies. Additionally, the Capital Region will need to contract RSUs and onboard units from a third party. For software needs, the regional partners should hire a software developer to design.

Cost and Maintenance

The cost to develop a connected corridor with instruments for CVs and AVs ranges from $100,000 to $150,000 per mile. The recurring and support costs for operating an interconnected vehicle system include hosting and storing data on a server ($12,000 per year for the Connected Columbus project). The CV integration will support future innovations and will have travel time and safety benefits for all users. Additionally, it collects more information that traffic agencies or municipalities can use to make the system more efficient.



Source: WSP

Figure 21 Niagara Falls Smart Mobility Components

Equity

Open datasets on Application Programming Interfaces (APIs) are beneficial for the public because they assist in the distribution of traffic information from RSUs and can be accessed by other agencies or private companies who wish to share information. Another equity consideration is the distribution of RSUs across geographic areas, incomes, and racial/ethnic groups.

AUTONOMOUS SHUTTLES

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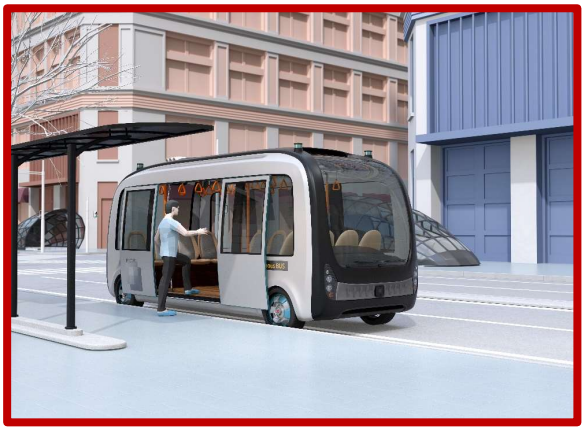
There is a lack of federal and state guidance on AVs, and their applications are still being tested in controlled environments. Within the Central Region, the closest pilot of AV technology is at the University at Buffalo. Additional testing and experimentation are recommended in the Capital Region to continue to make advancements in AV capabilities. To encourage this experimentation, it is beneficial to set local frameworks and legislation that supports this work. Additionally, local universities should be engaged and partner with



Credit: Chesky

Figure 22 Illustration of autonomous minibus pilot

the private sector and public agencies to pool resources and launch a pilot with significant public support. Interim steps between current AV capabilities and full AV adoption will include AV system testing and evaluation studies. Collaborations across regions are also beneficial to understanding lessons learned.

Coordination and Partnerships

The focus of this partnership is to facilitate collaboration and transparency of automation research, update legislation to support future innovations in AVs capabilities, and prepare the transportation system and infrastructure to improve safety for AVs. The U.S. Department of Transportation supports AV innovation across the country and has several ongoing federal programs that support investments and research in automation.

Cost and Maintenance

Vehicles are limited to pilot programs and studies. The cost to develop a connected corridor with instruments for CVs and AVs ranges from $100,000 to $150,000 per mile. **Section 5, Resources, includes potential funding sources.**

Equity

In considering AVs, it is recommended to identify potentially disconnected communities and historically disadvantaged communities to facilitate greater connectivity and minimize barriers to those groups.

DYNAMIC PARKING

Dynamic parking builds upon previous parking management applications and adds the capacity to set parking prices based on demand and the proximity to an in-demand area such as an urban corridor. In the Capital Region, the current demand management system has limited capabilities. Users can now pay for parking based on the zone noted on street signs and manage the parking reservation on their phones. Expanding the current capabilities of this application could help manage congestion by providing parking availability in advance, setting prices that can increase revenue for the parking agency, and managing congestion by offering cheaper parking further from congestion points. Dynamic wayfinding may be a helpful addition to dynamic pricing. This solution would install variable signage to direct drivers to available parking and update drivers on parking supply and pricing.

Coordination and Partnerships

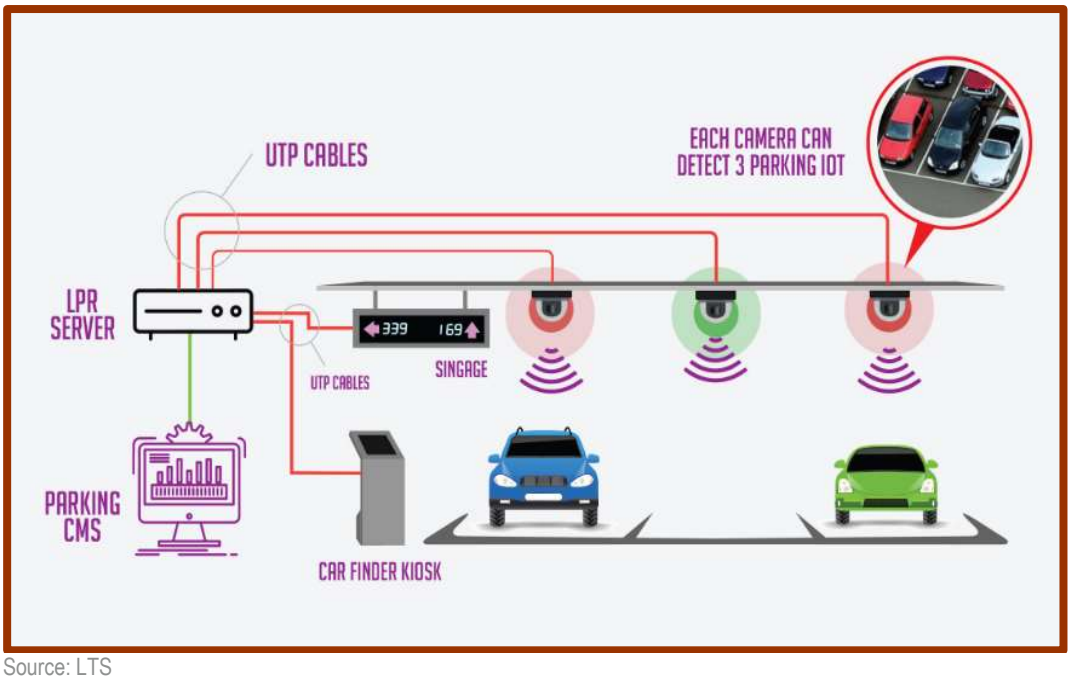
This dynamic parking application requires partnership with the municipalities and the implementation of smart sensors sufficient to cover the on-street and off-street public parking. Collaboration with private parking providers is recommended if there is a shortage of public parking in certain areas. When considering implementing this strategy, parking agencies should work with local municipalities to mandate reserved on-street parking for people with disabilities in selected regions or corridors.

Cost and Maintenance

The cost to upgrade from the current parking management system to one that dynamically changes rates will require the installation of sensors if none are installed in the area. Installation of this technology is affordable because the technology is mature and easy to install with access to electricity. The implementation cost for streets or streetlights with existing sensors or radar units will include systems architecture design to collect this information and share it with the parking authority. Then the costs associated will be maintaining and operating the interface that shares this information with the public. Like a standard parking management app, many municipalities may choose to contract this service to a private operator. **Section 5, Resources, includes potential funding sources.**

Equity

The dynamic parking model sets prices for parking spaces based on demand; because of this, the system inherently burdens low-income riders when there is a limited supply. Within this model, agencies should consider additional protections to protect other vulnerable populations. Disabled on-street parking should be incorporated into the inventory of all available parking and advertised to differently abled users.



Source: LTS

Figure 23 Illustration of Parking Guidance System

5 Resources

FEDERAL FUNDING

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Transportation Alternatives (TA) Program	Federal Highway Administration (FHWA)	$7.2 billion over five years. (10% of each state's Surface Transportation Block Grant program funds)	Recreational trails, bike/ped projects, micromobility, and other types of transportation alternatives.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Autonomous Shuttles ▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Smart Cycle Track ▪ Smart Mobility Hub ▪ Smart Sensors ▪ Universally Designed Intersections
Congestion Mitigation and Air Quality (CMAQ) Improvement Program	Federal Highway Administration (FHWA)	$2.75 billion	Transportation projects or programs that reduce congestion and improve air quality. CMAQ funding can be used for both capital and operating expenses.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Lane Management (Using Dynamic Flow) ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Smart Cycle Track ▪ Smart Mobility Hub

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Carbon Reduction Program (CRP)	Federal Highway Administration (FHWA)	$6.4 billion	Provides funds for projects designed to reduce transportation emissions from on-road highway sources.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Asset Management and Maintenance Applications ▪ Autonomous Shuttles ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Electric Vehicle Fleets ▪ Lane Management (Using Dynamic Flow) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Smart Cycle Track ▪ Smart Mobility Hub
National Electric Vehicle Infrastructure (NEVI) Formula Program	Federal Highway Administration (FHWA)	$5 Billion	Implementation of electric vehicle charging for EV charging infrastructure that is open to the public or to authorized commercial motor vehicle operators. OR to develop guidance for States and localities to strategically deploy electric vehicle charging infrastructure.	▪ Curbside Management ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services
Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT)	Federal Highway Administration (FHWA)	$7.3 billion (formula) $1.4 billion (competitive grant)	Conduct resilience planning studies on transportation systems. OR Enhance evacuation routes by increasing protection and safety from natural disasters. OR Redesign surface transportation infrastructure to handle the impacts of extreme weather events and other natural disasters.	▪ Asset Management and Maintenance Applications ▪ Community Wi-Fi/ Broadband Expansion ▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ Microtransit Services (Flexible Routing System) ▪ Smart Sensors ▪ Universally Designed Intersections

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Bus & Bus Facilities Program	Federal Transit Administration (FTA)	$2 billion	To replace, rehabilitate, purchase, or lease buses and buses related equipment and to rehabilitate, purchase, construct, or lease bus-related facilities – as well as capital funding for low or no emissions bus projects	▪ Autonomous Shuttles ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪
Low or No Emission Grant Program	Federal Transit Administration (FTA)	$1.1 Billion	To purchase or lease zero-emission and low-emission transit buses, including acquisition, construction, and leasing of required supporting facilities.	▪ Autonomous Shuttles ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪
Urbanized Area Formula Grant Program	Federal Highway Administration (FHWA)	$1.1billion	Planning, operation, and capital improvement for public transportation systems.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Asset Management and Maintenance Applications ▪ Autonomous Shuttles ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Quality Public Transit Website ▪ Smart Cycle Track ▪ Smart Mobility Hub ▪ Smart Sensors

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Active Transportation Infrastructure Investment Program	Federal Highway Administration (FHWA)	$200 million.	To provide safe and connected active transportation facilities in an active transportation network or active transportation spine.	▪ Curbside Management ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Smart Cycle Track ▪ Smart Mobility Hub ▪ Universally Designed Intersections
Rebuilding American Infrastructure with Sustainability and Equity (RAISE) discretionary grant	Office of the Secretary of Transportation (OST)	$15 billion (not a new program, but this funding is substantially more than in the past)	Local or regional projects that improve safety, environmental sustainability, quality of life, economic competitiveness, state of good repair, and community connectivity.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Community Wi-Fi/ Broadband Expansion ▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ Mobility as a Service (Maas) ▪ Smart Cycle Track ▪ Smart Mobility Hub ▪ Smart Sensors ▪ Universally Designed Intersections

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Advanced Transportation and Congestion Management Technologies Deployment Program (ATCMTD) or a follow up program	Office of the Secretary of Transportation (OST)	$60 million	Install advanced technologies at large scale that can serve as national models, improve safety, and reduce travel times for drivers and transit riders.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Autonomous Shuttles ▪ Community Wi-Fi/ Broadband Expansion ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ LED Light Conversions and Smart Technology-Enabled LED Lights ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Smart Mobility Hub ▪ Smart Sensors

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Strengthening Mobility and Revolutionizing Transportation (SMART) Grant Program	Office of the Secretary of Transportation (OST)	$100 million	Implement coordinated automation, connected vehicles, intelligent sensor-based infrastructure, systems integration, commerce delivery and logistics, leveraging the use of innovative aviation technology, smart grid, and smart technology traffic signals.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Asset Management and Maintenance Applications ▪ Autonomous Shuttles ▪ Community Wi-Fi/ Broadband Expansion ▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Dynamic Parking ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ LED Light Conversions and Smart Technology-Enabled LED Lights ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Parking Management Application ▪ Smart Cycle Track ▪ Smart Mobility Hub ▪ Smart Sensors

Program	Administering Agency or Organization	Funds Available (Nationally)	Can be Used For…	Smart City Strategies that might qualify…
Congestion Relief Program	Federal Highway Administration (FHWA)	Minimum award $10 million	To deploy and operate an integrated congestion management system.	▪ Advanced Transportation and Congestion Management Technologies (ATCMTD) ▪ Autonomous Shuttles ▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Dynamic Parking ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Mobility as a Service (Maas) ▪ Parking Management Application ▪ Smart Cycle Track ▪ Smart Mobility Hub ▪ Smart Sensors

STATE FUNDING

Program	Administering Agency or Organization	Funds Available	Can be Used For…	Smart City Strategies that might qualify…
Smart Street Lighting Grant	New York Power Authority (NYPA)	$20,000- $300,000	The installation of all smart city devices at the time of LED conversion NYPA (used as credit to the project to offset total project costs)	▪ LED Light Conversions and Smart Technology-Enabled LED Lights
Municipal Alternative Vehicle Program (MAP)	New York Power Authority (NYPA)	Provides 0% financing	For alternative drive, hybrid, or electric vehicles, in addition to battery charging equipment.	▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets
Public Transportation Modernization and Enhancement Program (PTMISEA)	New York State Department of Transportation (NYSDOT)	$41 million	To upgrade and enhance public transportation services.	▪ Asset Management and Maintenance Applications ▪ Electric Vehicle Fleets ▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System)
Climate Smart Communities (CSC) Grant	New York State Department of Environmental Conservation (NYSDEC)	Up to $12M in 50/50 matching funds.	Cities, towns, villages, and counties of the State of New York for eligible climate change mitigation, adaptation, and planning and assessment projects.	▪ Curbside Management ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ Influence Future Transit Services ▪ Lane Management (Using Dynamic Flow) ▪ Microtransit Services (Flexible Routing System) ▪ Smart Sensors ▪ Universally Designed Intersections
NYSERDA Clean Energy Communities Program (Designation Grants, Point Based Grants, and Action Grants)	New York State Energy Research and Development Authority (NYSERDA)	$5,000- $70,000 Additionally, it provides tools, resources, and technical assistance.	To implement clean energy actions, save energy costs, create jobs, and improve the environment.	▪ Asset Management and Maintenance Applications ▪ Deploy Roadside Units to Prepare Corridors for Connected Vehicles ▪ On-Street Electric Vehicle Charging Equipment/Stations ▪ Electric Vehicle Fleets ▪ Influence Future Transit Services ▪ LED Light Conversions and Smart Technology-Enabled LED Lights

PRIVATE SECTOR FUNDING

Program	Sponsoring Agency or Organization	Authorized Funds	Can be Used For…	Smart City Strategies that might qualify…
Better Bike Share Mini Grants	Better Bike Share Partnership	$2,500 - $10,000	Small, time-bound programs or events that aim to increase access to and use of shared micromobility options in low-income and/or communities of color	▪ Micromobility (Scooters, Bikes) ▪ Microtransit Services (Flexible Routing System) ▪ Smart Mobility Hub

Appendix 1 Summary of Community Engagement for the Smart Mobility Toolbox

OVERVIEW

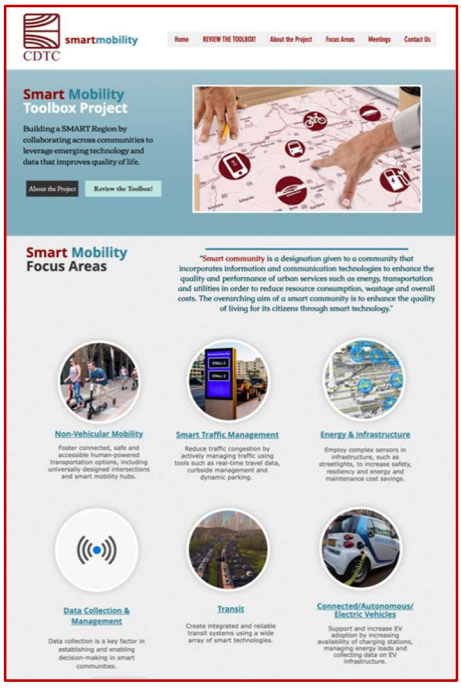
Capital District Transportation Committee's (CDTC) Smart Mobility Toolbox team undertook a range of community engagement efforts to gather public and stakeholder feedback over the course of the development of the Smart Mobility Toolbox. The community engagement components described in this summary included:

- **Project Website:** A dedicated project website at www.cdtcmpo.org/smartmobility was established to promote public education on smart communities and to support public outreach during the development of the Smart Mobility Toolbox.
- **Focus Group Discussions:** Three focus group sessions were held over the course of two months to gather input during the early development of the Smart Mobility Toolbox. Representatives from local government officials and regional transportation organizations were invited to participate in the discussions. The sessions each addressed a pair of targeted smart mobility topics: 1) Traffic and Parking Management, 2) Non-Vehicular Mobility and Transit, and 3) Electric Vehicles/Connected Vehicles/Autonomous Vehicles (EV/CV/AV) and Energy Infrastructure.
- **Direct Stakeholder Interviews:** Multiple stakeholder interviews were held as a follow-up to key topics that emerged during the focus groups. Interviews explored specific challenges, local initiatives and strategies that could be integrated into the Smart Mobility Toolbox.
- **Public Comment Period & Stakeholder Surveys:** Multiple surveys were developed to gather input on the draft Smart Mobility Toolbox during a public comment period from August 2022 to October 2022. A general public survey and three focus area surveys were made available on survey monkey and the project website. Companion videos were posted to explore short topics related to each survey area to interest stakeholders in taking the surveys.

CDTC SMART MOBILITY TOOLBOX - COMMUNITY ENGAGEMENT SCHEDULE												
	2021		2022									
TASK	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT
A. KEY STAKEHOLDER INPUT												
Focus Group #1: Traffic & Parking Management (Online)	●											
Focus Group #2: Energy/Infrastructure and EV/CV/AV (Online)		●										
Focus Group #3: Non-Vehicular Mobility and Transit (Online)		●										
Stakeholder Interviews			●	●	●							
Smart Mobility Toolbox Development	●	●	●	●	●	●	●	●	●	●	●	
B. PUBLIC COMMENT PERIOD												
Online Comment Period & Survey on Draft Smart Mobility Toolbox for General Public and Municipal Representatives										●	●	●
Presentation of Draft Smart Mobility Toolbox to CDTC Regional Operations & Safety Advisory Committee (ROSAC)											●	

PROJECT WEBSITE

A dedicated project website at www.cdtcmpo.org/smartmobility was established to promote public education on smart communities and to support public outreach during the development of the Smart Mobility Toolbox. The project website was live beginning mid-October 2021 through end of October 2022. CDTC will transfer and continue to host selected project content on the Smart Communities page of its official website at www.cdtcmpo.org.



WEBSITE CONTENT

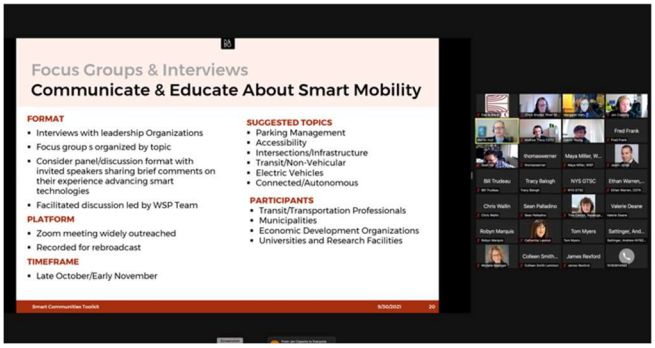
- The project website offered an overview of the Smart Mobility Toolbox project and individual resource pages on different smart mobility tools and technologies, including non-vehicular mobility, smart traffic management, transit, energy and infrastructure, data collection and management and EVs/CVs/AVs.
- Links were included to an array of smart-community models and websites.
- A comment tool was provided for public input.

- Online focus group sessions were promoted on a dedicated meeting page and videos of the discussions were posted after each session.
- The draft Smart Mobility Toolbox was posted on the project website beginning in late July 2022 for ongoing public review and comment.

WEBSITE TRAFFIC ANALYSIS

- Website analytics for the project website show a total of 236 site sessions with 169 unique visitors to the site. While steady the rest of the year, site traffic was at its peak from early August to early October, following CDTC media blasts to generate interest in reviewing the Smart Mobility Toolbox.

FOCUS GROUP DISCUSSION



In November and December 2021, the CDTC Smart Mobility Team held three online focus groups with local government officials, staff and representatives from regional transportation organizations. The discussions focused on learning about the challenges of adopting emerging technologies, managing big data, integrating new technologies into existing organizations and bureaucracies, and other real and perceived limits on implementing smart-cities projects. CDTC solicited the perspective of numerous participants and organizations regarding what should be considered in the implementation of new transportation technologies.

The focus groups addressed the areas of 1.) traffic and parking management, 2.) non-vehicular mobility and transit and 3.) energy infrastructure, and electric (EV), connected (CV) and autonomous (AV) vehicles. The first session, held on November 18, 2021, with 20 participants, covered traffic safety, incident management, regional traffic operations, and parking and curb management. The second focus group session, held on December 1, 2021, with 20 participants, addressed walking, bicycling, electric and micromobility, transit, and shared mobility services. In the final focus group on December 3, 2021, the 19 participants discussed transportation system electrification and automation – including private vehicles, shared vehicles, and transit. It also addressed infrastructure that may be required to support the safe operation of these vehicle types. The following is a summary of conversation across all three focus groups, including specific ideas generated for the Smart Mobility Toolbox, existing conditions within the Capital Region, best practices described as currently underway in the Capital Region, and areas that participants believed deserve further research and discussion within the Smart Mobility Toolbox.

IDEAS FOR THE SMART MOBILITY TOOLBOX

Participants were interested in seeing the following ideas included in the list of smart-community features addressed in the Smart Mobility Toolbox:

- Parking availability sensors
- Signal timing
- Universal intersections
- Audible crosswalks
- Transit Signal Priority
- Pedestrian priority at crosswalks
- Curb management
- Parking Mobility as a Service (MaaS) (variable pricing)
- Parking districts
- EV charging including integration with streetlights/utility poles
- Campus AV shuttles
- Streamlined paperwork for New York State Smart Community programs
- Transit electrification
- Non-profit fleet electrification
- Mobility hubs
- Electric bike charging stations
- Bike lane improvements (e.g., illuminated paint)
- FLEX service and microtransit

BEST PRACTICES/PEERS

Specific metro areas and agencies were mentioned as having programs or features that are of interest to the Capital Region:

- Rochester, NY GTC – Transportation System Management and Operations (TSMO) that optimizes the performance of the transportation system by using advanced technologies to better manage and operate roads, bridges, intersections, and other elements of the transportation system.
- Buffalo, NY – Transportation Management Center and university cooperation
- Cambridge, MA – Neighborhood EV charging and equity
- Montreal, Canada – On-street EV charging (snowy climate)
- New York, NY – Curbside EV charging stations (NYC DOT, Con Edison and FLO)
- Various locations – Signal Phase and Timing broadcast challenge to encourage roadway infrastructure owners to begin installing communication hardware for connected vehicles
- New York Power Authority Smart Streetlights program

EXISTING CONDITIONS IN CAPITAL REGION

Focus group participants mentioned these programs or smart technology successes in the Capital Region:

- Blue Line (Bus Rapid Transit) signal upgrades along the Albany-Watervliet-Troy- Cohoes corridor

- EV charging stations including Stewart's Program
- Route 5, Western, and Washington signal upgrades
- Conversion of streetlights to municipal ownership in Albany, Schenectady, and other communities
- Albany Airport parking availability system
- Various Capital District Transportation Authority (CDTA) programs – bus occupancy, carshare, scooter share, bike share, EV charging stations, MaaS, FLEX, etc. Electric buses have been successfully incorporated into CDTA fleet. Local car share will roll out soon.
- Albany Policy Department Traffic Safety Division is hub of many smart solutions in Albany
- Village of Scotia Police Department uses license plate recognition technology in conjunction with Schenectady
- Audible crosswalks installed by City of Saratoga Springs Public Safety Department
- New York State Energy Research and Development Authority (NYSERDA) electrical vehicle programs
- NYSERDA testing of electric self-driving shuttles on University of Buffalo campus
- Schenectady Metroplex and City of Schenectady downtown parking garage with passport payment system

RESEARCH/DISCUSSION ITEMS

General smart-community topics and challenges that attendees thought should be discussed in the Smart Mobility Toolbox included:

- Can Transit Signal Priority help implement other smart-community elements or features? (i.e., progressive signal timing, universal intersections, bike lane automation, curb management, etc.)
- Fuel cells
- Digital divide and equity
- Potential partnerships: organizations focused on accessibility, universities, medical complexes
- Resiliency and hazard mitigation
- Proprietary data and the limits it places on use of data or the interoperability of equipment
- System coordination across municipal boundaries
- Funding for operations
- What does the Infrastructure Investment and Jobs Act (IIJA) say about smart communities?
- EV charging stations - burden of maintenance and upgrade requirements, including cost of subscription services
- Data collection for planning purposes – parking usage, transit ridership, pedestrian volumes
- Need for education around smart technologies, their benefits, how they work and best practices
- Potential for a simple needs assessment form for agencies and organizations

- Role of smart-community features in land use, design of built environment and connections between places
- Challenges to rural areas, such as fixed-route transit service and need for cell service/connectivity for EV charging stations
- Range prediction tools for electric fleets (temperature, weather)

DIRECT STAKEHOLDER INTERVIEWS

In addition to the focus groups, the Smart Mobility Toolbox community engagement team reached out directly to individual stakeholders to further explore key topics that emerged during focus group discussions and during Smart Mobility Toolbox development. Interviews addressed specific challenges, local initiatives and strategies that could be integrated into the Smart Mobility Toolbox. While informal discussions were held with multiple stakeholders, six formal follow-up interviews were held with the following participants:

- Jose Holguin-Veras, Director; Jeffrey Wojtowicz, Sr. Research Engineer; Jack Reilly, Clinical Associate Professor at Rensselaer Polytechnic Institute Center for Infrastructure, Transportation and the Environment.

  Key topics and takeaways:
  - Challenges of managing all transportation modes (freight, passengers, etc.) and providing sufficient space for all.
  - Regions wrestle with price and information integration.
  - Equity issues can reflect the economics of freight/transportation (e.g., food deserts).
  - The COVID-19 pandemic exacerbated issues associated with curbside management with an explosion and prevalent use of new delivery services.
  - Multiple models of cities that proactively manage curbside for new uses that are in competition with freight and deliveries.
  - Infrastructure considerations.
  - On-the-job training needed for new planning and engineering staff in these tools and technology systems.

- Maria Hayford, Senior Community Planner, and Tim Crothers, ITS/OPS Engineer, Federal Highway Administration (FHWA)

  Key topics and takeaways:
  - Ensuring that maintenance needs are understand at the beginning of technology development and implementation.
  - Understanding cultural context in a region (e.g., willingness to have and share information for a central data hub).
  - Best practices on Intelligent Transportation System (ITS) architecture.
  - Challenge of coordinating and education municipalities with scarce resources.
  - Models for implementation of smart community solutions including updates to ITS architecture.

  - Integration of Building Information Models (BIM), Civil Integrated Management (CIM) and Light Detection and Ranging (LiDAR) into the transportation planning and design process.
  - Regions that are models for CV/AV readiness.
  - New discretionary funding programs for Smart Cities projects through USDOT.

- Mark Grainer, Policy and Planning Division; John Basset, Main Office; and Leslie Basset, Transportation Management Center, Region I; with the New York State Department of Transportation (NYSDOT)

  Key topics and takeaways:
  - NYSDOT smart strategies that should be integrated into the Smart Mobility Toolbox.
  - Smart-growth screening tool that allows NYSDOT to review every project and how they relate to infrastructure and smart growth.
  - Focus on systems operations.
  - Data sharing partners, issues and applications.
  - Necessity of regional forum for all levels of government.
  - Range of current NYSDOT projects and regional initiatives.

- Stanley Young, Advanced Transportation & Urban Scientist; Andrew Duvall, Transportation Behavior Analyst; and Venu Garikapati, Team Leader, Transportation Modeling and Metrics, center for Integrated Mobility Sciences; with The US Department of Energy National Renewable Energy Lab (USDOE/NREL)

  Key topics and takeaways:
  - NREL research and implementation with application to municipalities and urban and regional organizations.
  - Adviser to NYSERDA Clean Energy Prizes.
  - Provide liaison activities to SMART Columbus and branch out to cities with underserved communities.
  - Technologists in community program.
  - Micromobility and equity of access and improved outcomes.
  - Mobility Energy Productivity Metric developed as a theoretical research tool with the Department of Energy Vehicle Technologies Office.

- Tara Donadio, Assistant Director of Sustainability, Clean Energy Communities Outreach Coordinator, HeatSmart Capital Region team (CDRPC)

- Adam Ruder, Assistant Director and Jason, Zimbler, Project Manager, NYSERDA Clean Transportation Program

  Key topics and takeaways:
  - NYSERDA key programs include the Clean Energy Communities Program, Electric Vehicle Rebate Program and Truck Voucher Incentive Program, and DEC EV Rebate for the public sector.
  - NYSERDA support for public policies at the state level related to smart communities.

- Streetlights charging projects with National Grid.
- Clean-Transportation prizes.
- Clean-Energy Communities team.

PUBLIC COMMENT PERIOD

The draft Smart Mobility Toolbox was posted online early August in order to gather public input and additional stakeholder feedback. A corresponding general public survey and three focus area surveys were made available via survey monkey and links from the project website at www.cdtcmpo.org/smartmobility. The surveys were promoted through a range of outreach venues, including direct email blasts to stakeholders, announcements on the CDTC and project website, CDTC Facebook and other social media pages, and through flyers with QR codes and survey links that were distributed at multiple CDTC pop up events in early August. The surveys remained open for public and stakeholder comment from August 1, 2022, through end of October 2022.

To focus attention and encourage feedback on the distinct areas of the draft Smart Mobility Toolbox, a set of companion video clips were posted on the project website along with the Smart Mobility Toolbox and survey links. Sandy Misiewicz, Executive Director of the Capital District Transportation Committee, provided an overview video describing CDTC's Smart Mobility Toolbox Project. The Smart Traffic and Parking Management focus area featured guest speakers Steven Strichman, City of Troy Commissioner of Planning & Economic Development and David Hogenkamp, Project Director of Schenectady Metroplex Development Authority. A short clip addressing Energy Infrastructure and Electric, Connected and Autonomous Vehicles featured Tara Donadio, the Assistant Director of Sustainability for the Capital District Regional Planning Commission (CDRPC). Jeff Olson, co-founder of re:Charge-e and author of *The Third Mode: Towards a Green Society* discussed the third focus area of non-vehicular mobility and smart transit.

While the focus area surveys assumed a level of familiarity with the technologies addressed in the Smart Mobility Toolbox, the community survey was designed to elicit the general public's level of comfort with emerging technologies and general opinions about the recommendations in the draft Smart Mobility Toolbox.

SURVEY RESPONSES

Survey responses were minimal with a total of four respondents. Three general public and one non-vehicular mobility and smart transit survey responses were received. The general responses can be summarized as follows:

- Respondents were largely comfortable with the pace at which smart technologies are being introduced in their communities. One respondent noted that some technologies, such as micromobility, are being deployed too slowly.

- Respondents were "somewhat to very concerned" about privacy and data collection related to new smart technologies. One respondent commented that concerns about data privacy were not unique to smart mobility technologies. Another noted that "*we should avoid broad deployment of data-gathering technology unless there is a very specific public good to be gained, and we need to be far more proactive about ensuring that the data collected is limited to that specific purpose*."
- The top two smart tools and technologies that respondents were interested in seeing in the community included universally designed intersections and community Wi-Fi/broadband expansion, followed by interest in micromobility rentals, smart cycle track, tools to reduce traffic flow such as dynamic lanes, LED streetlights, and transit websites.
- All respondents indicated that they sometimes use app-based mobility services such as Rideshare, trip planners, parking meter apps, etc.
- One additional open-ended comment was provided: "*Smart" tech is great, but it's really just a gimmick if we can't make effective use of transportation technology and engineering that's been around for decades and centuries. I'd like to see the MPO's constituent municipalities focus on making the needed brick and mortar (and policy) changes that could make a big difference before we spend much money on expensive digital infrastructure that doesn't address the underlying issues*."

The survey received in the focus area for non-vehicular mobility and smart transit was from a respondent who described their organization as a new regional non-profit focused on promoting active transportation and reducing single occupant vehicle travel. The tools identified as most useful for their organization included micromobility, smart mobility hubs, universally designed intersections, smart cycle track, quality public transit website, asset management and maintenance applications, microtransit services and MaaS. The respondent noted "*Every one of these tools promotes transportation choices outside of the automobile and standardizes infrastructure/expectations for those that use active transportation no matter where they are in the region*." In response to which smart tools were less useful, the respondent noted "*Our organization is not likely to actively use asset management and maintenance applications, but we will promote its use among municipalities*." In terms of anything missing from the Smart Mobility Toolbox, the respondent indicated they would like to see more about curb management tools and alternative freight programs (like cargo bicycles): "*Large freight vehicles are not necessary in many of our urban cores and these vehicles are some of the most common offenders when it comes to blocking lanes or infrastructure dedicated to active transportation users. Minimizing the number of large freight vehicles like box trucks and providing clear loading zones when they are needed are vital to improving active transportation user experiences and safety*."