Cleveland Complete Corridor Project Application Narrative—SMART grant, 20.941
Overview

Project Description: In partnership with Greater Cleveland Regional Transit Authority (GCRTA) and Cleveland State University (CSU), the City of Cleveland proposes to design and pilot a next-generation, intelligent, cloud-based traffic signal system that:

- Leverages existing Automatic Vehicle Location (AVL) equipment;
- Eliminates need for expensive vehicle detection hardware at intersections;
- Provides transit signal priority based on expected time of arrival, using data such as speed, dwell times, and passenger counts rather than location check-in/check-out;
- Incorporates bicycle and pedestrian detection to develop multimodal priority protocols;
- Provides advanced cross-traffic protocols such as providing priority for one bus over another based on how behind schedule the bus is and passenger counts;
- Integrates with emergency vehicle signal preemption for public and private fleets;
- Identifies safety concerns such as near-crash incidents to inform intersection improvements and signal function;
- Provides insights such as volumes, turning movements, and vehicle classifications;
- Utilizes an open data sharing platform; and
- Provides analysis and reporting of performance metrics, including operability of system, travel time savings, and other benefits.

The pilot will explore available camera, LIDAR, and sensor technologies and adaptive signal control technologies to cover the spectrum of desired objectives. The findings will be integrated into general specifications for connected, intelligent, vendor-agnostic traffic signal equipment that can be implemented on other multimodal corridors in Cleveland and adopted by jurisdictions across the country to advance goals around complete streets and reductions in serious injuries and fatalities from crashes.

Issues & Challenges Addressed: In Cleveland, a network of key arterial corridors serves as the foundation of our transit system, accounts for a large share of fatal and serious injury crashes, and carries recommendations for priority bicycle connections. Because Cleveland is a legacy city with built-out urban form, the roadway space to accommodate all of these needs is set and limited. This proposal harnesses the power of technology to simultaneously address safety issues at signalized intersections, prioritize multimodal road users over private vehicles, and enhance emergency response times through dynamic traffic signals that can efficiently and safely manage these diverse and variable flows. The vehicle-to-infrastructure (V2I) communication and sensor technology will provide quick insights on vehicle volumes, classifications, and turning movements; multimodal demand; and near-crash interactions that now require expensive, time-consuming, and time-limited data collection and analysis to inform transportation decisions and action. Currently, lack of knowledge about the technologies available, benefits and drawbacks of different solutions, and unknown costs prevent the City from deploying these solutions.

Proposed Technologies: The project team proposes to pilot V2I technologies that connect cellular AVL communications from existing equipment on RTA buses, City fleet vehicles, and privately-owned fleets to receivers in traffic signals that use algorithms to dynamically adapt signal phase timing to prioritize the movements of multimodal roadway users (transit, pedestrians, bicycle and scooter riders) and facilitate emergency vehicle preemption. Additional optical sensors, using technologies such as cameras, radar, and/or LIDAR, will be integrated to facilitate bicycle and pedestrian detection and near-crash safety analysis. Available products from vendors such as Lyt, Opticom, Derq, Ouster, and MicroTraffic will be evaluated for functionality and adaptability, and will be piloted to achieve the desired project outcomes.

Desired Outcomes (Stage 1 and Stage 2) & SMART Goal Alignment: The Stage I planning and prototyping process will test technology and assess results using up to 25 intersections along one to two priority transit, safety, and multimodal corridors, resulting in the creation of a standard specification for intelligent traffic signals on complete, connected corridors. Stage 2 implementation will involve the design and installation of the smart signal package at intersections on corridors across the city, prioritized by transit ridership, fatal and serious injury crash data, bicycle and pedestrian activity, and frequency of emergency vehicle use. Anticipated outcomes include: improved transit service delivery (on-time performance, dwell times, route efficiency), improved safety outcomes for drivers, bicyclists, and pedestrians (reduction in serious injuries and fatalities over time, short-term reduction in near-crash interactions); improved air quality due to decreased vehicle idling; more efficient intersection operations; and eventual mode shift because of enhanced convenience, efficiency, and safety for multimodal users.

Improvements to Status Quo: The City of Cleveland currently has transit signal priority on one Bus Rapid Transit corridor that requires circa-2006 vendor-specific, specialty software. There is no emergency vehicle preemption, bicycle or pedestrian detection, or near-crash monitoring at any signalized intersection. Intersection safety hot spots have been identified through Vision Zero crash analysis, but these insights are limited to historic crash reports and do not allow proactive improvements to intersection design. ‘Smart signals’ are conceptually alluded to in transportation planning documents, but local agencies are unfamiliar with available technologies and which are most efficient and scalable to meet the city’s needs, so they are not pursued. When capital projects allow, signals are upgraded to include in-road loop/induction detection, which does not work for all bicyclists, and push-buttons for pedestrians, requiring extra attention and energy for what should be our highest priority roadway users. There is limited coordination among the City, RTA, academic experts, and industry on signalization possibilities. This Stage I proposal addresses all of these adverse existing conditions and results in insights that will benefit jurisdictions across the country.

Project Location

The City of Cleveland is a mid-sized urban community located in Ohio on the southern shore of Lake Erie, encompassing 82.47 square miles and 372,624 residents (2020 US Census). It is the second-largest city in Ohio, with a resident population that is 49% Black, 40% White, and 12% Hispanic. The median household income citywide is $30,907, and almost 33% of the population lives below the poverty level. The childhood poverty rate is over 50%. Cleveland and surrounding communities are served by GCRTA, which provides bus and rail service to residents and employment centers. Cleveland has also grown its multimodal presence over the last decade, with over 100 miles of bicycle infrastructure and four shared mobility companies offering scooter and bike share to residents and visitors.

The Stage 1 project will target signalized intersections on one to two corridors with frequent transit service, identified safety issues, notable bicycle and pedestrian demand, and frequent usage by emergency vehicles. West 25th Street from Detroit Avenue to MetroHealth Drive and Kinsman Avenue from East 75th Street to East 140th Street are identified as primary pilot locations and are almost completely located in Transportation Disadvantaged Census Tracts/Historically Disadvantaged Communities. Additional corridors meeting these criteria are identified as potential alternate pilot locations and targets for Stage II implementation. Each of the potential priority corridors is located in at least 40% Historically Disadvantaged census tracts. Final pilot locations will be confirmed based on the status of relevant capital projects on these corridors when the pilot commences and demographic data of the surrounding community.

Community Impact

The pilot project will benefit communities through: prioritizing people taking lower-cost, more accessible, and more climate-friendly transportation modes such as riding transit, walking, or riding bicycles; reducing idling and improving air quality; reducing crashes and improving safety outcomes; and improving emergency vehicle response times in historically disadvantaged communities. Both of the primary pilot corridors traverse through historically disadvantaged neighborhoods but are heavily used by commuters and freight vehicles from outside the neighborhoods, bringing with them the associated emissions, noise, and crash risks of larger vehicles and heavier traffic flows. These benefits will be measured by:

- Transit ridership; bicycle, scooter, and pedestrian counts; vehicle counts by classification;
- Transit travel time savings;
- Air quality monitors at intersections to assess changes in particulate matter;
- Changes in crash reports and near-crash conflict analyses;
- Average change in emergency response times for calls using pilot corridor routes;

Signal cycles that prioritize transit, bicyclists, and pedestrians may disadvantage private vehicle operators. We will assess potential for traffic diversion by collecting vehicle volume and speed counts along alternate routes to measure this impact. All of the metrics mentioned here can be collected with equipment the City has at its disposal or the new technology that will be added as part of the pilot.

Technical Merit Overview

Issue Description: The smart signal solution addresses technology in local traffic signals, transit delay, safety hotspots, bicycle and pedestrian detection challenges, emergency response times, and a lack of awareness of technology options among local agencies and decision-makers.

The City of Cleveland owns and maintains over 1,000 traffic signals equipped with Siemens Eagle M50 and M60 series TS1 and TS2 NEMA controllers. The City does not use an advanced traffic management system, and connectivity varies by intersection. The majority of signalized intersections are programmed for automatic recall. Loop detectors that we do have do not detect most bicyclists, and require pedestrians to use a push button, which many pedestrians do not do. Traffic volumes vary depending on location, time of day, and special circumstance, but are relatively low for the roadway capacity, resulting in vehicles regularly idling at red lights with no cross traffic waiting for the signal to change. In Cleveland, one Bus Rapid Transit corridor is currently equipped with transit signal prioritization (Euclid Avenue HealthLine) from circa 2006, which requires specialty equipment on both the transit vehicles and in the signal assembly, meaning there is no interoperability or resiliency across transit vehicles and troubleshooting across agencies is difficult due to the lack of a shared data portal.

The West 25th pilot corridor supports 5 transit routes for a total average weekday ridership of 9,160 people per day (October, 2022). The Kinsman priority corridor supports one transit route with average weekday ridership of 3,074. Transit signal priority benefits transit passengers by reducing travel time and the variability of travel time, thus improving the dependability of service. Comparing weekday and Saturday afternoon travel times to currently existing Sunday conditions allows us to approximate the impacts of congestion on travel times, which TSP will help to alleviate. Across these pilot routes, there is an average of 2 minutes and 15 seconds of delay on weekday/Saturday afternoons compared to Sunday afternoons. Although not currently quantified, we anticipate given local transportation dynamics that the impact of waiting at red lights causes significant additional transit delay beyond that due to congestion.

Based on Vision Zero analysis, from 2016 through 2020 each signalized intersection in Cleveland experienced an average of 9 to 10 crashes, compared to non-signalized intersections which averaged approximately one crash each. Crash analysis indicates that 45% of serious injury and fatal crashes occur at signalized intersections, and 71% are on arterial roadways that are also priority corridors for high-frequency transit service, bikeway connections, and emergency service delivery, and thus would be prioritized for traffic signal upgrades.

In 2021, Cleveland Emergency Medical Services (EMS) responded to over 109,000 calls. For 60% of life-threatening issue calls, EMS arrived on-scene in under 10 minutes. However, 12% of responses for these types of calls took more than 15 minutes. In Fall, 2022, 3 intersection crashes occurred with Cleveland ambulances responding to calls in a one-week period.

Local staff and decision-makers at the City of Cleveland and GCRTA recognize that there is technology available to address these challenges and make our transportation network more reliable, efficient, and safe for all users. However, information about the viability, effectiveness, and pricing of potential solutions is not readily available. Because signals are

maintained by the City and GCRTA is a separate agency, there is not clear and consistent communication and collaboration across bureaucracies to tie signal infrastructure decisions to what is best for transit. Cleveland has several 'complete streets' corridor projects programmed for the coming years that would greatly benefit from intelligent, adaptive signalization, but the best specifications to include in those plans are not evident.

Proposed Solution: The project will use existing cellular modem-based AVL equipment on fleet vehicles to pilot and document specifications for an intelligent, adaptive, cloud-based traffic signal solution that can detect and prioritize key fleet vehicles (transit and first responder) and bicyclists and pedestrians, as well as collect key safety information such as near-crash patterns to inform intersection improvements. The solution will include shared access across agencies to an online data portal to monitor performance and facilitate joint troubleshooting across agency boundaries. Although these technologies are separately available on the market, they have not yet been implemented as a package in an American city. This pilot will also document the process, challenges, and solutions of retrofitting existing, historical signals with this technology to create model specifications and process guidance for communities across the country who have infrastructure and issues very similar to Cleveland's. This project builds on successes of the 2021-2022 Intelligent Transit Signal Priority project in East Palo Alto, the LIDAR safety pilot underway in Chattanooga, and burgeoning AI/machine learning near-crash analysis. Connected signal solutions can be implemented and scaled much more rapidly than traditional roadway construction projects, allowing quick progress and benefits for the traveling public.

The proposed pilot locations span diverse urban contexts, from congested commercial corridors with high volumes of bicyclists and pedestrians to more suburban-style, car-centric arterials. Cleveland's weather patterns also provide an ideal test environment for the durability and resiliency of potential solutions, from high heat in the summer to bitter cold in the winter; ice, snow, fog, and rain; and high winds off of Lake Erie. Results and recommendations will thus be repeatable and generalizable across a variety of community and environmental contexts. Because the pilot data will be managed in a unified platform and do not rely on expensive proprietary equipment or data, the solution is scalable to additional intersections across the city as resources and need permits. Because this solution prioritizes intersections based on need, it is able to achieve the maximum benefit for the investment, which is key for a community like Cleveland with decreasing population and limited local resources.

Expected Benefits: The project addresses DOT's FY22-26 departmental goals by increasing the efficiency, safety, reliability, equitable accessibility, and climate friendliness of the transportation system, which fosters economic strength and competitiveness. This process will also build organizational collaboration and partnerships across divisions of government, academia, and private industry, leading to organizational excellence. It embraces the Department's innovation principles by using technology to advance policy priorities around advancing climate action in the transportation sector, designing and building complete streets, and eliminating serious injuries and fatalities from roadways; modernizing legacy American

transportation infrastructure; supporting agency workers and students directly through this process, as well as benefiting thousands of workers who will be able to more affordably and reliably access job opportunities via transit; creating an opportunity for collaboration and partnership in this space; fostering discovery and exploration for communities who are currently excluded due to lack of insight and technological knowledge; and creating a flexible, adaptive approach that can evolve as technology evolves. The planning process and resulting intelligent traffic signal solution will:

- increase safety for pedestrians, bicyclists, and scooter riders;
- improve emergency response timeliness and the safety of emergency responders;
- incorporate best practices for cybersecurity, as guided by experts from CSU;
- enhance equity and access by prioritizing the experience of people outside of cars;
- reduce climate change and pollution by reducing idling and encouraging mode shift;
- facilitate partnerships among local agencies, academics, industry, and advocacy groups;
- integrate solutions across infrastructure, vehicle fleets, and the broader traveling public;
- right-size the solution to be accessible to agencies with limited local capacity;
- provide open data and data sharing;
- foster workforce development through the inclusion of students and trainees; and
- evaluate performance improvements and cost savings related to transit service delivery, emergency vehicle efficiency, crash reductions, etc.

Project Readiness Overview

Feasibility of Work Plan

Months 1-3 1) Corridor Refinement.The City and RTA will conduct an in-depth location review, including review of transit delay, safety considerations, and site visits to confirm pilot locations and inventory traffic control equipment and connectivity. 2) Request for Information. The City will issue a Request for Information about available technologies to identify additional potential industry partners. 3) Initial Data Collection. Partners will collect pre-data in selected locations, including traffic volume and speed counts, air quality metrics, historic crash trends, and transit ridership and time trends. 4) Project Coordination. The project team will also coordinate with our metropolitan planning organization, NOACA, to ensure we are coordinated with their Traffic Signal Prioritization policy, and will work with the Ohio Department of Transportation to meet all requirements outlined in the *Ohio Procedures for Implementing ITS Regulations (23 CFR 940).* 5) Research Planning. The first stage of CSU's work, anticipated to span approximately 3 months, will include: a) enhanced feasibility analysis of the selected corridor(s), including urban communications needs and the functionality of existing signal technology; b) Review of available technologies, planning for data infrastructure and expandability, and cybersecurity planning; and c) establishment of the evaluation framework.

Months 4-6 1) Detailed Scope of Work. City of Cleveland with partners will create the procurement scope of work for vendors informed by the CSU research and the Request for Information. 2) Vendor Selection. The City will select vendor partner(s) following all applicable local, state, and Federal procurement policies, including Buy America if a waiver is not obtained.

Months 7-9 1)Vendor Delivery and Installation of Products and Services. Deliverables will include the cloud-based technology platform, signal protocols, and hardware and software components for signals and vehicles. Time is allocated for testing and refinement. 2) Workforce Training. On the ground workforce training for vehicle and system operators.
Months 10-15 1) Pilot Actuation. We expect the pilot period to span 6 months.
Months 16-18. 1) Program Evaluation. Final evaluation by the CSU research team and reporting on community impacts, performance improvements, and cost savings 2) Workforce Development Strategy. During the course of the pilot project, the team will work through the Cleveland/Cuyahoga County Workforce Development Board and through GCRTA's existing relationships with Cuyahoga Community College to enhance job training opportunities in coordination with the ATU, and to create a strategy for a pipeline of workers to implement Stage 2 improvements and other transportation investments anticipated through IIJA.

Community Engagement and Partnerships: Project partners have a strong history of public involvement through the engagement of block clubs, hosting public meetings and open houses, and recently providing online, virtual, and app-based engagement opportunities. This project will partner with local transportation advocacy groups Bike Cleveland and Clevelanders for Public Transit to engage travelers most impacted by this project. Additionally, City staff work with members of ADA Cleveland, the local chapter of the National Federation of the Blind, and staff in the City Community Relations Board to increase accessibility for people with disabilities and English as a second language.

Researchers at CSU will serve as technical advisers and evaluators to assess communications and cybersecurity needs; assist with signal design and algorithm selection; run simulations as needed; develop data management protocols and infrastructure; and track metrics. The research team brings key expertise in cellular communications in dense urban areas, individual and system-wide cybersecurity, data management, and evaluation. Partnerships with the private sector include third-party technology vendors and the four permitted scooter and bike share companies currently operating in Cleveland. Within the City itself, this project will foster communication and collaboration across divisions, including Streets (snow plows, street sweepers), Public Safety (police, fire, EMS), and Motor Vehicle Maintenance (MVM).

Leadership and Qualifications: With strong leadership from Mayor Bibb, City Council, and GCRTA CEO India Birdsong-Terry, the project team represents a diversity of experience and expertise. CSU researchers, GCRTA ITS staff, and MVM and traffic engineering staff at the City will provide relevant academic and applied technical expertise. Planning, engineering, and strategy staff at the City and GCRTA will spearhead project management, engagement, and collaboration across agencies and divisions. Community advocacy groups will bring community perspectives and grassroots engagement to the process. Each entity on the team has experience managing multi-stakeholder projects and has worked with and through Federal funding in the past.

Appendix I. Resumes

Cleveland State University

Jacqueline Jenkins, PhD, PEng

Title: Associate Professor, Civil & Environmental Engineering, Cleveland State University
Area of Expertise: Design and implementation of a wide range of transportation engineering studies to inform the planning, design, and operation of surface transportation facilities. Relevant traffic operations experience includes: collecting and analyzing pedestrian and vehicle data; evaluating existing technology, algorithms, models, and quantitative analysis tools; and developing algorithms, models, performance metrics and analysis tools.

Emmanuel Kidando, PhD, PE

Title: Assistant Professor, Civil & Environmental Engineering, Cleveland State University
Area of Expertise: Intelligent transportation systems (ITS), connected vehicle systems, freeway operations, highway safety, and data science. He has worked on numerous state and national projects related to ITS, traffic operations and safety. One of the closely related projects to this proposal was the evaluation of deployed connected vehicle and security credential system at traffic signals in Tallahassee, Florida. Dr. Kidando participated in developing an application for evaluating signal strength and reliability of a system using a multi-channel test tool. The experience Dr. Kidando has gained is unique and will be beneficial in conducting the proposed project.

Sathish Kumar, PhD

Title: Associate Professor, Electrical Engineering and Computer Science, Cleveland State University
Area of Expertise: Cybersecurity, Machine Learning, Distributed Systems, Internet of Things and related applications. Some of his recently completed cybersecurity related projects include: A) design of reinforcement and machine learning based solutions to secure lightweight Blockchain-based Internet of Things from Denial of Service Attacks; B) design of Privacy preserving federated learning to ensure privacy of the users in smart city and smart home context; C) detection and localization of DDoS attacks during inter-slice handover in 5G network slicing; and D) using generative adversarial network to improve robustness of convolutional neural networks-based MRI systems against adversarial attacks.

Mehdi Rahmati, PhD

Title: Assistant Professor, Electrical Engineering and Computer Science, Cleveland State University
Area of expertise: Communications and Networks for Smart Transportation, Cellular Vehicle to Everything (C-V2X), Wireless Technologies for Connected Vehicles and Autonomous Systems, Beyond 5G (B5G) and 6G Networks. Relevant experience includes the smart vehicle project, which is a portion of the smart city National Science Foundation (NSF) award, that enhances the state-of-the-art, reliable communications and data processing among 5G-enabled connected vehicles in Vehicle-to-Everything (V2X); and automated vehicle detection using machine learning in GPS-restricted areas, such as parking garages, sponsored by Ford Motor Company.

Haodong Wang, PhD
Title: Associate Professor, Electrical Engineering and Computer Science, Cleveland State University
Area of Expertise: Efficient and robust security protocol design and cryptography schemes for Internet of Things (IoT) devices and embedded systems. Extensive experience in implementing and deploying commercial-grade security schemes on resource constrained devices and systems. Efficient data management and optimization, including but not limited to, searching, storage, and aggregation, in IoT systems and cyber-physical systems.

Greater Cleveland Regional Transit Authority

Michael Lively
Title: Director, Information Technology and Intelligent Transportation Systems (ITS), GCRTA
Area of Expertise: IT, operations, business analyst. Mike oversees major projects, budget development, and strategic planning for GCRTA ITS, and manages infrastructure, telecommunications, end user support, database administration, field technology, and onboard vehicle technology. Mike managed the federally funded, $15 million GCRTA Radio Communication and CAD/AVL Replacement Project, has implemented a new fare collection system, and implemented real-time passenger information.

Michael J. Schipper, P.E.
Title: Deputy General Manager for Engineering and Project Management, GCRTA
Area of Expertise: Planning, design, and construction of GCRTA's $367 million 2017 – 2021 Capital Improvement Program, which includes all rail stations, track rehabilitation, bus garages, transit centers, bridges, and other facilities. He was instrumental in progressing the $200 million HealthLine Bus Rapid Transit program from preliminary engineering into final design and construction, led GCRTA's $45 million ARRA program implementation, and has received and implemented two TIGER grants. Mike holds Civil Engineering degrees, is a Registered Professional Engineer in the states of Ohio and Texas, and is a member of the American Society of Civil Engineers' National Committee on America's Infrastructure.

City of Cleveland

Dominic Martino
Title: Chief of Traffic Signal Unit, Division of Traffic Engineering, Department of Public Works, City of Cleveland
Area of Expertise: 23 years' experience in signal work across Ohio, including installing signals from various manufacturers for cities and the Ohio Department of Transportation

Calley Mersmann, MPA
Title: Senior Strategist, Transit & Mobility; Mayor's Office; City of Cleveland
Area of Expertise: multimodal planning, safety analysis, community engagement for transportation projects. Calley has led the development of the City's Vision Zero Action Plan, Safe Routes to School Districtwide Travel Plan, and several corridor-level transportation plans. She works closely with various departments across the City of Cleveland and regional partners to align core functions with the Mayor's vision of a safer and more multimodal transportation network.

Appendix II. Summary Budget Narrative

The project team requests $1,820,500 for its next-generation, intelligent, cloud-based traffic signal system pilot. Following the structure of SF-424A, the details of planned project costs are as follows:

Personnel: $290,957
Personnel costs include $148,252 for five faculty researchers from Cleveland State University (CSU) with relevant expertise in traffic operations, intelligent transportation systems, cybersecurity, machine learning, and smart transportation communications. See *Resume* attachment for more information. This cost is based on an estimated equivalent of two months' time contribution to the project from each faculty member. Personnel costs also include $63,000 in stipends and $79,705 in tuition payments for five graduate student assistants for three semesters each, to cover the duration of the Stage 1 SMART grant project.

Fringe Benefits: $33,170
Fringe benefits for faculty members and graduate student assistants are calculated by the university as $30,020 and $3,150 respectively.

Travel: $11,669
This travel allowance covers domestic travel for CSU faculty and students to pilot sites for field visits as well as anticipated travel to technical conferences to present results of the pilot.

Equipment: $1,265,500
Equipment costs are based on vendor quotes of: $300,000 for connected vehicle-to-signal software and necessary equipment installation for 25 intersections, including a two-year software license agreement; $500,000 for optical sensors (LIDAR/camera) at 25 intersections at a rate of $10,000/sensor with two sensors per intersection to guarantee coverage; and $300,000 for sensor software at 25 intersections a rate of $6,000 per sensor for a five-year agreement. A contingency of $165,500 (10 percent of grant request) has been allocated to this line item to account for unknowns in existing traffic control cabinets that may need to be upgraded for the pilot to be successful.

Contractual: $95,000
$50,000 is budgeted here for a consultant to provide project management services, coordinating pilot progress and ensuring movement across partner agencies to meet grant timelines. $45,000 is allocated for performance reporting and evaluation to meet grant requirements.

Indirect Charges: $124,204
Indirect charges are calculated using CSU's standard indirect cost rate of 48.5 percent on the base cost of $256,091.

Total Project Budget Request: $1,820,500

The City of Cleveland and Greater Cleveland Regional Transit Authority will also make in-kind contributions to the success of this grant in the form of staff time for planning, research, and implementation. The City will also contribute data collection in the form of traffic and speed counts and air quality measurements in-kind.

City of Cleveland
Justin M. Bibb, Mayor

Office of the Mayor
Cleveland City Hall
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November 18, 2022

Robert C. Hampshire, PhD
Deputy Assistant Secretary and Chief Science Officer
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: Strengthening Mobility and Revolutionizing Transportation (SMART) Notice of Funding Opportunity Number 20.941

Deputy Assistant Secretary Hampshire:

Thank you for your consideration of the City of Cleveland's application for the Cleveland Complete Corridor Project to the 2022 Stage I Strengthening Mobility and Revolutionizing Transportation (SMART) grant program.

Since my inauguration as Mayor in January, I have championed transportation initiatives in Cleveland that parallel the priorities and goals set forth by President Biden's administration, including the passage of an updated Complete and Green Streets ordinance and the adoption of a Vision Zero Action Plan. This SMART grant proposal advances these goals through the design and prototyping of an intelligent, cloud-based adaptive traffic signal system that provides next-generation transit and emergency vehicle priority based on cellular-based AVL location prediction and incorporates optical sensor-based bicycle and pedestrian detection and near-crash identification. In partnership with the Greater Cleveland Regional Transit Authority and Cleveland State University, this approach eliminates the need for expensive vehicle detection hardware on buses and City fleets, allows for dynamic signal adjustments to benefit multimodal roadway users, and provides analysis and reporting of performance metrics. The project will increase overall mobility equity through improved multimodal safety and efficient, reliable transit.

I strongly urge the Department of Transportation to fund the Cleveland Complete Corridor Project through the Strengthening Mobility and Revolutionizing Transportation (SMART) grant program. Please contact Calley Mersmann, Senior Strategist for Transit & Mobility, at cmersmann@clevelandohio.gov or 216-664-2952 with any questions.

Sincerely,

Justin M. Bibb
Mayor | City of Cleveland

Greater Cleveland
Regional Transit Authority

1240 West 6th Street
Cleveland, Ohio 44113-1302
Phone: 216-566-5100
riderta.com

November 18, 2022

Robert C. Hampshire, PhD
Deputy Assistant Secretary and Chief Science Officer
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE
Washington, DC 20590

Subject: Strengthening Mobility and Revolutionizing Transportation (SMART) Notice of Funding Opportunity Number 20.941

Dear Deputy, Assistant Secretary Hampshire,

The Greater Cleveland Regional Transit Authority (GCRTA) is pleased to commit to a partnership with the City of Cleveland to implement the proposed *Cleveland Complete Corridor Pilot* through the Strengthening Mobility and Revolutionizing Transportation (SMART) grant program.

The project will design and prototype an intelligent, cloud-based traffic safety system on the pilot corridor. The system will provide next-generation transit priority based on GPS-based AVL location prediction, incorporate advanced visually based bicycle and pedestrian detection, and integrate emergency vehicle signal preemption.

The project will leverage recent GCRTA communications technology upgrades. GCRTA used $5.8 million in 2017 Department of Transportation (DOT) grant funds to upgrade our radio communications system and fully utilize our GPS/AVL capability. The 2017 funding came from Advancing Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD). The successful deployment of our new communications system based on this DOT investment has positioned us to implement the next generation transit signal technology proposed for the pilot project.

GCRTA implemented first generation transit signal priority (TSP) fourteen years ago as part of the renowned Healthline Bus Rapid Transit (BRT), which has generated over $9.5 billion in community investment. While cutting edge at the time, first generation TSP systems have limitations compared to new systems using advanced technology.

GCRTA's Strategic Plan identifies priority bus corridors targeted for speed and reliability improvements across our service area. The priority corridors include E105th/93rd, Lorain Ave, Detroit Ave, Broadway Ave, Superior Ave, Cedar Rd, St. Clair Ave, Warrensville Centre Rd, Kinsman Ave, and the W 25th corridor, where the Metrohealth BRT project is in the FTA Small/New Starts construction funding pipeline. GCRTA is working closely with the City of Cleveland to plan and implement transit and mobility improvements on the priority corridors.

Greater Cleveland
Regional Transit Authority

During planning for the priority corridors, we have identified key advantages to adopting advanced TSP:

- Utilizes existing on-bus GPS-based Automatic Vehicle Location (AVL) equipment and communication, eliminating the need for expensive on-bus hardware
- Provides feasibility for entire bus fleet to be equipped to access signal priority, which supports flexibility for bus deployment on transit-prioritized routes.
- Eliminates need for expensive vehicle detection hardware at intersections
- Can provide priority based on expected time of arrival, using data such as speed, acceleration, dwell times, and passenger counts rather than simple location check-in/check-out
- Can be integrated with advanced bicycle and pedestrian detection and emergency vehicle signal preemption to develop multimodal priority protocols
- Can provide advanced cross-traffic protocols such as providing priority for one bus over another based on how behind schedule the bus is and passenger counts.
- Provides analysis and reporting of performance metrics, including real-time operability of system and actual travel time savings and benefits
- Can be replicated regionally across multiple jurisdictions served by GCRTA.

GCRTA is excited to work with the City of Cleveland to design and implement a pilot initiative that will demonstrate how smart signals can benefit our priority transit corridors, promote complete streets, and support the safety and priority of transit, bikes, and pedestrians as well as emergency vehicles.

Thank you for your consideration of funding for this vitally important project.

Sincerely,

India L. Birdsong Terry
General Manager & Chief Executive Officer

Office of the Provost

November 16, 2022

Ms. Calley Mersmann
Senior Strategist, Transit & Mobility
City of Cleveland
601 Lakeside Ave
Cleveland, Ohio 44114

Subject: **Letter of Commitment – Strengthening Mobility and Revolutionizing Transportation (SMART) Notice of Funding Opportunity Number 20.941**

Dear Ms. Mersmann,

Cleveland State University is pleased to partner with the City of Cleveland and the Greater Cleveland Regional Transit Authority. We are committed to this project, and our faculty has the availability and expertise to support the planning and implementation of a Smart Corridor. CSU is a leader in the development and adoption of public interest technology through our T.E.C.H. Hub multidisciplinary research center and our partnership in the IoT Collaborative with Case Western Reserve University. As a member of the Public Interest Technology University Network (PIT-UN), we continue to build our expertise with innovative technologies that address the needs of the public sector and broaden our community engagement to bring the greater Cleveland community in as an active partner. This growth is exemplified in multiple PIT-UN research grants and a newly awarded National Science Foundation Major Research Instrumentation grant that will support the acquisition and implementation of new computing equipment for a wide range of Smart City research.

Contact Information:

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Cleveland State University does not have any ownership in any legal entities nor does the company receive remuneration of any kind from organizations that would constitute (or be perceived as constituting) a conflict of interest to this project. Similarly, Cleveland State University does not have any properties, patents or interests that would benefit in any way from the findings of this research.

Cleveland State University looks forward to supporting the City of Cleveland and the Greater Cleveland Regional Transit Authority throughout the course of this interesting and valuable project. Please let us know if any additional information is needed from us.

Sincerely,

Nigamanth Sridhar, Ph.D.
Interim Provost and Senior Vice President for Academic Affairs

November 17, 2022

The Honorable Pete Buttigieg
Office of the Secretary
U.S. Department of Transportation
1200 New Jersey Avenue SE
Washington, DC 20590

Dear Secretary Buttigieg:

On behalf of the Northeast Ohio Areawide Coordinating Agency (NOACA), I am writing to support the City of Cleveland's application for funding through the U.S. DOT's SMART grant program. This project is consistent with NOACA's Long Range Plan (LRP), eNEO2050 -- An Equitable Future for Northeast Ohio. It is also consistent with NOACA's Plan for Regional Safety (SAVE), and it is a priority project in NOACA's Regional ITS Strategic Plan.

NOACA is the federally designated metropolitan planning organization (MPO) that represents the five counties of Greater Cleveland: Cuyahoga, Geauga, Lake, Lorain, and Medina. NOACA addresses the transportation, air quality, and water quality needs of Northeast Ohio, and works with its partners to develop and implement plans to ensure that travel throughout the region is safe, cost-effective and environmentally sound. In particular, NOACA develops the LRP and the Transportation Improvement Program (TIP) for the region.

In partnership with Greater Cleveland Regional Transit Authority and Cleveland State University, the City of Cleveland's Complete Corridor Project proposes design and prototyping of an intelligent, cloud-based adaptive traffic signal system that provides next-generation transit and emergency vehicle priority based on cellular-based AVL location prediction and incorporates optical sensor-based bicycle and pedestrian detection and near-crash identification. This approach eliminates the need for expensive vehicle detection hardware on buses and City fleets, allows for dynamic signal adjustments to benefit multimodal roadway users and increase safety, and provides analysis and reporting of performance metrics. The project will result in the creation of generic smart signal specifications that can be installed throughout the city and in other jurisdictions to increase mobility equity through improved multimodal safety and efficient, reliable transit.

NOACA looks forward to continued partnership with the City of Cleveland to implement advanced technology to meet the USDOT's SMART grant goals. We are excited to be a part of a collaboration benefiting this underserved and disadvantaged community. Please don't hesitate to contact me with questions at ggallucci@mpo.noaca.org and 216-241-2414 x100. Thank you for your consideration of the City of Cleveland's SMART grant application.

Sincerely,

Grace Gallucci
Executive Director and CEO

GG:bb 10019s

1299 Superior Ave., Cleveland, Ohio 44114-3204 Phone: 216·241·2414 FAX: 216·621·3024
Web: www.noaca.org noaca.org @noaca_mpo

CITY OF CLEVELAND
Cleveland City Council
www.clevelandcitycouncil.org

November 18, 2022

Robert C. Hampshire, PhD
Deputy Assistant Secretary and Chief Science Officer
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: Strengthening Mobility and Revolutionizing Transportation (SMART) Notice of Funding Opportunity Number 20.941

Dear Deputy Assistant Secretary Hampshire:

On behalf of Cleveland City Council's Transportation and Mobility committee, we strongly urge you to support the City of Cleveland's SMART grant application in partnership with Cleveland State University and Greater Cleveland Regional Transit Authority for the Cleveland Complete Corridor project. An intelligent, adaptive traffic signal system with transit and emergency vehicle priority, bicycle and pedestrian detection, and near-crash analysis will benefit residents through improved service delivery and safer and more convenient travel.

As the Council committee that handles all matters relating to the City-owned airports, aviation, bridges, and public transit, the Transportation and Mobility committee has worked for several months with Mayor Bibb's administration to pass and implement a strengthened Complete and Green Streets ordinance that provides multimodal and sustainable enhancements in City roadway projects. This SMART proposal builds directly on the legislative intent of that ordinance, as well as the direction of the recently adopted Vision Zero Action Plan. By leveraging the existing investment in cellular AVL technology on RTA and City fleets, the insights and outcomes of this SMART planning and prototyping grant will be scalable across the city, helping create a Cleveland transportation network that aligns with our multimodal and safety goals.

Sincerely,

Councilman Kerry McCormack
Chairman Transportation & Mobility Committee

Councilman Charles J. Slife
Vice Chairman Transportation & Mobility Committee

City Hall 601 Lakeside Avenue N. E., Room 220, Cleveland, OH 44114 • Phone (216) 664-2840 • Fax (216) 664-3837

November 18, 2022

Robert C. Hampshire, PhD
Deputy Assistant Secretary and Chief Science Officer
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: Strengthening Mobility and Revolutionizing Transportation (SMART) Notice of Funding Opportunity Number 20.941

Dear Deputy Assistant Secretary Hampshire:

Bike Cleveland is pleased to support the City of Cleveland's SMART grant application in partnership with Cleveland State University and Greater Cleveland Regional Transit Authority for the Cleveland Complete Corridor project. An intelligent, adaptive traffic signal system with bicycle and pedestrian detection and near-crash analysis will greatly improve the comfort, convenience, and safety of cyclists, scooter riders, and pedestrians on Cleveland's streets.

As an active participant in Cleveland's Vision Zero initiative and a vocal advocate for the recently adopted Complete and Green Streets legislation, we strongly support investments that make our streets safe for people walking, biking, and riding transit. The current signal technology in Cleveland does not adequately meet the needs of our growing population of bike riders. Learning which signal technologies can be adopted locally will be a key part of the success of upcoming cross-city bikeway projects.

Bike Cleveland offers its support for the Cleveland Complete Corridor Project and strongly urges the Department of Transportation to fund this project. If the grant is awarded, we will engage with the City and GCRTA to test detection technologies, collect cyclist and pedestrian input, and inform priority locations for future signal investments.

Sincerely,

Jacob VanSickle, Executive Director
Bike Cleveland

November 18, 2022

Robert C. Hampshire, PhD
Deputy Assistant Secretary and Chief Science Officer
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: Strengthening Mobility and Revolutionizing Transportation (SMART) Notice of Funding Opportunity Number 20.941

Dear Deputy Assistant Secretary Hampshire:

Clevelanders for Public Transit is pleased to support the City of Cleveland and Greater Cleveland Regional Transit Authority's SMART grant application for the Cleveland Complete Corridor project. The proposal will design and prototype an intelligent, cloud-based adaptive traffic signal system that provides next-generation transit and emergency vehicle priority and incorporates sensor-based bicycle and pedestrian detection to make it safer and more convenient for transit riders on and off the bus.

As a coalition of riders across Greater Cleveland who advocate for safe, accessible, affordable, reliable, and sustainable public transit, we know firsthand that a connected, intelligent traffic signal system with transit signal priority will significantly improve transit service. If the grant is awarded, we will engage with the City and GCRTA to provide rider input on the pilot's design and performance, as well as benefits experienced along the pilot corridor(s).

Sincerely,

Chris Martin
Chair, Clevelanders for Public Transit

Cleveland Complete Corridor Project—SMART grant, NOFO 20.941

Appendix II. Summary Budget Narrative

The project team requests $1,820,500 for its next-generation, intelligent, cloud-based traffic signal system pilot. Following the structure of SF-424A, the details of planned project costs are as follows:

Personnel: $290,957
Personnel costs include $148,252 for five faculty researchers from Cleveland State University (CSU) with relevant expertise in traffic operations, intelligent transportation systems, cybersecurity, machine learning, and smart transportation communications. See *Resume* attachment for more information. This cost is based on an estimated equivalent of two months' time contribution to the project from each faculty member. Personnel costs also include $63,000 in stipends and $79,705 in tuition payments for five graduate student assistants for three semesters each, to cover the duration of the Stage 1 SMART grant project.

Fringe Benefits: $33,170
Fringe benefits for faculty members and graduate student assistants are calculated by the university as $30,020 and $3,150 respectively.

Travel: $11,669
This travel allowance covers domestic travel for CSU faculty and students to pilot sites for field visits as well as anticipated travel to technical conferences to present results of the pilot.

Equipment: $1,265,500
Equipment costs are based on vendor quotes of: $300,000 for connected vehicle-to-signal software and necessary equipment installation for 25 intersections, including a two-year software license agreement; $500,000 for optical sensors (LIDAR/camera) at 25 intersections at a rate of $10,000/sensor with two sensors per intersection to guarantee coverage; and $300,000 for sensor software at 25 intersections a rate of $6,000 per sensor for a five-year agreement. A contingency of $165,500 (10 percent of grant request) has been allocated to this line item to account for unknowns in existing traffic control cabinets that may need to be upgraded for the pilot to be successful.

Contractual: $95,000
$50,000 is budgeted here for a consultant to provide project management services, coordinating pilot progress and ensuring movement across partner agencies to meet grant timelines. $45,000 is allocated for performance reporting and evaluation to meet grant requirements.

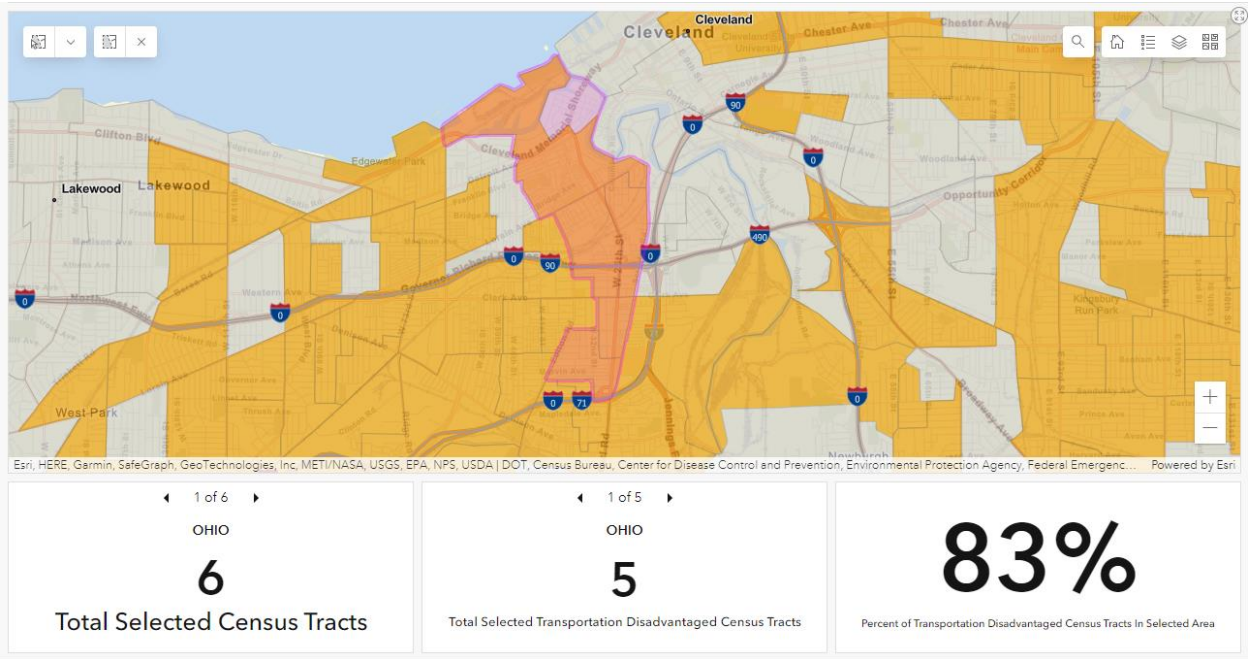
Indirect Charges: $124,204
Indirect charges are calculated using CSU's standard indirect cost rate of 48.5 percent on the base cost of $256,091.

Total Project Budget Request: $1,820,500

The City of Cleveland and Greater Cleveland Regional Transit Authority will also make in-kind contributions to the success of this grant in the form of staff time for planning, research, and implementation. The City will also contribute data collection in the form of traffic and speed counts and air quality measurements in-kind.

Cleveland Complete Corridor Project—SMART grant, 20.941

Priority Corridor #1: W. 25th Street, Cleveland, OH



Priority Corridor #2: Kinsman Avenue, Cleveland, OH