

City of Columbus

Solicitation Number: RFQ011174

Request for Proposals for Automated Vehicle Shuttle Service

**Smart Columbus
Capital Improvements Project No: 530163 – 100020**

Version Dated: January 17, 2019

Response Due Date and Time:

Friday, February 14, 2019

1:00 P.M., Eastern Time

Submit Electronic Proposal Package to:

<https://columbus.bonfirehub.com/projects/>

PROPOSAL SIGNATURE FORM

This page, signed by an officer of the offering firm or a designated agent empowered to bind that entity in a contract with Smart Columbus, should accompany each proposal submitted for consideration.

I, the undersigned, having carefully examined the Request for Proposals (RFP), propose to furnish services in accordance therewith as set forth in the attached proposal.

I hereby certify that, to the best of my knowledge, this submission is complete and all statements made therein are true and accurate.

I also affirm I am duly authorized to sign and submit this response on behalf of the Offeror named below.

I further acknowledge that by signing this form I am representing that, in the event this proposal is accepted, the Offeror is willing and able to execute a contract in the form shown in the RFP, with the understanding that the scope and compensation provisions will be negotiated and included in the final contract.

By my signature below, I attest that I have read, understand and agree to the terms, conditions and requirements set forth in the RFP, including, but not limited to: Smart Columbus' standard contract terms and conditions and any special terms and conditions incorporated in the solicitation documents.

Failure to sign and return this form may result in the rejection of the accompanying proposal.

OFFEROR INFORMATION:

OFFEROR (Company Name):

ADDRESS:

CITY, STATE, ZIP:

PHONE: _____ EMAIL: _____

AUTHORIZATION TO PROPOSE:

Signature (Manually signed in ink)

Date

Printed Name

Title

CERTIFICATIONS AND REPRESENTATIONS

(GRANT FUNDS)

BYRD ANTI-LOBBYING AMENDMENT COMPLIANCE AND CERTIFICATION

For all orders above the limit prescribed in 2 CFR 215, Appendix A, Section 7 (currently \$100,000), the Offeror must complete and sign the following:

The following certification and disclosure regarding payments to influence certain federal transactions are made per the provisions contained in OMB Circular A-110 and 31 U.S.C. 1352, the "Byrd Anti-Lobbying Amendment."

The Offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that:

No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the Offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance is placed when this transaction was made or entered into. Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person making an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

SIGNATURE: _____

COMPANY NAME: _____

DATE: _____

TERMS AND CONDITIONS FOR OFFEROR

INFORMATION FOR OFFEROR

SUBMISSION OF PROPOSAL

Proposals must be submitted according to this proposal form.

ACCEPTANCE AND REJECTION

This proposal submitted by the Offeror to the City of Columbus will be accepted or rejected within a period of 180 days from proposal due date. The City reserves the right to waive technicalities, and to request new proposals (rebid) on the required material. Each invitation for Bids, Request for Statements of Qualifications, and Request for Proposals issued by the City shall state that the Bid or Request may be cancelled and that any bid or proposal may be rejected in whole or in part when it is for good cause and in the best interests of the City.

WITHDRAWAL OF PROPOSALS

Offerors may withdraw their proposals at any time prior to the time specified in the advertisement as the closing time for the receipt of proposals. However, no Offeror shall withdraw or cancel his/her proposal for a period of 180 calendar days after said advertised closing time for the receipt of proposals.

APPLICABLE LAWS

The Revised Code of the State of Ohio, the Charter of the City of Columbus, and all City ordinances insofar as they apply to the laws of competitive bidding, contracts, and purchases, are made a part hereof.

CONTRACT

The Offeror to whom an award is made will be required to execute a written contract with the City of Columbus, Ohio within seven days after receiving such contract for execution.

LIABILITY, INSURANCE, LICENSES AND PERMITS

Where Offerors are required to enter or go onto City of Columbus property to deliver materials or perform work or services as a result of bid award, the Offeror will assume full duty, obligation and expense of obtaining all necessary licenses, permits, and insurance when required. The Offeror shall be liable for any damages or loss to the City and its partners occasioned by negligence of the Offeror (or his or her agent) or any person the Offeror has designated in the completion of this contract as a result of his bid. Particular attention is directed to the statutory requirements of the State of

Ohio relative to the licensing of corporation organized under the Laws of any other State.

TAXES

Federal and/or State Taxes are not to be included in prices quoted. The successful Offeror will be furnished an exemption certificate if needed.

CHANGES AND ADDENDA TO PROPOSAL DOCUMENTS

Questions as to the interpretation of the Request for Proposals shall be submitted in writing to the Office of Support Services at capitalprojects@columbus.gov. In order to receive consideration, questions must be received by the question cut-off date as indicated in the advertisement. Any interpretations of questions so raised, which in the opinion of the City or its representative require interpretations, will be issued by addenda posted on the City's Consultant Services web site. The City or its representative will not be bound by any oral interpretations which are not reduced to writing and included in the addenda.

CAMPAIGN CONTRIBUTIONS

Offeror hereby certifies the following: that it is familiar with Ohio Revised Code ("O.R.C.") Section 3517.13; that it is in compliance with Divisions (I) and (J) of that Section; that it is eligible for this contract under the law and will remain in compliance with O.R.C. Section 3517.13 for the duration of this contract and for one year thereafter.

IN THE EVENT OF A CONTRACT

An agreement which may result from this proposal shall not be modified or altered by any subsequent course of performance between parties or by additional terms contained in any subsequent documents unless said additional or differing terms are incorporated by contract modification authorized to be entered into by ordinance.

REMEDIES

All claims, counterclaims, disputes and other matters in question between the City, its agents and employees, and the Offeror arising out of or relating to this agreement or its breach will be decided in a court of competent jurisdiction within the County of Franklin, State of Ohio. Terms and conditions, submitted with this proposal, which are contrary to City Code or Charter shall be disregarded for the purpose of any

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subsequent contract. The successful Offeror shall be notified as to which terms and conditions, if any, have been deleted.

CONTRACT COMPLIANCE

The City of Columbus encourages the participation of City certified minority and female business enterprises*.

All Offerors shall identify all subconsultant(s) who will perform any type of contracting on this proposal(s). All Offerors shall include in their proposal response the anticipated scope of work and percentage of work that will be performed by all Sub-Consultant(s), along with their contract compliance number(s).

All Offerors, including subconsultants, who are party to a contract as defined in Columbus City Code 3901.01, must hold valid contract compliance certification numbers.

This information is gathered and monitored by the Office of Diversity and Inclusion. Please contact ODI for assistance with identifying potential minority consultants. Go to Vendor Services to verify that vendors have an active contract compliance number.

<http://vendorservices.columbus.gov/>

Office of Diversity and Inclusion
1393 E. Broad Street, 2nd Floor
Columbus, Ohio 43205
(614) 645-4764

M/FBE Certification/Contract Compliance
Tia Roseboro 614-645-2203

ADDITIONAL CONTRACT TERMS AND REQUIRED DOCUMENTS IN THE EVENT OF A CONTRACT

This section sets forth contract terms and the required contract documents that the successful Offeror must execute following the award of the contract by the contracting authority.

SAVE HARMLESS

The Offeror shall protect, indemnify and save the City and its partners harmless from and against any damage, cost, or liability, including reasonable attorneys' fees resulting from claim, by third parties for any or all injuries to persons or damage to property arising from the intentional, willful, or negligent acts or omissions of the Offeror, its officers, employees, agents, or Subconsultants in providing goods or services under the terms and conditions of this contract.

SAVE HARMLESS DISCLOSURE OF PROPRIETARY INFORMATION

The Offeror agrees to indemnify and hold harmless the City of Columbus, Ohio and its partners and their respective officials, employees and other agents and representatives, against loss, claim, liability in tort or by statute imposed, charge, cost or expense, including without limitation, attorneys' fees to the extent permitted; by law, which may be incurred in connection with, or in any manner of any damage or loss arising from disclosure of proprietary information.

CONFIDENTIAL INFORMATION

The director of the agency requesting proposals may choose to keep RFP information in confidence during the evaluation process and until the time a contract is executed. This information may include all proposal documentation, notes, including detailed prices, references, resumes, technical and cost information, etc. Thereafter, proposals and all submissions will become public information, as the City is subject to R.C. 149.43, the Public Records Act.

OFFEROR'S PROPRIETARY INFORMATION

The Offeror acknowledges that the City is subject to chapter R.C.149.43, the State of Ohio Public Records Law. The City agrees to keep any information confidential except as otherwise required to be disclosed by law including but not limited to the contract.

INDEPENDENT CONSULTANT STATUS

The Offeror shall perform its duties as an independent consultant and not as an employee. Neither the Offeror nor any agent or employee of the Offeror shall be or shall be deemed to be an agent or employee of the City of Columbus or its partners. The Offeror shall pay when due all required employment taxes and income tax on any monies paid pursuant to the contract. The Offeror shall acknowledge that the Offeror and its employees are not entitled to unemployment insurance benefits unless the Offeror or a third party provides such coverage and that the City does not apply for or otherwise provide such coverage. The Offeror shall have no authorization, express or implied, to bind the City or its partners to any agreements, liability, or understanding except as expressly set forth in the contract. The Offeror shall provide and keep in force worker's compensation (and show proof of such insurance) and unemployment compensation insurance in the amounts required by law, and shall be solely responsible for the acts of the Offeror, its employees and agents.

PROTECTION OF CITY'S AND ITS PARTNERS' CONFIDENTIAL INFORMATION

The Offeror shall acknowledge that some of the material and information which may come into its

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possession or knowledge in connection with the contract or its performance, may consist of confidential information, the disclosure of which to, or use by, third parties could be damaging. Therefore, access to information concerning individual recipients of the City's and its partners' services to individual clients, among other items, shall not be granted except as authorized by law or agency rule. The Offeror shall agree to hold all such information in strictest confidence, not to make use thereof for other than the performance of the contract, to release it only to authorized employees or subconsultants requiring such information, and not to release or disclose it to any other party. The Offeror shall agree to release such information or material only to subconsultants who have signed a written agreement expressly prohibiting disclosure. The Offeror shall further agree to either destroy or return all such information at the end of the term of the contract.

This section does not impose any obligation on the Offeror if the information is: (1) publicly known at the time of disclosure; (2) already known to the receiving party at the time it is furnished to the Offeror; (3) furnished by the City or its partners to others without restrictions on its use or disclosure; or (4) independently developed by the receiving party without use of the proprietary information.

CONTRACT PROVISIONS FOR NON-FEDERAL ENTITY CONTRACTS UNDER FEDERAL AWARDS

In addition to other provisions required by the Federal agency or non-Federal entity, all contracts made by the non-Federal entity under the Federal award must

contain provisions covering the following, as stated in 2 CFR 200 Appendix II:

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended—Contracts and subgrants of amounts in excess of \$150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended Act (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(H) Mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. 6201).

(J) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractors that apply or bid for an award of \$100,000 or more must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

1 Project Information

1.1 Project Name

Smart Columbus – Automated Vehicle Shuttle Service

Capital Improvement Project No: 530163-100020

1.2 Project Overview

Globally, the use of automated vehicle (AV) shuttles has been widely considered as a solution to the first-mile/last-mile/only-mile problem. The City of Columbus Smart Columbus Program (Smart Columbus) intends to identify challenges currently associated with conventional transportation options and propose options to promote safer and more efficient access to health care, education, and family-related services in a “smart city”, including AV technology.

Smart Columbus is seeking proposals from technology partners to deploy, operate, and maintain an AV shuttle service under an agreement that supports one full year of operations. The Offeror shall propose a turn-key system, where the Offeror provides the vehicles, storage and charging facilities, as well as all operations and maintenance of the vehicles. The Offeror must agree to share data related to both the operations of the AV shuttle service, as well as the vehicle’s performance as an AV. The system must be fully configurable to meet Smart Columbus’ requirements, outlined in this request for proposals (RFP).

In addition, Offerors’ attention is directed to Executive Order 2018-04K.¹ It is the intent of this RFP that the Offerors comply with the Executive Order and meet or exceed its intent where applicable.

2 Scope of Services

The scope of this project is to develop, deploy, and evaluate an AV shuttle service to address transportation needs in the Columbus area. This project builds on the lessons learned from the first AV shuttle deployment in Columbus, the Smart Circuit, a service around the Scioto Mile in Downtown Columbus that launched public operations in December 2018.

Smart Columbus intends to procure a turn-key AV shuttle service that operates on public roadways at a frequency deemed necessary to address first-mile/last-mile/only-mile challenges. Human operators are expected to be available on board each vehicle during operations to monitor the vehicle, explain the technology to passengers, and take control of the operation of the vehicle should the need arise.

Data from the deployed vehicles will be sent to the Smart Columbus Operating System (Operating System)² to support performance measurement, evaluation, and contribute to the region’s knowledge base. Smart Columbus has a multi-phase vision for enabling Operating System integration with the AV shuttle deployments, as will be explained in Section 2.1.

As this is a demonstration project, the learnings and research associated with the project are as important as the operations. Offerors must include in their proposal participation in research and lessons learned meetings and ability to share data associated with this project.

2.1 Background

In June 2016, the City of Columbus, Ohio won the United States Department of Transportation (USDOT) Smart City Challenge. Columbus intends to define what it means to be a “Smart City” and serve as a

¹ The Executive Order can be found here: http://governor.ohio.gov/Portals/0/%21%21%21EO%202018-04K%20%28Signed%205_9_18%29.pdf

² More information on the Smart Columbus Operating System can be found here: <https://www.smartcolumbusos.com/>

model for other cities wishing to fully integrate innovative technologies, such as automated and connected vehicles into the transportation network. Columbus is acting as a laboratory for Intelligent Transportation Systems (ITS), and it is disseminating lessons learned and best practices to cities across the United States in an effort known as Smart Columbus. The goal of the Smart Columbus project is to connect people by creating opportunity for city residents to better access jobs and services while improving the overall safety and efficiency of the transportation network.

Smart Columbus aims to deploy and evaluate AV shuttles against a series of use cases in a series of pilots commissioned by the City of Columbus, the Ohio State University (OSU), the Columbus Partnership, the Ohio Department of Transportation (ODOT), and DriveOhio and coordinated with the Central Ohio Transit Authority (COTA). The proposed technology solution involves vehicles that are Level 4 automated, as defined in SAEJ3016³, and preferably electric and connected, serving the public on short trips where other modes are not presently available or convenient. Operations of the fleet are expected to be similar to that of a traditional transit service, with pre-determined routes and signed stops along the routes for passengers to board and alight. The success of this project will be looked at as a guide for potential deployment of future AV routes in other parts of Columbus and elsewhere by verifying their ability to perform as intended and providing feasibility for their use in similar environments.

The City of Columbus is working with local partners, including ODOT, DriveOhio, OSU, and the Columbus Partnership to plan, implement, and evaluate this project. Each project partner's roles and responsibilities include:

- **City of Columbus:** The City manages the Smart Columbus Program, a large and diverse transportation technology deployment and data project, in a way that ensures successful implementation and builds sustainable solutions. The City will be the contract holder for this deployment and provide support services and facilitate the data exchange through the Operating System.
- **ODOT:** As the state DOT, ODOT is a key Smart Columbus partner coordinating data management and availability, managing transportation policy developments, and assisting in the transferability and portability of the Smart Columbus Program to other Ohio cities and regions.
- **DriveOhio:** This statewide initiative is the single point of contact to more quickly and efficiently access the needed resources for smart mobility projects. It serves as the hub for all things automated and connected in the State of Ohio.
- **Columbus Partnership:** This non-profit, membership-based Chief Executive Officer (CEO) organization represents 65 of Columbus' leading businesses and institutions. The Columbus Partnership is the proxy for key private sector engagement on implementation of the Smart Columbus Program.
- **OSU:** This university partner provides research and organizational support to the Smart Columbus Program, including through the Transportation Research Center and the Center for Automotive Research. It is providing research support for this project.
- **COTA:** The local transit agency provides high-frequency transit service near the potential AV shuttle service area, allowing for ample transfer opportunities for passengers.

Integration with the Operating System is central to Smart Columbus' vision for facilitating Mobility as a Service (MaaS) and other Smart City applications. The Operating System is a cloud-based, dynamic, governed data delivery platform that is at the heart of the Smart Columbus system. It is designed to ingest and disseminate data from external systems for processing via a microservices architecture in which components of other applications will reside in the Operating System as loosely coupled services. The

³ SAE International, J3016_201806: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles, revised June 2018, https://www.sae.org/standards/content/j3016_201806/.

Operating System also serves as the source for real-time operational data and archived historical data from a combination of data storage sources for use by the City of Columbus and third-party applications/developers. The Operating System is the data platform environment that integrates data and data services from multiple sources, including the planned Smart Columbus projects, traditional transportation data, and data from other community partners. The Operating System embodies open-data and open-source concepts to enable better decision-making and problem solving for all users to support a replicable, extensible, sustainable platform.

The Selected Offeror will, in addition to its own services, provide General Transit Feed Specification (GTFS), GTFS Realtime (GTFS-RT), and Automatic Vehicle Location (AVL) or similar to the Operating System to be made available for other applications.⁴ Further, the AVs will allow for capture and archive of onboard sensor data, as well as any incident data, including event logs. Additional detail on the data sharing requirements is included in Section 5.1.5. While the intention is to eventually include fleet management platforms for all Smart Columbus transportation providers in the Operating System, for the purposes of this RFP it will be sufficient for output feeds such as GTFS, GTFS-RT, and AVL to be made available for other applications to use outside of Smart Columbus, and in parallel, routing data to be shared with the Operating System itself.

2.2 Project Goals

The Smart Columbus team is interested in deploying AV technology to evaluate the ability of this technology and associated vehicles to enhance the mobility of residents and visitors, to operate on public roadways in Ohio, and to satisfy the specific operating purposes for which each service is intended. Further, the team is interested in better understanding the infrastructure required to implement and support the operation of this technology, the approach to public adoption, the types and value of data produced, the associated cost, and the benefits derived from the use of AVs. To minimize risk and to provide the best opportunity for understanding these factors, it is desired to procure turn-key solutions from vendors responsible for deploying, operating and maintaining the services. The Selected Offeror will collect and provide data to the Operating System on vehicle performance, such as time in service, miles traveled, ridership, high-accuracy positioning, speed, battery/fuel usage, number of and reasons for disengagements, hard braking, evasive maneuvers, and more (see Appendix A). From a program perspective, the data collected by the AV shuttles will be the primary focus and positioned as a data story in the Operating System, which will provide information, lessons learned, and best management practices to benefit the national community. Ultimately, it is the goal of this project to develop operational and testing guidelines that will help shape other deployments in the United States.

This AV shuttle deployment will benefit the region by demonstrating the potential of this emerging technology to local stakeholders and the public, allowing for an educational experience while also inspiring quicker adoption of future innovations. More broadly, results of this project will be used to inform the following overall program goals:

- Better connect the community to services through first-mile/last-mile/only-mile connections by providing a convenient and reliable transit option;
- Grow COTA ridership by encouraging a modal shift to public transit by increasing the attractiveness and availability of end to end transit options;
- Validate and ensure that emerging transportation technology solutions provide equitable and accessible transportation;
- Establish a common data exchange interface that is interoperable across various deployment locations, vehicle types, and system operators that builds off the Smart Circuit deployment;
- Aid in informing a set of procurement guidelines, including demonstrated vehicle performance and data sharing requirements, for both operational and capital projects;
- Develop a set of AV operational testing and evaluation guidelines to benchmark AVs;

⁴ More information on GTFS and GTFS Realtime can be found at gtfs.org and developers.google.com/transit/gtfs/.

- Develop a methodology for evaluating the operational safety of the system in various deployment settings based on real-time data provided to the Operating System; and
- Summarize lessons learned to help identify needs, understand how to garner user acceptance of systems, and study which interfaces work best.

2.3 Procurement Schedule

The expected timeline for this procurement is as follows:

Table 1: Procurement Schedule

RFP Sequence of Events	
Date of Advertisement - RFP/Bid Issued	January 17, 2019
Pre-Proposal Meeting	January 25, 2019
Proposal Inquiry Period Ends	January 31, 2019
Proposals Due/Opened	February 14, 2019
Notice to Proceed	June 2019

RFP Pre-Proposal Meeting: January 25, 2019 from 1:00 PM – 3:00 PM

Location:

Smart Columbus Experience Center, Green Scrum Room
170 S. Civic Center Dr., Columbus, OH 43215

WebEx Information:

<https://meetings.mbakercorp.com/orion/joinmeeting.do?MTID=aaef7021e550b38cfb8dd3b5de9d801e>

Audio Connection: 571-209-6390

Access Code: 995 177 369

3 Proposal Submittal Instructions

Proposals shall be submitted as a PDF document online via Bonfire until 1:00 PM Eastern Time on February 14, 2019. Proposals received after this date and time shall be rejected by Smart Columbus.

Submit Electronic Proposal Package to:

<https://columbus.bonfirehub.com/projects/>

3.1 Electronic Submittals

Proposals shall be submitted as a PDF document. The maximum file size is 100 MB. Please do not embed any documents within the uploaded file as such documents will not be accessible or evaluated. Proposals must be uploaded, submitted, and finalized prior to the Closing Time of 1:00 PM Eastern Time on February 14, 2019. Smart Columbus strongly encourages Offerors to allow sufficient time and at least one (1) day before the Closing Time to begin the upload process and to finalize their submissions.

- 3.1.1. Important Notes Regarding Submissions: Proposals will only be visible and accessible to the Department or evaluators after the Closing Time.

- 3.1.2. Uploading large documents may take significant time, depending on the size of the file(s) and Offerors' internet connection speed.
- 3.1.3. Offerors will receive an email confirmation with a unique confirmation number once they finalize their submissions. The date/time stamp on the email confirmation constitutes the official date/time of receipt. Offerors are solely responsible for ensuring their proposals have been successfully uploaded and received by Bonfire before the Closing Time specified in the RFP. Responses cannot be uploaded to Bonfire after the Closing Time specified in the RFP, and any in-process uploads cannot be finalized once the Closing Time has been reached.
- 3.1.4. Smart Columbus cannot see any uploads into Bonfire prior to the Closing Time specified in the RFP. Smart Columbus is unable to tell if an upload was successful until after the Closing Time specified in the RFP. However, successful submissions will receive an email as described in Section 3.1.3.
- 3.1.5. Minimum system requirements: Internet Explorer 11, Microsoft Edge, Google Chrome, or Mozilla Firefox. Javascript and browser cookies must be enabled.

3.2 Bonfire Technical Help

Smart Columbus is using a Bonfire portal for accepting and evaluating proposals digitally. Offerors must contact Bonfire for technical help related to submissions at:

- <https://columbus.bonfirehub.com/portal/support>
- or Support@GoBonfire.com
- or 1-800-354-8010 (extension 2)

3.3 Questions

Direct questions via the Bonfire portal only. No contact is to be made with Smart Columbus other than through the Bonfire portal. The deadline for questions is January 31, 2019. Answers to questions received will be posted on the Bonfire portal as an addendum no later than February 7, 2019. For technical questions regarding submissions on Bonfire, see Section 3.2.

3.4 Evaluation

Proposals will be evaluated based on the enclosed selection criteria and in accordance with Columbus City Code, Section 329.28. The evaluation criteria for any contract awarded under this section shall include, but need not be limited to, the following: (1) The competence of the offeror to perform the required service as indicated by the technical training, education and experience of the offeror's personnel who would be assigned to perform the work; (2) The quality and feasibility of the offeror's technical proposal; (3) The ability of the offeror to perform the required service competently and expeditiously as indicated by the offeror's workload and the availability of necessary personnel, equipment and facilities; (4) Past performance of the offeror as reflected by evaluations of the city agency, other city agencies and other previous clients of the offeror with respect to such factors as quality of work, success in controlling costs, and success in meeting deadlines; and (5) An environmentally preferable factor except when there is not an environmentally preferable manner in which to carry out the purpose of the contract. Pricing will be included in the evaluation criteria.

PUBLIC RECORDS REQUESTS

The City of Columbus, as a political subdivision of the State of Ohio, is subject to Ohio Revised Code Chapter 149, known as the Ohio Public Records Law. Consequently, the Offeror understands that ALL documents submitted in response to this RFP are considered public records and WILL be released when a public records request is made by news media, competitors, or other interested parties, in accordance with the law. If you contend that certain CLEARLY MARKED portions of your response constitute an

exception to Ohio's public records law, you **MUST** submit your legal basis in support of that assertion with your response.

If a public records request is made for any portion of the documents that you have submitted and you have **NOT** clearly marked such documents as information constituting an exception to Ohio's public records law, your information will be released immediately.

If a public records request is made for such information and you **HAVE** clearly marked portions of your response as information constituting an exception to Ohio's public records law, **AND** you have submitted the legal basis supporting such claim, the City will release a redacted version of your information to the requestor and notify you that a request was made and that a redacted version of your response was released. Should the requestor indicate that the redacted version is not sufficient for their purposes, you then will be **IMMEDIATELY** responsible for obtaining an order from a Court of competent jurisdiction in Franklin County, Ohio enjoining release of your clearly marked information constituting an exception to Ohio's public records law.

If a public records request is made for such information and you **HAVE** clearly marked portions of your response as information constituting an exception to Ohio's public records law, but you have **NOT** submitted the legal basis supporting such claim, the City **WILL RELEASE** your information to the requestor and notify you that a request was made and that your response was released.

DO NOT mark your entire response/submittal as information constituting an exception to Ohio's public records law. If your entire response/submittal is so marked, the City of Columbus will not consider your offer.

3.5 Proposal Format

Only the following format will be accepted.

- 3.5.1. Proposals may not exceed thirty (30) letter-size (8.5" x 11") pages and shall include the information specified in Section 3.6.
- 3.5.2. Complete the required Proposal Signature Form and the Byrd Anti-Lobbying Amendment Compliance and Certification Form. That document shall be signed by a person authorized to obligate the Offeror's firm and included as the front page of the Offeror's proposal. This does not count towards the 30-page limit described in Section 3.5.1.
- 3.5.3. Page numbers must be centered at the bottom of each page.
- 3.5.4. Font must be 12 point, Times New Roman or Arial.
- 3.5.5. Cover letters are not required. If submitted, a cover letter will count against the 30-page limit of the proposal.

3.6 Proposal Content

- 3.6.1. The Offeror shall limit the proposal to no more than 30 total pages of information (e.g. text, graphics, etc.). A 'page' is one side of a sheet of paper with text, graphics, etc. If only one side of a sheet of paper has text, graphics, etc., then that is one page. If both sides of a sheet of paper have text, that is two pages. The proposal shall include the Proposal Signature Form, which is not counted in the 30-page limit. No appendices or additional information is acceptable. **Proposals exceeding the 30-page limit will be rejected.**
- 3.6.2. Provide information requested below in the order outlined or the proposal may be rejected.
- 3.6.3. Proposals must address each of the following subjects in the order specified below, using the headings provided. These elements correspond to the evaluation criteria noted in Section 4. Note that page breaks **are not** required between sections; however, section tab dividers will

not be counted against the page limit unless they contain text other than that necessary to identify the section. **Failure to provide the information requested may result in the proposal being rejected.**

Section A. Project Team

Present the education, training, experience, overall qualifications, and availability for the project manager and key staff. Offeror should provide an overview of the resources Smart Columbus should consider as part of the implementation plan.

Section B. Past Performance

Present the project team and proposed vehicle's past performance on specific projects relevant to this project. For each project identified include: project name, project characteristics (including any unique conditions), team members and contact information, contract amount, and project duration (include dates). Projects with greater relevancy to this project will be given greater consideration, including those that have demonstrated an ability to accommodate passengers with disabilities. In addition, proposals must demonstrate the financial stability and project management and technical experience of the organization.

Section C. Solution, Understanding of the Project, and Approach

Address understanding of the topics and provide technical capabilities related to the areas discussed in Sections 1 and 2 and Appendix A. Discuss the approach to managing this complex project that includes coordination with multiple stakeholders and a systematic approach to testing and deployment.

Present a project proposal that demonstrates the Offeror's understanding of the scope, challenges, and limits within the context of the project. Include an explanation of public involvement, innovative approach, and cost containment measures for project execution. Also include recommended testing procedures the Offeror would use to demonstrate its vehicle's abilities to the public before deployment.

Section D. Infrastructure Support

Provide a full and honest assessment of known and potential infrastructure requirements that will maximize the safety and effectiveness of the deployment, such as antennae, infrastructure-based sensors, stationary objects for guidance support, etc. Include the costs thereof, and whether these costs are included in Section F. Be clear on what infrastructure changes may be necessary, what infrastructure may need to be updated or better maintained, and include the required power, communications, and specific location or mounting needs, if necessary.

Section E. Access to Data for Performance and Safety Evaluation

It is vital to the success of this project that relevant data is shared completely with project partners. Using the Table 2 (Section 5.1.5) as a guideline, provide an overview of the nature of the data that will be shared with Smart Columbus and/or OSU. This should at a minimum include the data requested in that table, as well as any additional data the Offeror would propose sharing with the Smart Columbus team.

Section F. Pricing

Based on the outlined approach, provide a complete not to exceed cost for deployment. Provide fully loaded hourly rates inclusive of overhead, profit, and base rate for each role proposed, including that of site supervisors and onboard operators. Include costs for items as detailed in Section 4.6.

4 Evaluation Criteria

Each proposal will be evaluated using the same criteria and associated point value as identified below. The maximum value that can be assigned to a proposal response is **150 points**. The proposal responses will be reviewed by a committee comprised of the City of Columbus, the Columbus Partnership, OSU, DriveOhio/ODOT, and COTA. Resultant scores will be based on the proposals and interviews with selected Offerors.

4.1 Project Team

Section Maximum Value: 15 Points

To support the Offeror's proposed solution, the Offeror should provide an overview of the staff it will provide and the resources Smart Columbus should consider as part of the implementation plan. The City of Columbus will be the contracting agency with the Offeror. Smart Columbus will guide the design, data collection, research, and evaluation efforts, while also serving as the project manager in support of the overall deployment. The organizational support plan should include the following components:

- A draft table of the Offeror's organization of staff and qualifications needed to deliver the proposed solution.
- A job description for each position within the draft table of Offeror's organization that identifies the roles and responsibilities in supporting the Offeror's proposed solution.
- The education, training, experience, overall qualifications, and availability for the project manager. Candidates should have strong communication skills and should have experience managing similar projects.
- A discussion of the approach the project manager and team will take to effectively manage this project.

4.2 Past Performance

Section Maximum Value: 25 Points

Responding Offerors will identify a maximum of three specific projects in its portfolio that best encapsulate the breadth of its capabilities (as it relates to automated vehicles as well as operating a mobility service), its ability to deliver the solution on time and its ability to send data to the Operating System. These featured projects will include a point of contact that can be called by the selection team as a reference. As the Offeror responds to the RFP, it should be made clear as to how many implementations have been delivered to date, both in the United States and internationally.

Offeror should describe its experiences using the proposed technology with disparate populations and to address distinct use cases. Demonstration of existing vehicles and past projects that accommodate riders with disabilities will be given full points consideration.

4.3 Solution, Understanding of the Project, and Approach

Section Maximum Value: 50 Points

The AV shuttle pilot program is vital to evaluating how AV technology can be used to enhance transportation options in a city for all potential users. This score will be based on completeness of the response, understanding of and support for the goals of the program, and alignment with Smart Columbus' expectations. When submitting the details of the solution, Offerors should respond to the items and address the individual functional and testing requirements defined in Appendix A, including completing Table 3 (Section 5.1.6).

The Offeror should identify adherence to the schedule in Section 5.1.4 and how it intends to meet the required deliverables and dates to fully deploy the pilot project.

The Offeror should describe its ability to meet Smart Columbus' goals listed in Section 2.2.

The Offeror should describe its ability to meet the needs of the end user, AV shuttle passengers, as well as those of Smart Columbus.

The Offeror should demonstrate a thorough understanding of the project and how the Offeror's entire team will successfully execute the project. The Offeror should make a clear presentation of how the project team is organized, its understanding of the project requirements, including the challenges and areas of risk and a detailed plan for execution.

Specifically, the Offeror's proposal must contain a narrative description tailored to the project, describing the staff assignments and the approach the Offeror intends to take to complete the project. The proposal should identify unique characteristics of the project and the challenges those elements present as well as options to overcome those challenges.

The Offeror's proposal should give the selection team a clear understanding of the Offeror's:

4.3.1 Process – The Offeror's process/approach to planning, testing, executing, and evaluating deployments such as this.

4.3.2 Capabilities – Demonstration that the Offeror's capabilities fulfill the requirements of the RFP as stated in Appendix A, including service requirements and accessibility, and additional needs that may arise during operations.

4.3.3 Initial Thinking – Offeror's initial ideas for achieving the project's objectives. This may include preliminary thoughts for operating in suboptimal conditions (such as inclement weather or heavy traffic), initial recommendations for testing procedures, and insights on how to advertise to and educate potential passengers.

4.3.4 Collaboration – How the Offeror will collaborate with the Smart Columbus team and within the Offeror's team to successfully deliver on the project's objectives. This includes a commitment to flexibility in route and operating parameters, in response to possible changes in real-world conditions, usage of operators represented by a collective bargaining agreement, as well as an openness to sharing data beyond the core data sharing requirements.

4.3.5 Creativity – This may include proven innovations in the approach to meet and/or exceed this RFP's requirements, not explicitly outlined within this RFP.

4.3.6 Understanding of connections to other Smart Columbus projects – Understanding of and commitment to the aims of the entire Smart Columbus program.

4.3.7 Mobility Expertise – Knowledge of COTA and understanding of fixed route bus or other vehicle system operations, including but not limited to potential transfer connections, ADA regulations, and stop placement.

4.4 Infrastructure Support

Section Maximum Value: 20 Points

The Offeror should provide detail on any infrastructure changes or installations that may be necessary to support its deployment, such as antennae, infrastructure-based sensors, stationary objects for guidance support, and anything else it deems necessary. Provide an estimate of the associated costs and whether these costs are included in Section 4.6.

4.5 Access to Data for Performance and Safety Evaluation

Section Maximum Score: 20 Points

The Offeror will describe its approach to meet the Data Sharing Requirements. Per Table 2 (Section 5.1.5), the Offeror should discuss its ability and strategy to provide data to Smart Columbus.

4.6 Pricing

Section Maximum Value: 20 Points

The City will negotiate scope and price with the Offeror prior to contract execution. The City will have the ability to modify the Offeror's contract if changes in scope are agreed upon by all parties. The total cost of the solution for the duration of pilot (approximately 18 months total, including preparation, testing, and one full year of public passenger service) will be assessed, including the following cost breakdowns:

- Infrastructure requirements (described in Section 4.4)
- Setup costs, including testing, up until normal operations begin
- Vehicle operations (presented monthly, as the Selected Offeror will be paid monthly throughout deployment)
- Staff (including site supervisors, onboard operators, etc.) Provide the total cost for staffing as well as fully loaded hourly rates inclusive of overhead, profit, and base rate for each role proposed.
- Any one time and ongoing licensing costs
- Storage and charging facility costs
- Vehicle wrapping costs

See Appendix C for an example table of what should be submitted by each Offeror. Additional rows may be added as appropriate. The tables in Appendix D and Appendix E are included for reference, and will be completed by the Offeror after selection.

5 Selection Process

The Selection Committee shall evaluate the Offerors strictly upon the submitted proposals and interviews with selected Offerors if interviews are conducted.

The committee shall evaluate all Offerors and proposals received and rank the Offerors based upon the evaluation criteria specified in the RFP. The committee may select two (2) or more of the highest qualified offerors with which to hold additional discussions. Offerors not selected for further discussions may be excluded from further consideration for the contract upon notification by the city.

The discussions identified in this subsection may include, but are not limited to, presentations by the offerors to the committee to elaborate upon their qualifications, proposals, and/or other pertinent information. The committee may permit revisions of proposals so long as all offerors who are selected for additional discussions are given equal opportunity to revise their proposals.

Based upon the content of the proposals received including any revisions thereto, and upon any additional discussions with the offerors the committee shall rank the remaining offerors based upon the evaluation criteria specified in the RFP.

The committee shall submit its ranking of the offerors along with a written explanation to the Chief Innovation Officer. The ranking and written explanation shall become part of the contract file.

The Chief Innovation Officer shall have discretion consistent with appropriate citywide administrative rules in selecting the Offeror with which to enter into contract negotiations. The city shall enter into contract negotiations with the selected offeror to determine the terms and conditions of the contract, including

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compensation to be paid by the city. If negotiations fail, negotiations with this offeror shall be terminated, and the city agency may enter into contract negotiations with another Offeror as selected by the director. This process may continue until a contract is successfully negotiated.

After successfully negotiating a contract, the city agency shall submit legislation to city council requesting approval of the contract. In its request for approval, the city agency shall explain the basis for the selection of the chosen contractor. No contract awarded under this section shall be effective until approved by ordinance of city council.

Appendix A: Functional Requirements

Refer to Appendix B, the Operational Concept, for information regarding the current system, its concept, modes of operation, user classes, description of desired changes, and the system's interactions.

The AV shuttles will be operated on open, public roads on the following route in Columbus, Ohio. This route has been designed with stakeholder input to provide first-mile/last-mile transit access to community services. A video of the main route is available at <https://youtu.be/WBhoKChjm4k> and a video of the potential alternative route is available at <https://youtu.be/dGdBZa5lKgg>. In addition, a more detailed route map is available in Appendix F.

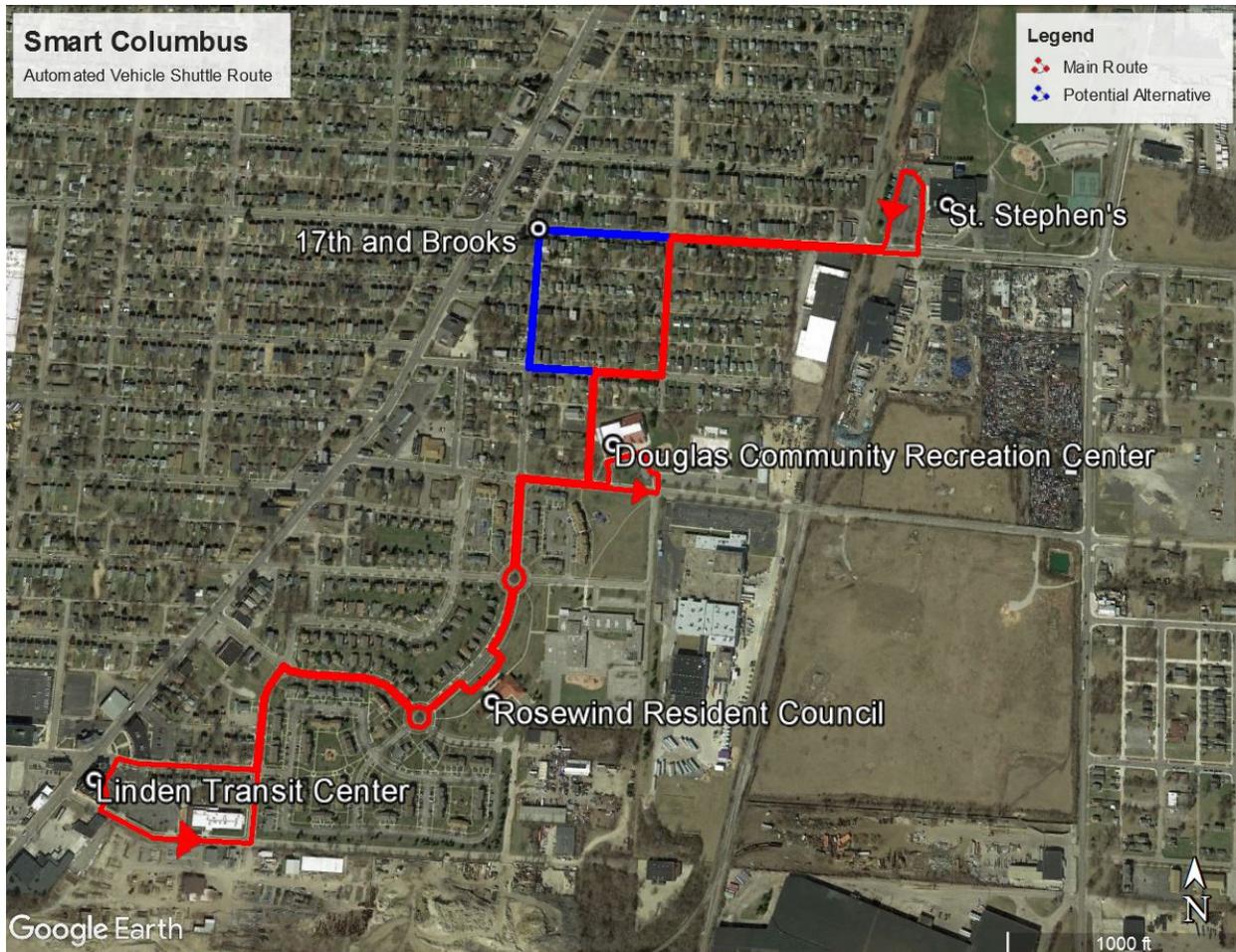


Figure 1: Linden Transit Center to St. Stephen's Route Map

This route travels between St. Stephen's Community House (upper right) and Linden Transit Center (lower left), both of which are designated as Smart Mobility Hubs within the Smart Columbus project portfolio. These Hubs provide access to mobility options at chosen areas of community focus, such as transit stops, libraries, and community centers to improve mobility for the surrounding area. Hubs include features such as real-time information displays; USB charging points; embedded touch screen displays at kiosks with access to trip planning, emergency calling and other applications; and multimodal resources including bike-share racks and car-share parking. The goal with this route is to connect the community center with the CMAX high-frequency bus rapid transit line as well as the neighboring community.

The route travels on some one-way roads and has been designed to minimize the number of left turns. The route encounters on-street parking, traffic circles with stop-controlled entry, a center left-turn lane, a narrow shoulder with no curb, and an intersection crossing from the stopped approach of a two-way stop

intersection. This route has a round-trip distance of 2.7 miles. In addition to the two Mobility Hubs, there are two additional stop locations that have presently been identified, Douglas Community Recreation Center and Rosewind Resident Council.

The segment in blue is an alternate route that provides service to Cleveland Avenue at 17th Avenue, providing an additional connection to high frequency COTA service. The purpose of this alternate is to provide passengers traveling to and from St. Stephen's somewhere north of the map area on a COTA route with a better connection. However, traffic operations near Cleveland Avenue may introduce additional complexity to the route. Whether this alternative is pursued (in one or both directions of the route, during all times or just during certain times) will depend on collaborative discussions between the Selected Offeror and the Smart Columbus team during scoping, testing, and initial deployment.

5.1.1 Operational Requirements

- Vehicles shall be delivered by September 9, 2019, to allow testing to commence in mid-September 2019 and passenger service to commence in November 2019. Passenger service is expected to be provided for one full year, November 2019 to November 2020.
 - Up to a week prior to the launch of public passenger service, a soft launch of full service shall commence to facilitate Partner Preview and Media Days.
- The Offeror shall provide service between the hours of 6 AM and 8 PM, seven days a week. Ridership shall be monitored by time-of-day and day-of-week, and operating hours may be adjusted to better accommodate demand, considering vehicle capabilities. For example, weekend service to St. Stephen's may not be required and the decision may be made to terminate the route at the Douglas Community Recreation Center on weekends.
 - Service may be suspended or reduced on Christmas Day, though it is desired that service be continued on other holidays consistent with the availability of services offered along the route, including St. Stephen's Community House, Douglas Community Recreation Center, and the Linden Transit Center.
 - Daily hours of operation shall be communicated to passengers in line with the approved Marketing and Education Plan and Communications and Engagement Plan deliverables. Any proposed changes to hours of operation shall be communicated to Smart Columbus at least two weeks in advance.
- The Offeror shall meet a minimum headway of twelve (12) minutes during hours in which service is provided. This is anticipated to be achievable on the proposed route with a minimum of two (2) vehicles in service at any time. As with operating hours, desired minimum headway may be modified during certain time periods depending on ridership but shall remain within the capabilities of the Offeror's originally proposed vehicle fleet size. Stop departure times shall be scheduled to complement nearby COTA services.
- The Offeror is responsible for identifying and obtaining a secure location for overnight storage, performance of maintenance work, and charging of the vehicles within a suitable distance of the proposed routes.
 - The Offeror is responsible for transporting the vehicles to/from the route and this storage facility, as well as to a nearby gas or charging station, if applicable. Operating the vehicles in automated or manual mode for this task is acceptable, and regularly towing the vehicles is not desirable.
 - This storage facility shall accommodate access that supports the full hours of operation defined herein.
- The Offeror shall be responsible for keeping the vehicles charged or fueled.
- The Offeror shall train onboard operators who will always be on board a vehicle when it is operating.
- Onboard operations shall have received training to:
 - Assist and interact with passengers, including providing mobility assistance during passenger boarding and alighting, as necessary
 - Provide accurate basic information about the vehicle, the purpose of the route, and the Smart Columbus program

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- Receive and record passenger feedback
- Operate a ramp, door, and/or charging/fueling station, if not automated
- Perform road testing of a vehicle
- Have a working knowledge of vehicle equipment
- Perform clean-up, including bodily fluid
- Intervene in vehicle operations, if necessary
- Operators shall be employees, contractors, or agents of the Offeror and also maintain:
 - Defensive driving certification
 - First Aid training
 - A valid driver's license that is recognized by the State of Ohio (note: if a City permit is required, an Ohio driver's license may be required)
 - No more than two traffic violations or preventable accidents in the last three years
- It is the responsibility of the Offeror to attain all licenses and permits to deploy the vehicles and operators. It is anticipated that the Offeror will need to apply for the following:
 1. State of Ohio Autonomous Vehicle Operations Permit
 2. Bureau of Motor Vehicles (BMV) vehicle registration and licensing
 3. Either:
 - City of Columbus Micro Transit Operator – Vehicle for Hire Owner and Vehicle for Hire Driver; or
 - Public Utilities Commission of Ohio (PUCO) Commercial Motor Vehicle
 4. City of Columbus (or relevant jurisdiction/entity) attachment permit if pole mounted equipment is required for operation

The City does not guarantee that this list is exhaustive of all licenses and permits but is provided to aid the Offeror in developing an approach to deploy and developing the price for its response.

- Any fleet management system(s) shall be open architecture to allow for potential integration with the Smart Columbus Operating System.
- The Offeror shall be responsible for developing Standard Operating Procedures for the vehicles and operations staff.
- The Offeror shall maintain the latest vehicle software update at all times at no additional cost to Smart Columbus.
- The Offeror shall monitor information on the vehicle's battery or fuel level, ensuring the vehicles are sufficiently charged/fueled or taken out of service early under abnormal conditions after servicing all passengers who are already on board.
- The Offeror shall monitor local weather patterns and be aware of any approaching severe weather event or other conditions that may impact vehicle operations. When a Level 1 Emergency or above (as defined by Franklin County) is announced, operations will be suspended. The Offeror may also define an inclement weather threshold (such as snow depth on the roadway, visibility, or other physical limitations) at which it would suspend or limit operations or shift to manual mode and define its response procedure in its Project Plan. The Offeror shall agree to notify Smart Columbus in the event this inclement weather threshold is met.
- The Offeror shall work in earnest with OSU to identify and/or support research opportunities.
- The Offeror shall commit the capacity and resources necessary to market and co-promote the pilot and build local stakeholder relationships along the route to increase user adoption.
- The Offeror shall actively engage the community in the operation of the vehicle and monitor their feedback. This can be accomplished through surveys of both riders and non-riders. Surveys may be distributed on board the vehicle, via either an onboard tablet or information that may allow passengers to complete a survey through their personal device. Survey questions will be provided by the City in coordination with OSU. It is expected that the survey will be similar in nature to the one being deployed with the Smart Circuit around the Scioto Mile.
- The Offeror shall immediately notify Smart Columbus of any crashes or incidents related to transporting customers.

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- The Offeror shall designate an employee as a liaison with Smart Columbus and shall provide Smart Columbus with contact information, including a mobile phone number, where the liaison can be reached.
- The Offeror shall provide a call-in number for Smart Columbus to contact in case of emergency, with an immediate response available during all operating hours.
- During the performance of any contract resulting from this RFP, the Offeror, for itself, its assignees, and successors in interest agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:
 - Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252) (prohibits discrimination on the basis of race, color, or national origin, and also requires programs receiving Federal funding to provide equal access to all regardless of income level or access to technology such as smartphones); and 49 CFR Part 21
 - The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. § 4601) (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-Aid programs and projects)
 - Federal-Aid Highway Act of 1973 (23 U.S.C. § 324 et seq.) (prohibits discrimination on the basis of sex)
 - Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. § 794 et seq.), as amended (prohibits discrimination on the basis of disability) and 49 CFR Part 27
 - The Age Discrimination Act of 1975, as amended (42 U.S.C. § 6101 et seq.) (prohibits discrimination on the basis of age)
 - The Civil Rights Restoration Act of 1987 (PL 100-209) (broadened the scope, coverage, and applicability of Title VI of the Civil Rights Act of 1964, the Age Discrimination Act of 1975, and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of Federal-Aid recipients, sub-recipients, and contractors, whether such programs or activities are Federally funded or not)
 - Titles II and III of the Americans with Disabilities Act (42 U.S.C. §§ 12131-12189), as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38 (prohibits discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities, including for passengers with mobility access issues as well as those with visual, hearing, cognitive, and other impairments)
 - Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (ensures non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations)
 - Executive Order 13166, Improving Access to Services for People with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, Offerors must take reasonable steps to ensure that LEP persons have meaningful access to their programs (70 Fed. Reg. at 74087 to 74100)
 - Title VIII of the Civil Rights Act of 1968 (Fair Housing Act), as amended (prohibits discrimination in the sale, rental, and financing of dwellings on the basis of race, color, religion, sex, national origin, disability, or familial status, such as presence of child under the age of 18 and pregnant women)
 - Title IX of the Education Amendments Act of 1972, as amended (20 U.S.C. 1681 et seq.) (prohibits discrimination on the basis of sex in education programs or activities)
 - Uniformed Services Employment and Reemployment Rights Act (USERRA) (38 U.S.C. 4301-4333) (prohibits discrimination on the basis of present, past or future military service)
 - Genetic Information Nondiscrimination Act (GINA) (29 CFR Part 1635, 42 U.S.C. 2000ff)

5.1.2 Vehicle Requirements

- Vehicles must be model/manufacturer year 2016 or newer, and free of any major dents, scratches, or other damage that may present a potential safety hazard or be cosmetically unappealing. Tires must be in good condition.
- The Offeror shall include responses for the vehicle to the USDOT National Highway Traffic Safety Administration (NHTSA) 12-point safety assessment, as well as whether the assessment has been submitted to NHTSA and, if not, whether there are any plans to do so.
- The vehicles shall comply with all applicable FMVSS or have approval to operate under an exemption to the FMVSS. If not compliant, describe how the items not in compliance are directly related to the full automation capability with no driver.
- Each vehicle shall have a capacity of at least 4 passengers excluding the operator. The vehicle shall also have space for passengers to store small amounts of luggage, such as grocery bags and strollers.
- The vehicles should implement Dedicated Short-Range Communications (DSRC) to communicate with roadside equipment to receive signal phase and timing (SPaT) and MAP data. While the route does not cross a signalized intersection, the vehicle will encroach upon Cleveland Avenue and 11th Avenue which will be a DSRC-equipped intersection. The project team is interested in evaluating the information received by the vehicle even though it will not be required to process the information to navigate the route.
 - If the vehicles do not have this capability, at a minimum the Offeror shall agree to install an onboard unit (OBU) supplied by Smart Columbus on each vehicle. This will allow the vehicles to communicate information on their location and share basic safety messages (BSM) with other connected vehicles in the Smart Columbus Connected Vehicle Environment and with vehicles equipped by OSU.⁵ The shuttle vehicles are not required to use the information they receive through the OBUs to inform decisions, though this is desirable. The Selected Offeror shall provide a means from which data from these OBUs will be collected.
 - A commercial Security Credential Management System (SCMS) will be provided by the City of Columbus for the vehicles to enroll in.
- The vehicles shall be equipped with cameras capable of viewing and recording the entirety of the passenger compartment. Further, the vehicles shall be equipped with cameras capable of capturing a 360 degree view external to the vehicle.
 - Video footage shall be collected and stored by the Selected Offeror and be accessible to Smart Columbus and/or the Columbus Police Department if requested.
 - Audio footage of the passenger compartment may also be collected.
- The Offeror shall agree to allow the vehicles to be wrapped or otherwise branded consistent with the intent of the deployment. Branding may include the Offeror's logo if desired alongside other graphics and sponsor brands. The Offeror shall provide limitations on placement of branding, so as to not occlude vital system functions, as part of its proposal. The final design will be coordinated with Smart Columbus.
- Vehicles shall be equipped with technology to count passenger boardings and alightings, with both location and time attributes, and this data shall be reported on a daily basis through an API to the Operating System.
- The vehicles shall stop and open doors at designated locations to allow passengers to board and alight. The vehicles shall not park in a spot blocking access to a fire hydrant or crosswalk. The vehicles shall also stop and open doors if they have detected that there is an issue on board, through sensors, passenger input, and/or secure override. The vehicles should also have multiple secure means of egress, in the event the primary exit is blocked and/or power failure occurs.

⁵ The Concept of Operations for the Smart Columbus Connected Vehicle Environment can be found at the following link: <https://smart.columbus.gov/uploadedFiles/Projects/Smart%20Columbus%20Concept%20of%20Operations-%20Connected%20Vehicle%20Environment.pdf>

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- The vehicles shall be capable of providing directional (i.e., northbound to St. Stephen's or southbound to Linden Transit Center) information in audible and visual form to passengers on both the inside and the outside of the vehicle.
- The Offeror shall identify the ability of its vehicles to operate the following operating functions in automated mode:
 - Performing a low-speed merge, pulling over to the side of the road, and moving out of the travel lane and stopping in order to service stop locations
 - Performing car following when approaching intersections and in stop and go traffic conditions by maintaining a safe distance behind the vehicle in front of them and determining when to proceed based on that vehicle's behavior
 - Navigating signalized (i.e., with the use of DSRC) and unsignalized intersections and performing left and right turns
 - Entering and emerging from a stop-controlled traffic circle
 - Crossing intersections with traffic speed limits up to 35 mph (and at times exceeding the posted speed limit)
 - Changing lanes (both left and right lane change)
 - Making appropriate right-of-way decisions when merging from a transit stop, at intersections, and when interacting with vulnerable road users
 - Detecting and responding to encroaching oncoming vehicles
 - Detecting stopped vehicles in their path and passing if necessary and safe
 - Detecting and responding to static and moving obstacles in their path
 - Detecting emergency vehicles, and when their sirens are on, and yielding appropriately
 - Detecting that they are being asked by law enforcement to move to the side of the road, and responding accordingly
 - Detecting and responding to vulnerable road users, such as pedestrians, cyclists, and scooters, in or approaching the vehicle's projected travel path, including at intersections and crosswalks
 - Providing a safe distance from vehicles, pedestrians, bicyclists, and scooters on the side of the road or sharing the lane
 - Decreasing speed when there is uncertainty regarding which action to take
 - Detecting and responding to detours and other temporary changes in traffic patterns, such as people (including construction workers and police officers) directing traffic in unplanned or planned events. An acceptable response includes informing the human operator of the need to take manual control.
 - Operating in normal rain, fog, and light snow conditions not deemed a weather emergency
- The vehicles shall be programmed with the ability to reasonably comply with local, state, and federal driving laws, regulations, ordinances, licenses, and certifications.
- The human operator shall have the ability to take manual control of the vehicle if deemed necessary.
- The vehicles shall be able to operate on the public roads as defined above in mixed traffic (integrated with other vehicles, trucks, bicyclists, pedestrians, etc.) without operator intervention, except in cases of extreme, abnormal conditions. Abnormal may include complete road closure due to a collision, unsafe road conditions (such as ice), or human-directed detours.
- The vehicles provided in the proposal must be accessible to those with disabilities. Onboard operators will be on board each vehicle during operations, and they may provide assistance to passengers beyond what the vehicle is independently capable of (such as securing a wheelchair or providing audible alerts). The Offeror shall identify its ability to comply with all applicable requirements of the Americans with Disabilities Act of 1990 (ADA), 42 U.S.C. 12101 et seq. and 49 U.S.C. 322; Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. 794; Section 16 of the Federal Transit Act, as amended, 49 U.S.C. app. 1612; and the following regulations and any amendments thereto:

- USDOT regulations, "Transportation Services for Individuals with Disabilities (ADA)," 49 CFR. Part 37;
- USDOT regulations, "Nondiscrimination on the Basis of Handicap in Programs and Activities Receiving or Benefiting from Federal Financial Assistance," 49 CFR. Part 27;
- US. DOT regulations, "Americans With Disabilities (ADA) Accessibility Specifications for Transportation Vehicles," 49 CFR. Part 38;
- Department of Justice (DOJ) regulations, "Nondiscrimination on the Basis of Disability in State and Local Government Services," 28 CFR. Part 35;
- DOJ regulations, "Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities," 28 CFR. Part 36;
- General Services Administration regulations, "Construction and Alteration of Public Buildings," "Accommodations for the Physically Handicapped," 41 CFR. Part 101-19;
- Equal Employment Opportunity Commission (EEOC) "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR. Part 1630;
- Federal Communications Commission regulations, "Telecommunications Relay Services and Related Customer Premises Equipment for the Hearing and Speech Disabled," 47 CFR. Part 64, Subpart F; and
- FTA regulations, "Transportation for Elderly and Handicapped Persons," 49 CFR Part 609.

5.1.3 Other Desired Capabilities

The following attributes, while not essential, are desired to enhance service efficiency, and will be considered for all available points in the Solution, Understanding of the Project, and Approach section.

- While the vehicles shall have a minimum capacity of 4 passengers (excluding the operator), higher (10+ person) capacity vehicles are preferred.
- The vehicles may be capable of operating equally well in both directions (forward and reverse), in order to change directions without needing to make a U-turn.
- The vehicles should be electric.
- The service may provide Wi-Fi to onboard passengers.
- The vehicles may have a screen on board, or a similar method of communicating information to passengers. This may include information on their route and current location, as well as visuals on the data and images the sensors are receiving and making decisions based on. It may also provide real-time, relevant COTA vehicle information for passengers making transit connections (COTA already sends this data to the Operating System). This could also be the method for survey dissemination if the Offeror chooses.
- It is the City's preference that individuals performing shuttle operations be represented by a collective bargaining agreement.

5.1.4 Project Deliverables

The Selected Offeror shall provide the following project deliverables (draft and final) for review and approval by Smart Columbus and its partners prior to the commencement of each project stage as specified. The format of deliverables will be coordinated with Smart Columbus, and some deliverables will be integrated into broader Smart Columbus Program documents and are not expected to stand independently.

Prior to vehicle delivery (September 2019):

- Project Plan: Outline of the project management approach, including a critical path method schedule that provides a more detailed timeline for all future deliverables.
- Site Assessment: After a site walk through with Smart Columbus, the Selected Offeror will verify the ability of its vehicles to operate in this environment, and identify potential risks. The Site Assessment will include an Infrastructure Improvement Plan that reflects the description of modifications included in the proposal.

- Safety Management Plan: Based on the risks identified in the Site Assessment, as well as prior experience with the vehicles, the Selected Offeror will develop a Safety Management Plan. This plan should also include impacts and mitigation strategies, and will be used to inform updates to Smart Columbus' existing Safety Management Plan.
- Data Interface Plan: This plan will identify the procedures and interfaces the Selected Offeror will use to meet the Data Sharing Requirements, including a schema of the API to the Operating System.

Prior to start of operational testing period (September 2019):

- Test Plan: Based on industry standards and the requirements in Section 5.1.6, this document will provide insight into the planned testing activities, including the following three demonstrations of the vehicle's capabilities:
 - Factory Acceptance Testing
 - Preliminary Acceptance Testing
 - The Full Operational Testing Period that culminates in Final Acceptance Testing
- Standard Operating Procedures: Documentation of the processes for operational situations the AV shuttle service is likely to encounter during normal operations and in non-normal situations. This document shall be made available for operations staff, the Smart Columbus team, and emergency services.
- Operator Training Plan: A strategy for recruiting onboard operators, a lesson plan for onboard operator training, and documentation of the permits that will be required.

Prior to start of passenger service period (November 2019):

- Test Report: A summary of the results of the testing activities outlined in the Test Plan, including a list of capabilities demonstrated, the conditions under which they occurred, and any corrective action necessary.
- Marketing and Education Plan: This plan describes the interface between promotion of the project by the Selected Offeror and the Smart Columbus marketing team, including the roles of each party and their intended actions and coordination.
- Communications and Engagement Plan: The Selected Offeror's plan for ensuring coordination with larger Smart Columbus Program Communications, as well as a list of primary points of contact.

Throughout project (November 2019 – November 2020):

- Data: This includes data to support transit information provision and vehicle performance, which will be required to be shared throughout the project period. More detail is in Section 5.1.5.
- Passenger Survey: The Selected Offeror may contribute questions to the passenger survey that is developed by Smart Columbus, subject to Smart Columbus' approval. The Selected Offeror shall support the dissemination of the passenger survey onboard its vehicles. Responses will be stored in the Operating System.
- Lessons Learned: The Selected Offeror is expected to continuously contribute to the discussion of lessons learned, which may result in a report and/or webinar coordinated by Smart Columbus.

5.1.5 Data Sharing Requirements

The Offeror shall agree to collect data and send this data to the Operating System via an API to inform the Data Sharing Requirements. Data will be stored for analytical purposes in the Operating System. Data that would be useful to potential passengers (such as real-time vehicle location information) will be shared via the Operating System at Smart Mobility Hub locations and in the Multi-Modal Trip Planning Application. **At a minimum, any and all of the data presented in Table 2 that is collected by the Selected Offeror shall be shared with Smart Columbus.** If certain data cannot be provided, the Offeror shall identify this in its proposal. Offerors may also suggest additional data they are willing to provide that would further enhance Smart Columbus's evaluation of the project in relation to program goals. Please note that proprietary data can be isolated.

Table 2: Minimum Data Needs

City of Columbus Solicitation Number: RFQ011174
 Request for Proposals for Automated Vehicle Shuttle Service

Data Type	Data	Frequency of Transmission
Operational	Vehicle route and schedule (GTFS)	Before launch and after any changes or updates are made
	Real-time vehicle location information (AVL, GTFS Realtime)	Real-time or near real-time
	Trip updates and service alerts	Real-time or near real-time
	Ridership (stop-level boardings and alightings)	Daily
	Actual stop arrival and departure times	Daily
	Vehicles miles traveled	Daily
	Vehicle hours traveled (hours the vehicle is in service)	Daily
	Number of route-trips served	Daily
	Duration of each trip	Daily
	Battery usage (such that it can be associated with weather, temperature, vehicle load, etc.)	Weekly
	Average vehicle speeds along each segment of the route	Weekly
	Count and duration of wheelchair ramp deployments	Weekly
Performance	Sensor and other telemetry data ⁶	Weekly
	Navigation variances ⁶	Weekly
	Probe data (nRTK-enabled or similar) ⁶	Weekly
	Mechanical data (vehicle condition)	Weekly
	Disengagements/interventions by the operator, relative to the amount of time spent in automated mode	Weekly
	Any other logged events (hard stops, evasive maneuvers, unruly passenger behavior, etc.)	Weekly
	Conditions driven in (weather, congestion, etc.)	Weekly
	Incident reports (Incidents include any collisions, and passenger behavior or other situations when an external entity is called upon for assistance)	Within one week following an incident
Communications	Record of operational data exchanged (includes SPaT and MAP messages the vehicle receives, BSM it sends, etc.)	Weekly

The Selected Offeror will be expected to contribute to sprint activities associated with the Operating System to ensure this data is properly integrated. This includes half-hour sprint activity meetings every two weeks, half-hour “scrum of scrum” meetings every week (which vendors for all Smart Columbus projects are expected to participate in), and hour-long demonstrations every month. All meetings can be attended remotely. Other meetings with emergency services, including a tabletop exercise, and other stakeholders shall occur in the lead-up to deployment.

The Offeror must exhibit a willingness and ability to partner with the Smart Columbus partners to achieve the outcomes of the pilot and contribute to evaluating lessons learned. This includes facilitating research collaboration with OSU, a commitment to marketing and co-promotion with Smart Columbus and institutions on the pilot route, a commitment to documenting learnings to inform best practice guidelines to be published by the City of Columbus as part of the U.S. Department of Transportation’s Smart City

⁶ Only on selected runs, for research use by OSU under an NDA and not subject to public records requests. Request includes all raw data and perception and decision-making outputs for the selected runs (preferably during different weather conditions).

Challenge grant, and an overall demonstration of ability to collaborate to continuously improve pilot outcomes throughout the 12-month operating period.

5.1.6 Testing Requirements

The Selected Offeror or its vehicle supplier will be responsible for conducting its normal factory acceptance testing prior to delivery of the vehicles to Smart Columbus. Representatives of the purchasing team will have the right to witness these tests, presumably at the manufacturer’s facility, or at another location as specified by the Selected Offeror. This testing should be performed for the actual vehicles that will be delivered. The Selected Offeror will be responsible for the preparation of a Test Plan and corresponding test procedures, with review by Smart Columbus prior to the conduct of the testing. Documentation of the test results and any corrective actions to be taken shall also be provided with each vehicle. Vehicles shall not be permitted to proceed to subsequent testing and deployment stages until the specified operating functions are demonstrated successfully.

The Selected Offeror will then conduct preliminary acceptance tests, with the purchasing team as witnesses, prior to testing on the route. This testing can be completed at the manufacturer’s facility, or another location as specified by the Offeror, and could be in conjunction with the factory acceptance testing if the Offeror chooses. Testing shall include the following operating functions in automated mode. The expectation of this service is to aim for fully automated operations, with the understanding that there may be an occasional need to disengage for safety. Offerors shall include a completed version of Table 3 in their response.

Table 3: Required Operating Functions

Operating Function	Description of Offeror’s Ability to Demonstrate this Operating Function Today or by Vehicle Delivery (September 2019)
Performing a low-speed merge	
Pulling over to the side of the road	
Moving out of the travel lane and stopping in order to service stop locations	
Performing car following when approaching intersections	
Performing car following in stop and go traffic conditions	
Navigating signalized intersections	
Navigating unsignalized intersections	
Performing left and right turns	
Entering and emerging from a stop-controlled traffic circle	
Crossing intersections with traffic speed limits up to 35 mph	
Changing lanes (both left and right lane change)	
Making appropriate right-of-way decisions when merging from a transit stop	
Making appropriate right-of-way decisions at intersections	
Making appropriate right-of-way decisions when interacting with vulnerable road users	
Detecting and responding to encroaching oncoming vehicles	
Detecting stopped vehicles in their path	
Passing stopped vehicles when safe	
Detecting and responding to static obstacles	
Detecting and responding to moving obstacles	
Interactions with emergency vehicles	

Operating Function	Description of Offeror’s Ability to Demonstrate this Operating Function Today or by Vehicle Delivery (September 2019)
Detecting and responding to vulnerable road users in or approaching the vehicle’s projected travel path, including at intersections and crosswalks	
Providing a safe distance from objects on the side of the road or sharing the lane	
Decreasing speed when there is uncertainty regarding which action to take	
Detecting and responding to detours and other temporary changes in traffic patterns	
Operating in rain, fog, and light snow conditions not deemed a weather emergency when such conditions are available	
Deploying a wheelchair accessible ramp	

Offerors should also include in their proposal any additional recommended testing protocols.

Upon successful testing and demonstration of the vehicles in factory acceptance and preliminary acceptance testing, the Selected Offeror will be permitted to proceed to full operational testing, to demonstrate the ability to operate as desired. During this phase, the vehicles will operate per the planned routes and schedule but without taking on passengers. Staff from Smart Columbus or as designated by Smart Columbus or the Selected Offeror will be permitted to ride the vehicles during this period and could simulate passenger boardings and alightings.

Prior to the beginning of passenger service, the Selected Offeror shall meet with City of Columbus emergency services (fire, police, ambulance, etc.) to provide background and operating information on the vehicles. Participation in a tabletop exercise detailing various response scenarios that test the thoroughness and accuracy of the Standard Operating Procedures is required.

Upon completion of the two month (or less) operational testing period, the Selected Offeror will again prepare and conduct a final acceptance test, similar to the preliminary acceptance test. The Selected Offeror will then produce a Test Report suitable for delivery to the USDOT. The Test Report will include any corrective actions necessary. The testing should demonstrate the vehicles’ ability to perform:

- Everyday operations on the route, demonstrating lane adherence, turning, stopping and starting, and safe reactions to situations the vehicle happens to encounter
- Service of the passenger stops (including pulling over, opening and closing doors, and merging back onto the route)
- Operations in changing roadway/weather conditions (if present)
- Operations in peak and off-peak traffic
- Other items from the preliminary acceptance testing as identified above

Upon meeting the criteria agreed to for this stage of testing, the operator shall proceed to normal operations, complete with passenger service, starting with partner and media days before opening the service to the general public.

5.1.7 Insurance Requirements

Before commencing any contract work, the Selected Offeror shall procure insurance to operate a motor vehicle in the State of Ohio under Ohio law covering each vehicle and its operator. This insurance shall be maintained during the life of the contract, unless otherwise specified. It is the responsibility of the Selected Offeror to provide evidence of its insurance policies and defined limits prior to contract award. Due to the uncertainties regarding AV insurance, at a minimum, Commercial General Liability, Business Automobile Liability, and Workers’ Compensation and Employers’ Liability insurance certificates are to be

provided and must be available for confirmation before the contract can be awarded. The insurance shall comply with the following requirements:

A. Workers' Compensation and Employer's Liability

The Selected Offeror shall provide and maintain workers' compensation insurance in compliance with Ohio's Workers' Compensation laws, and any other applicable workers' compensation or disability laws.

B. Commercial General Liability Insurance

The Selected Offeror shall provide and maintain commercial general liability insurance in an amount not less than \$1,500,000 per occurrence and \$2,000,000 general aggregate. Coverage shall be on an occurrence form, and include contractual liability.

The Selected Offeror shall provide Smart Columbus advance notice of a policy cancellation on the project. The policy shall require that the insurer endeavor to notify Smart Columbus of the policy cancellation. The City of Columbus, all approving parties, and all of their officers, agents, and employees shall be additional insured parties.

C. Proposed or Furnished Vehicle Liability and Automobile Liability

The Selected Offeror shall provide and maintain automobile liability insurance covering all owned, leased, borrowed, rented, or non-owned vehicles used by employees or others on behalf of the Selected Offeror for the conduct of the Selected Offeror's business, for an amount not less than \$1,500,000 Combined Single Limit for Bodily Injury and Property Damage. The term "automobile" shall include private passenger autos, trucks, and similar type vehicles. The policy shall be amended to include the following extensions of coverage:

1. Contractual Liability coverage shall be included to cover the assumed liability of the indemnity recited in this paragraph;
2. The Selected Offeror shall provide Smart Columbus advance notice of a policy cancellation on the project. The policy shall require that the insurer endeavor to notify Smart Columbus of the policy cancellation; and
3. The City of Columbus, all approving parties, and all of their officers, agents, and employees shall be additional insured parties.

D. Business Automobile Liability

Insurance with Occurrence Form shall be maintained by the Selected Offeror for the ownership, maintenance and use of all its owned, non-owned, leased or hired vehicles with limits of not less than \$5,000,000 Combined Single Limit Each Accident Bodily Injury and Property Damage.

The Selected Offeror shall purchase and maintain coverage on forms no more restrictive than the latest editions of the Business Auto Policies of the Insurance Services Office. Excess or Umbrella Insurance Coverage may be used to make up the difference between the policy limit of the underlying policy and the total amount of coverage required.

E. Valuable Papers and Records Insurance

Insurance covering valuable papers and records shall be included only if specifically required in the Agreement.

F. Umbrella Liability

Umbrella coverage in excess of the underlying liability policies in an amount not less than \$1,500,000 per occurrence / \$2,000,000 aggregate. The policy shall include the following extensions of coverage:

City of Columbus Solicitation Number: RFQ011174
Request for Proposals for Automated Vehicle Shuttle Service

1. A thirty (30) day notice of cancellation to Smart Columbus; and
2. The following form of primary general and automobile liability coverage:
 - a. The City of Columbus, all approving parties, and all of their officers, agents, and employees shall be additional insured parties;
 - b. Products and completed Operations; and
 - c. Contractual Liability.

G. Notice of Cancellation

Should any of the above-described insurance policies be cancelled, non-renewed, or be reduced in coverage or limits before the expiration date, the Selected Offeror shall provide Smart Columbus advance notice of a policy cancellation on the project as soon as practicable. The issuing company shall endeavor to notify Smart Columbus of the policy cancellation.

Appendix B: Operational Concept

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1 Introduction

This Operational Concept describes the development of subsequent phases of the Smart Columbus Connected Electric Autonomous Vehicle (CEAV) project. The purpose of this document is to summarize a high-level view of the system to be deployed. This document is not intended to fulfill the purpose of a more traditional Concept of Operations or other standard systems engineering documentation. Rather, it is intended to provide a quick reference for project stakeholders to ensure a consistent understanding of project needs, process framework, and other system attributes. This document contains the following sections:

Section 1 provides an overview of the document and of the system to be deployed.

Section 2 describes the proposed system and the systems that support it.

Section 3 outlines the impacts the system will have on stakeholders.

Section 4 explains how the system will be monitored and evaluated.

Section 5 presents the requirements of the system from different perspectives.

1.1 Context, Background, and Scope

In June 2016, the City of Columbus, Ohio won the United States Department of Transportation (USDOT) Smart City Challenge. Columbus intends to define what it means to be a “Smart City” and serve as a model for other cities wishing to fully integrate innovative technologies, such as automated and connected vehicles into the transportation network. Columbus is acting as a laboratory for Intelligent Transportation Systems (ITS), and it is disseminating lessons learned and best practices to cities across the United States in an effort known as Smart Columbus. The goal of the Smart Columbus project is to connect people by creating opportunity for city residents to better access jobs and services while improving the overall safety and efficiency of the transportation network.

Smart Columbus aims to deploy and evaluate automated shuttles against a series of use cases in a series of pilots commissioned by the City of Columbus, the Ohio State University (OSU), the Columbus Partnership, the Ohio Department of Transportation (ODOT), and DriveOhio and coordinated with the Central Ohio Transit Authority (COTA). The proposed technology solution involves vehicles that are Level 4 automated, as defined in SAEJ3016⁷, and preferably electric and connected, serving the public on short trips where other modes are not presently available or convenient. Operations of the fleet are expected to be similar to that of a traditional transit service, with pre-determined routes and signed stops along the routes for passengers to board and alight. The success of this project will be looked at as a guide for potential deployment of future automated vehicle (AV) routes in other parts of Columbus and elsewhere by verifying their ability to perform as intended and providing feasibility for their use in similar environments. The following context diagram provides an overview of the CEAV project and the systems that support this service.

⁷ SAE International, J3016_201806: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles, revised June 2018, https://www.sae.org/standards/content/j3016_201806/.

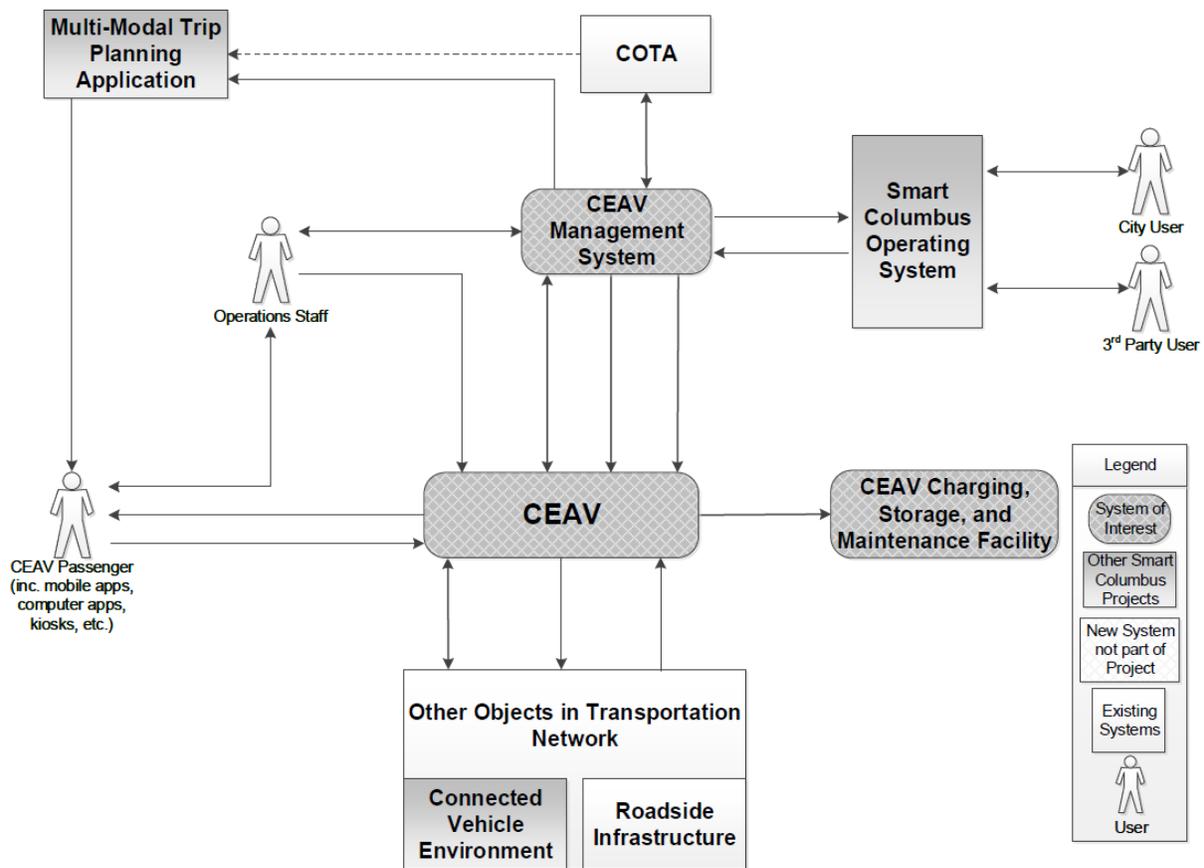


Figure 1-1: High-level Context Diagram for the CEAV System

Integration with the Smart Columbus Operating System is central to Smart Columbus' vision for facilitating Mobility as a Service (MaaS) and other Smart City applications. The Operating System is a cloud-based, dynamic, governed data delivery platform that is at the heart of Smart Columbus. It is designed to ingest and disseminate data from external systems in which components of other applications will reside in the Operating System as loosely coupled services. The Operating System also serves as the source for real-time operational data and archived historical data from a combination of data storage sources for use by the City of Columbus and third-party applications and developers. The Operating System is the data platform environment that integrates data and data services from multiple sources, including the planned Smart Columbus projects, traditional transportation data, and data from other community partners. The Operating System embodies open-data and open-source concepts to enable better decision-making and problem solving for all users to support a replicable, extensible, sustainable platform.

As it relates to AVs, Smart Columbus has a multi-phase vision for enabling integration with the Operating System. For the first phase, it is expected that a CEAV System Operator will, in addition to its own services, provide General Transit Feed Specification (GTFS) and GTFS Realtime (GTFS-RT) data as well as Automatic Vehicle Location (AVL) data to the Operating System to be made available for other applications. Further, the AVs should allow for capture and archive of onboard sensor data, as well as any incident data including event logs. The intention is to eventually include fleet management platforms for all Smart Columbus transportation providers in the Operating System, but initially it will be sufficient for output feeds such as GTFS, GTFS-RT, and AVL to be made available for other applications to use outside of Smart Columbus, and in parallel, routing data to be shared with the Operating System itself. Data needs are described in further detail in Section 5.2.

1.2 Goals and Objectives

The Smart Columbus team is interested in deploying CEAV technology to evaluate the ability of this technology and associated vehicles to enhance the mobility of residents and visitors, to operate on public roadways in Ohio, and to satisfy the specific operating purposes for which each service is intended. Further, the team is interested in better understanding the infrastructure required to implement and support the operation of this technology, the approach to public adoption, the types and value of data produced, the associated cost, and the benefits derived from the use of AVs. To minimize risk and to provide the best opportunity for understanding these factors, it is desired to procure turn-key solutions from vendors responsible for deploying, operating and maintaining the services. Vehicle performance will be recorded, such as time in service, miles traveled, ridership, high-accuracy positioning, speed, battery/fuel usage, number of and reasons for disengagements, hard braking, evasive maneuvers, and more. From a program perspective, the data collected by the CEAV will be the primary focus and positioned as a user story in the Operating System, which will provide information, lessons learned, and best management practices to benefit the national community.

The CEAV deployments will benefit the region by demonstrating the potential of this emerging technology to local stakeholders and the public, allowing for an educational experience while also inspiring quicker adoption of future innovations. More broadly, results of this project will be used to inform the following overall goals:

- Better connect the community to services through first-mile/last-mile/only-mile connections by providing a convenient and reliable transit option.
- Grow COTA ridership by encouraging a modal shift to public transit by increasing the attractiveness and availability of end to end transit options.
- Validate and ensure that emerging transportation technology solutions provide equitable and accessible transportation.
- Establish a common data exchange interface that is interoperable across various deployment locations, vehicle types, and CEAV System Operators.
- Aid in informing a set of procurement guidelines, including demonstrated vehicle performance and data sharing requirements, for both operational and capital projects.
- Develop a set of AV operational testing and evaluation guidelines to benchmark AVs.
- Develop a methodology for evaluating the operational safety of the system in various deployment settings based on real-time data provided to the Operating System.
- Summarize lessons learned to help identify needs, understand how to garner user acceptance of systems, and study which interfaces work best.

1.3 Overview of Users

The CEAV system is expected to affect and be affected by a variety of types of users. User classes and the groups of people who comprise them are presented in the following table.

Table 1-1: Users and User Classes

User Classes	Applicable Groups
CEAV	Vehicles that provide service for the CEAV system
CEAV Passenger	Area residents, employees, visitors, etc., some of whom have limited mobility and other disabilities
CEAV System Operator	Transportation operations and management entity
Operations Staff	Staff hired by the CEAV System Operator to perform tasks for the CEAV that require human assistance, including onboard operators and vehicle maintenance staff
City Staff	City of Columbus staff, responsible for infrastructure and roadway maintenance (including snow removal and landscaping)

User Classes	Applicable Groups
City Data Users	City of Columbus users, including Department of Technology (DoT) and Department of Public Service (DPS) employees
3rd Party Data Users	Public agencies, private application developers, researchers, and other public and private entities

Other involved personnel who are not direct users of the CEAVs but will interact with the CEAV system are included in Table 1-2. These groups are different types of other roadway users, and will interface with the CEAVs on the public roadways on which they are deployed. The CEAVs will need to be capable of safely interacting with all of these types of other roadway users.

Table 1-2: Other Involved Personnel

Class	Applicable Groups
Other Vehicle Operators	Area residents, employees, visitors, etc.
Bicyclists	Area residents, employees, visitors, etc.
Pedestrians	Area residents, employees, visitors, etc.
Emergency Vehicle Operators	Police/ambulance/fire
First Responders	Police/fire responding to incident involving a CEAV.

1.4 Process Outline

The City of Columbus is working in collaboration with other local partners, including ODOT, DriveOhio, OSU, and the Columbus Partnership to plan, implement, and evaluate this project. Each project partner's roles and responsibilities include:

- City of Columbus:** The City manages the Smart Columbus Program, a large and diverse transportation technology deployment and data project, in a way that ensures successful implementation and builds sustainable solutions. The City will be the contract holder for one of the deployments and provide support services and facilitate the data exchange through the Smart Columbus Operating System.
- ODOT:** As the state DOT, ODOT is a key Smart Columbus partner coordinating data management and availability, managing transportation policy developments, and assisting in the transferability and portability of the Smart Columbus Program to other Ohio cities and regions.
- DriveOhio:** This statewide initiative is the single point of contact to more quickly and efficiently access the needed resources for smart mobility projects. It serves as the hub for all things automated and connected in the State of Ohio. DriveOhio is the contract holder for the first deployment around the Scioto Mile.
- Columbus Partnership:** This non-profit, membership-based Chief Executive Officer (CEO) organization represents 65 of Columbus' leading businesses and institutions, the Columbus Partnership, is the proxy for key private sector engagement on implementation of the Smart Columbus Program, as well as a significant funder for the first deployment around the Scioto Mile.
- OSU:** This university partner provides research and organizational support to the Smart Columbus Program, including through the Transportation Research Center and the Center for Automotive Research. It is providing research support for this project. OSU may be a contract holder for a deployment within the Smart Columbus portfolio in the future.
- COTA:** The local transit agency provides high-frequency transit service near the potential AV shuttle service area, allowing for ample transfer opportunities for passengers.

Working with these partners and leveraging a public-private partnership model allows for the generation of various use cases, which will result in the deployment of CEAVs in various environments across Columbus, such as in a downtown setting, in a neighborhood, or on a university or corporate campus.

These entities intend to jointly issue requests for proposals (RFP) for CEAVs in various settings, aimed at solving various community mobility challenges. The first RFP was issued by ODOT, supported by a memorandum of agreement (MOA) with other project partners. The second RFP was supported by the release first of a request for information (RFI), followed by the RFP. The RFI was released in order to better understand current CEAV capabilities, solicit input on potential routes and route characteristics, and be able to propose a system that is feasible, attractive, and appropriately challenging for potential vehicle vendors, CEAV System Operators, and other project partners. The schedule for past and upcoming releases is included in Table 1-3.

Table 1-3: High-level Project Schedule

Task	Date
RFP#1 released	July 2, 2018
Vehicle delivery for RFP#1	September 2018
RFI released	October 11, 2018
Expected RFP#2 release	January 17, 2019
Expected vehicle delivery for RFP#2	September 2019

Partnering with private, academic, and public-sector partners presents the best opportunity to mitigate the risks to the program and ensure successful deployment. Additionally, it presents the best opportunity for community learning and addressing challenges faced by those seeking to deploy CEAV technology. Safety, interoperability, and user acceptance will continue to be challenges faced by cities and organizations seeking to deploy CEAV technology, and lessons learned by this process will be able to help provide guidance in navigating these challenges.

2 System Concept

The use of connected and automated shuttles has been widely proposed as a solution to the first-mile/last-mile/only-mile problem. The City of Columbus intends to address, investigate, and propose solutions to the social and technical challenges currently associated with the use of CEAV technology for safer and more efficient access to jobs and services in a “smart city”.

Social challenges that will be explored in this project include:

- How to gradually introduce and expand a CEAV solution for best results
- How to develop and improve user acceptance and user benefits of AVs
- How to integrate a new transportation system into the rest of the transportation network
- How to increase user perception of safety and reliability of AVs, in particular their use to supplement transit

Technical challenges that will be focused on in this project include:

- Determining how to strategically deploy AVs to improve overall mobility
- Resolving challenges with AVs operating in mixed traffic at higher speeds on urban roads
- Developing solutions to help automated shuttles navigate right of way problems at intersections and elsewhere along the roadway
- Ensuring pedestrian and bicyclist safety for interactions with AVs
- Exploring all-weather operation of CEAV technology
- Analyzing latency and high network traffic problems in connectivity through communications with other road users and infrastructure and to the data management hub

- Handling uncertainty due to unpredictable operation of non-automated vehicles, other road users, and environmental conditions

While all items in these lists are important and while the lists could easily be extended, the most important technical problem blocking the deployment of CEAVs in a smart city to enhance mobility is that no certification, testing, and rating systems for safe pre-deployment evaluation methods for these shuttles currently exist. This forces city officials and AV developers to rely on public road testing for the determination and solution of technical challenges like the ones above. This project intends to introduce and help develop holistic tools that will enable a priori determination and solution of connected and automated mobility technical challenges including the actual route and other vehicles and mobility improvements. This will be followed by proof-of-concept experimental work and pilot deployments to demonstrate that connected and automated mobility can be used to improve first-mile/last-mile/only-mile access in a smart city. This research will be supported by project partners, including OSU.

2.1 Routes and Potential Use Cases

Initially starting with 14 route ideas in various settings that narrowed down to four potential routes and use cases that were refined with stakeholder and industry feedback, Figure 2-1 presents the route where a CEAV service was determined to best enhance access to transportation and help fill a local need in Columbus within current technology constraints. This route has been discussed with stakeholder groups, and engagement is ongoing. This and the other potential routes were developed and created with the following localized goals:

- Connecting the community to jobs and services, including
 - Community centers
 - Opportunity centers
 - Food sources
 - Support services
 - Smart Mobility Hubs
- Improving safety and mobility of travelers by mitigating first-mile/last-mile/only-mile challenges
- Encouraging transit use by expanding locations served and implementing efficient schedules and integrated solutions
- Reducing traffic congestion and greenhouse gas (GhG) emission in the region

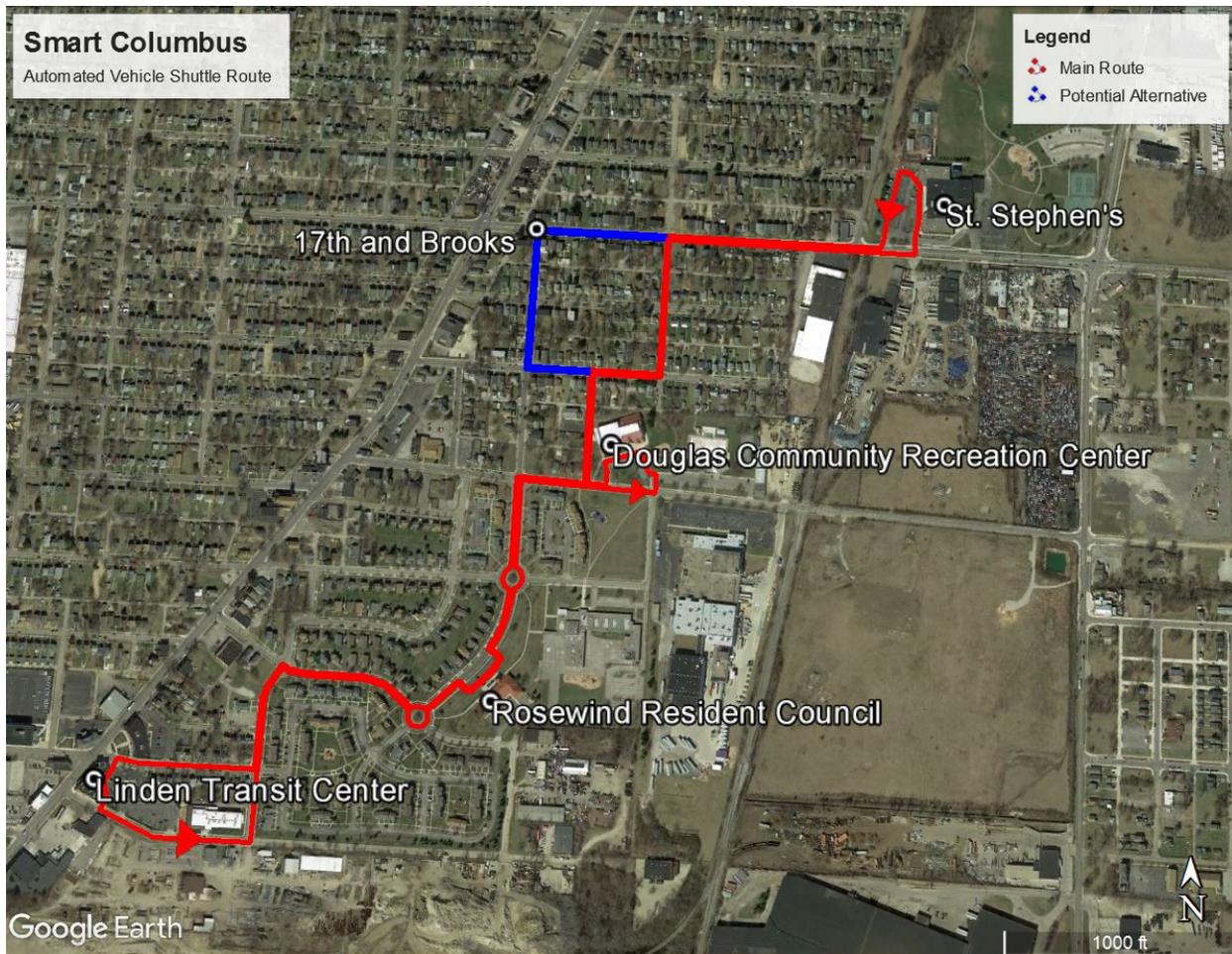


Figure 2-1: St. Stephen's to Linden Transit Center Route

The route chosen travels between St. Stephen's Community Center and Linden Transit Center, both of which are designated as Smart Mobility Hubs within the Smart Columbus project portfolio. These Hubs will provide access to mobility options at chosen areas of community focus, such as transit stops, libraries, and community centers to improve mobility for the surrounding area. Hubs may include features such as real-time information displays; USB charging points; embedded touch screen displays at kiosks with access to trip planning, emergency calling and other applications; and multimodal resources including bike-share racks and car-share parking. The goal of this route is to connect the community center with the CMAX high-frequency bus rapid transit line as well as the neighboring community.

The segment in blue is an alternate route that provides closer service to Cleveland Avenue, a road with high frequency COTA service. The purpose of this alternate is to provide passengers traveling to and from St. Stephen's somewhere north of the map area on a COTA route with a better connection. However, traffic operations near Cleveland Avenue may introduce additional complexity to the route. Whether this alternative is pursued (in one or both directions of the route) will depend on collaborative discussions between the vehicle vendor and the Smart Columbus team.

2.2 Modes of Operation

Modes of operation establish the "what, where, when, why, and who" of the operational condition of a system. The modes of operation specifically for the new CEAV system are as follows.

Table 2-1: CEAV System Modes of Operation

Mode	Definition
<p>Mode 1: Normal Operating Conditions System is operating as designed</p>	<p>All CEAVs in the fleet are operating on their routes as designed. The CEAVs have the charge/fuel available to complete their operations. When scheduled charging/fueling does occur, a CEAV returns to the appropriate location and safely obtains the needed charge. When daily operations are completed, all CEAVs are returned to their designated secure storage location after allowing all onboard passengers to alight at their desired stop.</p> <p>If severe weather or another event occurs but the CEAVs are safely taken out of operation before any safety incidents can occur, the system is considered to be operating as intended despite the transit service no longer being operational.</p> <p>CEAV passengers can communicate with the CEAV System Operator for questions and comments by speaking directly with Operations Staff (who will be stationed on CEAVs and possibly also at stops, especially during initial operations) or by using an onboard interface. Onboard operators are onboard each vehicle, monitoring operations and stepping in when necessary.</p>
<p>Mode 2: Failure/Degraded Conditions Situations that require the temporary shutdown of the system, such as “false” warnings and any “fail-safe” mode to which the system would revert</p>	<p>Everyday operations or a specific incident have caused conditions to degrade from the operational state. Degraded conditions include traffic causing the transit service to be behind schedule, high demand causing the CEAV to be at capacity, or a CEAV running out of charge/fuel unexpectedly and needing to return to a charging/fueling station immediately. This condition also includes a system component, such as an automatic charging capability, not working as designed and the system needing to revert into a fallback condition, in this case manual charging. The degraded mode also includes passenger safety issues that have caused a passenger alert to be called to the CEAV System Operator, or the CEAV System Operator otherwise being alerted that the CEAV needs additional monitoring or for Operations Staff to step in. Severe weather conditions that impact the safety of the roadway are also included if the CEAV is not removed at the point conditions reach an unsafe state outside the scope of the CEAV’s safe operating conditions.</p> <p>A failure condition occurs if the CEAV is not able to make it to a charging/fueling station before losing charge, if the CEAV has an interaction with a public safety official who believes it is operating in an unsafe manner, if there is a CEAV malfunction that could cause additional issues, or if a collision or other incident has occurred. In these cases, Operations Staff will need to be involved in order for the CEAV to return to a degraded or operational state.</p>
<p>Mode 3: Maintenance Conditions Conditions where repair is done for an unscheduled breakdown of equipment functionality or for scheduled preventative maintenance</p>	<p>The CEAVs will be regularly checked for any issues. If an issue is detected during routine maintenance, preventative measure is scheduled, or an emergency breakdown occurs, the CEAV will be taken out of service and repaired by the appropriately trained entity. If operations are ongoing and a spare CEAV is usually held during operations, this CEAV undergoing maintenance will become the spare and service will continue as regularly scheduled. Otherwise, partial service will be provided (i.e., at higher headway) until the vehicle in maintenance can be returned back to service.</p>

2.3 Operational Polices and Constraints

There are various policies and procedures governing the use of automated vehicles in the state of Ohio and the United States as a whole. These include:

- The Federal Automated Vehicles Policy, published by the USDOT and the National Highway Traffic Safety Administration (NHTSA) in September 2016 and updated (as Automated Driving Systems (ADS): A Vision for Safety 2.0) in September 2017 and (as Preparing for the Future of Transportation: Automated Vehicles 3.0) in October 2018, which provides guidance for the developing federal approach to automated vehicle performance specifications, the roles delegated to states, and current and proposed regulatory tools to maintain safety in this new transportation environment while not restricting technological innovation.
- The Federal House of Representatives passed a bill out of committee in 2018 that would have allowed automated vehicle testing for up to 100,000 vehicles in any state and would have overridden state laws. However, the Senate did not pass any similar legislation in 2018, so the bill did not become law. New legislation will need to be passed by the new Congress in 2019.
- Federal Motor Vehicle Safety Standards (FMVSS), also developed by NHTSA, continue to regulate features required of vehicles operated on public roads, in categories such as crash avoidance, crashworthiness, and post-crash survivability.
- ODOT is in the process of developing its approach to AV implementation and, in May 2018, Governor Kasich signed Executive Order 2018-04K to establish guidelines for testing AVs in the state.⁸ Each vehicle must have a designated operator onboard to monitor the vehicles at all times.

CEAV technologies are an emerging field, and in many cases, existing regulations have not kept pace with the growing capabilities of available products, or have been kept intentionally strict to minimize risk while new advances are tested and added competences are demonstrated. Because of this, it may be necessary to modify and/or customize the procured CEAVs in order to comply with regulations, by for example installing a steering wheel and brakes for a human to be able to take control, even if the CEAV is controlling itself for most, if not all, operations. These existing regulations and any potential changes or opportunities for exemptions will continue to be monitored, as it is possible that other solutions may become available within the planning horizon of the CEAV project. Therefore, the scope of the CEAV project may need to be adjusted based on the regulatory environment at the time of deployment, as well as advancing vehicle capabilities.

The CEAVs will be traveling on roads with mixed-traffic, and even in cases where the roads are closed for testing, the vehicles will need to be able to respond to traditional regulatory signs and signals. Regulatory signs and signals are currently produced for human operators, with regulations and standards on aspects such as the size and color of the text, but a CEAV may be able to understand a barcode or other symbol better than text, or may not even need a physical sign at all, especially if it is traveling on the same route every day and this information has been programmed in. However, it will be essential to maintain these fail-safe options of regulatory sign detection in the event of outages, weak signals, or traditional human vehicle operators who may be unfamiliar with the new technology. The CEAVs should have the ability to communicate with other vehicles in Smart Columbus's Connected Vehicle Environment using Dedicated Short Range Communications (DSRC).

Because the CEAVs are intended to be operated as a public transit service, this system will also need to operate in compliance with US laws and regulations on public transit. Mandatory compliance with these rules is generally determined by funding source and operating entity, but even if the CEAV system is not required to comply, it should still operate in line with best practices in the industry. This includes meeting Buy America requirements, complying with the Americans with Disabilities Act of 1990 (ADA), integrating universal design and inclusive information and communication technology, and ensuring an equitable

⁸ The Executive Order can be found here: http://governor.ohio.gov/Portals/0/%21%21%21EO%202018-04K%20%28Signed%205_9_18%29.pdf.

service that does not benefit one group at the expense of another (including, for example, a Title VI analysis to determine service and fare equity, if applicable).

2.4 Support Environment

The CEAV project is expected to be supported by an expansion in the responsibilities of certain stakeholders and the enthusiastic support of all project partners. In particular, additional support responsibilities will primarily be the responsibility of infrastructure owner/operators and the CEAV System Operator.

The City of Columbus has supported the development of a CEAV system in Columbus since this project's conception. Its input and ongoing support, particularly during the development of the routes, will be essential to ensuring the service fulfills project goals and is responsive to employee, resident, and visitor needs and wants in the deployment areas. Other project partners should expect similar responsibilities, particularly if they are the owner/operators of infrastructure in a deployment area.

A transportation operations and management entity will be responsible for CEAV operations and management; this entity is referred to as the CEAV System Operator. The entire CEAV system will be procured as a turnkey solution, and not assembled by the project team beyond specifying the deployment constraints and providing some customizable features such as the type of branding on the exterior and interior of the CEAVs. Thus, the identification and responsibilities of the CEAV System Operator will be specified in any procurement language and included in any eventual contracts. Maintenance will also be contracted out in the same contract as the procurement of the CEAVs, as few other groups have the necessary background and experience in CEAV technology. The CEAV System Operator will be responsible for ensuring the service is operating as designed and that any potential issues are communicated before a potential incident may occur. The CEAV System Operator will also be responsible for ensuring that passengers are aware of the service and can use it effectively, by coordinating communications and outreach, including for travelers with disabilities. Infrastructure maintenance will be the responsibility of the City of Columbus, but all other maintenance will be the responsibility of the CEAV System Operator. Exact roles and responsibilities will be spelled out in procurement documents and any eventual contracts.

The CEAV System Operator may be provided with a maintenance, storage, and electric vehicle charging facility in close proximity to the service route. If the vehicles are not electric and use gasoline or diesel instead, they may refuel at a public gas station or be provided with a dedicated station. The exact facility location(s) will be agreed upon during the procurement process.

2.5 Product Vision and Roadmap

The product vision is a turn-key CEAV service solution, including responsibility for providing, deploying, operating, and maintaining the service. The CEAV System Operator must:

- Be able to collect data, provide this data to the Operating System, and generate reports as to the operation of the vehicles on a regular basis
- Have a way to interact with the people using the service and determine their reaction to the technology, through survey or other method
- Have a demonstrated track record of deploying and operating a CEAV service in a mixed traffic environment, utilizing vehicle capabilities similar to the proposed service

A Request for Information (RFI) was released in the fall of 2018. The objective of this RFI was to better understand current CEAV capabilities and not to make a vendor selection. Planning for subsequent deployments is underway, with the ultimate route selection influenced by the outcomes of the RFI.

Current understanding of CEAVs is summarized in this section but is expected to continue to evolve as additional information from potential project partners is received and the technology advances.

CEAV shuttles are similar in size to existing shuttle-type vehicles, generally with a capacity of about 4 to 15 passengers. The preferred capacity of a vehicle will depend on the use case it is intended to serve. They are intended to be shared and are not individually owned, though they may be owned by a private corporation. They operate at low-speeds, on surface streets rather than freeways, and most are electric, which is efficient at these speeds. Current vehicle capabilities are limited, and selected CEAV System Operators will need to certify that they have visited or watched a posted video of the site during procurement, and plan to conduct an official site visit before deployment if selected, in order to ensure the environment is suitable for their vehicle. Some limitations from previous vendor outreach include:

- Operating speed: Capped at around 25 miles per hour, with a safe operating speed around 15 miles per hour or even lower in some pilots, in part due to the suddenness with which the vehicle stops when it detects an obstacle, and how this can be unsafe for passengers
- Clearance: For the vehicle, its sensors, and some buffer
- Grade: Especially when fully loaded with passengers, electric vehicles or those with more passengers may struggle climbing a hill compared to vehicles with internal combustion engines or fewer passengers
- Vehicle capabilities: Challenges such as changing lanes and making unprotected left turns have not yet been fully resolved, and many vendors are not comfortable operating on routes with these types of obstacles. They also have challenges detecting and responding to signage.
- Environmental obstacles: The vehicles need to be able to consistently obtain a signal for localization purposes, so obstacles such as tall grass and tree cover can be an issue
- Level of ADA compliance: Some vehicles are ADA-accessible (they have a ramp and audio/visual features), but not ADA-compliant (which would require a more sophisticated latching system, among other features). A substitute method used in some pilots to date is the deployment of an alternative, fully ADA-complaint vehicle that is not an AV and can be called if needed.

There are many opportunities to deploy CEAV shuttles to supplement or enhance existing transit service. Generally, these vehicles are ideal for short-distance service, where they can be used to tackle the first/last-mile problem. Deployments today have generally also been showcase opportunities, for an agency or organization to show they are innovative and supportive of AV technology. There have also been opportunities for data capture to help guide future developments. For example, a one-year pilot in Las Vegas is being sponsored by AAA, who is interested in seeing how people perceive AVs and whether their perceptions may change, if they are directly exposed to the technology. This shuttle was deployed in an area that attracts many tourists, and approximately half of the passengers have been from outside the state of Nevada, which allows AAA to reach a broader audience and not just the local public. CEAV shuttles can also be used for campus circulation, at a university, employment center, office park, or airport. For example, two shuttles owned by Mcity are being used to supplement the University of Michigan's existing bus transit service that circulates students and others around campus.⁹ Deploying these vehicles locally also provides an opportunity to educate the local public on emerging technologies. A transit agency or organization who pilots these technologies early on will be better able to adapt to future innovations, because both internal agency processes and the public will be better prepared for and accepting of AV technology.

There are a growing number of players in the automated transit bus and shuttle space, and new products could come to market at any time as many companies are working behind closed doors to protect their intellectual property and generate a larger splash when they do launch. Non-American vendors have become more familiar with US transit regulations since first introducing their vehicles in the US and have

⁹ <https://mcity.umich.edu/shuttle/>

begun installing additional features, such as ramps to comply with the ADA, in newer vehicle models. They have also begun opening manufacturing facilities in the US, to comply with Buy America requirements.

Most vendors offer their vehicles for sale or for lease, and most procurements in the United States so far have been via lease agreements. Vendors have often partnered with traditional transit operating entities to provide a turnkey solution. Vehicle costs vary depending on the supplier and on the features that are included. Lease agreements generally include many operating costs, such as vehicle monitoring and maintenance, while purchase agreements would require O&M costs as well as license and service agreements to be covered in addition to the purchase cost.

2.6 Sustainability and Adaptability

As CEAV technology continues to advance, many commercial CEAV vendors are striving to deploy more innovative and cutting-edge platforms and business models. It is possible that within the timeline of this project, including during the deployment period, a selected vendor or the industry as a whole will see a major shift, such as:

- Moving to a dynamic operating model, rather than serving stops along a fixed route
- Focusing on smaller capacity vehicles (i.e., personal rapid transit)
- Increased vehicle capabilities, particularly operating at higher speeds and performing better in mixed traffic
- Operating in a different regulatory environment, such as one that places fewer or additional restrictions on the testing of AVs

If any such a change occurs within the timeline of this project, the team may decide to re-evaluate the proposed routes and operating characteristics, potentially modifying a route alignment or switching to a new operating model, such as dynamic service within a specified zone. Overall project goals will remain the same, as will many project specifications such as the need for the service to be accessible to all, including those with mobility challenges, hearing, vision, and cognitive disabilities, and language differences, as well as those who do not own a credit card or smartphone.

3 Operational and Organizational Impacts

This section provides a summary of the operational and organizational impacts of the proposed system on stakeholders and other supporting entities. This includes a section on temporary impacts that are expected to occur while the new system is being developed, installed, and tested.

The CEAV system will be a small fleet of CEAVs on public roads in mixed traffic. Overall traffic operations on the roads served may be affected. This could lead to an increase in congestion due to the presence of these slow moving CEAVs on the roadway, though if the CEAVs remain on roads with low speed limits they may be able to meet the speed of local traffic flow without any issues. The hesitance of other drivers to interact with AVs may also increase congestion in the short term; however, this is expected to stabilize in the long term. If ridership on the CEAVs is significant, there could be a decrease in local congestion, if these trips would have otherwise been made by private auto.

Because the CEAV system will primarily serve trips of up to around a mile, other short-distance transportation options may see reduced demand. This includes walking and biking or using bike share programs. Localized boarding and alighting behavior on COTA bus routes in the deployment area may be shifted in response to the location of transfer points to the CEAV system and whether they provide a closer service to final destinations.

Modes of operation, particularly during unfavorable weather conditions, will be determined by the capabilities of the CEAV relative to the capabilities of existing transportation options. Certain criteria and processes will need to be established to ensure safe operations of the CEAVs during adverse weather conditions. Service using CEAVs will likely need to be halted during certain conditions that existing transportation options can safely navigate in, which will need to be communicated to passengers and potentially be backed up by another option. The City of Columbus will be responsible for ensuring that any roads along the route are prioritized for road clearing in order to maintain service as long as it is safe.

The implementation of CEAV service is also expected to result in minor organizational impacts for agencies that have agreed to take on additional responsibilities associated with the CEAV system. The CEAV System Operator will be responsible for operating and managing the service. This will include ensuring the CEAVs are operating as planned, safely and on schedule. To do this the CEAV System Operator will need to facilitate a system for monitoring the CEAVs, such as staffing a back office and deploying onboard Operations Staff for passenger questions and onboard monitoring, at least during initial operations. The CEAV System Operator will also be responsible for maintenance, though it may contract this out to an entity with more experience maintaining CEAVs, such as the vehicle manufacturer. Even if maintenance is contracted out, the CEAV System Operator may still need to assist with maintenance by coordinating its service schedule with planned maintenance and ensuring Operations Staff know how to respond to a broken down CEAV, which may be different from how traditional transit providers respond to broken down buses.

The local transit provider, COTA, will feature certain aspects of the CEAV service in its operations, such as showing the service on guide maps and maintaining communication on any schedule changes so the CEAV System Operator can coordinate its schedule with that of COTA (by, for example, providing similar service hours on holidays).

Law enforcement and other public safety personnel will need to know how to communicate with the CEAVs in order to maintain safety in the area, and have been engaged in order to discuss how to do so.¹⁰ Construction workers and managers may need to produce plans to communicate planned work to the CEAV System Operator to minimize the impact of road closures and detours to the service.

Temporary impacts during system development, installation, and testing will be minimal. The routes will be mapped virtually by the chosen CEAV System Operator. Some additional infrastructure investments are expected, including additional signage for new stops (for the benefit of passengers, not the CEAVs), vertical reference points¹¹, infrastructure-based cameras, real-time kinematic (RTK) antennae, and roadside units that leverage DSRC. Therefore, there will be limited on-site construction and other local impacts during development. The maintenance and storage garage will likely be an existing facility, with minor enhancements for security and electric loads.

On-site testing and route mapping will need to occur before deployment. At first, this will be done on closed roads, and could be done at night or during off-peak times. Introducing AVs into mixed traffic operations will be challenging, both for human drivers and for the automated vehicles, as both will have to deal with the unfamiliar and often unpredictable behavior of the other entity. However, this phased deployment approach provides the opportunity to modify the route alignments and other service characteristics if any potential concerns arise during preliminary testing and operations that inform the actual capabilities and safety of the CEAVs.

¹⁰ Additional safety management strategies are included in Smart Columbus's Safety Management plan.

¹¹ Regular stationary vertical elements, such as streetlights and poles, are used by AVs for localization.

4 System Analysis

Routes were selected based on vendor feedback (through the RFI) and assessment of vital characteristics as outlined in the following table.

Table 4-1: Draft Ranking Criteria for Selection of Preferred Route

Criteria	Description
Smart Mobility Hub	The route provides a connection to a proposed Smart Mobility Hub as part of the Smart Columbus initiative.
Food and Service Access	The route connects to food and services needed within a community. The list includes: grocery store, bank, pharmacy, and food bank/pantry
Ladders of Opportunity	The route connects residents with job or opportunity centers for enhanced placement access. The list includes an Opportunity Center and Ohio Means Jobs.
COTA	The route connects to a COTA stop and acts as a FMLM connection to expand the reach of a traveler
Healthcare Support	The route connects patients with services that can aid in monitoring and improving their health.
Neighborhood	The route connects to an opportunity neighborhood for increased mobility.
Recs and Parks	The route connects to a City recreation center or park.
Route navigation	The technology at the time of deployment will allow the route to be traveled.
Storage	The route provides a nearby facility for storage, maintenance, and charging or fueling of vehicles.
Alignment Considerations	The route satisfies an unmet transportation need rather than duplicating existing COTA service.
Safety and Accessibility	The route has lighting and sidewalks in the vicinity of anticipated stops.

After route selection and deployment, analysis of the deployed system will be guided by the following project objectives and evaluated accordingly. Analysis of progress toward performance measures will be based on the data provided by the CEAV System Operator, as outlined in Section 4.2.

Table 4-2: Project Objectives to Inform Performance Measures

Objectives	Hypothesis
Provide convenient, reliable first and last mile transportation	The CEAV will increase the number of convenient, reliable first and last mile trips in the deployment area by providing an automated shuttle service
Increase COTA ridership	The CEAV will increase COTA ridership by providing an automated shuttle service to assist with first/last mile transportation to/from COTA bus stops

4.1 Evaluation Criteria for Acceptance

Selected CEAV vendors will be responsible for conducting their normal factory testing prior to delivery of the vehicles to Columbus, and prior to becoming CEAV System Operators. This testing will be performed for the actual vehicles that will be delivered. The CEAV System Operator will be responsible for preparation of a Test Plan and corresponding test procedures, with review and approval by the purchasing team prior to the conduct of the testing. Documentation of the test results and any corrective actions should also be provided with each vehicle. Testing shall include:

Performing a low-speed merge	Making appropriate right-of-way decisions at intersections	Providing a safe distance from objects on the side of the road or sharing the lane
Pulling over to the side of the road	Making appropriate right-of-way decisions when interacting with vulnerable road users	Decreasing speed when there is uncertainty regarding which action to take
Moving out of the travel lane and stopping in order to service stop locations	Detecting and responding to encroaching oncoming vehicles	Detecting and responding to detours and other temporary changes in traffic patterns
Performing car following when approaching intersections	Detecting stopped vehicles in their path	Operating in rain, fog, and light snow conditions not deemed a weather emergency
Performing car following in stop and go traffic conditions	Passing stopped vehicles when safe	Entering and emerging from a stop-controlled traffic circle
Navigating signalized intersections	Detecting and responding to static obstacles	Crossing intersections with traffic speed limits up to 35 mph
Navigating unsignalized intersections	Detecting and responding to moving obstacles	Changing lanes (both left and right lane change)
Performing left and right turns	Interactions with emergency vehicles	Deploying a wheelchair accessible ramp
Making appropriate right-of-way decisions when merging from a transit stop	Detecting and responding to vulnerable road users in or approaching the vehicle's projected travel path, including at intersections and crosswalks	

In addition, prior to each vehicle delivery, each CEAV System Operator will meet with City of Columbus emergency services to provide background and operating information on the vehicles, as well as to conduct a tabletop exercise.

For each procurement, upon the delivery of the vehicles and completion of initial site and vehicle setup, the CEAV System Operator will conduct preliminary acceptance tests, with the purchasing team as witnesses, using the planned routes but in a controlled manner (i.e., necessary road closures, off-peak hours) to ensure component and system verification. At a minimum, the testing activities will include:

- Everyday operations on the route, demonstrating lane adherence, turning, stopping and starting, and safe reactions to situations the vehicle happens to encounter
- Service of the passenger stops (including pulling over, opening and closing doors, and merging back onto the route)
- Operations in changing roadway/weather conditions (if present)
- Operations in peak and off-peak traffic

Upon successful testing and demonstration of the vehicles in this manner, the CEAV System Operator will be permitted to proceed to full operational testing, otherwise known as shakedown, for purposes of data collection and demonstrated ability to operate as desired. During this phase, Operating Staff will be required to be onboard each vehicle, and the vehicles will travel on the planned routes and schedule, but without taking on passengers. Staff from Smart Columbus or as designated by Smart Columbus or the

Selected Offeror will be permitted to ride the vehicle during this period and could simulate passenger boardings and alightings.

Upon completion of the operational testing period, the CEAV System Operator will again prepare and conduct a final acceptance test and Test Report suitable for delivery. The Test Report will include any corrective actions necessary. The City and its partners will evaluate this report, and if it is accepted, the CEAV System Operator will be permitted to proceed to normal operations complete with passenger service.

4.2 Performance and System Monitoring

The CEAV System Operator will report on the vehicle’s operation on a regular basis to be agreed upon in any eventual service contract. This report will include at a minimum:

- The number of riders, broken down by time-of-day and day-of-week, using door Automated Passenger Counter (APC) devices, video for automated passenger counting, or another solution as specified in the proposal, with geospatial information showing the location where riders boarded and alighted
- On-time performance, with actual departure times from the stops and the causes for any deviations
- A record of trip updates and service alerts
- Number of vehicle trips and vehicle miles and hours traveled – including how many miles were driven in automated mode and the duration of each trip
- Battery performance
- Average vehicle speeds along each segment of the route
- Rider satisfaction (using a survey)
- Any disengagements or interventions by an operator

More detailed reports will be required if any incidents occur. This report will include:

- An identification of the vehicle involved
- Whether any people were involved, and how
- The extent of property damage, if any
- A description of the incident that includes whether the vehicle was in automated or manual mode at the time and any contributing factors
- Video footage of the incident (using video-based cameras both inside and outside the vehicle)
- Additional information as requested

5 User Requirements

At a high level, the required solution must be safe and accessible, and must satisfy the mobility needs of users. Overall requirements for the users introduced in Section 1.3 are provided in Table 5-1.

Table 5-1: User Requirements

User	Requirements
CEAV	<ul style="list-style-type: none"> - Needs to be able to transport passengers (stop at designated locations, open and close doors, deploy accessibility equipment, etc.) - Needs to have the ability to reasonably comply with local, state, and federal driving laws, regulations, ordinances, licenses, and certifications

User	Requirements
	<ul style="list-style-type: none"> - Needs to have Operations Staff onboard who have the ability to take manual control of the vehicle if deemed necessary - Needs to meet all applicable FMVSS or have approval to operate under an exemption to the FMVSS - Needs to comply with all applicable ADA requirements - Needs to comply with all applicable Buy America requirements - Needs to comply with all applicable requirements of Title VI - Needs to meet the USDOT National Highway Traffic Safety Administration (NHTSA) 12-point voluntary safety self-assessment - Needs to have enough power to complete planned operations - Needs to be able to connect to a charging source (or fueling location) - Needs to stop, open doors if safe, and alert the CEAV System Operator when it has detected that there is an issue on board or with the CEAV - The CEAVs should implement DSRC to communicate with roadside equipment to receive signal phase and timing (SPaT) and MAP data. A commercial Security Credential Management System (SCMS) will be provided by the City of Columbus for the vehicles to enroll in.
CEAV Passenger	<ul style="list-style-type: none"> - Needs to be able to board and alight the CEAV - Needs a designated pick-up/drop-off location to, at a minimum, have proper markings - Needs information on route, schedule, and ideally current vehicle location to be able to make travel decisions and use the service - Needs to be able to communicate that the CEAV should make an emergency stop
CEAV System Operator	<ul style="list-style-type: none"> - Needs to be able to program the operating routes into the CEAV, and make any changes as necessary - Needs to manage operations and make adjustments as necessary, ensuring the CEAVs are running on schedule - Needs to be able to monitor the situation inside and directly outside the CEAV - Needs to have access to a maintenance, charging/fueling, and storage facility in close proximity to the CEAV route - Needs to be able to contact emergency responders and other City agencies when necessary
Operations Staff	<ul style="list-style-type: none"> - Needs to have knowledge of and the ability to reasonably comply with local, state, and federal driving laws, regulations, ordinances, licenses, and certifications - Need to be able to take secure manual control of the CEAV while onboard if necessary
City Data Users	- Need access to accurate and timely data on the CEAV system
3rd Party Data Users	- Need access to accurate and timely data on the CEAV system

5.1 Operational/User Requirements

Operational requirements for deployment will include:

- Each deployment shall provide service during the hours of day and days of week with the highest expected demand.
 - Ridership shall be monitored by time-of-day and day-of-week, and it is expected that operating hours will be shifted and/or shortened in order to better accommodate demand, considering vehicle capabilities.

- Service may be suspended on major holidays as specified in a contract, though service may be continued on some holidays that are expected to see increased demand.
- Any changes to service shall be communicated to passengers by multiple modes of communication well in advance of the service change. This includes both schedule and route changes (due to roadway construction, expected changes in demand patterns, road closures due to special events, etc.).
- Each service shall meet a headway that allows for “walk-up” service during the hours in which service is provided, so that passengers can arrive at a stop and expect a vehicle to come within a reasonable amount of time rather than having to pre-plan their trip. The expectation is that a headway around 10 minutes would be a good goal, with the exact value depending on other operational characteristics.
 - As with operating hours, desired minimum headway may be modified during certain time periods depending on ridership, but is expected to be low enough to continue to provide “walk-up” service to potential passengers.
- A secure, indoor location shall be provided by each CEAV System Operator for overnight storage. This facility shall include access to electric vehicle charging portals, if required.
- Onboard operators (“Operations Staff”) shall be properly trained and shall always be onboard a vehicle.
 - Operations Staff shall be employees, contractors, or agents of the company, as specified in Executive Order 2018-04K.
 - CEAV System Operators for early deployments shall engage in the training of local operators to inform later CEAV deployments.
- Any fleet management system(s) used by a CEAV System Operator shall be open architecture to allow for potential future integration with the Smart Columbus Operating System.
- Each deployment shall have Standard Operating Procedures for the CEAVs and Operations Staff.
 - Procedures shall include emergency response protocols.
 - Procedures shall also include weather response protocols. To support this, local weather patterns shall be monitored such that the CEAV System Operator is aware of any approaching severe weather event or other conditions that may impact vehicle operations.
- Project team members shall identify and/or support research opportunities.
- The project team plans to actively engage the community in the operation of the vehicle and monitor their feedback. This will be accomplished through surveys of both riders and non-riders, and possibly other methods.

More specific requirements shall be outlined in any RFPs and contracts developed as part of this project, that are specific to each deployment and may be more restrictive than those outlined above.

5.2 Data Needs and Integration Requirements

CEAV System Operators will be required to agree to collect data on ridership, stop departure times, vehicle miles/hours traveled and route-trips served, battery performance, rider satisfaction, and any disengagements or interventions by an operator. Any and all data presented in the following table collected by the CEAV System Operator must be shared with Smart Columbus unless it is deemed proprietary information by the vendor.

Table 5-2: Proposed Data Needs

Data Type	Data
Operational	Vehicle route and schedule (GTFS)
	Real-time vehicle location information (AVL, GTFS Realtime)
	Trip updates and service alerts
	Ridership (stop-level boardings and alightings)
	Actual stop arrival and departure times
	Vehicles miles traveled
	Vehicle hours traveled (hours the vehicle is in service)
	Number of route-trips served

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Data Type	Data
	Duration of each trip
	Battery usage (such that it can be associated with weather, temperature, vehicle load, etc.)
	Average vehicle speeds along each segment of the route
	Count and duration of wheelchair ramp deployments
Performance	Sensor and other telemetry data
	Navigation variances
	Probe data (nRTK-enabled or similar)
	Mechanical data (vehicle condition)
	Disengagements/interventions by the operator, relative to the amount of time spent in automated mode
	Any other logged events (hard stops, evasive maneuvers, unruly passenger behavior, etc.)
	Conditions driven in (weather, congestion, etc.)
Communications	Record of operational data exchanged (includes SPaT and MAP messages the vehicle receives, BSM it sends, etc.)
Rider feedback (provided by survey results, not directly from CEAV System Operator)	Rider satisfaction
	Rider acceptance of the technology

Smart Columbus will also define a set of interoperability guidelines for multiple CEAV System Operators to communicate with infrastructure and a central fleet management system to ensure that various systems deployed throughout the city, state, and nation can be deployed interchangeably. To support this need, data which allows for traditional transit services, such as GTFS and GTFS-RT, will be required. Data related to the automated driving activities, including event logs, sensor data, and other telemetry data will also be required.

Appendix C: Sample Cost Table

Note: Please use Excel file provided in Bonfire to complete this table and insert into proposal response.

Infrastructure Requirements					\$
Mobilization, Set Up, and Testing					\$
Staff					\$
Licensing	One Time:	\$	Ongoing:	\$	Total: \$
Vehicle Wrapping					\$
Vehicle Operations	Month	Vehicle	Storage & Charging	Total	
	Month 1	\$	\$	\$	
	Month 2	\$	\$	\$	
	Month 3	\$	\$	\$	
	Month 4	\$	\$	\$	
	Month 5	\$	\$	\$	
	Month 6	\$	\$	\$	
	Month 7	\$	\$	\$	
	Month 8	\$	\$	\$	
	Month 9	\$	\$	\$	
	Month 10	\$	\$	\$	
	Month 11	\$	\$	\$	
	Month 12	\$	\$	\$	
Total					\$

Appendix D: Exhibit B Estimate of Labor Hours by Task Activity

Provided as FYI only – Selected Offeror will complete during final negotiations

PROJECT:											
PRIME CONSULTANT											
FIRM:											
<u>CLASSIFICATION & LABOR HOURS</u>											
TASK	SCOPE OF SERVICE SECTION	PM	SE	CL	*	*	*	*	*	*	TOTAL HOURS
											0
											0
											0
											0
Total Hours		0	0	0	0	0	0	0	0	0	0
SUBCONSULTANT No.: 1											
FIRM:											
<u>CLASSIFICATION & LABOR HOURS</u>											
TASK	STAFF	PM	SE	CL	*	*	*	*	*	*	TOTAL HOURS
											0
											0
											0
											0
Total Hours		0	0	0	0	0	0	0	0	0	0
SUBCONSULTANT No.: 2											
FIRM:											
<u>CLASSIFICATION & LABOR HOURS</u>											
TASK	STAFF	PM	SE	CL	*	*	*	*	*	*	TOTAL HOURS
											0
											0
											0
											0
Total Hours		0	0	0	0	0	0	0	0	0	0
SUBCONSULTANT No.: 3											
FIRM:											
<u>CLASSIFICATION & LABOR HOURS</u>											
TASK	STAFF	PM	SE	CL	*	*	*	*	*	*	TOTAL HOURS
											0
											0
											0
											0
Total Hours		0	0	0	0	0	0	0	0	0	0
TEAM											
<u>CLASSIFICATION & LABOR HOURS</u>											
TASK	STAFF										TOTAL HOURS
											0
											0
											0
											0
Total Hours		0	0	0	0	0	0	0	0	0	0

Appendix F: Detailed Route Map

The following six pages contain detailed maps of the main route and alternative route. These maps correspond to the following legend.

	Traffic Signal		Parking
	Stop Sign		CEAV Route
	Speed Limit		CEAV Direction
	School Zone		CEAV Stop
	Two-Way Street		CMAA Stop
	One-Way Street		Other COTA Stop

For additional information, view a video of the main route at <https://youtu.be/WBhoKChjm4k> and a video of the potential alternative route at <https://youtu.be/dGdBZa5lKgg>, or conduct a site visit.