Comprehensive Installation Plan (CIP)

Buffalo, NY ITS4US Deployment Project

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16. Abstract

The Buffalo NY ITS4US Deployment Project seeks to improve mobility to, from and within the Buffalo Niagara Medical Campus by deploying new and advanced technologies with a focus on addressing existing mobility and accessibility challenges. The technologies to be deployed are self-driving shuttles, a trip planning app that is customized for accessible travel, intersections that use tactile and mobile technologies to enable travelers with disabilities to navigate intersections, outdoor and indoor paths and destinations. The deployment geography includes the 120-acre Medical Campus and surrounding neighborhoods with a focus on three nearby neighborhoods (Allentown, Fruit Belt and Masten Park) with underserved populations (low income, vision impaired, deaf or hard of hearing, wheeled mobility device users and older adults).

This document, the Comprehensive Installation Plan (CIP) describes the acquisition, procurement and installation plan for the equipment acquired and installed by the Buffalo NY ITS4US Deployment Project. Installation of equipment includes the Transportation Information Hub (aka kiosk) at two facilities, Indoor Navigation System beacons at one facility, and Pedestrian Actuation Gateway (aka PED-X) at two intersections. In addition, the document also describes the high-level build process for the self-driving shuttle (SDS).

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1 Introduction

1.1 Purpose of this Plan

The Comprehensive Installation Plan (CIP) provides an overview of the acquisition and installation processes for the Buffalo, NY ITS4US Deployment project. The CIP identifies the acquisition and installation processes, as well as the materials included in the acquisition and installation including the device types and number used in the deployment. Currently, all installation elements are known, however, not all of the systems have been fully installed.

1.2 Intended Audience

The intended audiences for this document are the United States Department of Transportation (USDOT) and peer agencies seeking to deploy similar technologies/solutions.

1.3 Project Background

Buffalo is moving toward a sustainable future at all levels of society, incorporating actions in the community, government, and private entities in the area. Providing access to the City's underserved populations to jobs and healthcare is the primary motivation for all the regional partners involved in this deployment. A lack of public transportation that adequately addresses "first/last mile" challenges is a major problem for community mobility, especially for people with disabilities. This often leads to compromised healthcare (e.g., rescheduled or missed appointments, delayed care) and/or dependence on paratransit service, which is much costlier for transit agencies and can be burdensome for riders. The Complete Trip Deployment concept proposed here directly addresses these concerns by:

1. **Focusing on providing transit access to healthcare and jobs** to underserved residents or persons and allowing them to share in the economic development in downtown Buffalo.

2. **Putting technology to work in support of accessible transportation**, bringing leading edge researchers in accessible transportation, transit, and connected automation to solve a transportation need.

3. **Developing a scalable model** for considering accessibility and universal design in transportation technology projects.

The deployment location is targeted around the downtown Buffalo area with a focus on travel to and from the Buffalo Niagara Medical Campus (BNMC). The deployment includes the 120-acre Medical Campus and surrounding neighborhoods with a focus on three nearby neighborhoods (Fruit Belt, Masten Park, and Allentown) with underserved populations—see Figure 1.

More than 16,000 people work or study at the BNMC and more than 1.5 million visit each year for health care and other services, generating significant transportation demand for the area, its visitors, and its employees. The demographics of the surrounding neighborhoods (see **Table 1**) are emblematic of a broader socioeconomic and racial divide in Buffalo along Main Street, which this deployment seeks to bridge. In Allentown (west of Main Street), the percentage of traditionally underserved populations is significantly less than other neighborhoods east of Main Street, namely Fruit Belt and Masten Park. **Table 1** indicates percentages for Allentown that are far below average for the Metropolitan Statistical Area (MSA) in many categories, and percentages for Fruit Belt and Masten Park that are above average for the MSA.

Source: Buffalo, NY ITS4US

Figure 1. Buffalo Niagara Medical Campus relative to the neighborhoods of focus: Allentown, the Fruit Belt, and Masten Park.

While the Allentown neighborhood is not characterized by underserved populations, it contains a high concentration of transit service and commercial activity, including health care offices. Allentown hosts several significant bus lines (including the #20-Elmwood, the #25-Delaware, the #11-Colvin, and the #8-Main) that connect the BNMC and Downtown Buffalo with neighborhoods to the north, carrying over 10,500 riders on an average weekday.

Table 1. Demographics of Targeted Neighborhoods

Geography (ACS 2018tracts)	Percent 0-vehicle households	Percent population 65+	Percent poverty	Percent Black	Percent Hispanic / Latino	Percent limited English ability	Percent income <$25k	Percent with a disability (18 to 65 yrs old)	Percent veteran	Percent commute by transit	Total households	Total population
Fruit Belt	**47.0%**	**21.9%**	28.0%	77.0%	8.9%	4.2%	**39.5%**	**20.0%**	**6.7%**	**16.1%**	**976**	**2,435**
Allentown	**18.4%**	6.2%	28.8%	7.2%	6.6%	0.0%	17.4%	8.0%	7.8%	4.8%	1978	3,143
Masten Park	**35.0%**	18.5%	34.7%	89.7%	3.1%	2.9%	38.9%	15.2%	6.6%	11.7%	1496	3,208
Buffalo MSA	**36.6%**	**12.0%**	**31.1%**	**36.6%**	**11.6%**	**4.8%**	**30.7%**	**9.7%**	**5.7%**	**11.5%**	**11,0701**	**255,423**

BNMC sits adjacent to the Fruit Belt neighborhood, which has a poverty rate of 28%, and 47% zero-car households. Several community and social services are found within the neighborhood, which is relatively close to the wider array of services and jobs offered in downtown Buffalo. Several bus lines serve the area, although headways are relatively infrequent, ranging between ½ hour and one hour. Access to dispersed jobs in the suburbs via public transportation tends to be difficult. Although accessible to the Fruit Belt residents, the Niagara Frontier Transportation Authority (NFTA) Metro Rail station is 0.25 – 0.75 miles away, a distance that becomes amplified

during the winter and for travelers with physical difficulties. While BNMC continues to improve pedestrian accessibility, sidewalk quality and intersection crossings still are a challenge for wheelchair users and users with audible or visual impairments. The Fruit Belt struggles with aging infrastructure and infrastructure management issues, issues that have been consistently noted in community forums over the years.

This project seeks to improve transportation access for this population and utilize an innovative approach to find the most effective methods for supporting trip-making. BNMC's user population makes it an ideal location to test accessibility designs for safety and usability. The complete trip deployment in Buffalo focuses on two primary trip purposes: employee-related travel and patient/visitor travel to the campus from the three neighborhoods.

1.4 Project Description and Acquisition Approach

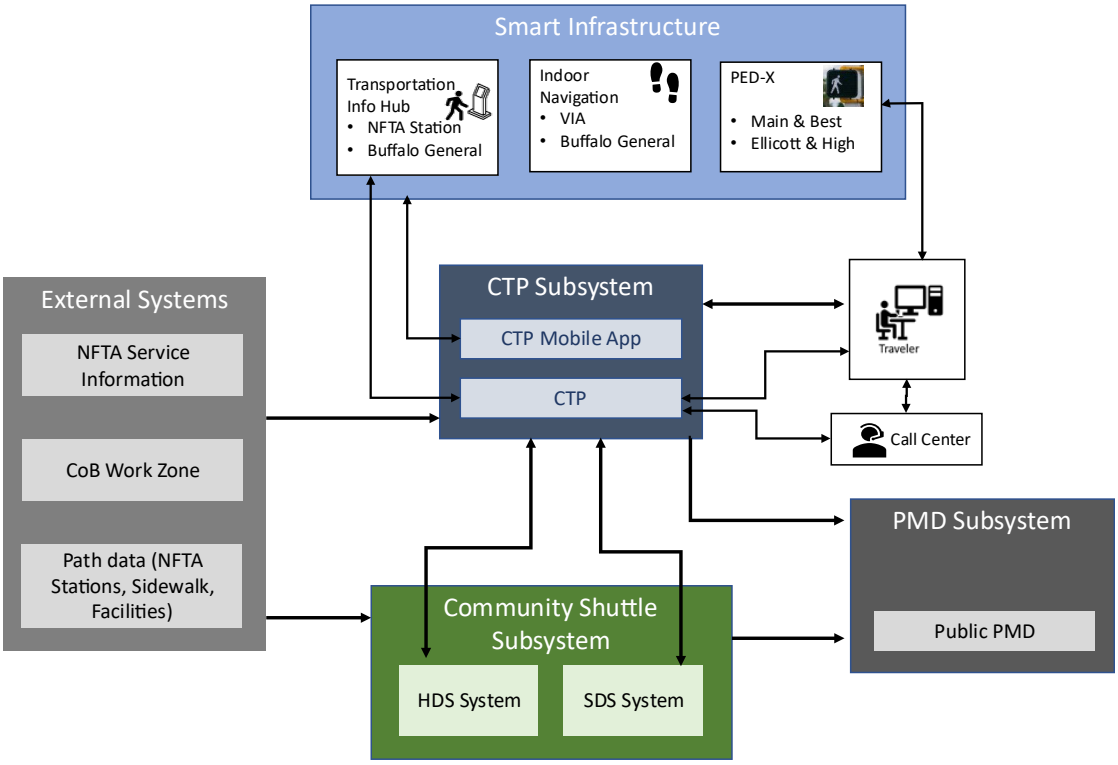
The project will deploy an integrated suite of technologies chosen to address identified needs of users and gaps within the systems and services provided. These technologies include:

- **Complete Trip Platform (CTP):** The CTP provides trip planning and travel functions for travelers. The tool is available for registered and non-registered account users. Account holders will be able to interact with other mobility partners for which they have accounts (e.g., NFTA paratransit and micro transit shuttle), personalize their trip preferences and customize hands-off turn-by-turn notifications, and access to wayfinding assets using components specified in the smart infrastructure subsystem. Non-registered travelers will be able to use the trip plan and travel tools to view accessible paths, transit services and alerts about asset status (e.g., elevator / escalator operations).

- **Community Shuttle Subsystem** – The Community Shuttle subsystem provides demand-responsive transit services within a specified zone of operations, using a mix of vehicles, including both human-driven shuttles (HDS) and self-driving shuttles (SDS). The SDS will operate on a predefined route(s), consisting of a set of streets within the zone and pick-up and drop-off locations, but will be responsive to travelers' demand (e.g., it can skip certain pick-up/drop-off locations if there is no demand). The human-driven vehicles will provide door-to-door on demand service within the zone of operation. Modules within this subsystem include both types of vehicles, as well as a Shuttle Operations Center (SOC).
- **Smart Infrastructure Subsystem** – The smart infrastructure subsystem includes wayfinding and orientation for indoor and outdoor environments, provision of navigation and destination finding through information kiosks (Transportation Information Hub (TIH)), augmented communications technologies (Bluetooth Beacons) for the Indoor Navigation System (INS), and intersection treatment for hands-free, pedestrian signal requests (PED-X).

- **Performance Dashboard Subsystem** – This subsystem measures and presents the performance of the system to the agency operating the system.

Figure 2 provides a high-level context diagram of the system and how the four subsystems interact with each other.



Source: Buffalo, NY ITS4US

Figure 2. Buffalo Deployment Project Context Diagram

Among the subsystems, only SDS vehicle and parking, and the Smart Infrastructure include the need to build or install hardware. **Table 2** provides a summary of the acquisition approach for each subsystem / application approach. This document summarizes the acquisition and installation processes associated with the acquired equipment. As identified in the summary table, installation plans are described for the following equipment:

- The SDS includes the need to build the automated bus and install parking for the vehicle. Since the SDS is a turnkey procurement and all installation will be managed by the solution provider, only a summary of the installation process is included in this document.
- The INS beacons will be installed in one facility at the Visual Impairment Association building.
- The PED-X will be installed and configured for two intersections in the project area.
- The TIH will be installed in two facilities on the campus – NFTA rail station and Buffalo General Medical Center.

Table 2. Summary of Acquisition Approach for Each Subsystem / Application

Subsystem / Application	Responsible Organization	Acquisition Approach
CTP	ICF	**ITS4US Award*:** the CTP is being developed by ICF (and partner Etch) as part of its contract for this project.
Performance Measure Dashboard (PMD)	ICF	**ITS4US Award:** the PMD is being developed by RSG as part of its contract for this project.
SDS	University at Buffalo (UB)	**Request for Qualifications (RFQ)/ Proposals (RFP)**:** the SDS is being procured through a competitive process based on UB's protocols for RFQ/RFP. The proposal was awarded to ADASTEC for a single self-driving bus.
HDS	NFTA	**In-house services:** the HDS is being provided by NFTA as part of their existing services, including equipment and personnel. Open Source Software was used for the reservation system.
INS	ICF	**Request for Qualification:** Kaleida Health's existing INS was enhanced and integrated with the ITS4US Buffalo project. The existing INS vendor, CXApp was procured through an RFQ process for their Software as a Service (SaaS) INS and Bluetooth Low Energy (BLE) beacons.
TIH	ICF	**Request for Proposal:** the TIH was procured through a competitive RFP process based on ICF's protocols. The contract was awarded to RedyRef for two kiosks.
Pedestrian Crossing (PED-X)	ICF / City of Buffalo (CoB)	**ITS4US Award:** the PED-X was implemented by ICF, in collaboration with the CoB's preferred intersection vendor, Miovision, as part of the contract for this project. All acquisition, deployment, installation, operations, and maintenance costs were included as part of the ITS4US Phase 2-3 budget.

* ITS4US Award refers to the approach in which equipment and services were procured as part of the Phase 2-3 award—that is, vendors and costs were provided as part of the team proposal for Phases 2-3.
** RFQ/RFP is a procurement process designed to solicit qualifications and/or technical and quotation proposals for defined equipment and services.

1.5 Document Organization

The document is organized as follows:

Section 1 Introduction – describes the scope, intended audience, purpose and organization of this document.

Sections 2 through 5 describe the acquisition and installation of each subsystem or system which requires equipment installation. These include:

- Section 2 Self-Driving Shuttle
- Section 3 Indoor Navigation System

- Section 4 Pedestrian Crossing System
- Section 5 Transportation Information Hub

Each section includes subsections on the following:

- Section X.1 Acquisition Overview – summary of the actual acquisition process described in the **Comprehensive Acquisition Plan (CAP)** (2023) including procurement approach, acquisition schedule, vendor outreach and the procurement specification summary. Not all the subsystems include all the categories.
- Section X.2 Installation Overview – summary of the asset management plan and installation schedule.
- Section X.3 Installation Plan Approach – overview of the installation plan including the equipment summary and any policies and procedures that guide the installation.

Section 6 References includes cited documents.

Appendices

- Appendix A Acronyms – list of all acronym descriptions.
- Appendix B Bill of Materials (BOM) – separate sections for each acquired / procured equipment.

2 Self-Driving Shuttle

2.1 Acquisition Overview

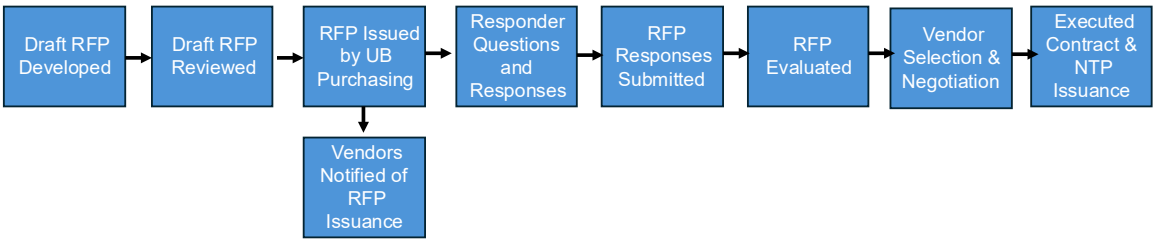
The following sections describe the acquisition approach for the SDS solution to support the Buffalo NY ITS4US Deployment Project.

2.1.1 Procurement Method

The acquisition of the SDS and its associated subcomponents, equipment, and software, including the SDS SOC, was accomplished through an RFP process which sought qualified vendors, capable of providing a turnkey SDS solution. As Phase 2 and Phase 3 lead of the Buffalo NY ITS4US Deployment Project, NFTA led the technical development of the RFP, working collaboratively with UB who led the acquisition process for the SDS.

The UB RFP process is illustrated in Figure 3. A Draft RFP was developed which described the expectations and requirements of the solution being sought. The draft RFP was then reviewed by the UB Purchasing Department. After incorporating the needed revisions and securing the final approval of the RFP, UB Purchasing Department issued the RFP on December 28, 2022, with a due date for responding of February 1, 2023. The RFP was published to the New York State (NYS) Contracts Reporter website (https://www.nyscr.ny.gov/adsOpen.cfm), and was labelled as the University at Buffalo Bid #22DBM0071 – The Buffalo ITS4US Deployment Project. This made the RFP immediately available for all registered vendors to the NYS Contracts Reporter system. Additional candidate vendors, who had been previously identified by the Buffalo All Access ITS4US team, were also contacted by UB Purchasing Department.

Potential responders to the RFP were given a period of two weeks (by January 11, 2023) to submit questions and to request clarifications about the RFP. The UB Purchasing Department received several questions from SDS vendors, to which detailed responses were developed by the UB Purchasing department personnel, who worked closely with the Buffalo All Access to respond to any technical or non-contract related question. The responses were published as Addendum #1 on January 20, 2023. The addendum also extended the due date for responding, by one week, to February 8, 2023.



Source: Buffalo, NY ITS4US

Figure 3. RFP Process Flow Diagram.

2.1.1.1 SDS Request for Proposal Details

The SDS RFP is included in the CAP. The RFP document was divided into six sections as follows.

SECTION 1 detailed the RFP process including milestones and timelines.

SECTION 2 listed the goals and objectives of the Buffalo ITS4US project.

SECTION 3 provided an overview of the project, its subsystems, project team and project phases. In addition, the SDS subcomponents (the focus of the RFP), were described. This included a description of the SDS vehicles, the SDS SOC, and the envisioned modes of operations.

SECTION 4 presented a high-level description of the SDS subsystem specifications or requirements. The requirements were divided into the following groups:

(1) requirements for the Operational Design Domain (ODD), including specification of the location, mode and hours of operations, and weather capabilities;

(2) requirements for interfacing the SDS SOC with the Buffalo All Access CTP; and

(3) requirements for the safety steward onboard the SDS who will be supervising the operations of the SDS and taking over the control of the vehicle during emergencies and when needed.

SECTION 5 listed the content expected to be included by the vendor by subject area for the technical aspects of the response. It included sections for:

(1) qualifications;

(2) technical approach;

(3) desired system requirements;

(4) services to be provided by the vendor;

(5) timing; and

(6) liability and insurance.

Section 5.2 of the RFP (the technical approach section) asked the vendor to describe the hardware and software associated with the vendor's SDS solution, including hardware, software, interface with infrastructure, testing and evaluation, vehicle models, accessibility features, the SOC and its scheduling and dispatch algorithms, and any passenger information systems. The section listed the "must have" system requirements that the proposed solution should satisfy. Section 5.3 of the RFP (the desired system requirements section) asked the vendor to indicate whether their solution fully addresses, partially addresses, or does not address the set of system requirements described as "desirable." The sections also asked responders to describe how they intend to test or verify that their solution fully/partially address each requirement.

Section 5.4 of the RFP (the services section) included sub-sections for:

(1) management;

(2) operations and management;

(3) regulatory approvals; and

(4) other services.

SECTION 6 listed the content expected to be included by the vendor by subject area for the commercial aspects of the response (i.e., pricing and budget). The vendor was asked to itemize their budget for the cost of the base vehicle, the self-driving automation (unless included in the vehicle cost), initial testing including route definition and high-definition maps, final testing and verification at the conclusion of Phase 2, executive management, operations management, SOC, integration of SOC with CTP, safety stewards, data and performance measures reporting, maintenance, fueling, and insurance.

2.1.2 Acquisition Schedule

The high-level schedule for procurement of key pieces of equipment or subsystems is listed in **Table 3**. The dates listed reflect the actual dates when each step was completed.

Table 3. SDS Acquisition Schedule

Date	Milestone
October 21, 2022	Preliminary Draft of RFP ready for review by the Buffalo ITS4US team
November 11, 2022	Final Draft of RFP and Evaluation Criteria developed
December 28, 2022	RFP Solicitation advertised (posted) and distributed to qualified vendors, with a due date of February 1, 2023
January 11, 2023	Questions due from vendors
January 20, 2023	Responses to RFP questions and issuing of an Addendum which extended the RFP response date to February 8, 2023

Date	Milestone
February 8, 2023	Deadline to receive responses to RFP
February 9 – May 17, 2023	Evaluation of submitted bid by the project selection committee, presentations by short-listed vendors (two such presentations were made by the two top bidders on March 15, 2023 and March 17, 2023), follow-up conversations and preliminary cost negotiations with the two top bidders, in an effort to bring cost within the Buffalo All Access budget
May 18, 2023	Selection of vendor, sending of Notice of Award to selected vendor, and Notices of Determinations to other vendors, and commencement of contract negotiations
May 18 – September 6, 2023	Final contract negotiations, contract review by the legal department of the Research Foundation of the State of New York (RF-SUNY) on behalf of the University at Buffalo, and final contract execution
September 7, 2023	Final Contract Executed

2.1.3 Vendor Outreach Plan

Since the start of Phase 1 of the Buffalo All Access ITS4US project, the project team has undertaken a comprehensive outreach effort to engage reputed SDS vendors. This outreach effort included phone conversations or Zoom meetings with the vendors, discussions with agencies where some of those vendors have deployed their SDS solutions in the past, as well as site visits by the project team to some of the current deployment sites of those vendors. A description of vendors was included in the CAP, Section A.2.

The RFP was published to NYS Contracts Reporter website, making it immediately available for all registered vendors. Additional candidate vendors, who had been previously identified by the Buffalo All Access ITS4US team, were also contacted by UB Purchasing Department.

2.1.4 Procurement Specification Summary

The SDS subsystem was procured as a turn-key system, consisting of one SDS with its suite of sensors and hardware, autonomous driving software and SOC software. A high-level description of each component is given below.

2.1.4.1 The SDS Vehicle and Hardware

Currently, SDS vendors offer two different approaches to deploying an SDS. The **first approach** involves designing an SDS from the ground-up. That approach allows the vendor to custom-design the shuttle from the onset as a *self-driving* vehicle. In that case, shuttles **may or may not** have a steering wheel (in case a steering wheel is not used, manual override may be provided via a joystick). In addition, SDSs that are designed from the ground up typically have low floors to enable better accessibility, providing significantly more open space that allows for the installation of wheelchair securement system for example. Given the current regulatory environment, one

problem with an SDS that does not have a steering wheel is that they may fail to satisfy current Federal Motor Vehicle Safety Standards (FMVSS) and therefore use on public roads may not be legal (this is currently the case in New York).

Examples of SDS solutions designed from the ground-up as a self-driving vehicle include Olli (Shi et al., 2021), EZ10 which was used in the Smart Columbus deployment (Smart Columbus, 2019); and Navya (Koldge et al., 2020). In addition, ADASTEC Corp. (ADASTEC), working with Vicinity Motor (Bus) USA Corp (VMC). Cooperation has a factory-outfitted shuttle. The ADASTEC/VMC shuttle is NOT a retrofitted vehicle, but a ground-up factory fitted automated bus produced by VMC, which means that the drive-by-wire conversion is done by the producer and thus exists prior to deployment (the ADASTEC/VMC shuttle was chosen for deployment in the Buffalo All Access project).

The **second approach** to developing SDS solutions is to outfit a traditional vehicle with the suite of sensors needed for autonomous driving (e.g., Light Detection and Ranging (LiDAR), radar, cameras, etc.) and with self-driving control software (e.g., Autoware). This approach was applied by Waymo in Chandler, Arizona (AZ), where Toyota Sienna vans were outfitted with the required suite of sensors and were driven autonomously by Waymo self-driving algorithms (Stopher et al., 2021). It is also the approach adopted by May Mobility in Arlington, Texas (Booth, 2021). A key advantage of this approach is that it faces fewer regulation hurdles. On the negative side, such vehicles may not be easily adaptable for universal design and accessibility for underserved populations. Our RFP entertained both options to increase the pool of responders.

Regardless of whether the shuttle is designed from scratch as an autonomous vehicle, or whether a traditional vehicle is outfitted for autonomous driving, the SDS is expected to be equipped with a complete suite of sensors and hardware to enable autonomous driving. This suite is likely to include: LiDAR sensors, cameras, imaging radar, drive-by-wire electronic control unit and X-by-wire systems, computing platform, and real-time kinematic (RTK) Dual Antenna Global Navigation Satellite/Inertial Navigation Systems (GNSS/INS) for mapping and real time navigation.

2.1.4.2 The Autonomous Driving Software

Software for autonomous driving typically consists of modules for providing the following three functions: (1) sensing and perception; (2) path and motion planning; and (3) vehicle control. With the exception of a few open-source autonomous driving software platforms (e.g., Autoware and Apollo), software controlling the SDS is typically proprietary.

2.1.4.3 The Shuttle Operations Center (SOC) and the Scheduling and Dispatch Software

The SDS RFP required that the SDS procured include a SOC software that is capable of interfacing with the Buffalo All Access app. This is needed in order to: (1) allow the SDS to operate in a demand-responsive mode by only stopping at the locations where a traveler needs to be picked up or dropped; (2) enable the monitoring of the SDS to determine its estimated arrival time; and (3) provide the data needed for calculating the SDS subsystem performance metrics. The RFP specified that the SOC software needed to be able to interface with the Buffalo All Access CTP, which is being developed independent of the SDS procurement.

2.1.4.4 Technical Services to be provided by Vendor

The RFP specified that the selected vendor would be responsible for providing the following services. It also required that the bidder include the cost of all those services in their cost proposal.

(1) Testing the SDS subsystem: The vendor was asked to demonstrate that their solution met all the "must have" requirements, and the majority of the "desirable" System Requirements listed. It also required bidders to discuss, in their response, the testing they planned to perform, the data they planned to collect, and their documentation plans for the test plans, test execution and results.

(2) Securing the required permits and approvals for the SDS to operate on public roads: The RFP also required that the selected vendor be responsible for working with NYS Department of Motor Vehicles (DMV) to secure the required permits for the operations of the SDS on public roads in the project's deployment area.

(3) Operating the SDS subsystem: Per the RFP, the operations of the SDS subsystem, with all its subcomponents and services, were to be provided by the selected vendor.

(4) Training and providing the safety human stewards: The RFP required that human safety stewards be present onboard the SDS at all times throughout the duration of Phases 2 and 3 of this project. The stewards are responsible for the safety of passengers on board the SDS. Responsibilities include taking over the control of the shuttle during emergencies and where driving conditions go beyond the ODD of the SDS. They are also required to note the reasons behind those disengagement events. In addition, they support passengers during operations, and, when needed, provide help to those with disabilities as they get on and off the shuttle. The training will provide detailed standard operating procedures for their interaction with passengers and vehicle operations responsibilities.

(5) Operations of the SOC: Vendors were asked to describe their approach to interfacing their SOC's software with the Buffalo All Access CTP. This required their describing the following:

- Required interfaces and system handoffs
- Compliance with the applicable General Transit Feed Specification (GTFS) Standards
- Testing and validation steps

(6) SDS maintenance and repair: Per the RFP, SDS repair and maintenance is expected to include: (1) repairs due to system failures (electrical, Autonomous Driving System (ADS), and mechanical); (2) repairs due to physical shuttle damage; and (3) repairs after an incident or collision. Repairs, unless in the unlikely event of a major physical damage to the shuttle, are expected to be completed within 5 business days.

(7) Required liability insurance: Vendors were asked to provide liability insurance needed to secure the required regulatory approvals.

(8) Collection of the data needed for evaluation: Finally, the RFP specified that the selected vendor be responsible for collecting needed data to complete the evaluation of the performance of the SDS subsystem. At a minimum, data shared with the project team should allow for

evaluating the safety and reliability of the autonomous driving functionality of the SDS. The data should include, but not be limited to, the following:

- Frequency of disengagements, along with reasons behind disengagements
- Time-stamped vehicle dynamics data such as position, roll, pitch, yaw, and velocity
- Data collected by the SDS sensors (e.g., LiDAR, radar, cameras)
- Coordinates of the route (virtual railroad track w/ stops and the safety envelope).
- Where the shuttle thinks it is located on the map at each time step

2.1.4.5 Ancillary Equipment

The SDS is being procured as a turn-key system, and hence all ancillary equipment will be part of the solution provided by the selected vendor.

2.1.4.6 Requirements and Specifications

The set of system requirements for the SDS subsystem, with all its components, was developed in Phase 1 of the Buffalo ITS4US project and was previously included in the CAP (specifically within Appendix A). The requirements are composed of system requirements specified for the SDS subsystem, system level components associated with the deployment, and project level requirements associated with procurement, reporting and operations and maintenance.

2.1.4.7 Certification Requirements

As previously mentioned, the RFP required vendors to describe, in their technical approach, how they planned to demonstrate their solution's ability to meet the "must-have" system requirements. It also required them to indicate the level to which their solution satisfied each of the "desirable" requirements (i.e., fully address, partially address, or does not address). For the requirements which the solution fully or partially addresses, and to describe the test or method they intended to use to verify that their solution addressed the requirement. Three stages of testing are planned. The first stage will involve testing the use-cases in a simulation environment developed based on a detailed 3-Dimensional (3-D) map developed for the deployment area. The second stage will involve testing in test tracks or on proving grounds in East Lansing, Michigan, where the headquarters of ADASTEC is currently located. Finally, the third stage of testing and verification will occur on the BNMC in downtown Buffalo (i.e., the deployment site of the Buffalo All Access project). The BNMC testing will be first conducted, without live passengers, followed by testing and verification with passengers, during the first three months of Phase 3.

2.1.4.8 Part Numbers/Quantities

Given that the SDS subsystem is procured as a turn-key solution, this section is not applicable.

2.1.4.9 Associated Software

The autonomous driving software of the SDS, as well as the SOC software are key components of the turn-key system described in the RFP. As such, they are a part of the selected SDS

solution. ADASTEC's autonomous driving software (flowride.ai), along with the SOC's software (flowride.ai cloud), are proprietary to ADASTEC.

2.1.5 RFP Evaluation

A selection committee was formed to review, evaluate and score the submitted responses. The committee was made of five members from UB, representing different academic backgrounds and included the Director of the University's Parking and Transportation Department. Other members representing the key stakeholders of the Buffalo All Access project served in an advisory capacity.

The UB Purchasing Department defined the criteria for evaluating the RFP, which included an assessment of the technical proposal, the cost proposal, and the oral presentation (only the short-listed bidders were invited to give the presentation). A total of five submittals were received by the RFP due date (although one of the five submittals was not truly a bid, but just expressing an interest). All four valid bids were carefully reviewed by all 5 members of the selection committee and were scored based on the criteria and weights established by the UB Purchasing Department which were also included in the RFP. As a result, two vendors were short-listed and invited to give an oral presentation.

The two short-listed vendors gave their presentations to the selection committee on March 15 and March 17, 2023. One challenge that the Buffalo All Access team encountered during the process of acquiring the SDS was that the cost proposals from the two short-listed bidders were both significantly higher than the budget the project had for the SDS component. To address this, additional meetings were set up with the two short-listed vendors on May 2, and on May 4, 2023, to discuss their cost proposals and to see if there was a way to reduce the cost. The cost negotiations were successful, and one of the short-listed bidders in particular, namely the ADASTEC and VMC team, offered the project a significant cost reduction which brought the cost to within a reasonable range from the available budget.

2.1.6 Vendor Selection

After careful evaluation and numerous discussions among the members of the selection committee, and with the committee's advisory members, the committee decided to award the project to the ADASTEC and VMC team. There were several factors which led the selection committee to favor the ADASTEC-VMC team. Some of these factors are listed below.

- The project team's preference was for a transit-like vehicle, and one that was FMVSS and ADA compliant. The ADASTEC-VMC team was the only bidder that provided such a solution.
- The ADASTEC-VMC team offered the project significant cost concessions which allowed the final cost to be within a reasonable range of the available budget.
- In terms of satisfying both the "must-have" as well as the "desirable" system requirements, the ADASTEC-VMC surpassed all other bidders in that regard and received the highest score from the selection committee members.

- From an accessibility standpoint and from a passenger capacity standpoint, the ADASTEC-VMC vehicle had clear advantages over the vehicles proposed by other bidders.

- The difference in the on-going cost of operating the SDS component beyond Phase 3 between the ADASTEC-VMC team and other bidders was significant. This was an important factor in the final selection since the Buffalo All Access project is committed to sustain operations for at least 5 years beyond the end of Phase 3.

2.1.7 Notice to Proceed and Final Contract Execution

On May 18, 2023, the UB Purchasing Department sent a Notice of Award to the ADASTEC-VMC team, as well as Notices of Determinations to the four other responders. With the Notice of Award issued, the Buffalo All Access team began working with ADASTEC on executing the final contract. A draft contract was developed and reviewed by the ADASTEC-VMC legal team. Given the unique nature of the product in this case, and how different it was compared to other products UB Purchasing Department had acquired in the past, some revisions of the draft contract were needed and were negotiated. Moreover, the need to ensure that the shuttle was manufactured and assembled in the United States to fully comply with the Buy America Act may have contributed to the prolonging of the period between when the notice of award was issued and the date of the final contract execution. The revised version of the contract was then reviewed by the legal department of the RF-SUNY on behalf of the UB. On September 7, 2023, the final contract was successfully executed.

2.2 Installation Overview

The SDS is a turn-key system which includes delivery of an automated, electric bus. To that end, there is no “installation” or build specifications that are associated with the vehicle. When the vehicle is delivered, it will be inspected to ensure that it complies with the procurement specifications. The inspection is part of the Operational Readiness Test and Demonstration activities. To that end, this section includes a short description of the vehicle components and the parking facility acquired to store the vehicle during project deployment.

2.2.1 Asset Management Plan

The asset management plan associated with the SDS is composed of collecting a digital twin of the operational domain. Operational data will be collected in two stages:

Pre-Deployment. Before the deployment, ADASTEC will be collecting the following data for simulating and planning for the proposed SDS route:

- Point Cloud Maps: Detailed 3-D point cloud of the route.

- Vector Maps: Detailed vector presentation of the route, including information about junctions, traffic rules, and regulations, lanes, connections, traffic lights, drivable areas, etc.

- Bus stop locations and route definitions.

- 3-D Simulation Data: Photorealistic digital twin of the route which will allow pre-simulation of the route with different edge cases and environmental conditions.

To collect this data, ADASTEC will be contracting with a company that specializes in this task. The company will be bringing their instrumented vehicle, equipped with a suite of sensors that resembles the sensors on a typical AV design, to Buffalo to collect the data toward the end of April 2024. Sensors onboard the instrumented vehicle are expected to include LIDAR, radar and cameras. Data collected from those sensors will then be used to generate the detailed 3-D point cloud of the route, the vector map, and the digital twin for testing.

Active Deployment. Operational data will be collected from the SDS while in operations. The operational data will be used in debugging, development and improvement studies. Data collected will include but is not limited to the following:

- Vehicle speed
- Vehicle acceleration
- Lateral acceleration of the vehicle
- Steering angle and rotation speed
- Sensor data
- Vehicle's location, coordinate information (x, y axis), heading direction
- Brake status information
- System health information
- Disengagement information

This data will be used to produce Service Level Agreement reports.

2.2.2 SDS Installation Schedule

The high-level schedule for building and delivering the SDS and parking facility is included in **Table 4**.

Table 4. SDS High-Level Installation Schedule

Description	Begin Date	End Date	Responsibility
Build in Ferndale, Washington	November 2023	May 2024	Vicinity Motors with support from ADASTEC

Description	Begin Date	End Date	Responsibility
Pre-Deployment operational domain data collection	November 2023	April 2024	ADASTEC with support from UB
Instrumented Vehicle Data Collection and Mapping of planned deployment route	April 2024	May 2024	ADASTEC contracting with a specialized company
Acquisition of permits and licenses	April 2024	August 2024	ADASTEC with support from UB
Deliver SDS to Michigan for Sensor Integration	April 2024	Mary 2024	Vicinity Motors
Final Assembly and integration of Sensor in Michigan	May 2024	July 2024	ADASTEC
Recruit Safety Drivers	May 2024	July 2024	ADASTEC
Acceptance Testing	June 2024	July 2024	ADASTEC with results delivered to UB
Wrapping the Bus	July 2024	July 2024	ADASTEC
Delivery SDS to Buffalo	July 2024	August 2024	ADASREC
Additional Data Collection and Final Mapping	August 2024	August 2024	ADASTEC
Train Safety Drivers	August 2024	August 2024	ADASTEC
Testing of Bus on Route	September 2024	October 2024	ADASTEC
Lease Parking	April 2024	July 2024	UB
Prepare Parking	July 2024	August 2024	UB

2.3 SDS Installation Plan Approach

2.3.1 SDS Deployment Route Selection

Based on current information regarding likely demand and major trip generators on the BNMC, the NFTA team has proposed a preliminary deployment route for the SDS. The proposed route is shown in Figure 4.

Source: Buffalo, NY ITS4US

Figure 4. Proposed SDS Deployment Route.

The proposed deployment route is 2.86 miles long, has a total of 17 signalized intersections, and a maximum speed of 30 mph. The route goes through some crowded areas including parking areas, houses, shopping stores and a school. Side and parallel parking exist along most of the route segments, along with mixed traffic of vehicles, pedestrians, and cyclists.

2.3.2 Route Risk Assessment

Based on the suggested route, ADASTEC conducted their own risk assessment of the route. The assessment resulted in the categorization of the deployment route into five segments shown in **Figure 5**. Each segment has different properties such as the number of lanes, maneuvering requirements, and speed limit. **Table 5** summarizes the segment characteristics, risks, and potential mitigation strategies.

Source: Buffalo, NY ITS4US

Figure 5. Existing Assessment: Road Segments

Table 5. Existing Assessment: Risk Assessment and Potential Mitigations

Segment Number	Characteristics	Risk Factors	Current System Behavior	Recommended Mitigation
1	Three lanes on each direction/ one lane used for parking	Illegal parking/ Parallel parking/ Cyclist on the AV lane	The AV detects and stops. It overtakes the vehicle/ AV follows the cyclist	Raising people's awareness/ regulate street parking
2	Turns: a total of 9	Vehicle parked on the turns	Manual intervention might be needed when vehicle parked on the corner	Prohibiting corner parking/ raising people's awareness
3	One directional road with four lanes and speed limit of 30 mph	Four-lane/ High speed route/ Uncontrolled junctions	AV detects vehicle applies harsh or soft brakes	Vehicles should avoid sudden movements when changing lanes/ install smart traffic light

Segment Number	Characteristics	Risk Factors	Current System Behavior	Recommended Mitigation
4	Two lane road with one lane designated for parking	One parking lane/ Side vehicle parking	The AV detects and performs avoidance. In areas without dashed lines, the vehicle does not perform avoidance, and human intervention may be required	Regulate street parking
5	One lane in the AV direction with no parking spots, two lanes on the opposite direction with one lane used for designated parking	Need to pass an obstacle in front, by entering into the opposite direction, risking a conflict with oncoming traffic	The AV applies the brakes and stops if it detects an obstacle/ vehicle in its lane	Regulate street parking/ people should wait for the AV to pass before crossing

In addition to the overall assessment of the risk of the five road segments, ADASTEC's analysis highlighted the specific risk factors associated with the SDS proposed deployment route. These factors included crossing different types of intersection, performing left-turn maneuvers, interactions with pedestrians, and weather conditions such as rain and snow. One proposed risk mitigation strategy ADASTEC proposed involves the installation of 'Autonomous Bus Lane' signs to raise people's awareness of the SDS.

2.3.3 Instrumented Vehicle Data Collection and Mapping of Planned Deployment Route

As was mentioned in section 2,2,1, ADASTEC plans to contract with a company that specializes in the 3-D point-cloud map generation for AVs. Data will be collected using the company's instrumented vehicle which has a suite of sensors that resembles the sensors on a typical AV design. Specifically, the instrumented vehicle will be driven along the suggested deployment route shown in Figure 4, and the data collected from those sensors will then be used to generate the preliminary 3-D point cloud map of the route. The data will also be used to develop a digital twin of the route for simulation testing.

2.3.3.1 Impact of the Planned Middle Main Street Construction Project

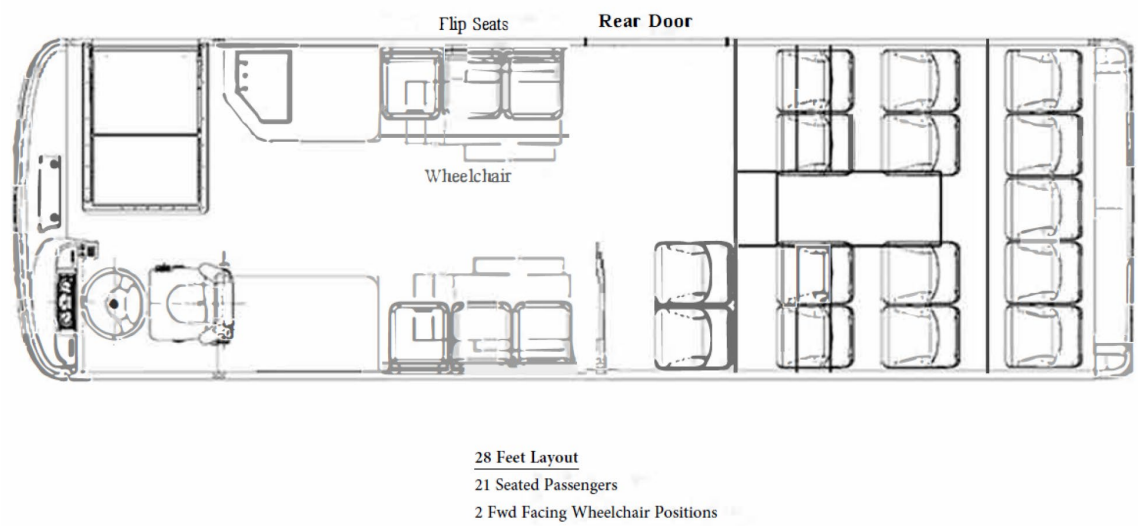
During the period from Spring 2026 to Fall 2027, the planned Middle Street construction project will likely impact the segment of the proposed SDS deployment route, along Main Street between High to the south, and Dodge to the north. Work zones may present a challenge to Autonomous driving, and hence may fall outside the ODD for the ADASTEC SDS. To mitigate this impact, we are proposing to run the SDS along Ellicott Street, instead of Middle Main, during that period. In

developing the High-Definition map, the project will make sure that this alternate route is included within the area to be mapped.

2.3.4 Self-Driving Automated Vehicle Configuration and Inspection

Once delivered, the SDS will be inspected to ensure that it meets the specifications for equipment. The inspection will review the equipment and passenger configuration.

Figure 6 shows the internal setup of the ADASTEC-VMC vehicle which will be deployed for the Buffalo All Access ITS4US project. As can be seen, the configuration has two doors, a total of 22 seats, with space for three wheelchairs.



Source: ADASTEC

Figure 6. Internal Setup for the ADASTEC-VMC SDS.

The SDS inspection checklist for installed components is listed in **Table 6**.

Table 6. Checklist for SDS Inspection

☐	100% electric (168 Kilowatt hours (kwh)) with 120-range
☐	Low floor
☐	28 feet (ft) long
☐	45 people capacity
☐	21 seats
☐	2 forward wheelchair locations
☐	Automated ramp
☐	Manual wheelchair locking system
☐	6 LiDARs (5 OUSTER OS1 64 channels LIDAR, 1OUSTER OS0 128 channels LIDAR)
☐	1 OBU (DSRC and C-V2X)

☐	6 RADARs (4 Smartmicro DRVEGRD 169 4DAUTOMOTIVE MEDIUM RANGE RADARSENSOR, 2 Smartmicro DRVEGRD 171 4DAUTOMOTIVE LONG-RANGE RADAR SENSOR)
☐	18 cameras (8 for the perception module and 3 for in-cabin management, and 7 for surveillance)
☐	2 Graphics Processing Unit (GPU) computers
☐	4 Central Processing Unit (CPU) based computers
☐	3 Ethernet switches
☐	1 Firewall
☐	1 Router
☐	3 Interior screens
☐	1 Exterior screen
☐	Interior Auditory System
☐	External Auditory System

2.3.5 Additional Data Collection and Final Mapping

The map which is to be developed as described in section2.3.3, should be regarded as preliminary, because it is developed using an instrumented vehicle with a sensor configuration that ONLY resembles the suite of sensors expected on the deployed SDS. Given this, following the delivery of the SDS to Buffalo, ADASTEC will use the SDS itself to collect additional data for the generation of the final 3-D point-cloud map of the deployed route. This second map will be developed based on data collected from the actual sensors that the shuttle will be using in real-world operations, and hence would be the most reliable one to use.

2.3.6 SDS Permitting

To secure the required license/permit which will allow the SDS to be operated on public roads in NYS, ADASTEC will have to submit an application for an Autonomous Vehicle (AV) Technology Demonstration / Testing Permit to NYS DMV. As part of the application process, ADASTEC will be required to submit their report on the demonstrations and tests undertaken pursuant to the DMV permit, to the Commissioner of Motor Vehicles. Current NYS Law requires the AV to comply with all federal standards, applicable NYS inspection standards, and to have a $5 million insurance policy. Moreover, the AV must have a licensed driver behind the wheel at all times, and that driver must be ready to take control of the vehicle whenever it is needed. Finally, ADASTEC will be required to develop a law enforcement interaction plan to ensure the safety of operations.

2.3.7 AV Shuttle Parking

ADASTEC requirements for a storage facility encompass a secure, enclosed garage for parking to ensure the safety and protection of our vehicles. Parking includes satisfying required length, width and height of the vehicle, including the installed sensors. The location will provide for adequate clearance around the vehicle, a power source for charging, heater, power door, and alarms. The space also includes amenities for staff including an office and bathroom. The parking facility should be near to the BNMC. A space has been identified that is located at the intersection

of Myrtle Avenue and S. Cedar Street in downtown Buffalo and is less than 2 miles away from the BNMC. We are currently negotiating with the landlord the terms of a possible lease of that space.

2.3.8 SDS Testing on BNMC

Following the securement of the required license/permit as described in section 2.3.6, the SDS will be tested on the actual deployment route on the BNMC. Testing will first be conducted with only the ADASTEC and UB project team onboard. The purpose of the testing would be to ensure that the shuttle is capable of navigating the proposed deployment route safely, while providing a smooth ride for the passengers. Instances of disengagements will be carefully noted, and analyzed to understand the reasons behind the disengagement and how to address them. Following testing with only ADASTEC and UB personnel onboard, beta testers will be utilized and surveyed for their ride experience.

2.4 SDS Equipment Summary

The equipment summary for the SDS is described in **Table 7**.

Table 7. Equipment Summary

Equipment Type	Total # Procured	Total # Configured & Installed
SDS bus (FMVSS, Americans with Disabilities Act (ADA), and Buy America compliant, 100% electric (168 kWh) with 120-range, low-floor, 28ft long, 45 people capacity, 21 seats, 2 wheelchair locations, manual ramp, manual wheelchair locking system). LiDARs, RGB Cameras, RADARs, Thermal Cameras, GPU and CPU based computers, ethernet switch, firewall, router, interior and exterior screens, interior and exterior speakers)	1	1

3 Indoor Navigation System

3.1 Acquisition Overview

This Section is specific to the Bluetooth Beacons (and supporting components) required to support Indoor Navigation.

The acquisition of the Indoor Navigation and its associated equipment and software has been acquired through an RFQ process as noted in **Table 2**.

3.1.1 Procurement Approach

The acquisition of the Indoor Navigation subsystem components was governed by the ICF procurement processes. Due to the compelling benefits of aligning with the technology solution already in place at Buffalo General Medical Center (BGMC) and other facilities within the BNMC, the project requested a response to RFQ from the BGMC vendor which was evaluated by the ICF Purchasing Department for the necessary components. The bid was reviewed and selected for procurement. The components are listed in **Table 8**.

Table 8. Indoor Navigation Components

Component	Description
Bluetooth Beacons	Physical component – mounted at designated facilities that will enable mobile held devices to accurately determine the location of the mobile device within a facility
Bluetooth Beacon Installation Services	Service component – one-time professional services engagement to plan and deploy Bluetooth Beacons within designated facilities
Licensing	Licensing component for the back-office tools – to enable the use of all deployed components (physical and software) for the duration of the project
Warranty	Warranty component – to provide warranty of all deployed components (physical and software) for the duration of the project
Facility Map Generation	Services component – one-time professional services engagement to generate maps representing the designated facilities (floor plan(s), Bluetooth Beacon placement, waypoint identification)

Facilities identified for Indoor Navigation capabilities are:

- BGMC (main level only), located at 100 High Street, Buffalo, New York 14203.

- Visually Impaired Advancement (VIA) Facility (main level only), located at 1170 Main Street, Buffalo, New York 14209.

The acquisition for each facility is described below:

1. VIA Facility:

    a. The project will procure all components required to outfit the first (main) floor of the VIA facility, along with any required licensing, software, or warranty required to align with the project timeline.

2. BGMC Facility:

    a. Service Level Agreements will be pursued between BNMC and BGMC ensuring existing and planned Indoor Navigation solution roadmaps support the needs of this project. Agreements will minimally include:

        i. Ensuring all Indoor Navigation components will remain in place, with vendor maintenance and all required licensing, through the end of Phase 3 (estimated March 14, 2026).

        ii. Ensuring any supporting processes or procedures (Operations and Maintenance (O&M)) required to support the Indoor Navigation components will remain active through March 14, 2026 (end of Phase 3).

        iii. Ensuring access to all supporting infrastructure required to use the existing Indoor Navigation, to include:

            1. Access to any vendor provided Software Development Kits (SDKs), including all upgrades provided by the Vendor.

            2. Access to all mapping data associated with Indoor Navigation of the Buffalo General Medical Center, including beacon locations and facility maps. The project will receive notification if any/all updates to this data.

3.1.2 Acquisition Schedule

Table 9 provides the planned acquisition schedule for this item and its' associated ancillary equipment and software, including the key acquisition dates, delivery dates and how they relate to the deployment and installation activities.

Table 9. Acquisition Schedule for Indoor Navigation Components

Date	Milestone
September 30, 2022	Initial facility outreach - Gather high level information about facility
November 30, 2022	Complete initial outreach to potential vendors

Date	Milestone
December 31, 2022	Complete gap analysis of vendor published solution capabilities against project requirements
January 15, 2023	Request / purchase minimal development “test kit” for deployment at two Research and Development (R&D) facilities
April 30, 2023	Complete ICF procurement documentation
May 1, 2023	Ready to submit purchase order(s) to Vendor
February 07, 2024	Submit purchase order for VIA facility beacons
March 22, 2024	Installation at VIA

3.1.3 Vendor Outreach Plan

Vendor outreach began November 2022 to validate vendor solution specification against project requirements. Any gaps between specifications and requirements were identified and contingency plans were developed. Vendor outreach was extended to:

- CXApp (https://cxapp.com)
    - 2479 E. Bayshore Rd, Suite 195, Palo Alto, California (CA) 94303, United States
    - 1-800-563-8065 / 1-408-702-2167

3.1.4 Procurement Specification Summary

Table 10 lists the relevant requirements and specifications that apply to the Indoor Navigation Bluetooth Beacons, as well as provides notes to vendors to contextualize each requirement when needed.

Note, these requirements are taken from the Phase 1 System Requirements Specification (SyRS) (FHWA-JPO-21-883) and represent the requirements applicable to Indoor Navigation.

Table 10. Requirements for Indoor Navigation

Req. ID	Req. Title	Req. Description	Notes to Vendor
Req-Sy-015.3	O&M Plan – System Monitoring	The O&M Plan shall include provisions for monitoring the system to ensure that each subsystem (and component) is operating effectively and safely. The specific service levels, if not identified in this specification, will be identified in Phase 2.	The vendor will need to provide process or procedures to assess Indoor Navigation equipment battery strength and condition.
Req-Sy-015.4	O&M Plan -- Maintenance Levels	The O&M Plan shall describe the maintenance levels and establish preventive maintenance procedures and schedules for all subsystem components.	The vendor will need to identify preventative maintenance procedures and schedules for Indoor Navigation equipment.
Req-Sy-015.6	O&M Plan -- Maintenance Procedures	The O&M Plan shall list the maintenance procedures for each component including repair and replacement activities.	The vendor will need to identify maintenance procedures and schedules for Indoor Navigation equipment.
Req-Sy-016	Software Change Bulletin	The System shall publish an announcement when software patches, updates or upgrades are planned. The software change bulletin should highlight any changes to data items (schema or semantics), interfaces, or operating systems. The software change process will be part of the change management process (to be included in the Phase 3 Project Management Plan (PMP)).	The vendor will need to provide release notes with all firmware updates.
Req-CTP-117	Indoor Navigation Beacons using BLE Common communication s protocols	The CTP shall interface with BLE Beacons using communication technologies supported by mobile devices (e.g., near field communication - Near Field Communication (NFC), BLE) without need for specialized functionality to be developed for the mobile app.	The vendor will need to supply Bluetooth Beacons using BLE technology

Req. ID	Req. Title	Req. Description	Notes to Vendor
Req-SI-008	Bluetooth Beacon durability	The Bluetooth Beacons shall operate in indoor and outdoor environments in the Buffalo, NY environment without degradation: -- operational temperature (-20 to +60ºC) -- Waterproof (IP67)	The vendor will need to supply Bluetooth Beacons suitable for the operating environment without degradation: -- operational temperature (-20 to +60ºC) -- Waterproof (IP67)
Req-SI-009	Bluetooth Beacon power	Bluetooth Beacons shall be powered with a replaceable battery power with an average life of 5 years (depending on usage) or by 120 AC power source (Power over Ethernet will be acceptable)	-
Req-SI-011	BLE Beacons	Bluetooth Beacons shall meet the following specifications: (1) support BLE 5 or above; (2) have a configurable broadcast range of between 50-100 meters for indoor spaces or 200-300 meters for outdoor spaces. The space will dictate the preferred range.	-
Req-SI-013	Bluetooth Beacon installation and mounting	Bluetooth Beacons shall be constructed to be installed using adhesive or screws mounted on a wall, shelter, or pole.	-
Req-INT-002	BLE 5	The system shall conform to the Bluetooth Specification Version 5.0 or higher. See https://www.bluetooth.com/specifications/specs/	The vendor will need to supply Bluetooth Beacons that meet the requirement.
Req-Proj-15	Indoor Nav Buy America Provision	The Indoor Navigation equipment shall conform to the Buy America Act requirements.	Vendor shall supply documentation (on vendor letterhead) self-validating conformance with the Buy US requirement

Req. ID	Req. Title	Req. Description	Notes to Vendor
Req-Proj-16	Indoor Navigation deployment services Project Management	Vendor shall assign a key staff person to manage and report to the ICF / facility owner and manage the deployment of all procured components	-
Req-Proj-17	Indoor Navigation Technical Support	Vendor shall assign a key staff person (or designate a mature process) to facilitate the timely response and resolution of all technical questions or concerns related to all procured components	-
Req-Proj-18	Indoor Navigation Operational Readiness Testing and Demonstration	Vendor shall participate in the Operational Readiness Testing and Demonstration (milestone gate to proceed to Phase 3).	-
Req-Proj-19	Indoor Navigation Component Testing and Reporting	Vendor shall collaborate with the Buffalo ITS4US vendors to develop, conduct and report test plans and test reports consistent with ICF testing documentation expectations. Vendor shall work collaboratively and in a timely manner to resolve any issues identified during testing, as well as provide any other support related to project testing and demonstration (specific to procured components)	-
Req-Proj-20	Indoor Navigation Operations and Maintenance Services	Vendor may be required to provide Operations and Maintenance Services for procured components for the duration of the planned project. This requirement will be further developed and refined based on the thorough understanding of the vendor's Indoor Navigation components and architecture.	-

Req. ID	Req. Title	Req. Description	Notes to Vendor
Req-SI-033	Indoor Navigation SDK	Vendor shall provide a well-documented SDK that the CTP mobile application will leverage to interact with the Bluetooth Beacons. This SDK will (at a minimum) allow the CTP mobile application to accurately determine the indoor location of the mobile device. Additional capabilities may be included in the SDK that will assist with the presentation of indoor facility maps, planned navigation routes and fixed waypoints.	-
Req-SI-034	Indoor Map Generation	Vendor shall work with the project team and facility owners to generate Indoor Maps detailing public areas and paths within the target facilities, including waypoints and areas of interest, cross referenced with Bluetooth Beacon placement (via the SDK)	-

In addition, as stated in Req-INT-002 in **Table 10**, vendors will need to provide equipment that conforms to the Bluetooth Specification Version 5.0 or higher. See https://www.bluetooth.com/specifications/specs/.

3.2 INS Installation Overview

This section describes the activities associated with the INS. The INS is separated into the software as a service component where the management and software systems reside and the beacon installation. The management functions are described in the System Design Document (SDD). Beacon installation and inventory management is described in this document.

3.2.1 Asset Management Plan

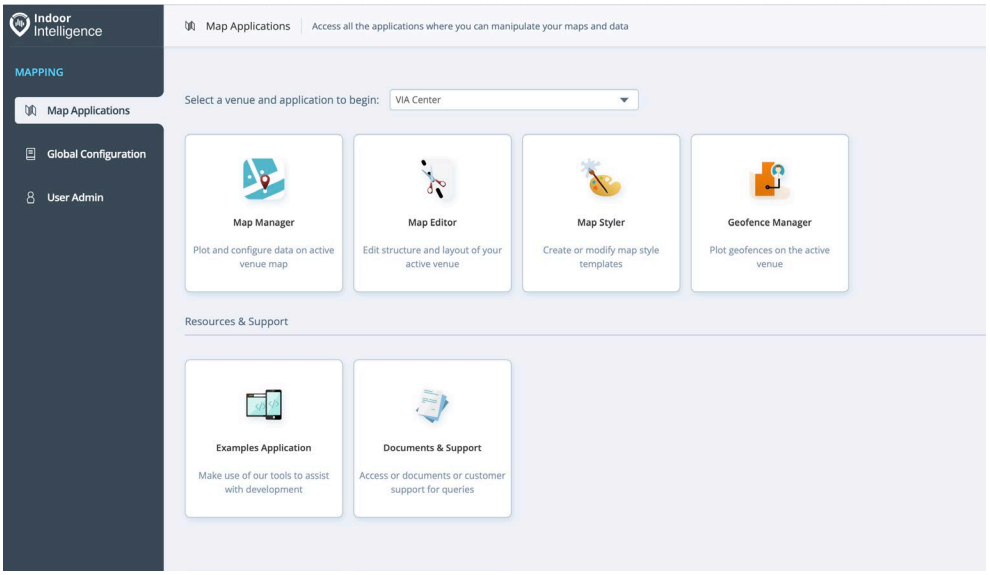
Managing the beacons requires two components: managing the map that describes the location of the installation and managing the beacon configuration.

3.2.1.1 Content Management

The SaaS Computing Platform (procured as an off-the-shelf, SaaS solution from CXApp (https://cxapp.com)) provides indoor navigation asset management (venue maps, waypoints, paths) and the interfaces for interacting with the asset database(s). A key component of the system is the Content Management System (CMS), which provides a cloud hosted platform for managing the features of buildings for the purpose of indoor positioning applications (Req-SI-034). Examples of CMS managed assets include:

- Amenities - represent a place of interest that can be navigated to on a map. Examples of amenities include restrooms, elevators, parking lots, etc.
- Destinations - locations or places on a map to which a user intends to visit. Examples of destinations include meeting rooms, offices, reception areas, kiosk, etc.
- Floors – a traversable level of a building.
- Paths – a link between waypoints. A user can only travel from waypoint to waypoint, if it connected via a path. A path may be connected to multiple waypoints.
- Path Types - mechanisms used to transport people from one floor to another. Path types have Speed, Weight, and Accessibility parameters, which can be used by the wayfinding algorithms to determine likely a given path is to be included in the route from source to destination.
- Zones - a collection of several waypoints. A zone typically encompasses a large area within a map. Examples of Zones include parking lots, office wings, large common areas, craft fair, etc. Zones can also exclude occupation (e.g., due to statue or construction).

The CMS is accessed via a web browser (**Figure 7**), and the user is authenticated with a username and password. One (or more) users can have the Administrator role who can add additional users as needed.



Source: CXApp

Figure 7. CXApp Content Management Home Page

3.2.1.1.1 Asset and Map Update Tools

Asset and Map Update Tools are included in the CXApp CMS solution to keep track of Indoor Navigation asset descriptions and locations as they are related to the facility layout. The CMS data is the “mapping source of truth” for the indoor navigation solution.

The CMS management solution include the following web-based tools:

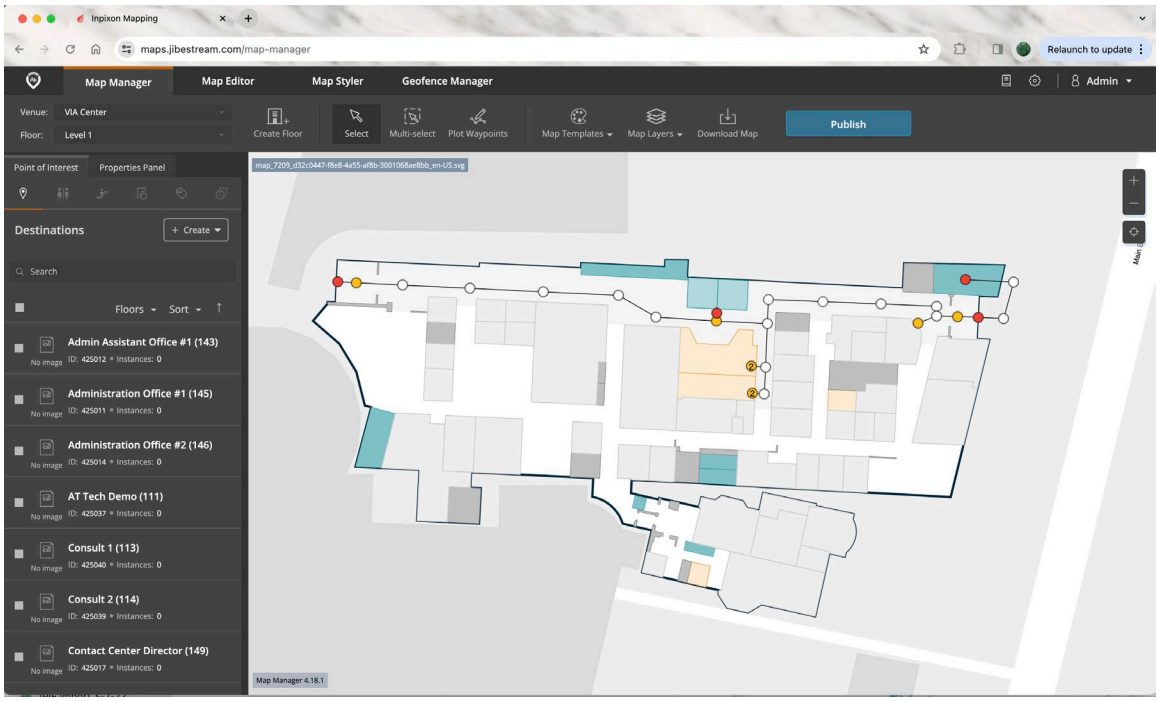
- Map Manager (Req-SI-034)
- Map Editor (Req-SI-034)
- Map Styler
- Geofence Manager

3.2.1.1.1.1 Map Manager

The map manager tool provides functions to review, update and delete walking paths and point of interest locations within the indoor facilities layout. To begin the process, up-to-date detailed floor plans were provided to CXApp to generate the initial map. The initial input to this process included:

- Computer Aided Design (CAD) (.dwg) format diagrams denoting structural map references including as-built drawings denoting the current, physical state of the building to be mapped and a detailed site plan of the surrounding area.
- List of all unique points of interest to be mapped:
    - Naming conventions were audited to match any physical signage or common nomenclature to ensure continuity of the experience.
    - Indication of each point of interest as public, or private/internal, or other segregated user group.
    - Keywords for all points of interest for relevant and related search terms that and end user may also query.
        - All relevant data was provided in English (locale code: us-EN) and Spanish (locale code: es-ES).

Based on the provided CAD diagrams, Technology Vendor (CXApp) generated a map with the WGS-84 Pseudo Mercator alignment (EPSG Code: 3857), so that Blue Dot (real-time position based) location can be enabled for users in the application—see Figure 8.



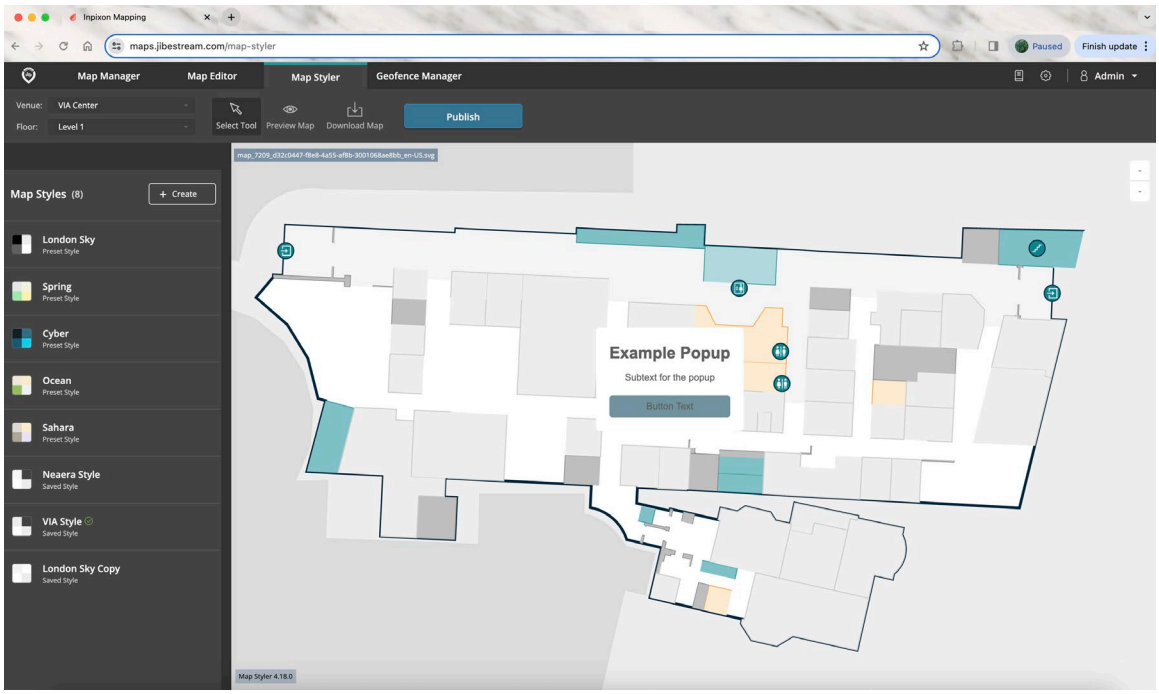
Source: CXApp

Figure 8. VIA Facility Map with Waypoints.

The Map Editor utility (web based, self-serve) will enable the project to make incremental changes to the initial map (Req-SI-034) should this be required (ex: additional parts of the facility are enabled for public indoor navigation capabilities in the future). All CMS map structure changes are versioned, allowing for the easy restoration of any version of previously saved maps. The CMS system automatically saves point-in-time changes with auto-generated map version name and indicates the date and time that the map was published.

3.2.1.1.1.2 Map Styler

The map styler utility is used to create and manage the appearance of rendered maps. Map styles include map color palettes, and map layer colors. The configured “VIA Style” is shown in **Figure 9**.



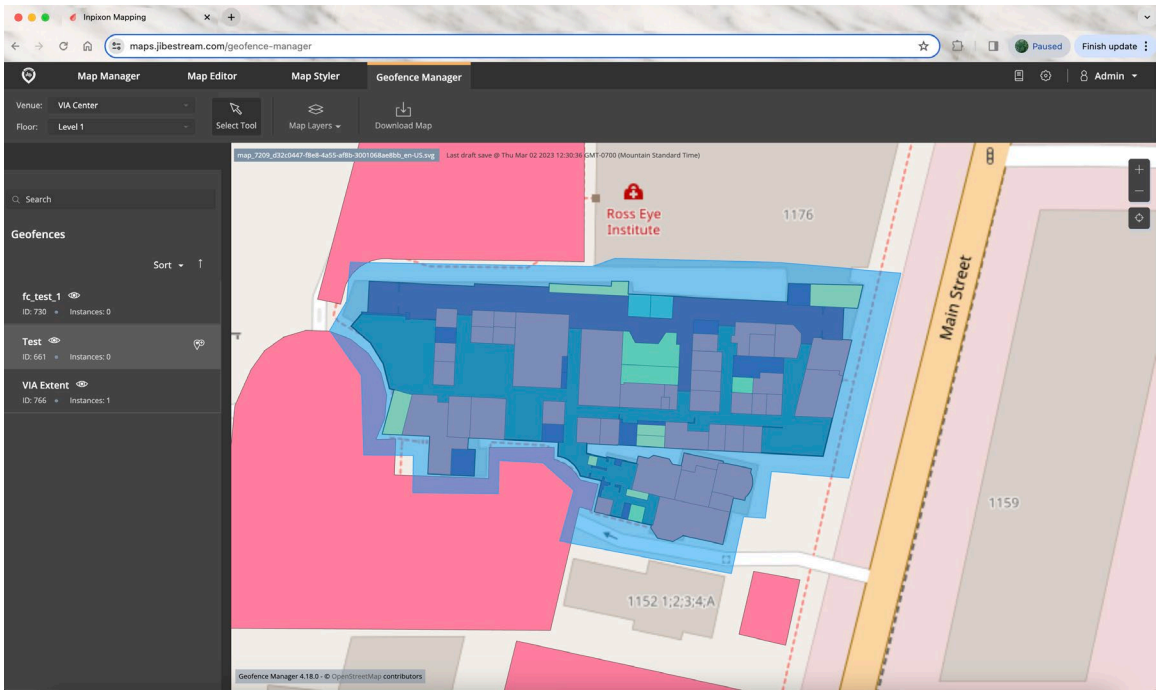
Source: CXApp

Figure 9. VIA Facility Map Style.

3.2.1.1.1.3 Geofence Manager

The Geofence Manager utility was used to create (and manage in the future) geofence definitions relative to the venues in-scope for indoor navigation. A geofence is a user-defined area of interest that is represented on a real-world map. Geofences are drawn as polygon(s) from a set of real-world longitude-latitude coordinates. The geofences allow the mobile device (App Access App) mechanism to switch to/from “indoor” navigation mode and “outdoor” navigation mode.

Figure 10 shows the geofences that were created for the VIA Facility.



Source: CXApp

Figure 10. VIA Geofence Configuration.

3.2.1.2 Device Inventory

3.2.1.2.1 Physical Device Configuration

Ascent Systems “iBKS Plus” BLE beacons were procured for the VIA facility (https://accent-systems.com/product/ibks-plus/). Ascent Systems provides a configuration application for the beacons. The App is available here:

- Android App Download Page:

  https://play.google.com/store/apps/details?id=com.accent_systems.ibks_config_tool

- iPhone Operating System (IOS) APP Download Page:

  https://apps.apple.com/us/app/ibks-config-tool/id929525388

The Physical Device Configuration steps are as follows:

- Beacon Power Up:

  Out of the box, the beacons are not powered on. The beacons do not have a power switch and must be opened up to be powered on. The following instructions review how to perform beacon power up:

  1. Remove the Front Cover - The front cover of the beacon is held onto the beacon via friction. To remove the cover, simply pull it straight out from the

beacon. Be mindful to pull evenly on all sides to prevent the cover from binding against the screw holes.

2. Unscrew the Corner Screws - Once the cover is removed, remove the screws in the four corners. The screws can be removed with a 2.5 mm Allen wrench (or equivalent).

3. Press the Tab releases - To open the unit, pinch the tabs on the top and bottom of the beacon. With the tabs pushed in, pull the back plate of the unit off from the casing.

4. Power On - Most of the volume inside the beacon is for the four AA batteries that power the unit. Each beacon should have four batteries, but they are not positioned properly to allow the unit to turn on. Before continuing, remove all four batteries from the unit and take note of the red circuit board beneath the batteries. On the back of the board is a QR code that can be used for easy connection to the beacon. Take note of this code if you would like to use it for connection. Place the batteries back into the unit to power it on. When the batteries are placed back in the unit, a green power light will flash for a few seconds. This light is visible from both the front and the back of the unit. The beacon should now show up in the configuration app.

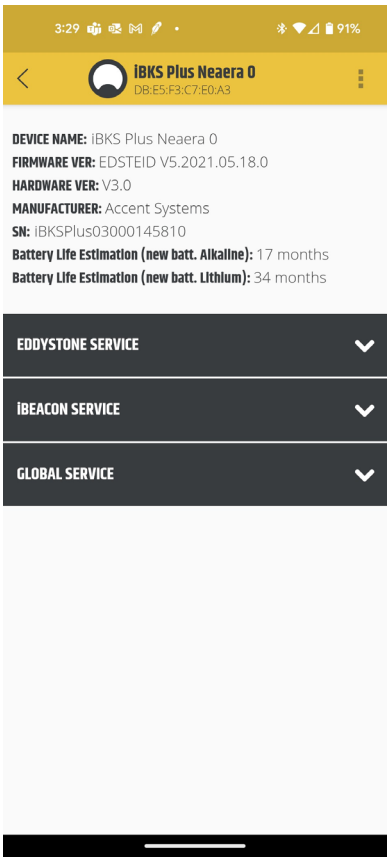
- Parameter Configuration (using the iBKS Configuration tool app):

1. Scanning for beacons - Tap the blue scan button in the bottom right corner of the screen. This will start the app in scanning mode and it will look for new nearby beacons. When the app is in scanning mode the arrow in the blue circle will continuously spin. Allow the app a few seconds to find the beacon that needs to be configured. Valid beacons are shown in white, while other devices are shown in grey. Once the beacon shows up in the list tap the scan button again to stop scanning.

   Note, you will not be able to connect to the beacon while the app is scanning, so make sure to manually stop the scanning process.

   Note, non-beacon devices may show up as beacons in the list. That app will allow you to try to connect to them and may even try a firmware update. Make sure that the device you are connecting to is indeed a beacon. The device name should be set to iBKS Plus by default.

2. Connect to a beacon - To connect to a beacon, tap the beacon in the list of available Bluetooth devices. You should see a screen similar to **Figure 11**.



Source : CXApp

Figure 11. iBKS Configuration App.

3. Verify Firmware numbers - The beacon should have up to date firmware when it ships. Make sure that the software version is greater than 5.0, otherwise further setup will fail. The app will automatically prompt you to update the firmware if it is necessary.

4. Change the Beacon Name - To help keep beacon configuration consistent, it is useful to set the name of a beacon to be something user friendly. Unlike Universally Unique Identifier (UUID)/Major ID/MinorID The beacon name can be set to human readable plaintext which is easy to understand. Tap the settings menu in the top right corner then select “Change Device Name” to set the device name. Set the device name to something meaningful to keep it from getting confused with other devices.

5. Setup iBeacon protocol parameters - iBeacon is the Apple supported protocol for performing beacon-based localization. Tap the drop down for iBeacon and select the opened pop-up to open the iBeacon configuration page. Change/set the following parameters:

   Advertising Interval: 400

   Radio TX. Power: +4

UUID [HEX] 00000000000000000000000000000000

MAJOR[HEX] 0000

MINOR[HEX] 0000

Notes:

- Ensure the UUID is the same for all the beacons in the same deployment / CXApp venue.
- Set Major Hex to the floor number where the beacon will be deployed. If the beacon is going to be underground, use two's complement notation (i.e., a method to represent signed integers in binary format) to indicate a negative floor.
- MINOR Hex must be unique for all beacons on the same floor. Do these incrementally.

- Locking the Beacons:

The iBKS beacons were password locked to prevent unauthorized tampering. Please read all the instructions below fully before locking the beacon. Failure to properly lock the beacon can result in permanent loss of access to the beacon and will require shipping the beacon back to the factory to recover.

1. Open the Global Service menu and select the grey 'LOCK and DISCONNECT' button at the bottom of the screen. This will lock the beacon and disconnect the user.
2. Reconnect to the locked beacon using the same procedure described above. When prompted for the beacon password enter the default password (32 zeros): 00000000000000000000000000000000
3. All passwords on the beacon must be **exactly** 32 characters long. The password entry form will throw a different alert for a password of invalid length, as opposed to an incorrect password. When reconnecting to a beacon via a password the process will take significantly longer than logging in without a beacon lock. This is normal and expected.
4. Once you have logged back into the beacon select the 3-dot menu in the top menu and select "Change Password". Note: this menu is available on an unlocked beacon but will not open until the beacon is locked.
5. A new dialog will appear asking you to enter the old and new password. The old password is the same password as used for login. Typically (32 zeros) 00000000000000000000000000000000. The new password was selected and configured for the project site. Note: This field accepts non-hex characters.

6. Once the password has been changed disconnect from the beacon and store the new password somewhere secure.

3.2.1.2.2 Device Inventory

Table 11. VIA Beacon Inventory

Beacon Name	Serial Number	UUID	Major ID	Minor ID	Advertising Interval	Signal Tx Power
iBKS Via 1	iBKSPlus0300 0154639	0000000000000000 000000000000F00D	0001	0001	200	4
iBKS Via 2	iBKSPlus0300 0154641	0000000000000000 000000000000F00D	0001	002	200	4
iBKS Via 3	iBKSPlus0300 0151846	0000000000000000 000000000000F00D	0001	003	200	4
iBKS Via 4	iBKSPlus0300 0154425	0000000000000000 000000000000F00D	0001	004	200	4
iBKS Via 5	iBKSPlus0300 0154418	0000000000000000 000000000000F00D	0001	005	200	4
iBKS Via 6	iBKSPlus0300 0154414	0000000000000000 000000000000F00D	0001	006	200	4
iBKS Via 7	iBKSPlus0300 0153631	0000000000000000 000000000000F00D	0001	007	200	4
iBKS Via 8	iBKSPlus0300 0154434	0000000000000000 000000000000F00D	0001	008	200	4
iBKS Via 9	iBKSPlus0300 0154403	0000000000000000 000000000000F00D	0001	009	200	4
iBKS Via 10	iBKSPlus0300 0153640	0000000000000000 000000000000F00D	0001	010	200	4
iBKS Via 11	iBKSPlus0300 0154432	0000000000000000 000000000000F00D	0001	011	200	4
iBKS Via 12	iBKSPlus0300 0154440	0000000000000000 000000000000F00D	0001	012	200	4
iBKS Via 13	iBKSPlus0300 0151148	0000000000000000 000000000000F00D	0001	013	200	4

Beacon Name	Serial Number	UUID	Major ID	Minor ID	Advertising Interval	Signal Tx Power
iBKS Via 14	iBKSPlus0300 0151334	0000000000000000 000000000000F00D	0001	014	200	4
iBKS Via 15	iBKSPlus0300 0151238	0000000000000000 000000000000F00D	0001	015	200	4
iBKS Via 16	iBKSPlus0300 0151340	0000000000000000 000000000000F00D	0001	016	200	4
iBKS Via 17	iBKSPlus0300 0151346	0000000000000000 000000000000F00D	0001	017	200	4
iBKS Via 18	iBKSPlus0300 0151322	0000000000000000 000000000000F00D	0001	018	200	4
iBKS Via 19 (spare)	iBKSPlus0300 0151320	0000000000000000 000000000000F00D	0001	019	200	4
iBKS Via 20 (spare)	iBKSPlus0300 0153642	0000000000000000 000000000000F00D	0001	020	200	4
iBKS Via 21 (spare)	iBKSPlus0300 0151142	0000000000000000 000000000000F00D	0001	021	200	4
iBKS Via 22 (spare)	iBKSPlus0300 0153627	0000000000000000 000000000000F00D	0001	022	200	4

3.2.2 INS Installation Schedule

The INS installation schedule is described in **Table 12**.

Table 12. INS Installation Schedule

Task	Role	Start	End
Beacon Configuration and Q/A • Initial Beacon Inventory, Power On and Quality Assurance (QA) • Configure UUID / Major ID / Minor ID / Beacon Tx Power • Prepare for Ship to VIA	Buffalo Tech Team	March 11, 2024	March 15, 2024
Beacons in Transit to VIA	FedEx	March 18, 2024	March 20, 2024
Beacon Physical Installation – VIA	VIA Facility	March 20, 2024	March 21, 2024
Indoor Navigation On Device Positioning Calibration / Optimization	VIA Facility Representative Buffalo Tech Team CXApp Technical Support	March 21, 2024	March 31, 2024

3.2.3 INS Installation Plan Approach

The installation approach consists of the following activities:

- All BLE beacons are installed by VIA facility staff.
- VIA facilities staff will install the BLE beacons directly to facility walls using suitable methods to attach the beacons to wall surfaces (primarily drywall). Attaching the beacons with drywall anchors and screws is recommended (at the discretion of the VIA facilities staff).
- Beacons will be installed in the locations shown at a typical height of 8-ft above ground level.

The installation plan is a checklist that includes the following sections:

1. Location for beacon installation
2. Resourced needed for installing the beacons including
    a. beacon model/manufacturer and count, mounting materials

b. people and their roles for installing the beacons

c. tools needed to install and test the beacons

d. policies and procedures that govern installation

3. Location and placement, e.g., the guidance on placing and installing the beacons for best results.

4. Diagrams for installing the beacons.

5. Configuration and Commissioning the devices (i.e., optimizing and activating)

Also included are some recommended test procedures to further optimize the effectiveness of the wayfinding capability.

3.2.3.1 Beacon Installation Checklist

The installation plan is described in the steps below.

1. Location for beacon installation

   VIA, 1170 Main Street, Buffalo, NY 14209

   See Figure 12 for beacon installation locations

2. Resources

   a. BOM for site

      Sty: 22 Accent Systems iBKS-Plus Beacons

      Qty: 100 #4 screws for attaching Beacons to wall mounting locations

   b. People

      VIA Facilities Personnel

   c. Tools

      iBKS-Plus Beacons

      Handheld Drill (optional)

      2.5mm Allen wrench

      Phillips Head Screwdriver

      Ladder allowing Facilities Personnel to safely secure beacons to mounting locations (typical – 8 ft. above floor)

d. Policies and Procedures (applicable policies / rules)

VIA Facilities Site Policies and Procedures

Occupational Safety and Health Administration (OSHA) Policies and Procedures pertaining to Ladder use

The policies and procedures are available from VIA facilities staff.

3. Locations / Mounting approach / Procedure

See **Source:** CXApp

Figure 12. VIA Beacon Placement Map

Typical mounting height = 8 ft. above floor level

a. Procedure

i. Remove front cover: The front cover of the beacon is held onto the beacon via friction. To remove the cover, simply pull it straight out from the beacon. Be mindful to pull evenly on all sides to prevent the cover from binding against the screw holes.

ii. Unscrew Corner Screws: Once the cover is removed, remove the screws in the 4 corners. The screws can be removed with a 2.5 mm Allen wrench (or equivalent).

iii. Press Tab releases: To open the unit, pinch the tabs on the top and bottom of the beacon. With the tabs pushed in, pull the back plate of the unit off from the casing.

iv. Secure Beacons to Wall Surface: Secure the beacon back plate to mounting surface (wall) with two (2) (minimum) to four (4) #4 screws per device (installer discretion) – use the screw holes on the back plate (pilot holes are not required for attaching to drywall surfaces). If mounting using only two (2) screws, use screw holes diagonally opposite each other.

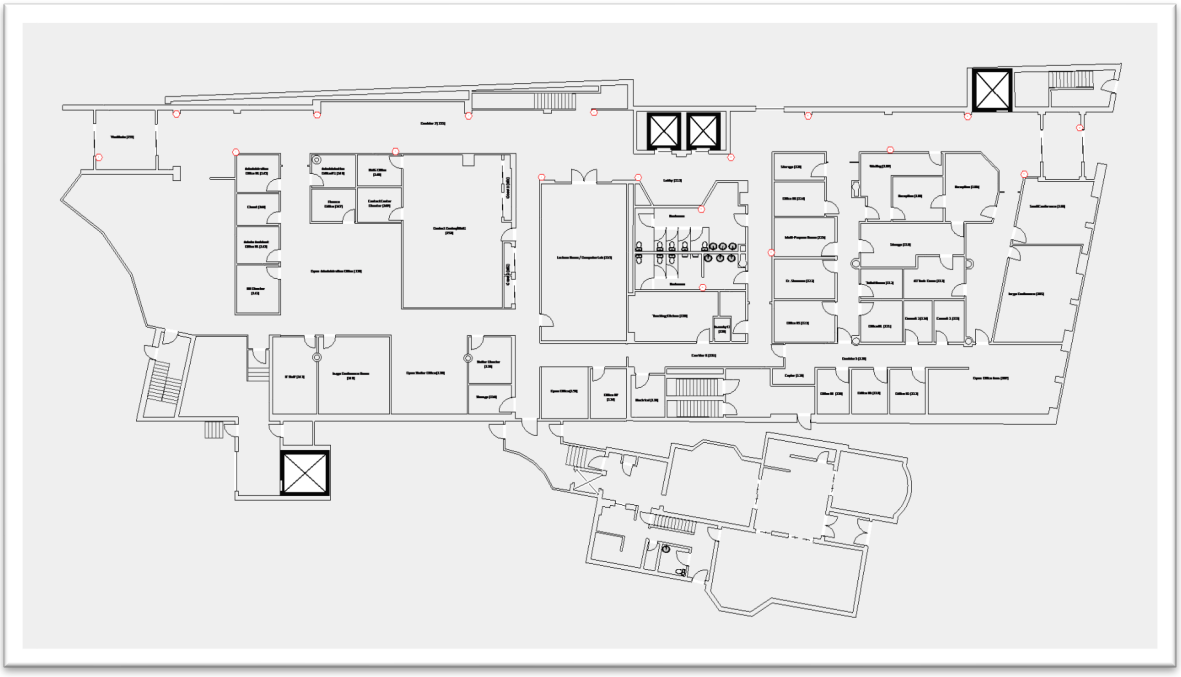
v. Reattach beacon/casing to back plate using firm hand pressure until the Tab releases are positively re-engaged

vi. Reattach 4 corner screws using 2.5mm Allen wrench (or equivalent)

vii. Reattach front cover of the beacon using firm hand pressure until the front cover is positively re-engaged (friction-fit)

4. Diagrams

See Figure 12 for beacon placement.



Source: CXApp

Figure 12. VIA Beacon Placement Map

5. Configuration and Commissioning

No additional software configuration is required

No additional data prep configuration required

QC Check List (to be performed by VIA Facilities staff post BLE Beacon installation):

a. Verify beacons are broadcasting:

- Using the iBKS Configuration Tool (refer to download information in section 3.2.1.2.2 - Device Inventory) Tap the blue scan button in the bottom right corner of the screen.
- Allow the app a few seconds to display a list of BLE broadcasting devices near-by
- Ensure each beacon is broadcasting (refer to “Beacon Name” from Table 11. VIA Beacon Inventory)

Several test procedures were developed to test the efficacy and effectiveness of the All Access App (aka CTP) with the beacons. In addition, there are recommendations by the vendor to optimize positioning and signal broadcast of the beacons. These include the following:

"The basic use case for beacons in CXApp On-Device Positioning aims to require no special tuning on a per-beacon basis after the laydown is complete. Some facilities, due to unavoidable blockages of beacon signals, placement of beacons at drastically different heights from the floor, and other device-to-device variation, have benefitted from adjusting the individual strength corrections for each beacon."

"The primary use case for adjusting individual beacons comes from the desire to have the location solution more or less readily drawn to specific beacon locations by modifying the perceived reception power. In order to maintain a clean, low-noise, reception of the beacon signal, it is not recommended that the beacons themselves be set to broadcast lower power. In fact, the default configuration for beacons used, should always be maintained."

"Instead, the 'power' field of the Beacon UUID/MajorID/MinorID file can be adjusted by a few dB at a time to change system behavior, making the value higher (more positive) if a user wants to see the computed location (in the app) not move to the beacon location as responsively, and making the value lower (more negative) if a user wants to see the computed location drawn to the beacon location with higher authority. A typical step size for trying to make minor modifications to system behavior is +/- 2dB."

"Any desired changes to the UUID/MajorID/MinorID file will be submitted to the CXApp support team for implementation (this configuration is not self-service by the end user/development team)." (CXApp documentation)

3.2.4 INS Equipment Summary

Table 13 details the total number of devices procured as well as the number of devices that will be configured and installed for indoor navigation.

Table 13. Equipment Inventory

Equipment Type	Total # Procured	Total # Configured & Installed
CXApp Portal (SaaS Content Management System)	1	Not applicable
Accent Systems iBKSPlus BLE Beacons (https://accent-systems.com/product/ibks-plus/)	22	18 (4 spare)

4 Pedestrian Crossing System

4.1 Acquisition Overview

The Pedestrian Crossing (also referred to as PED-X) equipment and integration services are included in the NFTA ITS4US award. The acquired equipment (hereafter referred to as the pedestrian actuation gateway) will facilitate communications from the traveler (via the CTP and CTP mobile app) to the signal system. Other equipment, such as the signal system, Intelligent Transportation System (ITS) cabinet, and audible pedestrian system (APS) are already deployed (at Ellicott & High Street intersection) or are in the process of being procured (under the Middle Main Street construction project led by the CoB) and are outside of the scope of this project. The pedestrian actuation gateway equipment, installation, configuration and integration with the CTP was acquired as part of the NFTA ITS4US award.

4.2 PED-X Installation Overview

The PED-X installation consists of the Miovision camera and TrafficLink module. The camera is installed on a pole and the module is located in the traffic signal controller cabinet.

4.2.1 PED-X Asset Management Plan

The Miovision equipment will be configured and managed by the CoB to meet their specifications. All management, monitoring and asset inventory management will be governed by existing CoB operations and management processes.

4.3 PED-X Installation Schedule

The PED-X installation schedule is described in **Table 14**.

Table 14. PED-X Installation Schedule

Task	Lead	Start	End
Validate Miovision Hardware / Software Requirements	ICF	May 1, 2024	August 15, 2023
Miovision Purchase Order Placed	ICF	Sept 1, 2023	Oct 23, 2023
Miovision Equipment Received by NFTA	NFTA	Oct 24, 2023	Nov 17, 2023

Task	Lead	Start	End
Miovision Installation at Intersections • Ellicott / High Street • Main / Best	CoB	March 5, 2024	March 5, 2024
Reinstallation due to Middle Main Construction Project in Spring 2026. The equipment will be removed from the old cabinet/signal controller and reinstalled in the new cabinet / signal controller.	CoB	expected in Spring 2026	expected in Spring 2026

4.4 PED-X Installation Plan Approach

The PED-X installation plan approach is to deploy key Miovision technology at two intersections in the project area:

- Intersection of High and Ellicott Street
- Intersection of Main and Best Streets

The Miovision technology will be installed at the two in-scope intersections in March by City of Buffalo Department of Public Works (DPW) under the direction of a City Engineer (Professional Engineer).

The deployment at Main and Best will be impacted (during this project's period of performance) by a major Middle Main renovation project. The construction project is currently in the planning and design phase, with a final schedule to be determined. The Main and Best Miovision installation will be moved from its initial deployment traffic poles to temporary poles as a component of the Middle Main construction renovation, and then moved to final poles as the construction effort progresses. This is a working plan and final details will be dictated by the overall Middle Main construction schedule, which is not available at this time.

All specifications related to the Miovision deployment are governed by the CoB DPW procedures based on prior Miovision installations, and the working relationships between CoB DPW and Miovision.

The installation plan is a checklist that includes the following sections:

1. Location for Miovision Core DCM and camera installation

2. Resourced needed for installing the equipment including

a. Bill of Materials – equipment, part number and quantity

b. People and their roles for installing the equipment

c. Tools needed to install the equipment

d. Policies and procedures that govern installation

3. Location diagrams of the sites.

4. Mounting and Securement of Camera– these reference the guides published by the manufacturer, Miovision

5. Installation for TrafficLink in Cabinet – these reference the guide published by the manufacturer, Miovision

Note: The reinstallation plan will follow the same checklist unless Miovision or the installation team needs to change the provisions.

4.4.1 Miovision Equipment Installation Checklist

1. Location of installation

   Location: High Street and Ellicott Street Intersection (Southwest corner of Kaleida Health / Buffalo General Medical Center).
   https://maps.app.goo.gl/nMdZ34MuB3bJUV7EA

   Location: Main Street and Best Street Intersection (near the Summer-Best Metro Rail Station, and approx. 1/2 block South of VIA).
   https://maps.app.goo.gl/jT6heaZCpNVmTa4W6

2. Resources

   a. BOM for site

Table 15. Equipment Inventory (for a single Site)

Miovision Product	Miovision Part Number	Quantity (for a single Site)
Core DCM (detection and count module)	NA-MIO-CTM-DCM-V1	1
SmartView 360 Camera	ITS-CAM360-HTD	2
Universal Mounts	SP-CAM360-UNIMOUNT	2
Detection License	ITS-SW-SS-DETECTION	1

Miovision Product	Miovision Part Number	Quantity (for a single Site)
Ethernet Cable	SP-PT-ETHERNET Ethernet Cable - 1000 ft.	1
Comms for 2 years (2GB)	ITS-MNGDATA-2GB	2
Pre-emption/priority	ITS-CORE-PRIIO-Cable	1

b. People

CoB DPW staff, under the direction of CoB City Engineer (Professional Engineer)

c. Tools (not included in Miovision equipment purchase):

- For SmartView Camera Installation:
  - Bucket Truck: Schedule a bucket truck with a minimum reaching height of 9.14 m (30 ft.).
  - Stainless steel banding - 12.7 or 19 mm (½ in or ¾ in) band width recommended
  - Banding tool
  - RJ45 crimping tool
  - Ethernet cable test unit
  - For traffic-pole installation:
    - Stainless steel banding - 12.7 or 19 mm (½ in or ¾ in) band width recommended
    - Banding tool
  - For mast-arm installation:
    - 14.29 mm (9/16 in) Wrench: To loosen and tighten the nuts on the mount
- For Miovision Core / Miovision Core CDM Installation:
  - Drill and 7/8 in (22 mm) hole saw or punch
  - Industrial-strength cleaner
  - Heat gun if installing in temperatures under 41°F (5°C)

- Drop cloth or container to catch drill filings

d. Policies and Procedures for installation and safety from CoB.

- The City of Buffalo followed the manufacturer's installation recommendations with incidental modifications as necessary to accommodate site specific conditions.

3. Location Diagrams

Photographs of the installation sites are shown in Figure 13.

Source: Buffalo ITS4US

Figure 13. Photographs of installation Sites.

4. Mounting and Securement for Camera Installation

Miovision documents, referenced below, address securement, safety and installation directions for camera installation:

Miovision Core & Miovision Core DCM Hardware Installation Manual
(https://Miovision.my.salesforce.com/sfc/p/50000000a2wf/a/1T000001B9PP/yoLRosJVS00agGpqxUOI5bkATeCNIK58k0YF0s2L360)

Miovision SmartView Approach + 360 Installation Guide
(https://miovision.my.salesforce.com/sfc/p/50000000a2wf/a/1T000001AEzt/gRnl5EeqxRRSToRRFOItVb5iHHTqekxBOP1LR5M5KCk)

5. Installation for TrafficLink in Cabinet

Miovision documents, referenced below, address directions for installation of the TrafficLink module in the cabinet:

Miovision Core Cabinet Installation Checklist
(https://help.miovision.com/s/article/TrafficLink-Cabinet-Installation-Checklist?language=en_US)

4.4.2 Equipment Summary

A summary of the equipment is listed in **Table 16.**

Table 16. Equipment Inventory

Equipment Type	Total # Procured	Total # Configured & Installed
Miovision Core DCM	2	2
Miovision SmartView 360 Camera	4	4
Miovision Universal Mounts	4	4
Miovision Detection License	2	2
Miovision Comms for 2 years (2GB)	4	4
Miovision Pre-emption/priority	2	2

5 Transportation Information Hub

5.1 Acquisition Overview

The acquisition of the TIH and its associated subcomponents, equipment, and software—including installation, operations and maintenance — was acquired through an RFP process which sought qualified vendors who are capable of providing a solution that meets the needs and requirements of the project. The following subsections provide details on the TIH, a physical Kiosk that is expected to be installed in two locations: within Kaleida Health's BGMC and within the NFTA Summer-Best station.

5.1.1 Acquisition Approach

The acquisition of the TIH and any subcomponents, equipment, software and services (e.g., maintenance), was acquired through an RFP process which sought qualified vendors who are capable of providing a viable TIH solution. As the Phase 2 and Phase 3 lead of the Buffalo NY ITS4US Deployment Project, NFTA worked collaboratively with ICF who led the acquisition process.

ICF selected a vendor through a competitive process to seek the best value from available vendors. Best value procurements are often used when additional evaluation criteria other than price should be included in determining the supplier proposal that offers the best solution. In general, ICF took into consideration the following criteria when reviewing:

- **Technical Capability**: The extent to which the vendor demonstrates the ability to provide the depth and breadth of experience, skills, and knowledge required by this work. This will include a review of professional references and associated documentation provided by respective offerors.

- **Cost**: Award will be based upon the receipt or negotiation of a technically acceptable offer at a fair and reasonable price to include acceptable unit pricing models and monthly retainer fees.

- **Completeness and Quality of Bid Response**: The thoroughness and concern for quality in the vendor's fully responsive offering.

- **Past Performance**: Award will be based upon detailed past performance data provided through business related data concerning corporate overview, capabilities statements, and past performance references.

Below are the basic steps that were followed for issuing the best value RFP, evaluating proposals, and selecting an awardee:

1. Buyer and Program/Project Manager (PM) draft requirements and define evaluation criteria, including price, technical factors, past performance, etc. Buyer and PM will document the evaluation criteria to be used and the relevant importance of each factor (for example, past performance and technical approach may be considered to be equal, but both may be weighted more than price) prior to issuance of the RFP to potential offerors.

2. Buyer issues RFP.

3. RFP specifies the basis for award.

4. Vendors submit proposals.

5. PM evaluates proposals received based on evaluation criteria (using a Technical Evaluation form).

6. The vendor that ranked the highest based on the evaluation criteria and relative weighting was selected and awarded the contract.

5.2 Acquisition Schedule

Table 17 provides the acquisition schedule for the TIH, which includes all associated ancillary equipment and software.

Table 17. TIH Acquisition Schedule.

Date	Milestone
Dec 31, 2022	Complete Initial Outreach to Potential Vendors.
June 1, 2023	Final Draft of RFP and Evaluation Criteria developed.
June 15, 2023	RFP Solicitation advertised (posted) and distributed to qualified vendors.
June 30, 2023	Last time to receive questions from vendors. ICF to respond within 1 week.
July 14, 2023	Responses to RFP Due.
Aug 1-15, 2023	Presentations by vendors.
Aug 31, 2023	Selection of vendor and presentation of draft contract provided to selected vendor.
Sept 1- Dec 31, 2023	Contract negotiations.
Jan 1-31, 2024	Executed Purchase Order.

5.3 Vendor Outreach Plan

The project team identified potential vendors based on industry knowledge and experience. The team reached out to a series of vendors to schedule information meetings that took place during the months of November and December 2022. The list of vendors included:

- Kiosk Information Systems - KIOSK: Kiosk Self-Service Kiosks Manufacturer & Supplier
- Meridian - Kiosks & Digital Signage - Customer Experience Leader | Meridian Kiosks
- Redyref - Kiosk Manufacturer | Digital Self-Service Solutions | REDYREF
- Advanced Kiosks - Self-Service Computer Kiosk Machine Systems - Advanced Kiosks
- LamasaTech - LamasaTech | Interactive Touch Screen Technology | Hardware & Software
- MetroClick - MetroClick Touch Screen Company Supplier - Interactive Displays, Kiosks, Digital Signage, Software, Photobooth | Rental & Sale

5.3.1 Procurement Specification Summary

The TIH is a physical kiosk that will have the capability to provide access to selected capabilities of the CTP. Expected capabilities include, but are not limited to accessing user's CTP account, generating trip plans, and booking an on-demand trip on a SDS or HDS (during Community Shuttle operating hours). The final list of capabilities will be determined by the development team in collaboration with the selected vendor.

The TIH will provide multiple types of accessibility channels through an interactive web browser, interfaces to audio, and visual icons. The form factor will be fully accessible to people with ambulatory, visual and auditory disabilities. The system will be available to people without a phone or smart phone and will be accessible in several languages.

Table 18 lists relevant requirements, specifications, and standards that apply to the TIH.

Table 18. Requirements for TIH

Req. ID	Req. Title	Req. Description
Req-SI-016	TIH thin client for CTP	The TIH shall serve as a thin client implementing the same functionality as the CTP website. A thin client uses resources stored on a central server instead of a localized hard drive--that is, they connect remotely to a server-based computing environment where most applications, sensitive data, and memory, are stored.
Req-SI-017	TIH CTP configuration	The CTP used on the TIH shall be configured to generate a trip plan with the origin at the TIH location. Other default settings (including timing out, logging out of account, and other services) will be driven by stakeholder input during the Agile development process.

Req. ID	Req. Title	Req. Description
Req-SI-018	TIH CTP connection	The TIH shall connect to the CTP central functionality through an internet connection.
Req-SI-019	TIH equipment	The TIH shall be composed of the following equipment components: (1) hardened touch screen display with embedded keyboard and track pad. (2) back-end processor (e.g., laptop, tablet) with speaker / microphone and Bluetooth interface. Power, internet access and installation support (including form factors for equipment) shall be provided by the facility owner.
Req-SI-021	TIH talking model	The TIH shall speak the name of the location in English and up to two other languages to be selected by the facility owner
Req-SI-028	Public kiosks	The Smart Infrastructure shall deploy a TIH installed at selected location around the BNMC which travelers can use to access CTP registration, trip planning and CS reservation services.
Req-SI-029	TIH environmental conditions	The TIH shall operate in indoor and outdoor environments in the Buffalo, New York environment without degradation: -- operational temperature (-20 to +60ºC) -- Waterproof (IP67)
Req-SI-030	SI durability	The Smart Infrastructure equipment shall be durable and hardened for use. The hardening process shall secure physical, software, user interface devices and other peripherals from harm, as applicable.
Req-SI-035	TIH ADA Compliance	The TIH shall be ADA compliant.
Req- SI-036	TIH Connectivity	The TIH shall provide Wi-Fi / Ethernet or Cellular connectivity.
Req- SI-037	TIH Operating System	The TIH shall offer a commercial operating system such as Windows, Android or Linux.
Req- SI-038	TIH Web Access Restriction	The TIH shall provide configuration control to restrict web access to specified Uniform Resource Locators (URL).
Req-Proj-9	TIH Buy America Provision	The TIH equipment shall conform to the Buy America Act requirements.

Req. ID	Req. Title	Req. Description
Req-Proj-10	TIH User Outreach and Training	The vendor shall participate in user outreach and training including any special events conducted in Phase 2 or 3 of the project.
Req-Proj-11	TIH Operational Readiness Testing and Demonstration	The vendor shall participate in the Operational Readiness Testing and Demonstration (milestone gate to proceed to Phase 3).
Req-Proj-12	TIH Test planning and reporting	The vendor shall develop, conduct and report test plans and test reports consistent with USDOT testing documentation expectations.
Req-Proj-13	TIH Installation	The TIH vendor shall provide installation requirements and instructions on their equipment.
Req-Proj-14	TIH Operations and Maintenance	The TIH vendor shall provide operations and maintenance during the period of performance.

As part of the vendors' responses to the RFP, vendors were asked to indicate the level to which their solution satisfies each requirement (i.e., fully address, partially address, or does not address). For the requirements which the solution fully or partially addressed the requirements, the vendors were asked to indicate the test or method they intended to use to verify that their solution addressed the requirement. The initial testing will be conducted on a test environment (provided by the vendor), followed by testing and verification with users on BNMC, once installed, toward the end of Phase 2.

5.4 TIH Installation Overview

This section describes the installation overview of the TIH. Although the project will "own" the two procured kiosks, the shipping, installation and management of the devices are subcontracted to the kiosk vendor.

5.4.1 Asset Management Plan

Asset management will be conducted by the vendor's (RedyRef) kiosk management software, Engage. The Engage platform allows kiosk systems to be monitored in real time through a remote portal. The NFTA team procured full support that includes all monitoring and asset management functions.

Facility owners, NFTA and BGMC, will manage communications, power and security assets using their own internal systems.

5.4.2 TIH Installation Schedule

This section describes the high-level installation schedule of the installation and deployment of the TIH.

Table 19. High Level Kiosk Installation Schedule

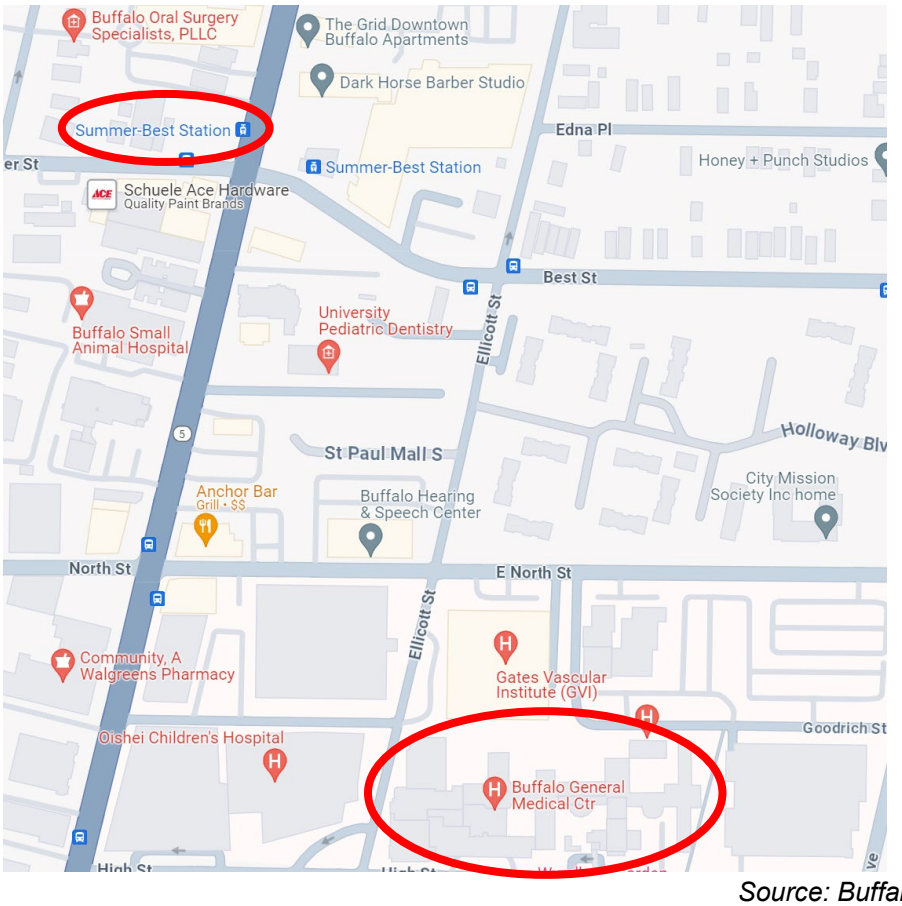
Step	Start Date	End Date	Lead / Responsibility
Issue Purchase Order	10/23/2023	1/23/2024	ICF • Purchase order issued and signed
Order	1/23/2024	4/1/ 2024	ICF • Coordinate with NFTA for delivery and transfer to installation sites
Build, Ship, Delivery	1/23/2024	4/12/2024	RedyRef • Pack and ship kiosks to NFTA
Pre-installation Preparations	4/1/2024 2024	4/12/2024	Each Facility Owner: • Prepare power and Wi-Fi • Prepare location
Prepare software for installation	3/12/2024	4/8/2024	Etch • Build and test All Access App to work in a kiosk environment
Installation and Testing	4/15/2024	5/1/2024	RedyRef
Buffalo General Medical Center	4/15/2024	5/1/2024	Kaleida Health • Support installation • Test equipment
NFTA	4/15/2024	5/1/2024	NFTA • Support installation • Test Equipment
Approval	5/1/2024	5/1/2024	Facility Owners • NFTA • Kaleida Health

5.5 TIH Installation Plan Approach

The vendor is contracted to install the kiosk at two locations. The kiosks will be delivered and installed on the same day of delivery. The kiosk will be located within the BGMC and NFTA Best/Main Rail station—see Figure 14.

The kiosks will be configured and quality tested at their factory site. NFTA will schedule the installations at the two sites where the vendor will package, deliver (“white glove delivery”) and install the two kiosks.

Kaleida Health and NFTA will ready the sites for installation based on vendor requirements, kiosk dimensions, communications, and power requirements.



Source: Buffalo ITS4US

Figure 14. TIH installation locations (NFTA's Summer-Best Station and Buffalo General Medical Center.

The installation plan is a checklist that includes the following sections:

1. **Kiosk Dimensions**
2. **Resourced needed for installing the equipment including**
    a. Materials needed to install the kiosk – two methods
    b. People and their roles for installing the equipment
    c. Tools needed to install the equipment
    d. Policies and procedures that govern installation
3. **Step by step directions for installation** – directions from the vendor on how to install the equipment
4. **Configuration and Commissioning Procedures –** procedures for configuring software and verifying communications are active.

5.5.1 TIH Installation Checklist

This section includes the elements of the TIH Installation checklist.

1. **Kiosk Dimensions**

   - Empire 3.0 43” Touch Screen (kiosk) Dimensions are 32.25” x 20” x 69.5” and 197.0 lbs. See Figure 15 for Dimension Callout Diagram and Figure 16 for base plate drawing.

   - Packaged dimensions are 48”x40”x78” 265.0 lbs.

2. **Resources Needed to Install the Kiosk**

   a. **Materials needed to install Kiosk**

      - If Product is to be anchored:
        - Kiosk
        - Floor anchors
        - Nuts and Washers
      - If Product is freestanding:
        - Kiosk

   b. **People Needed:** The following resources are required to install the kiosk at each site:

      - two (2) people are required for installation of each kiosk (vendor staff);
      - Facility owners to support placement, power and communications.

   c. **Tools**

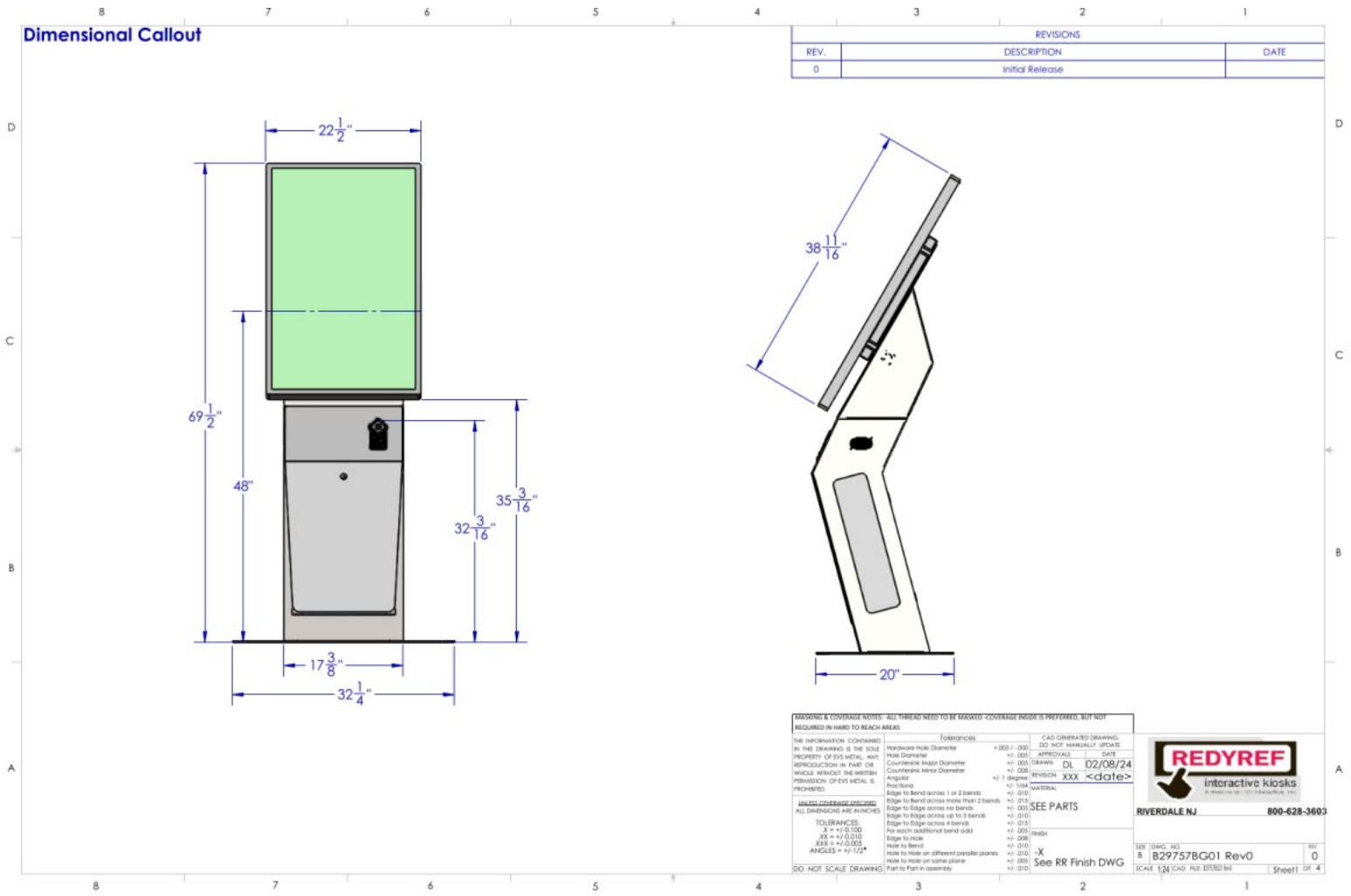
      - If Product is to be anchored:
        - Rubber wheeled dolly
        - Hammer Drill
        - ½” Masonry Bit
        - Masking tape
        - Vacuum

- Wire Brush
- Hammer
- ¾" Open Ended Wrench
- Torque Wrench

- If Product is freestanding:
  - Rubber Wheeled Dolly

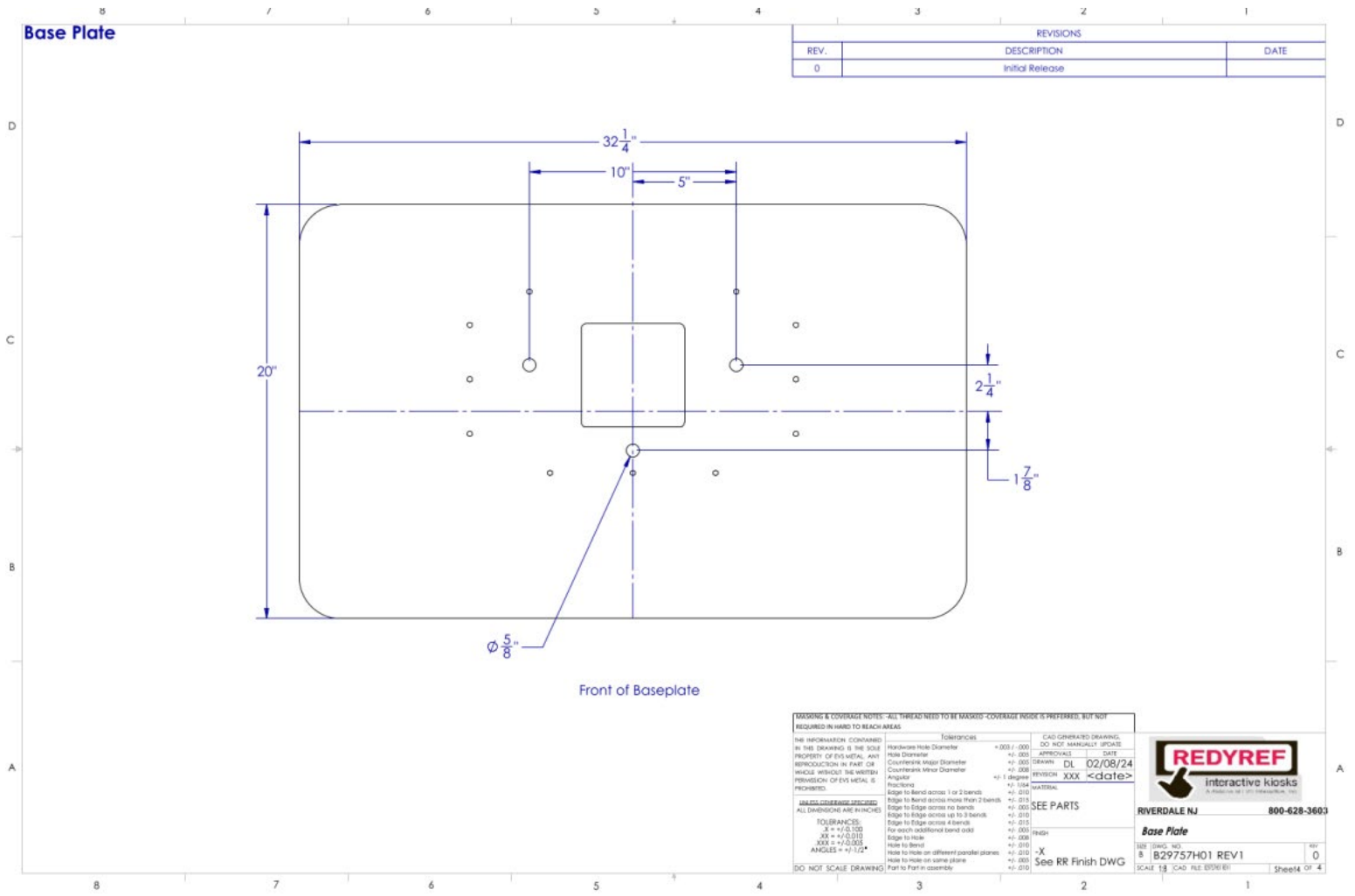
d. Policies and Procedures for Kaleida General and NFTA

- Site specific requirements for admittance and safety protocols
- Two-man lift
- Safety glasses when drilling for anchors



Source: RedyRef

Figure 15. Dimension Callout Drawing.



Source: RedyRef

Figure 16. Base Plate Drawing.

3. **Step by step directions for installation**

How to Install the REDYREF Kiosk on a concrete pad with stud anchors.

1. Verify site is ready with a suitable pad; concrete fully cured and free of cracks with an area greater than the size of the kiosk baseplate.
2. Mark the pad using the dimensions of the baseplate provided with this instruction.
3. Adjust the depth gauge or put tape on the drill bit to measure the anchor so that once the hole is drilled, the anchor will stand proud at least 1” from the surface of the concrete.
4. Using a hammer drill, and ½” size masonry bit, drill the hole in the concrete, making sure the depth is adequate to allow at least 1” of the anchor to stand proud from the concrete surface. For this installation we recommend an anchor at least 5-1/2” x ½” diameter; McMaster part number 91578A838. Repeat for all three mounting locations.
5. Use a wire brush, compressed air or vacuum to clean the hole of all debris
6. Hammer the anchors into each drilled hole, making sure not to deform the threads.
7. Set the kiosk in position above the anchor points so that the holes in the baseplate align with the anchors below. Use caution to not damage the display while adjusting into position.
8. Start fasteners by hand to ensure proper threading, then tighten bolts with a ½” wrench and apply sufficient torque (roughly 50 to 60 ft. lbs.) to secure kiosk to the pad.
9. Connection: For standard NEMA 5-15 power receptacle applications, plug in the power cord and data, and verify the kiosk is online. For hardwired power applications defer to the electrician on site, coordinated by the customer, to connect power to the kiosk.
10. Check in with REDFYREF support prior to leaving the installation site.

How to Install the REDYREF Kiosk freestanding

1. Place Kiosk in location.
2. Plug Power into customer provided outlet
3. Plug data into customer provided data jack if applicable.
4. Open front door and turn on main power.
5. Verify unit comes on and boots to main application.

4. Configuration and Commissioning Procedures

Software configuration approach

1. Step 1 – Configuration details and prep are determined during preliminary design phase with the Buffalo Technical Team
2. Step 2 – All configuration and tests are performed at the factory prior to shipment
3. Step 3 – Onsite configuration for network connectivity, i.e., connection to wireless router, will be performed at install
4. Step 4 – Schedule training with Engage technical team

Step by step communications verification

1. Step 1 – Connect unit to network (physical / wireless connection)
2. Step 2 – Verify connection between kiosk and Engage Server
    a. Call Engage support team @ 800-628-3603 x 2
    b. Support team will validate connection is live or assist with troubleshooting
3. Step 3 – Customer responsible for validating customer provided software / application / website communication.
    a. The kiosk validation has been divided into 3 phases by the project team:
        i. Phase 1 – Evaluate the kiosk application within a normal web browser. This is testing the overall user experience and workflow and the interaction of the page elements with the on-screen keyboard.
        ii. Phase 2 – Test within the Engage platform Lockdown kiosk software within a virtualized environment. This shows us where the kiosk environment differs from a normal web browser, such as the potential issue that was identified with hardware-accelerated map graphics display. It also allows testing the kiosk's behavior for managing user sessions and going into its standby mode.
        iii. Phase 3 – Physical "fit check" testing on the kiosk in the field. Does the application perform well within the screen dimensions and resolution? Are the on-screen buttons responsive to physical touch? Are they sized appropriately based on the accuracy of the touch detection? Does the position of the keyboard provide good access for wheelchairs but not require standing individuals to stoop down in an uncomfortable way? This would include the steps Jesse mentioned below.

    Each stage is verifying a different class of criteria. Workflow -> Behavior -> Physical Interaction. Any sort of modifications or identified regression could be checked by re-iterating through these phases.

5.6 Equipment Summary

Table 20. Equipment Inventory.

Equipment Type	Total # Procured	Total # Configured & Installed
Kiosk	1 for each site	1
Floor anchors	1 kit for each site	1
Nuts and Washers	1 kit for each site	1

6 References

The references used to develop this document are provided below.

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Appendix A. Acronyms

Table 21. List of Acronyms summarizes the acronyms used in this document.

Table 21. List of Acronyms

Acronym	Description
3-D	3-Dimentional
ADA	Americans with Disabilities Act
ADASTEC	ADASTEC Corp.
ADS	Autonomous Driving System
APS	Audible Pedestrian System
AV	Autonomous Vehicle
AZ	Arizona
BGMC	Buffalo General Medical Center
BLE	Bluetooth Low Energy
BNMC	Buffalo Niagara Medical Campus
BOM	Bill of Materials
CA	California
CAD	Computer Aided Design
CAP	Comprehensive Acquisition Plan
CIP	Comprehensive Installation Plan
CMS	Content Management System
CoB	City of Buffalo
CPU	Central Processing Unit

Acronym	Description
CTP	Complete Trip Platform
dB	Decibel
DMV	Department of Motor Vehicles
DPW	Department of Public Works
FHWA	Federal Highway Administration
FMVSS	Federal Motor Vehicle Safety Standards
ft.	Feet
GNSS/INS	Dual Antenna Global Navigation Satellite/Inertial Navigation System
GPU	Graphics Processing Unit
GTFS	General Transit Feed Specification
HDS	Human-Driven Shuttles
INS	Indoor Navigation System
iOS	iPhone Operating System
ITS	Intelligent Transportation System
JPO	Joint Program Office
KWh	Kilowatt hours
LIDAR	Light Detection and Ranging
MSA	Metropolitan Statistical Area
NFC	Near Field Communication
NFTA	Niagara Frontier Transportation Authority
NY	New York
NYS	New York State
O&M	Operations and Maintenance

Acronym	Description
ODD	Operational Design Domain
OSHA	Occupational Safety and Health Administration
PED-X	Pedestrian Crossing
PM	Project Manager
PMD	Performance Measure Dashboard
PMP	Project Management Plan
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
RADARs	Radio Detecting and Ranging
RFP	Request for Proposals
RFQ	Request for Qualifications
RF-SUNY	Research Foundation of the State of New York
RGB	Red, Green, Blue
RTK	Real-Time Kinematic
SaaS	Software as a Service
SDD	System Design Document
SDK	Software Development Kits
SDS	Self-Driving Shuttles
SOC	Shuttle Operations Center
SyRS	System Requirements Specification
TBD	To be determined

Acronym	Description
TIH	Transportation Information Hub
UB	University at Buffalo
URL	Uniform Resource Locators
USDOT	United States Department of Transportation
UUID	Universally Unique Identifier
VIA	Visually Impaired Advancement
VMC	Vicinity Motor (Bus) USA Corp

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