Phase 2 Comprehensive Acquisition Plan (CAP)

Georgia Department of Transportation: Safe Trips in a Connected Transportation Network ITS4US Deployment Project

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Final Report — June 30, 2023
FHWA-JPO-23-111

ITS4US
IT'S TRANSPORTATION FOR ALL OF US

U.S. Department of Transportation

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Notice

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16. Abstract

The Georgia Department of Transportation ITS4US Deployment project, Safe Trips in a Connected Transportation Network (ST-CTN), is leveraging innovative solutions, existing deployments, and collaboration to make a positive impact using transportation technology to support safety, mobility, sustainability, and accessibility. The ST-CTN concept is comprised of an integrated set of advanced transportation technology solutions (connected vehicle, transit signal priority, machine learning, predictive analytics) to support safe and complete trips, with a focus on accessibility for those with disabilities, older adults, and those with limited English proficiency.

The Comprehensive Acquisition Plan (CAP) provides an overview of the proposed acquisition approach that includes an assessment of time-to-procure relative to the overall deployment schedule. In addition, the CAP is a resource for others in the industry interested in pursuing similar deployments by giving them examples of equipment and vendors that have already been vetted.

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1 Introduction

The Georgia Department of Transportation (GDOT) and Atlanta Regional Commission's (ARC) Safe Trips in a Connected Transportation Network (ST-CTN) project was selected by the U.S. Department of Transportation (USDOT) as a part of the ITS4US Deployment Program. The project seeks to enhance the traveler's complete trip travel experience by enhancing mobility, accessibility, reliability, and safety for system users, particularly for underserved communities, including people with disabilities, older adults, and users with limited English proficiency (LEP). This is done by leveraging innovative solutions, existing deployments and team collaboration such as integrating connected vehicle (CV) data with an open-source software-based trip planner that is used to provision web-based and mobile application user access. The trip planner will provide users with the ability to create a personalized trip plan with information regarding the navigation of physical infrastructure, the ability to resolve unexpected obstacles, and ensure users' visibility throughout the trip. The proposed deployment will provide targeted users with the ability to dynamically plan and navigate trips based on their specific needs and preferences.

1.1 Document Purpose

The Comprehensive Acquisition Plan (CAP) provides a high-level overview of the procurement approach and schedule necessary to acquire equipment for the ST-CTN project. During project planning, outreach was conducted with the vendor community to understand the equipment capabilities. Systems engineering documents were developed to document desired capabilities of the system, system requirements, system interfaces, and system architectures. Moving forward, equipment will be procured and integrated with existing and future systems.

This document identifies the necessary equipment that will be deployed for the project and how it will be acquired. The CAP will be a living record of the ST-CTN project acquisition process for the purpose of transparent reporting to project sponsors and stakeholders about the methods and status of these acquisition efforts. Throughout the document, there are sections identifying unknowns which will be updated as the project team works to develop the Request for Proposal (RFP) to procure equipment and software. Other items will be finalized as the project completes the final design phase.

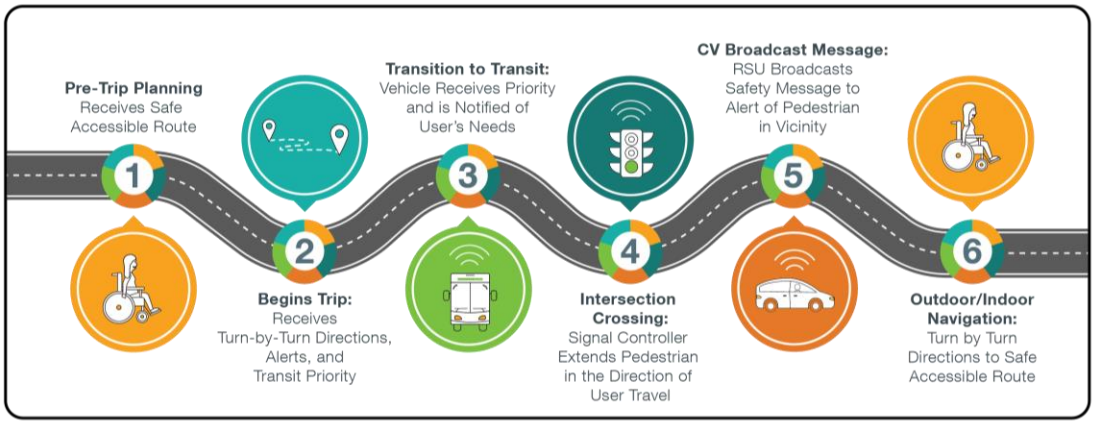
1.2 Intended Audience

The intended audience for this document is the USDOT, the project team which includes the GDOT, the Atlanta Regional Commission (ARC), its consultants and partners. This document may be used as a reference for the future selected vendor team, including their systems and software support, installation team, and others supporting the success of this project deployment. In addition, it is expected that other agencies or industry professionals interested in deploying a project of similar nature may reference this document to understand how the acquisition methods and processes were completed for the ST-CTN project deployment.

1.3 Project Background

The ST-CTN is one of four projects selected for Phase 2 ITS4US Deployment Program to showcase innovative business partnerships, technologies, and practices that promote independent mobility for all travelers regardless of location, income, or disability.

The ST-CTN project aims to upgrade and integrate existing technologies and services to assist underserved populations with completing their complete trip successfully, safely, and reliably. The vision of the project is to provide users complete trip functionality with directions, conditions, and status on the links between trip legs that are personalized based on the user's profile, while connecting the user to CV infrastructure to provide safer trips and more transportation network awareness. As an illustration of how the ST-CTN system will be used, transit-based trips were delineated into six segments (as depicted in **Figure 1**) to allow for easier understanding and a greater breakdown of priorities and goals.



Source: ARC, 2020

Figure 1. Traveler's Complete Trip

The delineated trip segments include the following steps and project components:

- **Step 1 Pre-Trip Planning.** The traveler plans for and receives a safe accessible route.
    - The ability to customize trip preferences based on the user's abilities.
- **Step 2 Begins Trip.** The traveler begins their trip and receives turn by turn directions, alerts, remote pedestrian activation, and can trigger transit signal priority (TSP) if the user requires additional time boarding or alighting a transit vehicle, is unable to stand for long periods, or is sensitive to weather conditions.
    - Turn by turn, shortest path, directions along pathways that meet user defined preferences.
    - Provides support services for users if they become disoriented or have issues accessing defined paths.
    - Activates TSP for buses if the user requires additional time boarding or alighting a transit vehicle, is unable to stand for long periods, or is sensitive to weather conditions.

- **Step 3 Transition to Transit.** The traveler transitions to transit and the transit vehicle receives priority and is notified of users' needs. TSP can be triggered if the bus is running behind schedule due to a longer boarding time needed by a user.
    - Provides users with transit trips that have accommodations that meet user defined preferences.
    - Sends alerts to transit vehicles when users need additional time to board, navigate internally, or alight the transit vehicle.
    - Remotely requests service from transit vehicles while waiting to board or alight.
    - Triggers TSP if the bus is running behind schedule due to a user needing additional time to board or alight.
- **Step 4 Intersection Crossing.** When crossing a signalized intersection, the traveler indirectly interacts with the signal controller in that an authorized system call is made to the controller which extends the pedestrian phase in the direction of user travel.
    - Allows the user to communicate with connected intersections if they are unable to reach or press the crosswalk button.
    - Provides the user with information about the intersection crossing and adds time to the crossing if needed.
- **Step 5 CV Broadcast Message.** Roadside units (RSUs) broadcast safety message to alert CVs of pedestrians in the intersection.
    - Provides the ability for users to remotely request service from transit vehicles while waiting to board or alight.
    - Provides communications to CVs from pedestrian crossing signal system (via RSUs) to make them aware of pedestrians crossing a roadway.
    - Provides communications between transit vehicles and travelers waiting at a transit stop to make them aware of each other.
- **Step 6 Outdoor/Indoor Navigation.** The traveler is provided with turn-by-turn directions to a safe accessible route.
    - Hands-free navigation via mobile apps and/or wearables and accessible channels (haptic, voice, text).
    - Alerts and dynamic rerouting in response to changes in path conditions.
    - Provides the user with accessible routes into and through transit hubs within the project area.
    - Provides users with updates on the operating status of indoor infrastructure such as elevators and escalators.

System development and system integrations completed within the scope of this project will enable travelers – specifically those in the underserved community – to program and safely complete single mode or multimodal trips that are based on their abilities; improve the transition between modes by providing additional details to users and transit service operators; suggest dynamic routing changes based on infrastructure condition and calculated delay.

The existing initiatives that are being leveraged to support the proposed ST-CTN system are defined in more detail below as well as those components that will be developed specifically to

support ST-CTN project evaluation. The icons and colors depicted below are used throughout the SAD to clearly identify the critical components of ST-CTN. In some cases, partner agencies are upgrading the services within their current systems to create a more robust data set or toolset for the ST-CTN program.

OTP for G-MAP. Atlanta Rider Information and Data Evaluation System (ATL RIDES) includes an Open Source Software (OSS) multi-modal trip planning and mobile application, integrated mobile fare payment options, and a Connected Data Platform (CDP) using regional General Transit Feed Specification (GTFS) transit service data. The tool supports multi-agency context, multilingual support, and mobile app turn-by-turn directions. The OpenTripPlanner (OTP) architecture facilitates integration with additional OSS tools including a data analytics engine, call center module with application programming interfaces (APIs), and account management system. The existing ATL RIDES application will be modified and enhanced based on ST-CTN project needs and leveraged to create a new, independent application which will be differentiated as the *OTP for G-MAP* subsystem (hereafter referred to as G-MAP).

SIDEWALKSIM. SidewalkSim is an asset management system and shortest path (lowest impedance) routing tool for pedestrian pathways. Site inspections provide more detailed ADA and inclusive design and condition data for use in pathway accessibility analysis. SidewalkSim identifies the best path between any two points in the pedestrian network, given the set of pathway characteristics and any user-specified needs and route penalties.

CV1K. The Atlanta region is home to one of the largest CV deployments in the United States – Regional Connected Vehicle Infrastructure Deployment Program (CV1K). CV1K is deploying interoperable CV technologies at signalized intersections throughout the Atlanta region using both Dedicated Short-Range Communications (DSRC) and Cellular Vehicle to Everything (C-V2X) technologies to deliver safety and mobility-based applications. The program provides support to configure, operate, and maintain CV infrastructure and applications, including TSP. Gwinnett County is one of the largest recipients of the first phase of this deployment.

CVTMP. Gwinnett County's Connected Vehicle Technology Master Plan (CVTMP) sets out to develop and improve economic viability and quality of life, address the needs and challenges to motorized and non-motorized modes, establish guidelines for deploying technology, and have broad applicability to Gwinnett, other local jurisdictions, and across the state—to set the standard for implementing CVs. Among the high priorities is establishing a mobile accessible safety program and alternative strategies for TSP in Gwinnett County.

STM. The Space Time Memory (STM) platform processes traffic volume and speed data from multiple monitoring and modeling sources, tracks network performance measures, and predicts evolving route conditions using traditional and machine learning techniques. The STM projects trip trajectories through the transportation network, as network conditions change in space and time. This tool will be applied to analyze and predict performance through the multi-modal transportation network. The shortest path analysis will be applied to the combined roadway, transit, sidewalk, and shared-use path networks, allowing routing decisions to incorporate travel time, safety, and other impedances into path selection.

In addition, the ST-CTN system will include the development of a Performance Measurement Dashboard (PMD) that is not currently in use.

PMD. The PMD is a data storage and distribution tool that archives operational, survey and performance metrics of the system. The PMD is envisioned to ingest, quality check, and curate all types of data – static and dynamic, structured and unstructured, open and private datasets. The PMD will store the datasets so that they can be viewed and accessed based on user roles. The PMD will include a public PMD for the public to access open data presented on an interactive dashboard to the public.

1.4 Scope

The ST-CTN project will integrate several components from existing systems as well as external systems being developed by other projects. The CAP focused on the acquisition of components within the system boundaries of the project, as defined in the various systems engineering documents. While several components – including but not limited to connected vehicle components – will be leveraged as part of the ST-CTN effort, these components will be procured by other projects. The key acquisition within scope of the CAP is an indoor navigation system (INS).

The ST-CTN project will require use of a turnkey INS to increase the location accuracy of an end user while indoors at one of two outfitted locations. The INS will integrate with the G-MAP subsystem and provide data to support routing algorithms used to determine turn-by-turn directions for end users based on their needs and preferences. All other components that comprise the ST-CTN system are being leveraged through existing systems, external resources, or are being developed within the Phase 2 project resources. The following subsections describe the acquisition approach and plan for the ST-CTN project.

2 Acquisition Overview

This section describes the high-level overview of ST-CTN methods of acquisition. It provides a description of the internal acquisition policies and how they will meet federal, state, and local regulations.

2.1 Acquisition Approach

As described in the project background, **Section 1.3**, the ST-CTN is composed of four subsystems – 1. G-MAP (OTP for G-MAP), 2. STM Platform, 3. Connected Vehicles, and 4. PMD. Several applications will be integrated with the G-MAP subsystem. Although all the subsystems are leveraging existing infrastructure or services, additional acquisitions may be needed to augment the enabling technology. To that end there are several approaches to acquire equipment or services for the ST-CTN deployment. Equipment and services will be acquired through one or more of the acquisition types listed in **Table 1**.

Table 1. Acquisition Types and Authority

Acquisition Type	Acquisition Authority	Description / Process
Purchase Order (PO)	GDOT	Equipment must be listed within an existing contract to be purchased.
Request for Qualifications (RFQ)/ Request for Proposal (RFP)	GDOT, ARC	See **Section 2.2**; this approach follows the methodology as described in the GDOT Procurement Manual.
Request for Information (RFI)/Request for Proposal (RFP)	GDOT, ARC	See **Section 2.2**; schedule is reflective of the process. These include services or acquisitions included in the budget as direct or indirect costs.
Notice of Funding Opportunity (NOFO) Response / ITS4US Deployment Program Award	USDOT	ST-CTN project team is awarded program funds to pursue Phase 2 and Phase 3 project deployment. The ST-CTN project team responded to the *Complete Trip - ITS4US Deployment Program Phases 2 & 3* NOFO on March 11, 2022. An oral presentation and interview were held on March 29, 2022. The ST-CTN project team was notified of award on June 8, 2022.

The primary method of acquisition for system design, development, and deployment will be through the recent Phase 2 / Phase 3 ITS4US Deployment Program award. Equipment and services required for the ST-CTN project will use the PO, RFQ/RFP, or RFI/RFP acquisition approach as described in the sections below and as shown in **Figure 2.** Information about the acquisition of components and equipment is provided in **Section 3.1** of this document. Responding vendors will be required to comply with detailed provisions of the PO request, describing their plan to meet the specifications, including a listing of the parts and quantities needed.

The ST-CTN project team will consider the potential services and/or equipment on a case-by-case basis to determine the appropriate acquisition approach to employ.

Purchase Order. A purchase order is a contract between GDOT, or lead agency, and the supplier. The supplier has an existing contract with the agency prior to a purchase order being considered. The ST-CTN project team will utilize the Traffic Signal Electrical Facility (TSEF) parts contract administered by GDOT.

Request for Information (RFI). The RFI is a means of advertisement that will describe the needs and purpose of the acquisition, identify the desired information, and provide the method for responding to the request. Vendors are not required to respond to the RFI, however they are strongly encouraged as this is a way to ensure the agency is aware of the vendors' ability to respond to the RFP. The RFI period is typically 30 days and followed by the posting of the RFP. Vendors will submit their proposals and bids at that time. See process in **Section 2.2**.

Request for Qualifications (RFQ). The RFQ identifies the minimum requirements or products and will use performance specifications, design specifications, references to particular products, use of qualified products lists, and/or performance and services. To be considered responsive, the vendor's bid must meet all of the specifications and requirements. The vendor will respond with a Statement of Qualifications (SOQ). The pool of qualified vendors will then submit a proposal and bid at such time the RFP is posted.

Request for Proposal (RFP). The RFP is the process that allows for vendors to propose their own solutions to the state's needs as described in the RFP. The RFP will describe specific requirements or metrics that are required to be met by the vendor and will include a series of questions to which the vendor must respond to be considered responsive. Categories of questions may include some or all of the following:

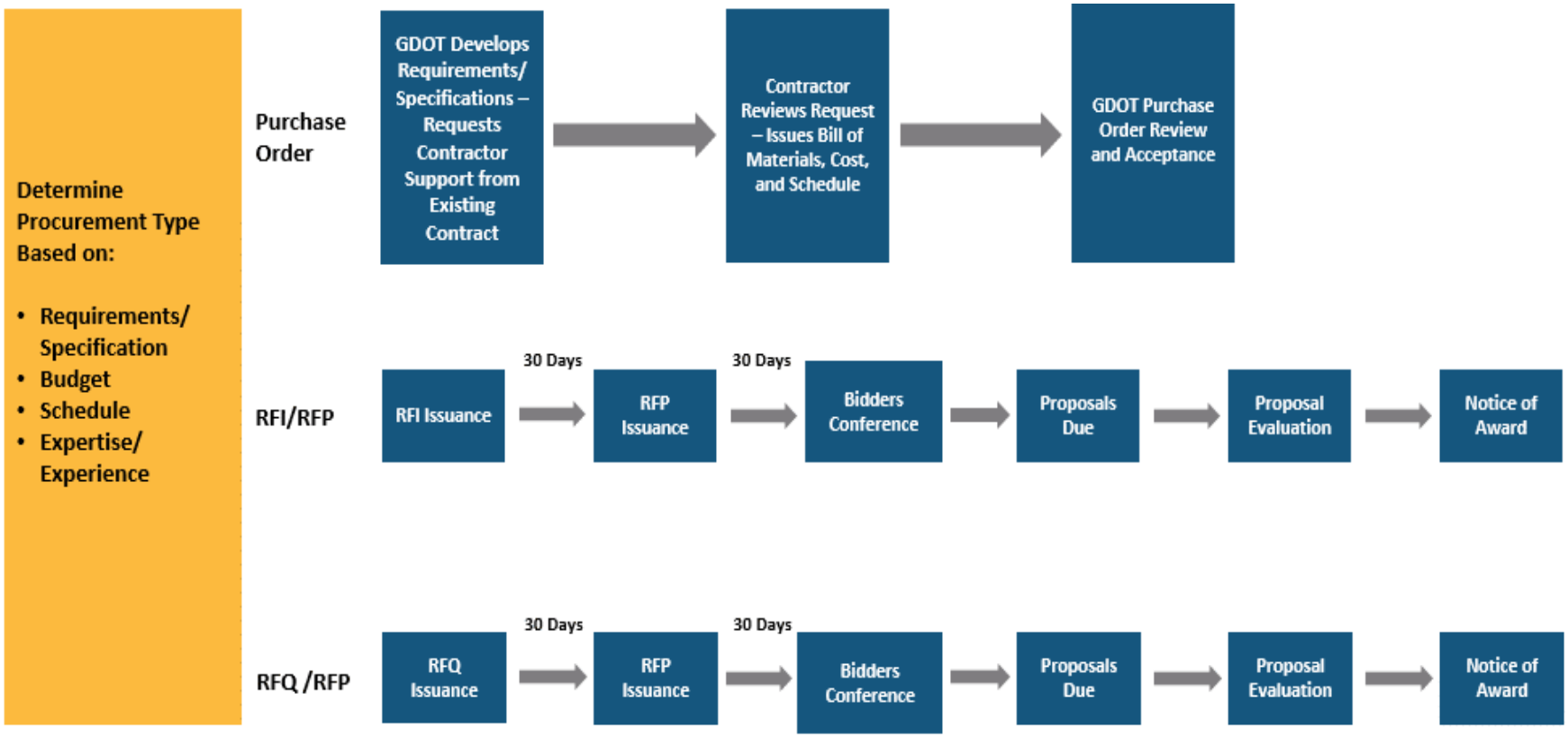
1. Mandatory Requirement: A vendor must demonstrate they meet this requirement to be eligible for participation. This could be a qualification or a performance requirement.

2. Mandatory Scored Requirement: Similar to the mandatory requirement, however the response will be graded. For example, this could be a schedule to demonstrate that the vendor can meet a project deadline.

3. Additional Scored Requirement: This can refer to a service that is desirable but not required or could open the vendor to demonstrate an optional service that would set them apart from other vendors. The vendor is not required to respond to these and will not receive additional points to their overall score.

The procurement methodology chosen will be determined in partnership with the lead agency, GDOT, and ST-CTN project team. Determining factors may include budget, project schedule, vendor interest and experience, requirements and specifications.

For additional information, reference the GDOT Procurement Manual – For the Procurement, Management and Administration of Engineering and Design Related Consultant Services: TSPManual.pdf (ga.gov).



Source: GDOT, 2022

Figure 2. Acquisition Type Workflows

2.1.1 G-MAP Subsystem Acquisition Approach

The G-MAP subsystem is composed of several server-based modules and mobile applications. The base software uses open-source software (OSS) and tool sets upon which to develop the core functionality. All subsequent development activities will also be licensed as OSS. The eventual product will be stored on a publicly accessible GITHUB site.

Acquisition of the developer, testing and production cloud resources are needed for the G-MAP tools. These services are included as direct labor and other direct costs within the Phase 2 / Phase 3 project award and will be administered by the Arcadis IBI Group.

2.1.2 CV Subsystem Acquisition Approach

The CV subsystem will leverage existing infrastructure procured under the Gwinnett County Smart Corridor and the GDOT CV1K projects. It is anticipated that additional hardware may be needed to augment the infrastructure being deployed under the CV1K project. GDOT will purchase the Roadside Units (RSU) and SCMS services through the existing CV1K open contracting mechanism with set pricing through a purchase order funded through the Phase 2 / 3 award.

Modifications to configurations and any integration required to support the ST-CTN project such as integrating PED-X actuation requests are included as direct labor and other direct costs through GDOT and Gwinnett County within the Phase 2 / Phase 3 project award.

2.1.3 STM Subsystem Acquisition Approach

The STM subsystem is composed of a server-side module. The software will be developed and deployed through Georgia Tech and GTRI who are included in the ST-CTN project award. All software modules will be licensed as OSS. The eventual product will be stored on a publicly accessible GITHUB site.

Acquisition of the developer, testing and production cloud resources are needed for the STM tools. These services and components are included as direct labor and other direct costs within the Phase 2 / Phase 3 project award.

2.1.4 PMD Subsystem Acquisition Approach

The PMD subsystem is composed of a server-side module. The software will be developed by ICF and is included in the ST-CTN project award. All software modules will be licensed as OSS. The eventual product will be stored on a publicly accessible GITHUB site.

Acquisition of the developer, testing and production cloud resources are needed for the PMD tools. These services and components are included as direct labor and other direct costs within the Phase 2 / Phase 3 project award.

2.1.5 Pedestrian Safety Application Acquisition Approach

The Pedestrian Safety application will leverage the existing Gwinnett County infrastructure of Audible Pedestrian Signal (APS). All infrastructure – NaviGAtor (GDOT's advanced traffic management system), signal controllers, ITS cabinets, etc. are currently deployed by Gwinnett. The system integration needed to actuate the back-end of the PED-X request will use existing GDOT resources such as their existing services through the Gwinnett County Smart Corridor project.

2.1.6 Connection Protection Application Acquisition Approach

The Connection Protection Application to support traveler requests for bus service will use the Gwinnett County Transit (GCT) existing CAD/AVL equipment. Additional GCT subcontractor services provided by GCT's current vendor and system integrator, Avail, are included in the ST-CTN project award and will be used to integrate the Connection Protection with G-MAP services.

2.1.7 Indoor Navigation System Acquisition Approach

The Indoor Navigation System (INS) acquisition approach will be a purchase order process and is described in **Section 3**. The acquisition approach will be led by GDOT with support from the Executive Management Team (EMT) and is included within Phase 2 / Phase 3 project award.

2.1.8 System Level Acquisition Approach

Several system level tools have been acquired to coordinate and collaborate among the technical developers such as Jira and Confluence. These tools are included as other direct costs in the Phase 2 / Phase 3 project award to be used by the Agile development team.

2.1.9 Other Materials Acquisition Approach

If other tools, services, or materials are determined to be necessary and acquired during the deployment or evaluation phases of this award, the project team will use one of the acquisition approaches as described in **Table 1.** Acquisition Types and Authority. Determination of the need to acquire other material will be approved by the EMT.

2.1.10 Summary Acquisition Approach for Equipment and Services

A summary of the acquisition approach for each subsystem, application and other materials is provided in **Table 2**.

Table 2. Acquisition Approach for Subsystems, Applications and Other Materials

Subsystem / Item	Acquisition Type	Responsible
G-MAP	ITS4US Deployment Program Award	Arcadis IBI Group
CV	ITS4US Deployment Program Award or PO	GDOT / Gwinnett
STM	ITS4US Deployment Program Award	GA Tech / GTRI
PMD	ITS4US Deployment Program Award	ICF
Pedestrian Safety Application	ITS4US Deployment Program Award or PO	Gwinnett
Connection Protection Application	ITS4US Deployment Program Award	GCT / Avail
Indoor Navigation System	PO	GDOT / EMT
System Level	ITS4US Deployment Program Award	EMT
Collaboration Tools	ITS4US Deployment Program Award	ICF
Other Material	ITS4US Deployment Program Award	EMT

2.2 Acquisition Schedule

For the purposes of anticipating impacts of acquisitions to the overall project schedule, the below information can be used as a guideline. Detailed schedules should be developed in conjunction with the overall project schedule to determine the methodology best suited for the system.

Purchase Order. The most expeditious method. A purchase order can be issued on an existing contract and executed within 30 days. Risks for this may include, but are not limited to an available contractor, time to negotiate pricing, and vendor ability to meet all scope requirements.

RFI/RFP. Estimated time to execute is 6 to 8 months from procurement kickoff through award. Risks for issuing an RFI would be vendors do not respond to the RFI and a re-issue or additional vendor outreach may be necessary.

RFQ/RFP. Estimated time to execute is 8-9 months from procurement kickoff through award. Risks for this schedule are that it has the longest duration and may impact the overall project schedule.

Instructions and a schedule of events for both the RFI and RFQ solicitations will be generated and provided to the vendors during issuance if required.

2.3 Vendor Outreach Plan

Vendors are encouraged to participate to ensure an equitable and competitive environment. The vendor outreach process varies based on acquisition type and are generally described in **Table 3**.

Table 3. Summary of Outreach by Acquisition Type

Acquisition Type	Vendor Outreach Method
Purchase Order	Vendors with an existing TSEF contract will be contacted by the agency to negotiate pricing for outright purchase of a system.
RFQ / RFP	Advertisement and schedule will be published on the Georgia Procurement Registry (GPR).
RFI / RFP	Advertisement and schedule will be published on the GPR.

The ST-CTN project team conducted high-level research of prospective vendors during Phase 1 of the project to better understand the current technology and readiness of INS. The informational meetings served to inform the Integrated Complete Trip Deployment Plan (ICTDP) and Phase 2 budget.

The RFI will be advertised via the GPR and notifications of this event will be sent to those registered to the GPR. In addition, the project team will contact known vendors in this space and those interviewed during Phase 1.

3 Indoor Navigation Subsystem

The ST-CTN project team will select a vendor to deploy an INS to aid indoor wayfinding and navigation. This system will be integrated with the OTP for G-MAP subsystem to provide hands-free, door to door trip planning by travelers. This section provides an overview of the INS, requirements and specifications, and intended acquisition approach and schedule. Many details of this section are unknown because there are various technologies that provide navigation services through an indoor facility. Further information, including ancillary equipment, certification requirements, part numbers/quantities etc. are provided in the Comprehensive Installation Plan (CIP). Based on vendor input in the PO process as described in **Section 2.3**, and discussions with the vendor post-selection, the detailed solution and integration elements will be developed, deployed, tested and operated.

3.1 Indoor Navigation System

The foundational engineering documents developed in Phase 1, including the Concept of Operations (ConOps) and the System Requirements and Specifications Document (SyRS), define the initial requirements for the INS. **Sections 3.1.1** and **3.1.2** will be refined upon vender selection after the INS technology is defined.

3.1.1 Technical Description

The ST-CTN system will provide the user with turn-by-turn directions within two indoor facilities. The technology to achieve the requirements and specifications described in **Section 3.1.3** will be determined during the procurement process. For example, the Bluetooth Low Emitting (BLE) beacon may be selected which offers low power usage, variable range broadcast, and configurable message sets to support travelers. Other technologies also exist including WiFi. G-MAP will use the indoor navigation system information to aid navigation algorithms onboard mobile apps and on-line in the G-MAP routing engine.

The goal of this acquisition is to procure an indoor navigational system, its associated software, and further enlist the services of the vendor to install, configure, deploy, and test these devices. Requirements and specifications of the purchase order are provided in **Section 3.1.3**. Suppliers are required to submit responses with a list of all parts and accessories for each category listed in the scope. The list will be used by the Department in the evaluation process where interviews are conducted for suppliers that meet specifications for the provision of commodities. Once selected, the Department will issue the supplier with Notice to Proceed (NTP), and prices to be paid for items ordered are the prices listed on the PO.

3.1.2 Ancillary Equipment

Any additional equipment or materials required to support the indoor navigational device installation and operations will be included by the vendor as part of their award.

3.1.3 Requirements and Specifications

The indoor navigation system will adhere to the following requirements in **Table 4**. These requirements were developed as part of the Phase 1 SyRS document which also traces identified needs to requirements. System requirements are managed through a configuration management process in which any changes or refinements made are tracked and updated throughout all documentation to ensure consistency. Phase 1 documents such as the SyRS will be updated at the end of Phase 2.

Table 4. Indoor Navigation Subsystem Requirements

Requirement ID	Requirement Title	Requirement Statement	Mandatory/ Desired
2.1.0-051	Service Level Agreement (SLA) and Uptime	The system and system dependencies shall be designed to provide uptime operations and other SLAs for core and ancillary functionality. These SLAs will be described following preliminary system design or post-selection of vendor (during Phase 2 of the ST-CTN project).	M
2.1.0-057	Software Patches and Updates	Each subsystem shall publish a system change notification when system maintenance, software changes or interface changes are anticipated and completed. These include scheduled and unscheduled patches, version updates, or system upgrades.	M
2.3.0-081	Open Architecture	The system shall exchange data using open APIs including but not limited to REST, JavaScript Object Notation (JSON), XML or comma delimited separated datasets.	M
6.1.0-152	Import Indoor Asset Condition Data	The system shall implement the data curation process for static and dynamic indoor asset data including elevator outages, escalator outages, and building entrance closures.	M (static data) D (dynamic data)
6.2.0-181	Beacons Pairing	G-MAP shall provide information for travelers to pair with [interconnect to] facility-deployed beacons enabled by transceivers (communications devices) that provide indoor wayfinding and navigation support.	Corollary requirement
6.2.0-182	Indoor Navigation Using Beacons	G-MAP shall interface with beacons using communications technologies including Wi-Fi, Bluetooth, or near field communication (NFC) available on mobile devices to provide supplemental location data for indoor navigation.	Corollary requirement
6.2.0-183	Indoor Tracking Using Beacons	G-MAP shall use facility-deployed beacon fixed location mapping data to supplement Mobile Unit (MU) native navigation sensors commonly available on cell phones such as,	Corollary requirement

Requirement ID	Requirement Title	Requirement Statement	Mandatory/ Desired
		WiFi, Bluetooth, or NFC, to track performance of indoor navigation and wayfinding. Note: The assumption is that the mobile app will integrate the vendor's SDK used to detect the local beacons and present to the user the complete workflow for indoor navigation.	
6.2.0-184	Indoor Navigation	G-MAP shall provide wayfinding instructions indoors at selected facilities. Wayfinding includes navigation, orientation, and destination finding through notifications to the traveler.	Corollary requirement
6.2.0-184.1	INS Wayfinding	The SDK shall provide G-MAP app via SDK with wayfinding instructions and door to door (facility entrance to indoor navigation destination) including notifications. Notifications should include alerts via audio, text, and visual navigation instructions to support hands off and vulnerable communities (e.g., older adults, people with disabilities).	M
6.2.0-184.2	Re-routing	The SDK should be capable of re-routing users if the user navigates away from the initial defined route.	M
6.2.0-185	Beacon Asset Inventory Collection	The INS Vendor (system) shall collect asset information on beacons that are installed in facilities to support indoor navigation.	M
6.2.0-186	Beacon Asset Inventory	The Beacon Asset Inventory shall contain at a minimum, beacon identifier, location relative to facility map, location attributes, date installed, last maintenance date, and other pertinent information to support traveler navigation and wayfinding as well as asset maintenance.	M
6.2.0-187	Access to Beacon Asset Inventory	The INS shall provide access to the beacon asset inventory to authorized users including OTP, STM, building owners, and other third parties.	M
6.2.0-188	Acquire Beacon Asset Inventory	G-MAP shall acquire beacon asset inventory to support indoor mapping. The curation process, as described by Req 6.1.0-148, will be developed in Phase 2 of the ST-CTN project, including processing, integration and application in the routing service.	Corollary requirement
6.2.0-189	Beacon Environmental Conditions	The beacon shall operate in the following environmental conditions without degradation: • Operational temperature (-20 to +60ºC) • Waterproof (IP67)	M

Requirement ID	Requirement Title	Requirement Statement	Mandatory/ Desired
6.2.0-190	Beacon Power	The beacon shall be powered by replaceable battery power with an average life of 5 years (depending on usage).	M
6.2.0-191	Beacon Communication Channel and Pairing	The beacon shall support Bluetooth Low Energy (BLE) version 5 or above.	D / other technologies will be considered
6.2.0-192	Beacon Transmission Small Space Distance	The beacon shall have a broadcast range of between 50-100 meters.	M
6.2.0-193	Beacon Transmission Large Space Distance	The beacon shall be able to be configured to have a broadcast range for between 200-300 meters.	D
6.2.0-194	Beacon	A beacon technology shall be deployed at key waypoints to aid indoor wayfinding and navigation by G-MAP.	M
6.2.0-195	Beacon Installation and Mounting	The beacon shall be constructed to be installed using adhesive or screws for mounting the device.	M
6.2.0-196	Beacon App SDK	The beacon/INS shall include an SDK to interface with iOS and Android to receive and resolve message content.	M
6.2.0-196.1	SDK Navigation Experience	The SDK shall support the ability to fully integrate the navigation experience (audio, visual, text based commands) within third party apps developed using native technology.	M
6.2.0-196.2	SDK support and maintenance	The SDK shall be maintained and updated to support future maintenance releases of operating systems from Apple and Google, as well as meet compliance with Apple App Store and Google Play policies and procedures.	M
6.2.0-197	Beacon Message Configuration	The beacon/INS shall provide an administration module to configure the content and operations of each beacon.	D
6.2.0-198	Beacon Broadcast	The beacon shall broadcast its message (or identifier) at configurable intervals or when connected to a mobile app.	M
6.2.0-199	Location Positioning and Beacon Configuration	The beacons shall be installed and configured to provide accurate positioning in multiple architectural layouts.	M
6.2.0-199.1	Beacon configuration to support accurate	The beacon deployment shall ensure that positioning determination can differentiate different floors in an open space (i.e., as laid	M

Requirement ID	Requirement Title	Requirement Statement	Mandatory/ Desired
	Positioning Multiple Floors	out in the Gwinnett Justice and Administration Center – GJAC)	
6.2.0-199.2	Beacon configuration to support accurate Positioning	The beacon deployment shall ensure positioning determine can precisely (within 2-4 meters) describe the pathways between and around the two facilities.	M
6.2.0-200	Generate facility map	The vendor shall develop the facility map inclusive of routable/connected paths through the facility and between floors. The indoor network shall include features such as entrances, conveyances (elevator, escalator, stairs), rooms, destination and special areas. Features shall also include attributes that describe condition and status including time-based access and accessibility (e.g., for people in wheelchairs). Places shall include attributes that describe their condition and status.	M
6.2.0-200.1	Map updates	The vendor shall provide a web based mapping tool for facility owners to manage and update facility map updates and feature status (e.g., special events in geofenced areas, elevator outages, etc.).	M
6.2.0-200.1	Map download	The vendor mapping tool shall export map data in a standard-based map format (e.g., shape files, OGC map service / OGC feature service, Open Street Map, KML).	D

Additional requirements to meet Award provisions include the following:

4. The vendor shall comply with the Federal Highway Administration (FHWA) Buy America Requirement in accordance with CFR 635.410 and any amendments thereto, which permits FHWA participation in a project only if certain requirements with respect to the use of domestic materials for the project are met.

5. The INS vendor shall provide inputs into the Comprehensive Operations and Maintenance Plan (COMP) related to supporting operations and maintenance of the INS through Phase 3 and post-deployment.

6. The INS vendor shall support periodic team and USDOT technical meetings as designated by the Co-Project Management Leads (Co-PML), System Engineering Lead (SEL) and co-Deployment Leads (Co-DL).

7. The INS vendor shall comply with outreach and communications provisions of the USDOT which requires any communications related to this project be vetted and approved by the USDOT prior to publication.

8. The INS vendor shall develop an installation plan for each of the two facilities for installing and configuring beacons and other equipment and tools. The installation plan shall meet the provisions of the Comprehensive Installation Plan (CIP) template provided by the USDOT.

9. The INS vendor shall support the system test plan and reporting documentation.

10. The INS vendor shall support on-site operational readiness testing and demonstration. This includes demonstrations conducted in May-June 2024 in Gwinnett County Georgia.

11. The INS vendor shall assign a project manager as key personnel for the duration of the program including Phase 2 deployment and Phase 3 operations and evaluation. Any changes to the assigned project manager shall be reviewed and approved by the GDOT EMT.

12. The INS vendor shall collaborate with the G-MAP vendor to integrate the INS wayfinding with the G-MAP mobile app.

13. The INS vendor shall collaborate with the facility owner(s) to install beacon equipment in the facility.

3.1.4 Certification Requirements

Certification information that meets requirements will be provided by the vendor post-award as part of the installation and operation of the subsystem.

3.1.5 Part Numbers/Quantities

Specific part numbers and quantities will be provided by the vendor post-award as part of the final design. The intent is that the vendor will provide full coverage of the public areas within the facilities identified in the PO.

3.1.6 Associated Software

Any software required to support the indoor navigational path mapping (and updating), device configuration, optimization, and operations will be provided by the vendor post-award. At this time, it is unknown whether the software is custom-built by the vendor or if it is commercial off the shelf (COTS). It should be noted that the INS software is not required to be open source if it has the potential to expose intellectual property of the vendor.

3.1.7 Acquisition Method

System acquisition will be included in the process discussed in **Sections 2.1** and **2.2**. This is intended to be a turnkey solution for devices, ancillary equipment and materials, software, labor,

operations and maintenance through Phases 2 and 3. The acquisition of the Indoor Navigation System will be procured via a PO methodology.

PO methodology involves selecting a vendor that meets specifications for the provision of commodities. Requirements list including equipment specifications is provided in Appendix. Vendors are required to submit responses with a pricing list of all commodities for each category. The list will be used in the evaluation process where interviews are conducted. NTP will be issued to the selected vendor and prices to be paid for items will be the prices listed on the PO.

The schedule in **Section 3.1.9** will be used as a guide for the acquisition of a vendor to provide, install, and deploy any system that requires an PO including the INS. **Figure 2** from **Section 2.1** is a step-by-step illustration of the process that will be followed from the initial phase, the PO, through award.

3.1.8 Potential Vendors

Potential vendors are those that meet identified pre-qualifications as per the TSEF contract. There has been outreach by the project team to understand the options and types of equipment and systems available to support this effort. The selected vendor will be identified within this section once secured.

3.1.9 Acquisition Schedule

Below is the anticipated INS acquisition schedule for the procurement of all devices, ancillary equipment and materials, software, and labor to deliver a turnkey solution.

Table 5. Acquisition Schedule – INS Solution Vendor Procurement

Tasks	Date
Vendor Review	March 2023 – Complete
Refine Requirements	April 2023 – Complete
Vendor Interviews	April/May 2023 – Complete
INS Vendor Estimate	June 9, 2023 - Complete
Vendor Selection	June 26, 2023 – Complete
Vendor Notification	June 30, 2023
Vendor scope of work	July 7, 2023
Contracting	July 17, 2023
Develop and submit waiver	TBD

4 Bill of Materials

A Bill of Materials will be provided within the CIP upon selection of a turnkey solution vendor.

5 References

Table 6 lists the documents that were used to support the development of the ST-CTN CAP. References to these documents are identified with the acronym provided in brackets.

Table 6. Referenced Documents

ID	Referenced Documents
[CVTMP]	AECOM. "Gwinnett County Connected Vehicle Technology Master Plan (CVTMP)." Duluth: Gwinnett County Department of Transportation. (2019).
[ARCRTP]	Atlanta Regional Commission. (2021). “The Atlanta Region’s Plan: Regional Transportation Plan” Atlanta: Atlanta Regional Commission.
[UNIRP]	Atlanta Regional Commission. Deliverable Task 1.B User Needs Identification and Requirements Planning. Atlanta: U.S Department of Transportation. (2021).
[SyRS]	Atlanta Regional Commission. Deliverable Task 6.1 System Requirements and Specifications Document. Atlanta: U.S Department of Transportation. (2021).
[NS]	Atlanta Regional Commission. Deliverable Task 2.2 Needs Summary. Atlanta: U.S Department of Transportation. (2021).
[CIP]	Georgia Department of Transportation. Deliverable Task 2D Comprehensive Installation Plan. (2023).
[CV1K]	Georgia Department of Transportation. "The Regional Connected Vehicle Program Scope of Work." Atlanta: Georgia Department of Transportation.
[GPM]	Georgia Department of Transportation. Procurement Manual: For the Procurement, Management and Administration of Engineering and Design Related Consultant Services.
[PSRG]	Gwinnett County Transit. Paratransit Service Rider's Guide. Duluth: Gwinnett County Government. (2018).
[MARTA4GC]	Gwinnett County Transit. The Plan - MARTA for Gwinnett. Duluth: Gwinnett County Government. (2021).
[IEEE-1362]	IEEE. Guide for Information Technology - System Definition - Concept of Operations (ConOps) Document. IEEE. IEEE Std 1362-1998
[IEEE-1028]	IEEE. Guide for Software Reviews and Audits. IEEE. IEEE Standard 1028-2008.

ID	Referenced Documents
[IEEE-29148]	IEEE. ISO/IEC/IEEE International Standard - Systems and Software Engineering -- Life Cycle Processes -- Requirements Engineering, IEEE/ISO/IEC 29148-2018
[IEEE-1609]	IEEE. Wireless Access in Vehicular Environment. IEEE. IEEE Standard 1609.2-2016.
[NTCIP-1211]	National Transportation Communications for ITS Protocol 1211 Object Definitions for Signal Control and Prioritization. (2014) Washington, D.C.: AASHTO, ITE, NEMA.
[SAE-J2735]	SAE J2735-2020 C2X Message Set. Warrendale: SAE International.
[SAE-J2945]	SAE J2945-2017 On-Board System Requirements for V2V Safety Communications. Warrendale: SAE International.
[IMISOW]	The ATL. (2020). Integrated Mobility Innovation Statement of Work - Atlanta-Region Rider Information and Data Evaluation System. Atlanta: Federal Transit Administration.
[IVR]	TTEC. (2021). Interactive Voice Response (IVR). Englewood: TTEC.
[FAST]	U.S. Department of Transportation Federal Highway Administration. (2015). Fixing America's Surface Transportation Act.
[ARC-IT v9.1]	U.S. Department of Transportation Federal Highway Administration. (2022). Architecture Reference for Cooperative and Intelligent Transportation, ARC-IT v9.1. https://www.arc-it.net/index.html (accessed May 10, 2022).
[SE-ITS]	U.S. Department of Transportation, Federal Highway Administration, Federal Transit Administration. (2007). Systems Engineering for Intelligent Transportation Systems - An Introduction for Transportation Professionals. Washington D.C.: Department of Transportation, Office of Operations.
[BAA]	U.S. Department of Transportation, Federal Highway Administration. (2020). ITS4US Broad Agency Announcement. Washington D.C.: U.S. Department of Transportation.
[ACS]	United States Census Bureau. (2017). American Community Survey. Washington D.C.: U.S. Department of Commerce.
[ADA]	United States Department of Justice, Civil Rights Division. (2009). Americans with Disabilities Act of 1990. Washington D.C.: United States Government.

6 Definitions, Acronyms, and Abbreviations

This section provides definitions, acronyms, and abbreviations used throughout the CAP.

6.1 Definitions

Americans with Disability Act (ADA) – An act to “provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities.” The act provides enforceable standards to address discrimination against individuals with disabilities and requires public facilities to be readily accessible and usable by individuals with disabilities [ADA].

Application Programming Interface (API) – Enables companies to make available the data of their products and services to external developers and business partners. This allows multiple services and products from different companies to communicate and leverage each other’s data for improved collaboration, innovation, and added security [API].

Artificial Intelligence – Intelligence that is learned, displayed, and carried out by machines. An "intelligent" machine perceives its environment and then takes actions that maximize its chance of success at some goal. Examples that we know include human speech recognition, which turns spoken words into the contents of a text document or email, and autonomous driving, where the vehicle has a learning element to recognize its environment including other vehicles, pedestrians and the infrastructure. Intelligence and decision-making that comes from a machine and an autonomous vehicle is known as artificial intelligence. Deep learning and machine learning are mainly included in AI. [CAV]

Basic Safety Message (BSM) – Data content that is broadcasted through V2V or V2I at a 10 Hz frequency. The data elements are vehicle position (latitude, longitude, elevation) and motion (heading, speed, acceleration). [CAV]

Cellular – Vehicle to Everything (C-V2X) – A connected vehicle platform that works over the cellular network to provide vehicle-to-vehicle, vehicle-to-infrastructure, and vehicle-to-pedestrian communication. It is similar to DSRC but uses the cellular network instead of a short-range spectrum [CVTMP].

Cellular V2X – Cellular V2X (C-V2X) is a 3GPP standard describing a technology to achieve the V2X requirements. C-V2X is an alternative to 802.11p, the IEEE specified standard for V2V and other forms of V2X communications.

Connected Vehicle (CV) – A vehicle (car, truck, bus, etc.) that is equipped with a wireless communication device (1). A CV uses any of the available wireless communication technologies to communicate with other cars on the road (vehicle-to-vehicle [V2V]), roadside infrastructure (vehicle-to-infrastructure [V2I]), and other travelers and the cloud. [CAV]

Dedicated Short-Range Communication (DSRC) – A protocol for communication between vehicles and between moving vehicles and fixed roadside access points. The protocol addresses safety critical issues associated with sending and receiving data. The protocol provides low-latency data-only V2V and V2I communications. [CAV]

General Transit Feed Specification (GTFS) – A data specification that allows public transit agencies to publish their data to be consumed by a variety of transit-related applications. This data includes schedule, fare, and vehicle position which can be used to predict arrival times and display real-time information [GTFS].

High Precision Positioning/Timing Source -- Source data service which could be a base station or a satellite allowing the system to calculate positioning and UTC for system processes or provide position corrections. An example of a High Precision Positioning/Timing Source is a GNSS receiver. [CI]

Intelligent Traffic Signal System (I-SIG) – A traffic signal system that controls signals and maximizes flows in real time by collecting data from vehicles through V2V, V2P, and V2I communications. [CAV]

Interactive Voice Response (IVR) – Automated phone system that allows users to access information using a voice response system of pre-recorded messages to convey information without having to speak to an agent. [IVR].

Mobile Unit (MU) – [A device that] performs the data exchange between the infrastructure and a road user. MUs may be integrated with cellular phones or otherwise be carried by pedestrians, cyclists, other travelers, or workers in the roadway. [CI]

Onboard Unit (OBU) – An ITS related hardware that performs the data exchange between the infrastructure and a vehicle and installed in a vehicle (includes an after-market device). An OBU may contain applications that process the data received from the infrastructure and other sources such as another OBU. [CI]

OpenTripPlanner (OTP) – OpenTripPlanner is a family of open-source software projects that provide passenger information and transportation network analysis services. [OTP]

Personally Identifiable Information (PII) – Information on an individual's identity such as name, address, identifying number, telephone number, email address, etc.

Personal Safety Message (PSM) – A data broadcast by a vulnerable road user (such as pedestrians) to announce their presence to approaching vehicles. [CAV]

Privacy – The ability of an individual or group to seclude themselves or seclude information about themselves, thereby revealing themselves selectively. [CAV]

Roadside Unit (RSU) -- A transportation field device that performs the data exchange between OBUs, MUs, and other infrastructure elements. [CI]

Signal Phase and Timing (SPaT) – The signal state of the intersection and how long this state will persist for each approach and lane that is active, according to the SPaT Benefits Report. The SPaT message sends the current state of each phase, with all-red intervals not transmitted.

Movements are given to specific lanes and approaches by use of the lane numbers present in the message. In a connected vehicle environment, the message is sent from the roadway infrastructure to approaching vehicles. [CAV]

SCMS/Security Backend -- A system that provides and manages security certificates to support trust within the CI system. [CI]

Traffic Signal Electric Facilities (TSEF) – Purchase order contract used for the acquisition of INS equipment [TSEF]

Transit Signal Priority (TSP) – A part of a signal system that allows transit agencies to manage service by prioritizing buses and granting their right of way based on schedule adherence or passenger loads. [CAV]

6.2 Acronyms and Abbreviations

Table 7 provides a summary of key acronyms and abbreviations used throughout the document.

Table 7. Acronyms and Abbreviations

Acronym/Term	Description
APS	Audible Pedestrian Signal
ARC	Atlanta Regional Commission
BLE	Bluetooth Low Emitting
CAD/AVL	Computer Aided Dispatch / Automatic Vehicle Location
CAP	Comprehensive Acquisition Plan
CIP	Comprehensive Installation Plan
CV	Connected Vehicle
C2C	Center to Center
DOAS	Department of Administrative Services
EDP	Enterprise Data Governance
GCT	Gwinnett County Transit
GDOT	Georgia Department of Transportation

Acronym/Term	Description
G-MAP	Georgia Mobility and Accessible Planner
GPR	Georgia Procurement Registry
ICTDP	Integrated Complete Trip Deployment Plan
IMI	Integrated Mobility Innovation
INS	Indoor Navigation System
IRB	Institutional Review Board
ITS	Intelligent Transportation Systems
JSON	JavaScript Object Notation
MARTA	Metropolitan Atlanta Rapid Transit Authority
NFC	Near Field Communication
NOA	Notice of Award
NOIA	Notice of Intent to Award
NTP	Network Time Protocol
OBU	Onboard Unit
OSS	Open-source Software
OTP	OpenTripPlanner
PED-X	Pedestrian Signal
PMD	Performance Measurement Dashboard
PRL	Protocol Requirements List
RFI	Request for Information
RFP	Request for Proposal
RSUs	Roadside Units

Acronym/Term	Description
SCMS	Security Credential Management System
SLA	Service Level Agreement
ST-CTN	Safe Trips in a Connected Transportation Network
STM	Space Time Memory
TCC	Transportation Control Center
TMC	Traffic Management Center
TSEF	Traffic Signal Electric Facilities
TSP	Transit Signal Priority
UTC	Coordinated Universal Time

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