SMART Wayfinding System: System and Subsystem Requirements:

Leveraging Innovative Technology to Develop the *SMART* Wayfinding Standard to Facilitate Independent Use of Public Transit by Individuals with Cognitive Disabilities

U.S. Department of Transportation

Produced by AbleLink Smart Living Technologies, LLC
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16. Abstract

The System and Subsystem Requirements Specification establishes the functional, performance, design, and development requirements for this project. Requirements are detailed for each component that is being developed as part of AbleLink Project #1: *Leveraging Innovative Technology to Develop the SMART Wayfinding Standard to Facilitate Independent Use of Public Transit by Individuals with Cognitive Disabilities*. The SMART Wayfinding Specification will provide a de facto standard for cognitively accessible wayfinding apps which will provide a well-defined specification for developers to promote cross-platform use of routes created for one system with those created for other systems. Specially designed methodologies are required to overcome cognitive limitations experienced by individuals with cognitive disabilities and others with limited ability to use mainstream travel tools to enable these individuals to independently travel by bus or other public transportation vehicle to their destination without assistance from others.

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Executive Summary

This System and Subsystem Requirements Specification establishes the functional, performance, design, and development requirements for this project. Requirements are detailed for each component that is being developed as part of AbleLink Project #1: *Leveraging Innovative Technology to Develop the SMART Wayfinding Standard to Facilitate Independent Use of Public Transit by Individuals with Cognitive Disabilities*. The term "SMART" is used herein to describe the Specialized Media for Assisting Route Travel (SMART), a standardized protocol used for enhancing independent transportation for individuals with cognitive disabilities and others with special needs. The SMART Wayfinding Specification will provide a de facto standard for cognitively accessible wayfinding apps which will provide a well-defined specification for developers to promote cross-platform use of routes created for one system with those created for other systems. Specially designed methodologies are required to overcome cognitive limitations experienced by individuals with cognitive disabilities and others with limited ability to use mainstream travel tools to enable these individuals to independently travel by bus or other public transportation vehicle to their destination without assistance from others. Unique applications and tools are being created to use mobile technology, such as tablets or smartphones, to deliver these methodologies thus enabling individuals to travel independently despite existing cognitive limitations or existing difficulty using public transportation systems.

WayFinder is a commercially available transportation support system that has been available since 2010 and was developed specifically for individuals with cognitive disabilities to allow them to take fixed route public transportation independently. The system was developed through research funding from the U.S. Department of Education and the National Institutes of Health. Research shows that the system allows individuals to use public transportation more independently and that agencies serving individuals with cognitive disabilities can reduce both organizational transportation costs and usage of paratransit services (Davies, Stock, Holloway, and Wehmeyer, 2010; Hoetzel & Mullen, 2012). In this project, this technology is being extended to many additional individuals with cognitive and other disabilities through the development of a new standard language for smart wayfinding which will pave the way for new wayfinding technologies that can enable transportation system consumers with disabilities to access and share routes created for use with any smart wayfinding technology that adheres to the de facto standard. In Phase I of this two phased project we are 1) developing, testing and publishing the first version of this standard, 2) developing a suite of cloud-based support tools for creating routes and enabling individuals to easily locate, download, and modify the standardized routes based on personal needs for use with the wayfinding system that works best for them, and 3) validating the technical concept in an empirical pilot study. In Phase II, the technologies have been revised and enhanced based on the results of the pilot study to fully implement the SMART Wayfinding Specification system and allow for extended field testing of the system in a mid-sized U.S. city to evaluate its effectiveness for transitioning individuals with cognitive disabilities from paratransit services to fixed route system services, and 2) enabling individuals with cognitive disabilities who are *not* current paratransit users to take public transit independently, rather than be dependent on agency staff and others to provide rides when needed. The standard will leverage existing technology and build upon our proven technological approach used in our WayFinder system that has been previously validated through research and ongoing usage by travelers with disabilities.

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Building on Existing Technology: Quick Overview of WayFinder

WayFinder is a specialized application which operates on off-the-shelf mobile devices and uses GPS and specialized visual, audio, and vibration prompts to allow individuals with cognitive disabilities to be able to use fixed route transportation independently. With WayFinder, multiple travel itineraries to desired destinations, or routes, can be programmed into a single device to enhance travel choices and independent transportation. Currently, direct support professionals (DSPs), family members, transportation trainers or other caregivers ride the route (either on the bus or in a personal vehicle) and use the system's Route Builder utility to set waypoints, record instructions for those waypoints and optionally take pictures to provide visual cues along the way. Once a route is created with the device, a rider with cognitive abilities can then select the route and follow the multimedia step-by-step GPS-based prompts to arrive at his or her destination.

SMART: A Standardized Route Travel Protocol

Based upon research, development, and customer usage of our WayFinder app, AbleLink has pioneered a technical approach that lays the foundation for creating the standardized travel route protocol that is described in the specification, called SMART. SMART will use a JSON-based structure and common media formats for providing location-based multimedia prompting instructions to travel to specific destinations. This structure can facilitate creation, distribution, playback and sharing of travel content across organizations and across technology platforms. By using a simple and open language for storing data and structuring that data, the SMART protocol will be able to be used to deploy step-by-step travel instructions for individuals with cognitive disabilities to use public transportation, or even detailed walking or hiking instructions for health-focused individuals, as well as guided tour instructions in an accessible manner for visitors of outdoor attractions, such as National Parks, zoos or open-air museums through use of the SMART Route Builder application. The focus of this project has been providing access to public transportation, but the results of this project will be transferable to these other uses as well. The ways in which SMART travel routes can be used is only limited by the imagination of the content developer. The SMART Wayfinding Specification will provide a common language for travel applications and technologies so that the content can be created once and then utilized on multiple systems and platforms and easily shared with other individuals or organizations. Sharing of routes will be facilitated through use of SMART Route Libraries within a geographical area which will house relevant SMART Routes based on public transportation available from a local transit agency, as well as other routes that may have common interest (such as a walking route for a historic part of downtown). The next section identifies the specific components that will be developed to provide all of the necessary tools and support services for the SMART Wayfinding Specification to be implemented as a service within metropolitan areas by transit agencies. In addition, the overall User Needs are identified in Table 1-1 to allow the requirements of the system to be understood in the context of the specific needs of users of the SMART Wayfinding Specification and associated tools.

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Chapter 1. Needs Identification

There is a total of four interrelated development objectives for this project. Each of these development objectives will be met through research and development activities conducted in Phase I and Phase II of this project to develop each of these system components. The table below provides a high-level summary of the needs that the SMART Wayfinding Specification toolset will be designed to support.

Table 1 User Needs the SMART Wayfinding Specification System Will Address

User Needs Listed in No Particular Order
User Need 1 - The need to create, preview and manage new routes that comply with the SMART Wayfinding Specification.
User Need 2 – The system needs to provide cognitively accessible routing and navigation capabilities on a mobile device including visual, auditory, and textual prompts for each step in the process of taking a transit vehicle (such as bus or light rail) from point of origin to a desired destination.
User Need 3 - The need for periodic landmarking prompts to provide positive orientation to users during travel, such as "There's the lake outside the window across the street – you are half-way to work."
User Need 4 - The need to easily select a desired pre-built route containing visual and auditory prompts from the cloud-based SMART Route Library by anyone desiring use of a SMART-compliant wayfinding route.
User Need 5 - The need to download/transfer a desired pre-built route from the cloud-based SMART Route Library.
User Need 6 - The need to share/upload newly created routes to a cloud-based SMART Route Library (for those with administrator access to the SMART Route Library).
User Need 7 - The need for travel trainers, family members, caregivers or other travel support professionals to easily delete previously selected routes or modify the route to change the starting or ending point of the route and add new waypoints as needed for a particular user.
User Need 8 - The need for family members or caregivers to easily delete previously selected routes or modify the route to personalize it with additional prompts for describing relevant landmarks and reminders, such as a message that says, "Remember Sue, don't forget your backpack!"
User Need 9 - The need to provide route correction or error recovery features to help individuals return to routes when they deviate from them or to receive needed help from others.
User Need 10 - The need to automatically send notifications to family members or caregivers when the individual leaves from home to go to work, when they arrive at their destination, or if the individual deviates from his or her route or aborts the route for some reason.

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> **User Need 11** - The need to automatically send periodic notifications while an individual is traveling to provide family members or caregivers ongoing feedback as to the individual's progress during the individual's travel activity.

> **User Need 12** - The need for a local transit authority to implement a SMART wayfinding service provided by AbleLink within their geographic area to provide standardized routes for their locale at no cost to the end user (if desired) to facilitate access to specialized travel support technology and readily available routes that can be downloaded and used to facilitate independent travel.

The system requirements for each component will be documented in this specification and updated throughout the project

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Chapter 2. Reference Documents

The following reference documents are applicable to this report:

SMART Wayfinding Specification JSON Specification, Leveraging Innovative Technology to Develop the SMART Wayfinding Standard to Facilitate Independent Use of Public Transit by Individuals with Cognitive Disabilities, AbleLink Smart Living Technologies, Version 1.0, February 2019.

Smart Travel Concierge System (STCS) Requirements Specification, Leveraging Innovative Technology to Develop the Smart Travel Concierge System to Facilitate Pre-Trip Planning and Virtualization for Individuals with Cognitive Disabilities, AbleLink Smart Living Technologies, December 2018.

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Chapter 3. Requirements

3.1 System Definition

The overall objective of this project is to develop a route standard that can be used as a common technical language for providing step-by-step travel instructions on a mobile device to facilitate independent travel by individuals with cognitive disabilities, as well as others desiring similar travel support.   The SMART Wayfinding Specification will provide a common language for travel applications and technologies so that the content can be created once and then utilized on multiple systems and platforms and easily shared with other individuals or organizations. The SMART Wayfinding Specification will provide a well-defined description of required and optional elements that will be included in a *smart.json* file. This will allow developers choosing to create applications (such as mobile wayfinding apps or route builder programs) to build their applications so they can read and write data from a *smart.json* file and thus provide new SMART-compliant applications to provide individuals with cognitive disabilities, their families and caregivers, as well as travel support professionals, with needed new capabilities to support independent travel. The availability of a de facto standard that is adopted and used widely within the industry promotes technological innovation and the development of new transportation support technologies that can improve transportation options for those with cognitive disabilities and offers these individuals the opportunity to successfully transition to more independent modes of travel (such as using fixed route transit rather than more costly paratransit of private travel services). To accomplish this overall objective, there are three subsystems that will be developed. Figure 1 provides a functional block diagram showing the relationship of the three subsystems presented in Table 2.

Table 2 SMART Wayfinding Specification Subsystems

Subsystem	Description
SMART Route Builder	Web-based Application for SMART Route Creation/Modification
SMART Route Library	Geographically Specific Cloud-based Route Library for Route Distribution
Mobile Wayfinding App	WayFinder Application to Support SMART Wayfinding Specification and Interface with SMART Route Library

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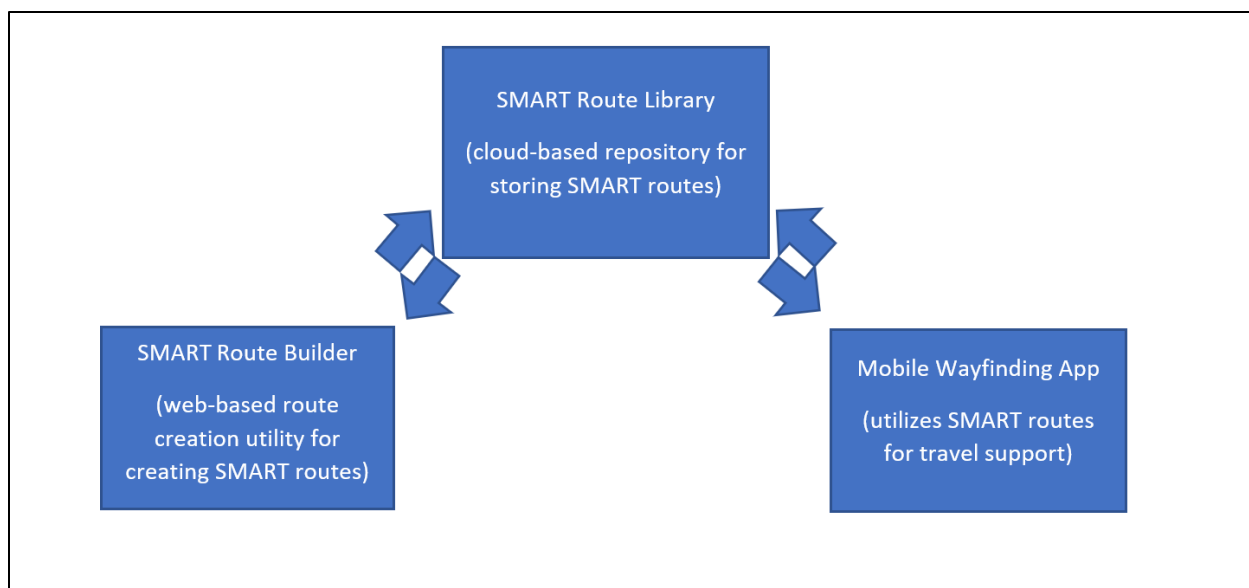
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Figure 1. SMART Wayfinding Specification System Functional Block Diagram

Understanding the Subsystems of the SMART Wayfinding Specification System

SMART uses a JSON-based structure and common media formats for describing travel routes. JSON (Java Script Object Notation) is a commonly used data presentation format for cross-platform use among technology developers. Therefore, the JSON-based content containing route specific information will be easily used by any wayfinding app developer. The structure facilitates creation, distribution, playback and sharing of travel content across organizations and across technology platforms. By using a simple and open language for storing data and structuring those data, the SMART protocol will be able to be used to deploy step-by-step travel instructions for individuals with cognitive disabilities to use public transportation, or even detailed walking or hiking instructions for health-focused individuals, as well as guided tour instructions in an accessible manner for visitors of outdoor attractions, such as National Parks, zoos or open-air museums. Each specific element of the SMART protocol is documented in the SMART JSON Specification. The project activities conducted during this project are designed to identify all required and optional components of the SMART wayfinding de facto standard.

Figure 2 provides a conceptual overview diagram showing the relationship of the SMART Wayfinding Specification and the three major subsystems. Routes used for enabling individuals with cognitive disabilities and others with special needs to travel more independently are first created using SMART Route Builder (Subsystem 1). These travel routes include specific turn by turn instructions for getting to a specific bus stop, riding on the bus, and notifying the driver when to stop the bus. In addition, custom travel instructions can be added to a route for walking from home to the transit stop and for getting to a desired final destination after exiting the bus or train. SMART Route Libraries (Subsystem 2) store routes created with SMART Route Builder, which typically are based on a transit agency's General Transit Feed Specification (GTFS) route data for a local area. Then, a SMART Ready Mobile Wayfinding App (Subsystem 3), i.e. an app that has been created or modified to utilize travel routes created according to the SMART Wayfinding Specification, can download routes from a SMART Route Library to provide

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accessible travel instructions to the traveler. Each of these subsystems are described in the following paragraphs.
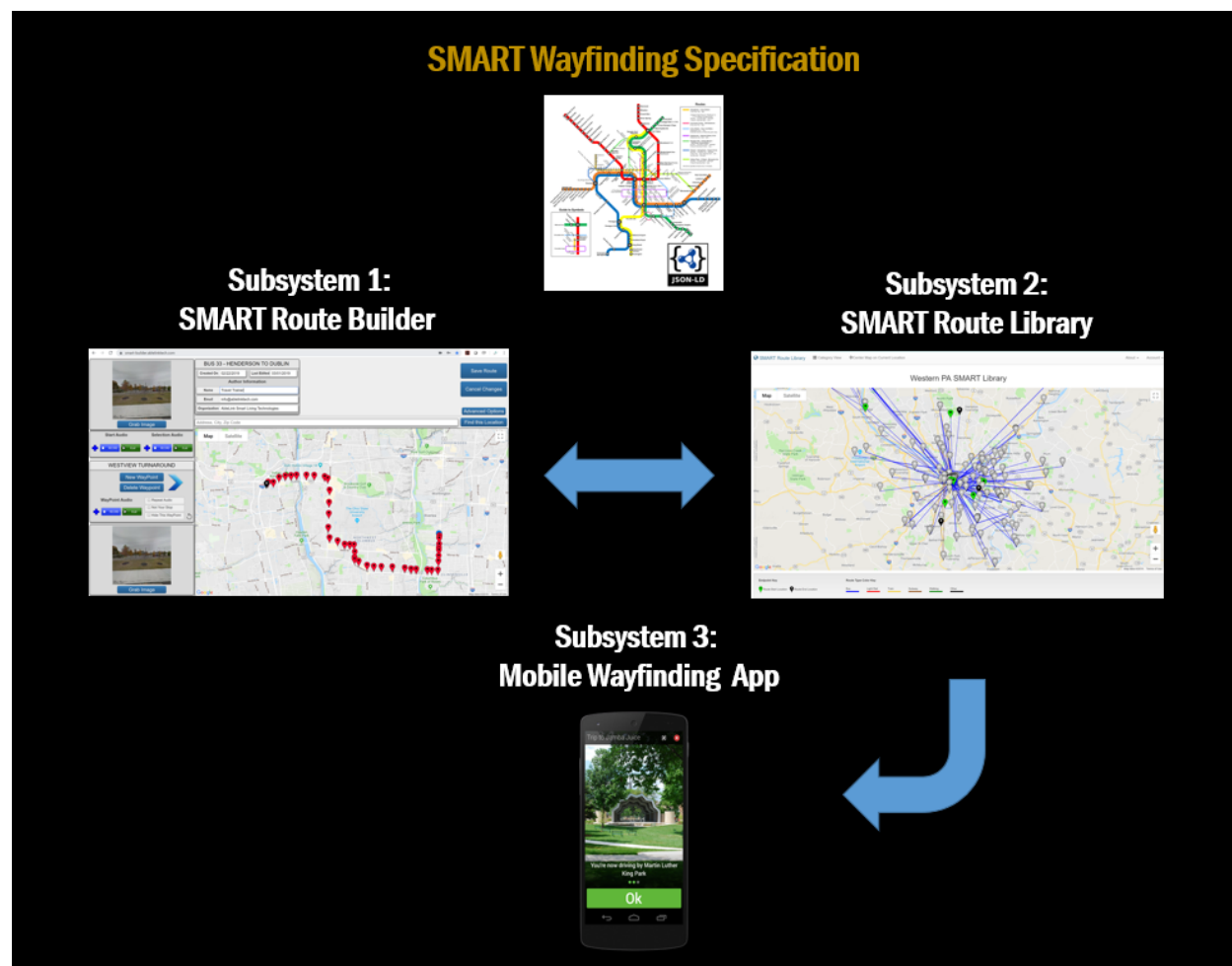
Figure 2. Conceptual Overview

Subsystem 1: SMART Route Builder

SMART Route Builder (renamed from Travel Manager in previous versions) is a web-based application developed to allow SMART compliant routes to be created and then contributed to a cloud-based route library.   While AbleLink's WayFinder application included a route building module that works on the smartphone itself, customers have requested tools for creating routes on a desktop computer using mapping software, such as Google Maps, as well as the desire for much more robust route creation and editing tools. The web-based route editing application (SMART Route Builder) enables travel trainers or caregivers using this service to create, edit and assign GPS coordinates to key locations on a designated route and record custom audio cues, such as "Do not get off here, you need to wait until the next bus stop" or "This is the doctor's office, you can get off the bus when it stops." These cues are received by individuals with cognitive disabilities via a simplified interface on the smartphone that processes the GPS coordinates and automatically plays the audio prompt (along with physical vibration alerts) assigned for

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the respective coordinate. This allows caregivers not only to program cues for target destinations, but also provides the opportunity to anticipate points along the route where a mistake might be made and provide a pre-emptive cue (e.g., "Remember John, this is a different Starbuck's, so do not get off the bus here. Wait for your phone to tell when to get off.") Digital pictures (which can be captured directly from the smartphone while editing a route or simply by selecting images available online when using SMART Route Builder to create routes) can be displayed along with the audio prompts to help identify landmarks at a destination or along a route. Google Maps is currently the only tool used within SMART Route Builder as it included the most robust set of features for creating routes, such as grabbing images from Street View programmatically. Users certainly can use other tools (such as Open Street) as a resource in a separate window while deciding what waypoints to set within Route Builder while creating routes.

Subsystem 2: SMART Route Library

The SMART Route Library is part of the cloud-based service that house SMART travel routes. These travel routes are created with a SMART-compliant mobile application, a web-based route creation utility and can be uploaded to the SMART Route Library to be shared with other individuals. After a route has been created, a user with administrative privileges can be given an option to upload the route to the SMART Route Library. This is optional and can be done any time. SMART Route Library has been built upon Able Link's previously developed Learning Library technology. Once the route is uploaded, the SMART Route Library server application opens the route folder, conditions all of the media contained in the route if necessary and reassembles it. The reason for this step is to ensure media playback compliance across multiple platforms due to the difference of supported file formats from one mobile operating system to the next. Once the route is reassembled it is categorized based on location and made available for download. Another user can then browse the SMART Route Library from their smartphone and search for available routes specific to the user's current location or for destinations they are planning to visit. They would simply download the routes they wanted and use them when needed.

Subsystem 3: Mobile Wayfinding App

WayFinder is a specialized application which operates on off-the-shelf mobile devices and uses GPS and specialized visual, audio, and vibration prompts to allow individuals with cognitive disabilities to be able to use fixed route transportation independently. With WayFinder, multiple travel itineraries, or routes, can be programmed into a single device to enhance travel choices and independent transportation. To setup the system using the built-in route builder utility, teachers, family members, transportation trainers or other staff ride the route (either on the bus or in a personal vehicle) and use the system's Route Builder utility to set waypoints, record instructions for those waypoints and optionally take pictures to provide visual cues along the way. (Alternatively, the SMART Route Builder app can be used to build routes as well.) Once a route is created with the device, a rider with cognitive abilities can then select the route and follow the multimedia step-by-step GPS-based prompts to arrive at his or her destination.

3.1.1 Operational Assumptions

Travel support for individuals with cognitive disabilities is comprised of multiple facets, including paratransit, specialized travel services provided by agencies serving individuals with cognitive disabilities and natural supports (such as family and friends). Research shows that specially designed wayfinding supports can enable individuals with cognitive disabilities to use public transportation more independently and that agencies serving individuals with cognitive disabilities can reduce both organizational transportation costs and usage of paratransit services (Davies, Stock, Holloway, and Wehmeyer, 2010; Hoetzel & Mullen,

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2012). This project will extend proven travel support technology to increased numbers of individuals with cognitive and other disabilities through the development of a new de facto standard language for smart wayfinding which will pave the way for new wayfinding technologies that can enable transportation system consumers with disabilities to access and share routes created for use with any smart wayfinding system that utilizes the SMART Wayfinding Specification. In Phase 1 of this project we 1) developed, tested and submitted this de facto standard, 2) developed cloud-connected support tools for creating routes and enabling individuals to easily locate, download, and enhance the standardized routes based on personal needs for use with the wayfinding system that works best for them, and 3) validated the technical concept in a proof of concept pilot study. One of the primary purposes of this open route standard is to encourage other wayfinding technology developers to build new systems which work with the standard so that routes created for these new systems can be used interchangeably with other compatible systems.

In Phase II, these technologies have been revised and enhanced based on the results of the pilot study and are undergoing field tested in several dispersed locations to evaluate system effectiveness for 1) transitioning individuals with cognitive disabilities from paratransit services to fixed route system services, and 2) enabling individuals with cognitive disabilities who are *not* current paratransit users to take public transit independently, rather than be dependent on agency staff and others to provide rides when needed. The de facto standard leverages existing technology and builds upon the proven technological approach used in AbleLink's WayFinder system that has been previously validated through research and ongoing usage by travelers with disabilities

3.1.2 System Interface Requirements

The subsystems detailed in this specification operate in conjunction with the SMART Wayfinding Specification that is being developed as part of this project and documented in a separate document.

3.1.2.1 System External Interfaces

The WayFinder system will be capable of interfacing with a widely available system for identifying current bus location so that the WayFinder user can be alerted as to when the target vehicle is coming, such as GTFS. Currently, GTFS is the only external interface to WayFinder. Specific information for interfacing with GTFS and other identified feeds in the future will be included in the developer website (https://www.ablelinksmarttravel.com/) as they are identified through project activities and identification of specific needs in collaboration with the project steering committee.

3.1.2.2 System Internal Interface

This section summarizes the requirements associated with each of the three subsystems identified in Section 3.1. Each subsystem is broken down into Components which encompass a group of related requirements for each function of the respective component. Figure 3 depicts the components for each of the three subsystems.

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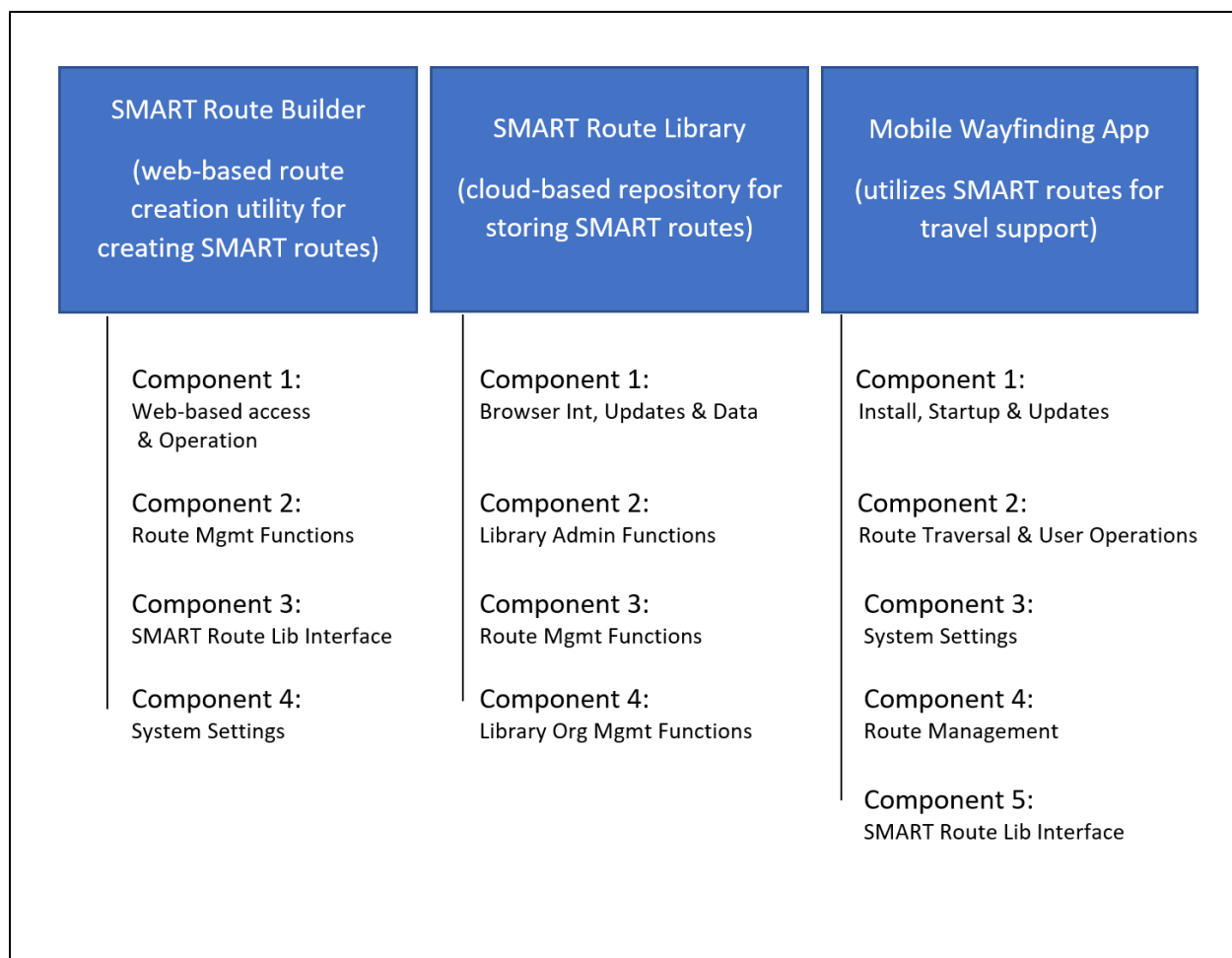
Figure 3. Subsystems and Functional Components Diagram

3.2.1 Performance

SMART compliant wayfinding apps will be utilized during travel by individuals with cognitive disabilities. In addition, other populations may benefit from the system, including seniors, individuals that have Limited English Proficiency, and foreign visitors to the United States. Systems utilizing the SMART standard shall operate wherever sufficient GPS signal strength is available to provide reliable and accurate geo-location information to the wayfinding app. The system is not expected to provide location information when GPS data is not available. The system is expected to continue to check for GPS signal strength and then resume providing location specific travel instructions as soon as sufficient GPS signal strength is detected.

3.2.2 Physical Characteristics

All outputs of this project are electronic software and textual documents and thus physical characteristics are not applicable to this system.

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3.2.3 Reliability

Reliability of the web-based applications will be developed and refined throughout the Beta portion of application testing and deployment. AbleLink will develop tests to measure rigorous interaction with the web-based applications and services and determine thresholds of reliability. This will help assess scalability needs as well as refinement of the applications as necessary to reduce bandwidth and stress on the services. End-user Beta testing was conducted during the Year 1 Pilot Study was extended during the Year 2 field evaluation. In addition, beta testing is being offered to additional organizations affiliated with and recommended by the project steering committee so as to test with as broad of an audience as possible, to help iron out potential issues with the mobile applications, web applications, and services prior to final deployment.

3.2.4 Maintainability

AbleLink will continue to refine and improve performance of the de facto standard and publish changes so that developers can incorporate new functionality into their apps to maintain compatibility with the standard. For the latest information on the SMART Wayfinding Specification, visit https://www.ablelinksmarttravel.com. Maintainability of the web-based applications and services developed in this project will be handled via package management and source control tools such as *npm, git,* and Mercurial. Server-level OS patches will be handled via the default mechanism on the platform, such as *apt, yum, dnf, and rpm*. Maintainability of the web applications and services will be performed after hours or at predetermined patch windows, which will be communicated to customers of the SMART Wayfinding Specification system.

Maintainability of any SMART-compliant mobile applications will be handled via their respective source providers. For example, AbleLink's WayFinder system will be maintained by AbleLink to ensure future versions remain compatible with the current version of the SMART Wayfinding Specification. Any other organization that develops an app or web-service that utilizes the SMART Wayfinding Specification will be responsible for maintaining their own systems respectively.

Preventative maintenance is maintenance activity that is routinely performed to lessen the likelihood of failure and to discover issues in a proactive manner to lessen their impact. AbleLink performs preventative maintenance on the SMART Wayfinding Specification service components (WayFinder App, SMART Route Builder, and SMART Route Library). Those preventative maintenance activities are documented here.

Table 3 : Preventative Maintenance Activities

Activities	Description	Frequency	Effort
Review public data for PII or other anomalies	Review public data for PII or other anomalies	Monthly	.5 hours
Request archive of data	Request data archive from Operating System	Quarterly	.5 hours

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SMART Route Builder website availability check	Continuously monitor the availability of the SMART Route Builder website through an external monitor and notification service to ensure the service is available for use.	Continuous/Ongoing	
SMART Route Library website availability check	Continuously monitor the availability of the SMART Route Library website through an external monitor and notification service to ensure the service is available for use.	Continuous/Ongoing	
GTFS Realtime Updates middleware API availability check	Continuously monitor the availability of the GTFS Realtime middleware API through an external monitor and notification service to ensure the service is available for use.	Continuous/Ongoing	
Server Operating System Upgrades	When new server operating system software and patches are released, upgrade and patch to keep current with the latest releases and security patches.	Semi-annually	2 hours

3.2.5 Environmental Requirements

Mobile wayfinding apps that will be implementing a SMART wayfinding route are expected to operate on off-the-shelf mobile devices designed to withstand typical environmental conditions encountered during transportation events, including conditions in the natural environment (i.e., wind, rain, temperature, geographic location), and noise and environment conditions expected with bus and rail vehicles. These are typical environment conditions experienced when using smartphones and tablets during travel activities and are within the operating tolerances adhered to by mobile technology device developers. There are no additional environmental requirements for devices that will be used to operate SMART-compliant apps.

3.3 Design and Construction

3.3.1 Electromagnetic Radiation

Travel support provided by a SMART compliant wayfinding app utilizing a SMART route will be highly dependent upon accuracy of GPS coordinates received by the mobile app. If electromagnetic radiation may interfere with delivery of accurate GPS data, then the system should not be used in locations where this interference can be expected. Usage guidelines for developers of SMART compliant wayfinding apps

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will recommend the development of contingency plans by support personnel for individuals with cognitive disabilities for events which can occur during travel, such as loss of GPS-signal and other possible events, such as loss of battery power, loss of device, getting lost while traveling, etc.

3.3.1.1 Signal Loss Notifications to User

The system shall include features to communicate loss of GPS signal to the end user using both audio and visual prompts when signal loss occurs for more than 30 seconds.

3.3.1.2 Signal Loss Notifications to Remote Caregivers

The system shall communicate sustained loss of GPS signal to the monitoring caregiver/family member via remote notifications to enable the remote caregiver to intercede as necessary.

3.3.2 Workmanship

The SMART Wayfinding Specification and SMART-compliant wayfinding apps will utilize best commercial practices for workmanship. For example, wayfinding apps will be expected to support evolving versions of the SMART Wayfinding Specification and thus support backward compatibility with older routes created previously and not with the most recent version of the SMART Wayfinding Specification. In addition, applications are expected to be developed using universal design principles and with standard interface elements to facilitate independent used by individuals with varying abilities. Cognitive design strategies will be applied to all design components, as applicable. Organizations choosing to develop products in accordance with the SMART Wayfinding Specification will be provided information for following developments and changes to the SMART Wayfinding Specification and API so that the developer can maintain compatibility over time.   A website is in development (https://www.ablelinksmarttravel.com) as a resource for SMART application developers to access up-to-date information and to download relevant documents, such as the SMART API and SMART Wayfinding Specification documentation.

3.3.3 Interoperability

The SMART standard will utilize JSON as the format for creating travel routes that provide the necessary multimedia supports to individuals with cognitive disabilities to facilitate independent travel. JSON is a widely used standardized data storage and transfer protocol that can be used by any developer of new wayfinding apps choosing to adhere to the SMART Wayfinding Specification. Media files will be conditioned by the SMART Route Library for maximum interoperability on disparate operating systems and platforms. This will be accomplished at the server level when a SMART-compliant travel route is uploaded to the library. When the library receives the travel route, if needed, it will extract all of the images, audios, and videos from the route file and condition each type of media to standard file types that can be played and viewed on all platforms. This is most important for Android and iOS platforms due to their unique media creation standards and their incompatibility with one another. Video files, specifically, will be converted to MP4 format, utilizing h.264 compression. Image files will all be unified as JPG with slight compression and audio files will be converted to WAV format, mono, 22050 Hz. The converted files will be reassembled into the route and stored on the server to await download from another client. A positive side effect of this conditioning is the reduction in size of the route files.

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3.3.4 Safety and Security Requirements

The primary issue of safety relates to safety of travelers with cognitive disabilities that are new to the use of public transportation. The SMART Wayfinding Specification describes routes to specific destinations and are designed to be reusable and shared between travel training organizations and other support agencies.   Therefore, safety support features will be incorporated into wayfinding apps by the app developer, as desired. Safety features in AbleLink's WayFinder app are described in sections 3.7.3.3.3.2.1.3 and 3.7.3.3.3.2.11. Security will be incorporated into the cloud-based SMART Route Library to ensure that routes contributed to the library are compliant with the SMART Wayfinding Specification and thus will be able to be expected to function properly when downloaded to a SMART-compliant app. Data security features of the SMART Route Library are described in section 3.7.2.3.2.

3.4 Human Factor Requirements

The target user population for this system includes individuals with cognitive disabilities. Therefore, universal design principles shall be applied where appropriate to provide a design that is independently accessible to users with cognitive disabilities. For example, literacy skills are often limited for this population, so other modes of communication (e.g., audio, graphics, etc.) will be used in conjunction with text-based information. Error minimization strategies will be employed as well to further enable error-free operation. An example of an error minimization strategy is to remove buttons from the display when they are not applicable to the current operation rather than simply "greying" out buttons. Individuals with cognitive disabilities often times have difficulty distinguishing a greyed-out button from a button that is not greyed out, leading to unsuccessful attempts to press or activate the greyed-out button. The United States Access Board provides resources on universal design. Visit the Access Board website at https://www.access-board.gov/guidelines-and-standards/communications-and-it/26-255-guidelines/825-principles-of-universal-design for more information. AbleLink Smart Living Technologies has been a leader in cognitive design research and development and includes a selected bibliography of research articles on their cognitive design research as well as a list of research projects at https://www.ablelinktech.com/index.php?id=78. The articles references contain research summaries which contain descriptions of various cognitive design strategies used by AbleLink and other organizations.

3.5 Documentation

Not Applicable

3.6 Personnel and Training

As indicated previously, a website is in development (https://www.ablelinksmarttravel.com) as a resource for SMART application system users and developers to access up-to-date information and to download relevant documents, such as the SMART API, SMART Wayfinding Specification documentation, and various training materials. This website will a primary resource for training materials for utilizing SMART Route Builder and accessing the available SMART Route Libraries, as well as for using the SMART Ready apps and associated services as they become available. Initially, training materials will be posted on this site for the WayFinder App from AbleLink, which is the first SMART Ready App that is available. In

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addition, this site will serve as a central location for other resources, including videos, new articles, and other materials that relate to the SMART Wayfinding system that are made available publicly.

3.7 Subsystem Requirements

Three subsystems compose the overall SMART Wayfinding Specification system that is being developed in this project. The table below summarizes each of these subsystems.

Table 3. Project Subsystems

Subsystem	Description
SMART Route Builder	Web-based Application for SMART Route Creation/ Modification
SMART Route Library	Geographically Specific Cloud-based Route Library for Route Distribution (AbleLink Proprietary)
SMART WayFinder App	Mobile App that implements SMART Wayfinding Routes to Support Independent Transportation for People with Cognitive Disabilities (AbleLink Proprietary)

3.7.1 SMART Route Builder: Subsystem Requirements

3.7.1.1 Definition

A web-based application will be developed to allow SMART compliant routes to be created online and contributed to the relevant cloud-based route library. The cloud-base route editing application (SMART Route Builder) will enable travel trainers or caregivers to create, edit and assign geo-location data to key locations on a designated route and record custom audio cues, such as "Do not get off here, you need to wait until the next bus stop" or "This is the doctor's office, you can get off the bus when it stops." These cues will be received by individuals with cognitive disabilities via a simplified interface on the smartphone that processes the GPS coordinates and automatically plays the audio prompt (along with physical vibration alerts) assigned for the respective geo-locations. This will allow caregivers to program cues for target destinations, and to provide the opportunity to anticipate points along the route where a mistake might be made and provide a pre-emptive cue (e.g., "Remember John, this is a different Starbucks, so do not get off the bus here. Wait for your phone to tell when to get off.") Digital pictures (which can be captured directly from the smartphone while editing a route or simply by selecting images available online when using SMART Route Builder to create routes) will be displayed along with the audio prompts to help identify landmarks at a destination or along a route.

3.7.1.2 Interfaces

The following subsections define the interfaces and files used by the web-based SMART Route Builder application.

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3.7.1.2.1 Web-based User Interface

The following subsections define the web-based user interface used by the SMART Route Builder application.

3.7.1.2.1.1 User Input

The SMART Route Builder web-based application shall support the input of user commands through the SMART Route Builder GUI, using a standard keyboard and mouse pointing device.

3.7.1.2.1.2 User Output

The SMART Route Builder web-based application shall support user commands, through the SMART Route Builder GUI, to direct the creation and management of SMART compliant routes for use with a mobile wayfinding app. User output includes SMART compliant routes for specific destinations.

3.7.1.2.2 SMART Route Library Interface

The system will provide the capability to interface with the SMART Route Library from within the SMART Route Builder web-based application.   Interfacing provides the functionality to meet the following user needs:

1) choosing an online route library to connect to

2) searching the library of available routes

3) selecting routes from the library to transfer to the SMART Route Builder application

4) contributing new routes created with the SMART Route Builder application to the online library in a specific category

3.7.1.3 SMART ROUTE BUILDER Requirements

All available routes in the user's online route library will be displayed in a list onscreen when SMART Route Builder is first accessed. Before creating a new route, the route creator will need to know both the desired destination, route and the needs and abilities of the end user who will be using a SMART-compliant mobile wayfinding app to navigate the route. Routes created with the web-based application will be made possible through a mapping feature integrated within the application. Building a route will involve locating the specific starting position of the route on the map and adding each waypoint by interacting with the mapping interface. Text, recorded audios, images and geo-location data will be able to be added for each waypoint during route creation. The SMART Route Builder route creation utility will be able to be launched from the main menu of the web-application after logging in. Users of the SMART Route Builder web-based application will include 1) transit organization staff interested in creating general routes to support travel in their geographic area via the transit organizations vehicles (buses, trains, etc.) and 2) caregivers for those with cognitive disabilities interested in creating new or modifying existing routes to meet the specific travel needs of the individuals they are supporting.

3.7.1.3.1 Component 1: Web-based Access and Operation

3.7.1.3.1.1 Web Browser Requirements

SMART Route Builder shall be accessed via a website login using a unique username and password.

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3.7.1.3.1.1.1 Internet Explorer Support

SMART Route Builder shall operate on all commonly used mainstream browsers for desktop computers including Internet Explorer.

3.7.1.3.1.1.2 Microsoft Edge Support

SMART Route Builder shall operate on all commonly used mainstream browsers for desktop computers including Microsoft Edge.

3.7.1.3.1.1.3 Google Chrome Support

SMART Route Builder shall operate on all commonly used mainstream browsers for desktop computers including Google Chrome.

3.7.1.3.1.1.4 Mozilla Firefox Support

SMART Route Builder shall operate on all commonly used mainstream browsers for desktop computers including Mozilla Firefox.

3.7.1.3.1.1.5 Apple Mobile Device Browser Support

SMART Route Builder shall operate on Apple's mobile device browser.

3.7.1.3.1.1.6 Android Mobile Device Browser Support

SMART Route Builder shall operate on Android's mobile device browser.

3.7.1.3.1.2 Offline Operation Not Required

SMART Route Builder is a web-based application that provides the capability to create routes for various destinations and contribute those routes to a SMART Route Library. Off-line operation is not required.

3.7.1.3.1.3 Application Update Requirements

Updates to the SMART Route Builder web-based application shall be performed directly on the server containing the application by system administrators. Therefore, no updates to the SMART Route Builder web-based application will be required by users accessing the system via a web-browser.

3.7.1.3.2 Component 2: Route Management Functions

The SMART Route Builder web-based application will display a listing of all routes available in the user's account. Travel routes will be able to be created from within the SMART Route Builder web-based application in accordance with the SMART Wayfinding Specification. Thus, routes created with SMART Route web-based application will be cross-platform and able to be used on any device that is designated as SMART-compliant. Routes can be created for walking, driving or using public transit (e.g., city buses) as a support for independent travel using the integrated mapping features to define geo-locations. The SMART Route Builder web-based application will contain a library of routes created and saved in the user's online account. These routes will be able to be edited/changed as needed. Routes can also be

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able to be selected from one or more online route libraries and copied into the web-based route building application for editing.

Once an initial route has been created, the Edit feature of the SMART Route Builder web-based application will provide the capability to integrate recorded audio messages, change out the digital photos or other graphical images, and set waypoint geo-location data use the integrated mapping features if desired. SMART Route Builder web-based application will allow default images for using with common waypoint types (e.g., a moving bus, a hand pulling a ring bell cord, etc.) to be added to a route.   These images will be able to be replaced by actual photos of the traveler while on the bus, or pictures of landmarks along the route. Similarly, audio recordings will be able to be re-recorded with improved wording or minus the background noise often present if a route was created with a SMART-compliant mobile device, such as WayFinder.

3.7.1.3.2.1 Creation of New Routes

The system shall provide the capability to Create new routes that adhere to the SMART Wayfinding Specification.

3.7.1.3.2.1.1 Creation Date of New Routes

The system shall provide the capability to automatically record the date the new route was created.

3.7.1.3.2.1.2 New Route Title

The system shall provide the capability to enter a Title for the new route to allow the user to identify the route on the mobile wayfinding app.

3.7.1.3.2.1.3 New Route Image

The system shall provide the capability to select an Image for the new route to allow the user to identify the route on the mobile wayfinding app.

3.7.1.3.2.1.4 New Route Audio

The system shall provide the capability to record a descriptive Audio for the new route to provide the user instructions as to what to do after the route is selected.

3.7.1.3.2.1.5 New Route Audio Playback

The system shall provide the capability to playback the route audio for the route to allow the route creator to hear the specific audio that was recorded.

3.7.1.3.2.1.6 New Route Audio Deletion

The system shall provide the capability to delete the route audio for the route.

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3.7.1.3.2.1.7 New Route Description

The system shall provide the capability to enter a Description for the new route to provide more detailed information about the route and its destination.

3.7.1.3.2.1.8 Mapping Interface

3.7.1.3.2.1.8.1 Direct Entry of Route Starting Geo-Location Coordinates

The system shall provide the capability to enter the starting location geo-location coordinates (latitude and longitude) directly for the new route.

3.7.1.3.2.1.8.2 Selection of Route Starting Geo-Location Coordinates Using Mapping Interface

The system shall have the capability to utilize a mapping technology within the SMART Route Builder web-based application to support route creation. This will be used to choose waypoints for the route and save the GPS coordinates of the selected waypoints in the format required by the SMART Wayfinding Specification. This will enable routes created with the web-based SMART Route Builder web-based application to be used on any SMART compliant wayfinding application, including at a minimum, AbleLink's WayFinder app.

3.7.1.3.2.1.8.3 Depiction of Route Using Mapping Interface

The mapping interface shall also provide the capability to depict a route created with SMART Route Builder web-based application directly on a map display within the SMART Route Builder web-based application.

3.7.1.3.2.1.9 Save New Route File using SMART Wayfinding Specification

The system shall provide the capability to save all route information in a smart.json file in the format specified by the SMART Wayfinding specification. All route information is identified within the smart.json file, organized by the tags defined in the SMART standard.

3.7.1.3.2.1.9.1 New Route Author Information

The system shall provide the capability to optionally enter author information to identify the source of the new route.

3.7.1.3.2.1.9.2 Location Information

The system shall provide the capability to create one or more locations for a route. A typical route may include five to fifteen locations but may be created with any number of locations. The following route information shall be capable of being stored for each location.

3.7.1.3.2.1.9.2.1 Location Description

The system shall provide the capability to store a location description as a text string that is displayed to the end user along with the location image and audio.

3.7.1.3.2.1.9.2.2 Location Image

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The system shall provide the capability to store a picture that is displayed when the user enters the range for the specific GPS location.

3.7.1.3.2.1.9.2.3 GPS Geo-Location Coordinates

The system shall provide the capability to store specific GPS coordinates identifying the center point of the geo-location for the waypoint.

3.7.1.3.2.1.9.2.4 Location Sequence

The system shall provide the capability to either store a sequence value which contains the sequential order of the location relative to other locations in the route or save locations to the SMART JSON file in the appropriate sequence.

3.7.1.3.2.1.9.2.5 Location Capture Time Stamp

The system shall provide the capability to store the time that the waypoint's geo-location coordinates were captured.

3.7.1.3.2.1.9.2.6 Location Audio

3.7.1.3.2.1.9.2.6.1 Interfacing with Computer Microphone

The system shall provide the capability to interface with the computer microphone to record and save an audio file which provides information and/or instructions for the end user related to reaching the specific geo-location.

3.7.1.3.2.1.9.2.6.2 Interfacing with Local Storage to Select Audio File

The system shall provide the capability to interface with the local storage on the computer to select a pre-recorded audio file containing information and/or instructions for the end user related to reaching the specific geo-location.

3.7.1.3.2.1.9.2.7 Not Your Stop Location

The system shall provide the capability to store a setting which indicates whether the specific waypoint is a "not your stop waypoint" which will only activate when two conditions are met: 1) user enters the waypoint location and 2) the user's vehicle is traveling equal to or slower than the designated speed threshold.

3.7.1.3.2.1.9.2.8 Repeat Audio

The system shall provide the capability to store a setting for when the user needs to have the audio message repeated for the location to aid in comprehending the audio message.

3.7.1.3.2.1.10 Off-Route Support

The system shall include off-route support features to notify the traveler when and if the traveler is "off-route" for a minimum of 30 seconds. The SMART Route Builder application shall have the capability to define the instructions (*3.7.1.3.2.1.10.1*) needed to help an individual get back on route as well as identify the notification parameters (*3.7.1.3.2.1.10.2 and 3.7.1.3.2.10.3*).

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3.7.1.3.2.1.10.1 Return to Route Instructions

The system shall provide instructions to the user for returning to the route when this option is turned on.

3.7.1.3.2.1.10.2 Off-Route Email Notifications

The system shall have the capability to optionally send off-route email notifications to a caregiver or family member when the individual is off-route.

3.7.1.3.2.1.10.3 Off-Route Text Notifications

The system shall have the capability to optionally send off-route text notifications to a caregiver or family member when the individual is off-route.

3.7.1.3.2.1.10.4 Back On-Route Email Notifications

The system shall have the capability to optionally send email notifications to a caregiver or family member when the individual that has been off route returns to the route.

3.7.1.3.2.1.10.5 Back On-Route Text Notifications

The system shall have the capability to optionally send text notifications to a caregiver or family member when the individual that has been off route returns to the route.

3.7.1.3.2.2 Route Editing

Routes shall be able to be edited by selecting the route and then invoking an Edit feature. The most common reasons for editing routes may be to re-record audio instructions to add detail or eliminate environmental noise, or to replace digital pictures associated with each location.

3.7.1.3.2.2.1 Editing Existing Routes

The system shall provide the capability to modify existing routes and modify all information associated with the route, with the exception of the date the route was created.

3.7.1.3.2.2.2 Canceling Changes to Edited Route

The system shall provide the capability to cancel changes to a route prior to saving the edited route if the user wishes to abort the edit activity.

3.7.1.3.2.3 Route Deletion

3.7.1.3.2.3.1 Deleting Existing Routes

The system shall provide the capability to delete routes.

3.7.1.3.2.3.2 Confirmation of Route Deletion

The system shall provide a confirmation dialog that the user must acknowledge prior to the route being deleted.

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3.7.1.3.2.3.3 Restoring Deleted Routes

The system shall provide the capability to restore a deleted route if restoration of the activity is attempted prior to the cache of deleted routes being emptied by the user as a maintenance activity (similar to emptying the Recycle Bin in Windows).

3.7.1.3.2.4 Route Copying

3.7.1.3.2.4.1 Copying Existing Routes

The system shall provide the capability to make a copy of an existing route to create a new route with a unique route ID.

3.7.1.3.2.4.2 Creating New Route ID for the Copied Route

The system shall provide the capability to create a unique route ID for the copied route to distinguish it from the original route.

3.7.1.3.2.4.3 Creating New Route Title for the Copied Route

The system shall provide the capability to enter a new title for the copied route to allow the new route to be identified to the user with a different name.

3.7.1.3.2.5 Auto-save Feature

The system shall include a periodic auto-save feature during route creation and editing so loss of data is minimized if a power loss or connectivity loss occurs.

3.7.1.3.2.6 Previewing Routes

3.7.1.3.2.6.1 Preview Route Feature

The system shall have the capability to preview a route and simulate how it will appear to the end user when using the route on a mobile device to be able to see the behavior of route waypoints without having to take the route or copy the route to the mobile device.

3.7.1.3.2.6.2 Editing Route Information During Route Preview

The system shall provide the capability to enter edit mode to modify route elements while in preview mode.

3.7.1.3.3 Component 3: Interface with Online SMART Route Library

The SMART Route Builder web-based application shall have the capability to interface with the SMART Route Library from within the application.

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3.7.1.3.3.1 Default Route Library

The system shall provide the capability to store a default library in settings to allow the user to connect to the route library of routes that is most commonly used by the user.

3.7.1.3.3.2 View Alternate Route Library

The system shall provide the capability to view a list of available alternate travel libraries.

3.7.1.3.3.3 Select Alternate Route Library

The system shall provide the capability to select a library from the displayed list of available alternate travel libraries.

3.7.1.3.3.4 Transfer Route from Route Library

The system shall provide the capability to interface with the online route library to allow a route to be transferred to the SMART Route Builder web-based application to be used as is or modified as necessary to meet the needs of the traveler.

3.7.1.3.3.5 Contribute Route to Route Library

The system shall provide the capability to contribute either a newly created route or a route that has been modified to the online library.

3.7.1.3.3.5.1 Optional Author Identification

The system shall have the capability to optionally include the identification of the creator of the route and his or her organization (if any).

3.7.1.3.3.5.2 Date Created Information

The system shall have the capability to store the date created with the route information.

3.7.1.3.3.5.3 Date Modified Information

The system shall have the capability to store the date modified (if any) with the route information.

3.7.1.3.4 Component 4: System Settings

The following system settings shall be supported within the SMART Route Builder web-based application.

3.7.1.3.4.1 Default Author Name

The system shall provide the capability to store a default author name to automatically save with the smart.json file to identify author source information.

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3.7.1.3.4.2 Default Author Organization

The system shall provide the capability to store a default author organization to automatically save with the smart.json file to identify author source information.

3.7.1.3.4.3 Default Author Email

The system shall provide the capability to store a default author email to automatically save with the smart.json file to identify author source information.

3.7.1.3.4.4 Default Public SMART Route Library

The system shall provide the capability to store a default public SMART Route Library for the SMART Route Builder web-based application based on the geographic location or agency affiliation of the user.

3.7.2 SMART Route Library: Subsystem Requirements

3.7.2.1 Definition

The SMART Route Library is a cloud-based service that houses SMART (Specialized Media for Assisting Route Travel) travel routes for traveling to specific destinations. These travel routes are created with a SMART-compliant mobile application (e.g., WayFinder) or with a web-based route creation utility (e.g. SMART Route Builder) and can be contributed to the SMART Route Library to be shared with other individuals. After a route has been created, the user is given an option to contribute the route to the SMART Route Library. This is optional and can be done any time. Once the route is transferred, the SMART Route Library server application opens the route folder, conditions all of the media contained in the route, and reassembles it. The reason for this step is to ensure media playback compliance across multiple platforms due to the difference of supported file formats from one mobile operating system to the next. Once the route is reassembled it is categorized based on location and made available for download. Another user can then browse the SMART Route Library from a SMART-compliant app on his or her smartphone or tablet and search for available routes specific to the user's current location or for desired destinations. Users will simply download the routes they want and use them when needed. As described in the project proposal and contract, the SMART Route Library and all enhancements developed in this project to enable the SMART Route Library to operate with the SMART Wayfinding Specification remain the intellectual property of AbleLink Smart Living Technologies.

SMART Route Libraries will have the capability of being a *public* repository of routes containing SMART routes with no personally identifying information or a *private* SMART Route Library for agencies creating personalized routes for specific individuals. For example, a public SMART Route Library may be implemented for a city which contains SMART Routes based on the city transit agency's bus or light rail system. Users of SMART Route Builder or a SMART Ready mobile app will be able to download routes from the public SMART Route library but will *not* have the capability of uploading custom routes created for specific individuals to prevent the possibility of personally identifying information from being contributed to a public SMART Route Library. A human service agency, such as an agency serving individuals with intellectual and developmental disabilities, may choose to implement a private SMART Route Library to manage routes that agency staff create for specific individuals. Such agencies will be required to abide by federal regulations for ensuring the safety of personally identifying information while

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using the SMART Wayfinding system technologies. Safeguards have already been built into the SMART Route Builder and SMART Route Libraries interfaces (as well as the WayFinder app) to prevent the possibility of custom routes which may contain personally identifying information from being uploaded to a public SMART Route Library.

3.7.2.2 Interfaces

The following subsections define the interfaces and files used by the SMART Route Library web-based application.

3.7.2.2.1 User Interfaces

The system shall provide the capability to manage the content and organization of the SMART Route Library through a password protected web-based interface to the application which allows individuals with administrator privileges to log into their respective SMART Route Library to make desired changes.

3.7.2.2.1.1 User Input

The SMART Route Library web-based application shall support the input of user commands through the SMART Route Library GUI, using a standard keyboard and mouse pointing device.

3.7.2.2.1.2 User Output

The SMART Route Library web-based application shall support user commands, through the SMART Route Library GUI, to direct the creation and management of SMART-compliant route categories for use with a mobile wayfinding App. User output includes SMART compliant routes for specific destinations that are selected for download.

3.7.2.2.2 Interface with SMART Route Builder

The system shall provide the capability to interface with the web-based SMART Route Builder application as needed to allow the SMART Route Builder application to view the categories and routes available within the selected SMART Route Library, and to allow the SMART Route Builder application to contribute and transfer routes from the online library.

3.7.2.2.3 SMART Route Library Interface to Web-Based and Mobile Applications

The system shall provide access to SMART routes contained in the SMART Route Library from within a SMART-compliant web-based or mobile application. Interfacing provides the functionality to meet the following user needs: 1) choosing an online route library to connect to, 2) searching the library of available routes, 3) selecting routes to download, and 4) contributing new routes created with the SMART Route Builder application to the online SMART Route Library to a specific category.

3.7.2.2.3.1 Delivering Routes from the SMART Route Library to a SMART-compliant Application

The system shall provide the capability to deliver a geographically categorized listing of routes for travelling to a desired destination based on a query provided by a SMART-compliant web-based or mobile application. Selected routes can then be downloaded to the SMART-compliant web-based or mobile application to be used as is or modified as necessary to meet the needs of the traveler.

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3.7.2.2.3.2 Filtering Routes Based on User's Current Geo-Location

The system shall provide the capability to filter routes based on the user's current GPS location to provide context-relevant routes when accessing routes available in the SMART Route Library from a SMART-compliant mobile app.

3.7.2.2.3.3 Receiving Routes from a SMART-compliant Application by the SMART Route Library

The system shall provide the capability within the SMART Route Library web-application to receive contributed routes from a SMART-compliant web-based or mobile application.

3.7.2.2.3.4 SMART Conformance Testing

The system shall test the newly contributed route for conformance with the SMART Wayfinding Specification prior to accepting the route and integrating the route into the library.

3.7.2.3 SMART Route Library Requirements

Routes to destinations within a designated geographic area shall be available to a SMART-compliant web-based or mobile application for review and/or download.

3.7.2.3.1 Component 1: Brower Interaction, Application Updates, and Data Integrity

3.7.2.3.1.1 Installation Requirements

There are no installation requirements for the SMART Route Library as it will not need to be installed to a local computer.

3.7.2.3.1.2 Web Browser Requirements

3.7.2.3.1.2.1 Internet Explorer Support

The SMART Route Library shall operate on all commonly used mainstream browsers for desktop computers including Internet Explorer.

3.7.2.3.1.2.2 Microsoft Edge Support

The SMART Route Library shall operate on all commonly used mainstream browsers for desktop computers including Microsoft Edge.

3.7.2.3.1.2.3 Google Chrome Support

The SMART Route Library shall operate on all commonly used mainstream browsers for desktop computers including Google Chrome.

3.7.2.3.1.2.4 Mozilla Firefox Support

The SMART Route Library shall operate on all commonly used mainstream browsers for desktop computers including Mozilla Firefox.

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3.7.2.3.1.2.5 Apple Mobile Device Browser Support

The SMART Route Library shall operate on Apple's mobile device browser (e.g., currently Safari).

3.7.2.3.1.2.6 Android Mobile Device Browser Support

The SMART Route Library shall operate on Android's mobile device browser (e.g., currently Chrome).

3.7.2.3.1.3 Offline Operation Not Required

The SMART Route Library is a web-based application that provides access in real-time to available routes for a geographic area. Connectivity to the internet is required for the SMART Route Library transfer data to the target web-based or mobile device and thus offline operation is not required.

3.7.2.3.1.4 Application Update Requirements

Updates to the SMART Route Library web-application will be performed directly on the server containing the application by system administrators. Therefore, no updates to the SMART Route Library application will be required by users accessing the system via a web-browser.

3.7.2.3.1.4.1 Data Integrity with Application Updates

Updates to the SMART Route Library web-application shall maintain data compatibility with the current version of the SMART Wayfinding Specification.

3.7.2.3.1.4.2 Data Conversion

As new versions of SMART Wayfinding Specification are published, the SMART Route Library shall convert routes in older formats to the most current format of the SMART standard.

3.7.2.3.2 Component 2: SMART Route Library Administrator Functions

Users shall be provided the capability to manage the content of the SMART Route Library by logging into the site to perform administrator functions.

3.7.2.3.2.1 Login Requirements

The system shall provide the capability for an administrator to log into a specific SMART Route Library using a username and password.

3.7.2.3.2.2 Password Modification Requirements

The system shall provide the capability for an administrator to change his or her password after logging into the SMART Route Library.

3.7.2.3.2.3 Temporary Password Retrieval

The system shall provide the capability for an administrator to request a one-time use temporary password be sent to him or her in a secure fashion to log into the site if the password not known.

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3.7.2.3.2.4 New Administrator Account Creation

The system shall provide the capability for an administrator to create new accounts for additional users of the SMART Route Library with unique usernames and passwords.

3.7.2.3.2.5 Assignment of Administrator Privileges

The system shall provide the capability for an administrator to set/modify the level of access for additional administrator accounts by identifying which system functions are available to the newly created admin user (e.g. deletion of routes, changing organizational structure of library, etc.).

3.7.2.3.2.6 Explicit Logout

The system shall provide the capability for an administrator to specifically log out of the system.

3.7.2.3.2.7 Inactivity Logout

The system shall provide the capability to automatically log an administrator out of the system after 30 minutes of inactivity.

3.7.2.3.2.8 Incorrect Password Lockout

The system shall provide the capability to automatically lockout the user if an incorrect password has been entered on three consecutive attempts. The user will then need to invoke the temporary password retrieval feature (*3.7.2.3.2.3) to regain access to the system.*

3.7.2.3.3 Component 3: Route Management Functions

3.7.2.3.3.1 Accepting Routes Uploaded from SMART Compliant Apps

The system shall provide the capability to receive a zipped route file containing a SMART-compliant route from SMART-compliant applications into a selected category within a specific SMART Route Library. Uploading a route involves transfer of identifying information and all files associated with the route, including the *smart.json* file for the route and all media files (audios, pictures, and videos) that are part of the route.

3.7.2.3.3.2 Selecting Category for Route

The system shall provide the capability to select a category to place the route in to support organization of the routes within the SMART Route Library.

3.7.2.3.3.3 Upload Date of New Routes

The system shall provide the capability to automatically record the date a route is uploaded.

3.7.2.3.3.4 Renaming Routes

The system shall provide the capability to rename a route in the SMART Route Library to keep the route up to date with relevant transit information (e.g. bus number or route title changes).

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3.7.2.3.3.5 Changing Route Image

The system shall provide the capability to change the image associated with the route when it is displayed within the SMART Route Library.

3.7.2.3.3.6 Route Audio Playback

The system shall provide the capability to play the audio file (if one exists) that is associated with the route to hear the description of the route.

3.7.2.3.3.7 Viewing Routes Online

The system shall provide the capability to allow users to view the path of travel of the route via a mapping interface.

3.7.2.3.3.8 Reorganizing Routes

The system shall provide the capability to move routes from one category to another category within the SMART Route Library.

3.7.2.3.3.9 Route Modification Disallowed

The system shall provide the capability to disable the route modification features for users without Admin privileges.

3.7.2.3.4 Component 4: Library Organizational Management Functions

The SMART Route Library shall be developed so that the organizational structure of the content for a specific library applies to the geographic area of a particular transit organization or other travel support agency.

3.7.2.3.4.1 Category Management

3.7.2.3.4.1.1 Creation of New Categories

The system shall provide the capability to create new categories within the SMART Route Library to support organization of routes.

3.7.2.3.4.1.1.1 Category Name

The system shall provide the capability to enter a name of the new category which will be displayed to users when routes are perused from a SMART-compliant web-based or mobile application or to administrators when perusing the online SMART Route Library from a web browser.

3.7.2.3.4.1.1.2 Category Description

The system shall provide the capability to enter a description (such as a geographic region) of the new category which will be displayed to users when routes are perused from a SMART-compliant web-based or mobile application or to administrators when perusing the online SMART Route Library from a web browser.

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3.7.2.3.4.1.1.3 Category Image

The system shall provide the capability to add an image to a category to aid in comprehension of the category name or the geographic area represented by the category.

3.7.2.3.4.1.2 Geographic View of Category

The system shall provide the capability to display the geographic area covered by the category using a mapping interface.

3.7.2.3.4.1.3 Nesting of Categories

The system shall provide the capability to nest categories within other existing categories as needed to support organization of routes.

3.7.2.3.4.1.4 Editing of Categories

The system shall provide the capability to edit existing categories within the SMART Route Library.

3.7.2.3.4.1.4.1 Editing Category Name

The system shall provide the capability to edit the name of an existing category.

3.7.2.3.4.1.4.2 Editing Category Description

The system shall provide the capability to edit the description of an existing category.

3.7.2.3.4.1.4.3 Editing Category Image

The system shall provide the capability to change the image for an existing category.

3.7.2.3.4.1.4.4 Editing Geographic View of Category

The system shall provide the capability to modify the geographic area covered by an existing category using a mapping interface.

3.7.2.3.4.1.5 Deletion of Categories

3.7.2.3.4.1.5.1 Deleting Existing Categories

The system shall provide the capability to Delete existing categories that do not contain sub-categories or routes.

3.7.2.3.4.1.5.2 Confirmation of Category Deletion

The system shall provide a confirmation dialog that the user must acknowledge prior to the category being deleted.

3.7.2.3.4.1.6 Moving Categories

The system shall provide the capability to move a category (and its contents) from one category to another within the library.

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3.7.3 WayFinder Mobile App: Subsystem Requirements

3.7.3.1 Definition

WayFinder is AbleLink's proprietary specialized mobile application which operates on off-the-shelf mobile devices and uses GPS and specialized visual, audio, and vibration prompts to allow individuals with cognitive disabilities to be able to use fixed route transportation independently. With WayFinder, multiple travel itineraries, or routes, can be programmed into a single device to enhance travel choices and independent transportation. As indicated previously, currently DSPs, family members, transportation trainers or other caregivers ride the route (either on the bus or in a personal vehicle) and use the system's Route Builder utility to set waypoints, record instructions for those waypoints and optionally take pictures to provide visual cues along the way. Once a route is created with the device, a traveler with cognitive abilities can then select the route and follow the multimedia step-by-step GPS-based prompts to arrive at his or her destination. This section defines the requirements for the revised WayFinder system that will operate with the new SMART Wayfinding Specification developed in this project. As described in the project proposal and contract, WayFinder and all enhancements developed in this project to enable WayFinder to operate with the SMART Wayfinding Specification remain the intellectual property of AbleLink Smart Living Technologies. Thus, Section 3.7.3 and all sub-sections of this requirements document are to be considered proprietary information and not for public disclosure.

3.7.3.2 Interfaces

The following subsections define the interfaces and files used by the WayFinder mobile application.

3.7.3.2.1 User Interfaces

3.7.3.2.1.1 User Input

3.7.3.2.1.1.1 Touch Input Operation

The user interface of the WayFinder system shall operate via the standard touch user interface available on the mobile device.

3.7.3.2.1.1.2 Voice Input Operation

The user interface of the WayFinder system shall operate via voice input if available on the mobile device.

3.7.3.2.1.2 User Output

3.7.3.2.1.2.1 Text-based Output

The system shall provide text information to convey necessary information to users to complete routes.

3.7.3.2.1.2.2 Graphical Output

The system shall provide visual graphics to convey necessary information to users to complete routes.

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3.7.3.2.1.2.3 Audible Output

The system shall provide audio instructions to convey necessary information to users to complete routes.

3.7.3.2.2 Administrator Interfaces

An administrator mode shall be made available within the WayFinder system to allow travel trainers, family members or other travel support individuals to perform all administrative functions.

3.7.3.2.3 Interface with SMART Route Library

The system shall provide the capability to access route information contained in the SMART Route Library from within WayFinder.

3.7.3.2.3.1 Auto-loading Default SMART Route Library

The WayFinder system shall provide the capability to store a default SMART Route Library for the system to connect to when desired by the user.

3.7.3.2.3.2 Changing Default SMART Route Library

The WayFinder system shall provide the capability to change the default SMART Route Library for the system and store this information for future use.

3.7.3.2.3.3 Search Library of Available Routes

The WayFinder system shall provide the capability to search the library of available routes in the default SMART Route Library that is setup for the device by navigating the categories available in the library.

3.7.3.2.3.4 Search Library of Available Routes Based on Current Location

The option shall be provided to search the library of available routes based on the user's current starting location.

3.7.3.2.3.5 Downloading Routes

The user shall have the capability to select and download a desired route for use with the WayFinder system from the library of available routes.

3.7.3.2.3.6 Uploading Routes

While in admin mode users shall have the capability to select a desired category available in the default SMART Route Library and upload the selected route to that category.

3.7.3.3 WayFinder Mobile App Requirements

This section describes the requirements for the WayFinder app which will be modified to support the SMART Wayfinding Specification developed in this project. This includes all existing system requirements as well as newly identified requirements based on user input and other project activities.

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3.7.3.3.1 Component 1: App Installation, Startup and Updates

3.7.3.3.1.1 Apple Device Installation

The WayFinder app shall be available as a downloadable app directly from the Apple App store.

3.7.3.3.1.2 Android Device Installation

3.7.3.3.1.2.1 Android Device Installation from Google Play Store

The WayFinder app shall be available as a downloadable app directly from the Google Play store.

3.7.3.3.1.2.2 Android Device Installation via .apk File

Android versions of WayFinder shall be able to be installed directly to the device using an .apk file containing the WayFinder application.   This feature will allow for installation of the WayFinder system by copying the .apk file directly to the device and thus not require connection to an online App store.

3.7.3.3.1.3 Application Update Requirements

3.7.3.3.1.3.1 iOS Version Updates

iOS version updates to the WayFinder app shall be made available through the Apple App store.

3.7.3.3.1.3.2 Android Version Updates

3.7.3.3.1.3.2.1 Android Version Updates via Google Play Store

Android version updates to the WayFinder app shall be made available through the Google Play store.

3.7.3.3.1.3.2.2 Android Version Updates via .apk File

Android version updates to the WayFinder app shall be made available through .apk files which can be delivered to users electronically.

3.7.3.3.1.3.3 Data Integrity with Application Updates

Updates to the WayFinder App shall maintain data compatibility with the most recent version of the SMART Wayfinding Specification.

3.7.3.3.1.3.4 Data Integrity Previous Route Versions

Updates to the WayFinder app shall maintain data compatibility with routes created according to previous versions of the SMART Wayfinding Specification.

3.7.3.3.1.3.5 System Startup

3.7.3.3.1.3.5.1 Direct Startup

WayFinder shall be able to be launched from the standard icon on the device.

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3.7.3.3.1.3.5.2 Time-based Startup

WayFinder shall be capable of being launched to a specific route based on a scheduled event added to the scheduling component of the Smart Travel Concierge System. This feature is designed to enable the appropriate WayFinder route to be initiated automatically based on the user's personal schedule and current location.

3.7.3.3.1.4 Daisy Chaining Routes

The system shall provide the capability to "daisy-chain" routes so that at the end of a route, the next relevant route is presented to the user. This can support routes which require transfers from one bus to another.

3.7.3.3.1.4 Launching Instructional Task within Smart Travel Concierge System

The system shall provide the capability to launch a task within the Smart Travel Concierge System which can contain further travel instructions for completing a journey within a building or structure that do not enable geo-location information to be used to guide the traveler. For example, a task may contain multimedia instructions for taking the elevator in the building to a specific floor and then for finding a specific doctor's office on the floor.

3.7.3.3.2 Component 2: Route Traversal and End User Operation

The main menu will display available routes when the user launches WayFinder. Multiple modalities will be used to convey the identity of the route to the end user. These modalities will be able to include at a minimum, an image, text name, and an audio description when the user first selects the route. If more routes are available than can be displayed, a method will be provided to the user to allow access to the additional routes that cannot be displayed, such as via a swipe action.

3.7.3.3.2.1 System Controls

Controls shall be provided on the main menu display to access all needed system components, including travel routes to specific destinations, the Route Editor and System Settings.

3.7.3.3.2.1.1 User Interface

3.7.3.3.2.1.1.1 Graphical Representation of User Controls

User controls shall be presented with a graphical icon.

3.7.3.3.2.1.1.2 Size of Graphical Controls

Graphical controls shall be sufficiently large to allow easy operation by a finger touch

3.7.3.3.2.1.1.3 Audible Feedback

Audible feedback shall be provided when a user control icon is selected.

3.7.3.3.2.1.2 Main Menu Interface Controls

3.7.3.3.2.1.2.1 GPS Indicators

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3.7.3.3.2.1.2.1.1 GPS Connectivity

The system shall have the capability to display a GPS signal present indicator to indicate when there is GPS connectivity and when there is no GPS connectivity.

3.7.3.3.2.1.2.1.2 GPS Signal Strength

The system shall have the capability to display a GPS signal strength indicator to communicate to the user the strength level of the GPS signal.

3.7.3.3.2.1.2.2 Route Selection

The system shall provide the capability for users to select a desired travel route.

3.7.3.3.2.1.2.2.1 Multi-modal Route Identification Features

The system shall provide features to identify routes using a combination of images, text and audio to facilitate route selection by individuals with cognitive disabilities.

3.7.3.3.2.1.2.2.2 Method to Access Full Listing of Available Routes

The system shall provide features to allow the user to access the full listing of available routes when the screen size does not allow all available routes to be visible on the screen.

3.7.3.3.2.1.2.2.3 Visual Indicator When Additional Routes are Available

The system shall provide a visible indication to the user when additional routes are available but not currently visible due to display size limitations.

3.7.3.3.2.1.2.3 Local Routes Feature

The system shall provide the capability to dynamically modify the list of available routes based on the user's current geo-location.

3.7.3.3.2.1.2.4 Route Creation/Editor Button

The system shall provide the capability to display a button to enter an Admin Mode to create or edit routes and system settings.

3.7.3.3.2.1.2.4.1 Preventing Accidental Activation of Admin Mode

The system shall include one or more features to prevent accidental activation of the Admin Mode.

3.7.3.3.2.1.2.5 Settings Button

The system shall provide the capability to display a button to enter the settings module to allow changes to system settings.

3.7.3.3.2.1.2.5.1 Preventing Accidental Entry to System Settings

The system shall include one or more features to prevent accidental entry to the Settings Module by end users to prevent end users from changing system settings when it would be inappropriate for them to do so.

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3.7.3.3.3 Component 3: System Settings

When the system settings option is selected, the system shall display a screen where the user/caregiver can select or modify the system settings.

3.7.3.3.3.1 GPS Settings

GPS range and speed settings shall be grouped together and separated from other settings on the System Settings display. These settings will affect the operation of the system with respect to GPS detection of locations and other related system behavior.

3.7.3.3.3.1.1 In Range Distance Setting

A setting shall be provided to set the radius of the circle (in feet) that WayFinder must be in before it will geo-location based instructions. For example, if the In Range Distance is set at 20 feet, WayFinder will launch audio and picture-based information when it is within a circle with a 20 foot radius (or 40 foot diameter) of the designated waypoint. Therefore, the smaller the In Range Distance, the more the user must be precisely within the geo-location circle to activate the instructions for that waypoint.

For further explanation of the relationship of the In Range and Out of Range settings (see 3.7.3.3.1.2), as a waypoint is approached along the route, the In Range distance value (ex 50 feet) will be used to detect when the individual has "arrived" at the waypoint. At that time, the image is displayed, the device vibrates, and the audio message begins playing. If the audio message is set it repeat, it will continue to repeat the instruction until the user acknowledges the waypoint by clicking an OK button on the screen. If they do NOT click the OK button and continue traveling the route, the Out of Range distance is used then to tell the system when to hide the image and stop playing the instructional audio. So if it is set to 25 feet, then 25 feet after the traveler has passed the waypoint location, the system will make the image go away and stop the audio. Important note: The audio message will always play through completely at least once, *even if the Out of Range distance parameter has been met.*

3.7.3.3.3.1.1.1 Modification of In Range Distance

The In Range Distance shall be able to be modified in increments (not less than 10 feet) to increase or decrease the range.

3.7.3.3.3.1.1.2 Protection Against Exceeding Available Values

The system shall provide the capability to prevent the In Range Distance setting from exceeding available values and stay within the range of acceptable values.

3.7.3.3.3.1.2 Out of Range Distance Setting

The system shall provide a setting to determine when the user is out of range of the selected geo-location to automatically stop playing the waypoint message and corresponding image when the unit moves out of the Out of Range Distance.

3.7.3.3.3.1.2.1 Modification of Out of Range Distance

The Out of Range Distance shall be able to be modified in increments (not less than 5 feet) to increase or decrease the range.

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3.7.3.3.3.1.2.2 Protection Against Exceeding Available Values

The system shall provide the capability to prevent the Out of Range Distance setting from exceeding available values and stay within the range of acceptable values.

3.7.3.3.3.1.2.3 Auto-return to In Route Travel Display

The system shall provide the capability to automatically return the user to the standard travel display when the Out of Range Distance is exceeded without the user acknowledging the location message.

3.7.3.3.3.1.3 Local Route Distance Setting

The system shall provide the capability to set the distance when local routes will be displayed on the main menu.

3.7.3.3.3.1.3.1 Show In Range Routes

The system shall list all routes that are within range of the user's current location (i.e. those that are within the Local Route Distance setting**)**.

3.7.3.3.3.1.3.2 Hide out of Range Routes

The system shall hide all routes that are not within range of the user's current location (i.e. those are further away from the user, as determined by the Local Route Distance setting).

3.7.3.3.3.1.4 Not-Your-Stop Threshold Setting

The system shall provide the capability to set the speed threshold for the Not-Your-Stop waypoints to indicate the speed below which these instructions are presented to the user.

3.7.3.3.3.1.4.1 Invoking a Not-Your-Stop Waypoint

The system shall invoke (i.e., show relevant prompts for the geo-location) the Not-Your-Stop waypoint when the user's vehicle is 1) within the specified geo-location and 2) is traveling equal to or slower than the Not Your Stop speed threshold.

3.7.3.3.3.1.4.2 Ignoring a Not-Your-Stop Waypoint

The system shall ignore (i.e., not show relevant prompts for the geo-location) the Not-Your-Stop waypoint when the user's vehicle is 1) within the specified geo-location and 2) is traveling faster than the Not Your Stop speed threshold.

3.7.3.3.3.2 Operational Settings

3.7.3.3.3.2.1 Notifications

3.7.3.3.3.2.1.1 Notification Recipient Address

The system shall provide the capability to enter an email address for notifications.

3.7.3.3.3.2.1.2 Name

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The system shall enable a Name to be entered to help identify the traveler within the notification message.

3.7.3.3.3.2.1.3 Standard Route Event Notifications

The system shall provide the capability to turn on or off Standard Route Event Notifications which when turned on will send a notification to the address in 3.7.3.3.3.2.1.1 when 1) the Start button is tapped after selecting a WayFinder route from the main menu, 2) if and when a route that has been started is aborted by the end user, and 3) when a route has been completed as indicated by the user tapping the Done button at the end of a route.

3.7.3.3.3.2.1.3.1 Starting Route *Notification*

The system shall provide the capability to send a notification to the address in 3.7.3.3.3.2.1.1 when the user starts a route.

3.7.3.3.3.2.1.3.2 *Route Completion Notification*

The system shall provide the capability to send a notification to the address in 3.7.3.3.3.2.1.1 when the user completes a route.

3.7.3.3.3.2.1.3.3 Notification of Aborted Route

The system shall provide the capability to send a notification to the address in 3.7.3.3.3.2.1.1 when the user aborts a route.

3.7.3.3.3.2.1.3.4 Standard Route Event Notification Content

The system shall provide the capability to include the time, date and nature of the notification, username, the device it was sent from, and a hypertext map link that, when opened, shows the location of the WayFinder device at the time the notification was sent.

3.7.3.3.3.2.2 Vibrate Device

The system shall provide the capability to optionally cause the WayFinder device to vibrate when the user reaches waypoints during route playback (along with playing the audio instructions and displaying a picture if one was provided during route setup). This feature will only be available, on devices that have a vibration motor, to provide tactile feedback to users who may be easily distracted or when in a loud environment and ear buds are not being used.

3.7.3.3.3.2.3 Local Routes

The system shall provide the capability to turn on or off the Local Routes feature. When this option is checked (i.e., turned on), WayFinder will only display routes on the Main Menu that are in the proximity of the user's current GPS location. In other words, it will not display routes which cannot be started from the user's current location. For example, when this feature is on and a user leaves home for work, only the route to work shall be displayed on the main menu (along with other routes that start from the same bus stop); conversely when work is over, only the route back to home will be displayed from the work location.

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3.7.3.3.3.2.4 Walking Route

The system shall provide the capability to turn on or off the Walking Route setting. When this setting is checked (i.e., turned on), WayFinder will reduce the frequency at which the system polls the GPS location of the system for the purpose of conserving battery due to the slower speed of pedestrian travel.

3.7.3.3.3.2.5 Show/Hide Route Exit Button

The system shall provide the capability to hide the display of the Route Exit button. When this feature is turned on the Route Exit button will be displayed to allow routes to be exited before reaching the destination location. Display of the Route Exit button is useful for 1) testing a set of route instructions while the route is being created, or 2) for more experienced users who may be able to abort WayFinder instructions and finish route navigation without assistance. The capability to turn off display of the Route Exit button is provided to prevent less experienced travelers from inadvertently exiting the route instructions before the route has been completed.

3.7.3.3.3.2.6 Show/Hide Waypoint Preview

The system shall provide the capability to show upcoming pictures for the next waypoint on screen. This feature is provided to enable a preview of the next waypoint location to the user. This feature is for users that can benefit from preparing for the next waypoint in advance while traveling.

3.7.3.3.3.2.7 Auto-Record Audio

The system shall provide the capability to turn on or off the feature to have the audio recorder started automatically when creating new route locations to facilitate ease of route creation. This feature is provided to ease the route creation process by eliminating one step in the route creation process by not requiring the individual creating the route to press a button to start the recording.

3.7.3.3.3.2.8 Text Resizing

The system shall provide the capability to adjust the size of text displayed on the screen for waypoint descriptions.

3.7.3.3.3.2.9 Contact Me Button

The system shall provide the capability to optionally display a "Contact Me" button which will be able to be used by the end user while traveling routes to send a pre-formatted message to request a contact from the individual indicated in the notification address. This feature will only be available on devices that have an active data plan in place.

3.7.3.3.3.2.10 OK Button

The system shall provide the capability to optionally display an "I'm OK" button which will be able to be used by the end user while traveling routes to send a pre-formatted email message to the individual identified in the notification email address indicating that the traveler is "OK and doing just fine." This feature will only be available on devices that have an active data plan in place.

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3.7.3.3.3.2.11 Periodic Notifications

The system shall provide the capability to turn on or off a feature to send periodic geo-location notifications to the individual indicated in the notification address.

3.7.3.3.3.2.11.1 Modification of Periodic Notification Frequency

The system shall provide the capability to modify the frequency of periodic notifications in 5-minute intervals up to 60-minute maximum.

3.7.3.3.3.2.11.2 Content of Periodic Notifications

The system shall provide the capability to include the title of the route, the device the route is being used on, the date and time, and GPS location data at the time of the notification presented with a clickable map link to view the current location of the person. This feature will only be available on devices that have an active data connection.

3.7.3.3.3.2.12 Use Corridor Data

The option shall be provided to capture sufficient GPS coordinates as a route is being created to support off-route detection (i.e., when the traveler departs from the "travel corridor" which represents the expected path of travel).

3.7.3.3.3.3 Route Backup

3.7.3.3.3.3.1 Backing up Routes

The system shall provide the option to backup routes to a desktop computer or online storage location.

3.7.3.3.3.3.2 Route Restore

The system shall provide the capability to restore routes that have been backup up to a desktop computer or online storage location.

3.7.3.3.3 Component 4: Route Management

Travel routes to desired destinations will be able to be managed from within the WayFinder system. This will include route creation, editing, deleting, reordering and copying. Routes created with the mobile WayFinder system will be cross-platform and able to be used on any other mobile app that is SMART compliant.

Once an initial route has been created, the capability will be provided to modify the route data, including audio messages, digital photos, and even waypoint locations if desired.

3.7.3.3.3.1 Types of Route Travel

The system will support creation of routes for walking, driving or using public transit (e.g., city buses) as a support for independent travel. Travel routes that are created using the WayFinder route building utility will involve traveling the route and setting waypoints, recording audio instructions, and optionally taking pictures of landmarks, bus stops and other important places along the way.

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3.7.3.3.3.2 Creation of New Routes

The mobile system shall provide the capability to Create new routes that adhere to the SMART Wayfinding Specification.

3.7.3.3.2.2.1 Creation Date of New Routes

The system shall provide the capability to automatically record the date the new route was created.

3.7.3.3.2.2.2 New Route Title

The system shall provide the capability to enter a Title for the new route to allow the user to identify the route on the mobile wayfinding app.

3.7.3.3.2.2.3 New Route Image

The system shall provide the capability to select an Image for the new route to allow the user to identify the route on the mobile wayfinding app.

3.7.3.3.2.2.4 New Route Audio

The system shall provide the capability to record a descriptive Audio for the new route to provide the user instructions as to what to do after the route is selected.

3.7.3.3.2.2.5 New Route Audio Playback

The system shall provide the capability to playback the route audio for the route.

3.7.3.3.2.2.6 New Route Audio Deletion

The system shall provide the capability to delete the route audio for the route.

3.7.3.3.2.2.7 New Route Description

The system shall provide the capability to enter a Description for the new route to provide more detailed information about the route and its destination.

3.7.3.3.2.2.8 Capturing Geo-Location Coordinates

3.7.3.3.2.2.8.1 Direct Capture of Geo-Location Coordinates

The system shall provide the capability to directly invoke a control (e.g., press a button) to capture geo-location coordinates (latitude and longitude) for route waypoints when the waypoint is added during creation of the new route.

3.7.3.3.2.2.8.2 Automatic Capture of Geo-Location Coordinates

The system shall provide the capability to automatically capture geo-location coordinates (latitude and longitude) for route waypoints when the waypoint is added during creation of the new route.

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3.7.3.3.2.2.9 Save New Route File using SMART Wayfinding Specification

The system shall provide the capability to save all route information in a smart.json file in the format specified by the SMART Wayfinding Specification. All route information is identified within the smart.json file, organized by the tags defined in the SMART standard.

3.7.3.3.2.2.9.1 New Route Author Information

The system shall provide the capability to optionally enter author information to identify the source of the new route.

3.7.3.3.2.2.9.2 Waypoint Information

The system shall provide the capability to create one or more locations for a route. A typical route may include five to fifteen locations but may be created with any number of locations. The following route information shall be capable of being stored for each location.

3.7.3.3.2.2.9.2.1 Location Description

The system shall provide the capability to store a location description as a text string that is displayed to the end user along with the location image and audio.

3.7.3.3.2.2.9.2.2 Location Image

The system shall provide the capability to store a picture that is displayed when the user enters the range for the specific geo-location.

3.7.3.3.2.2.9.2.2.1 Default Location Images

The system shall provide default images to associate with waypoints as they are created (e.g., a moving bus, a hand pulling a ring bell cord, etc.).

3.7.3.3.2.2.9.2.2.2 Taking New Photo with Device Camera

The system shall provide the capability to take a new photo and replace the current image with the new photo for a waypoint.

3.7.3.3.2.2.9.2.2.3 Selecting Image from Stored Location on Device

The system shall provide the capability to select an existing photo available on the device and replace the current image with the selected photo for a waypoint.

3.7.3.3.2.2.9.2.3 GPS Geo-Location Coordinates

The system shall provide the capability to store the specific GPS coordinates identifying the GPS center point of the waypoint.

3.7.3.3.2.2.9.2.4 Location Sequence

The system shall provide the capability to either store a sequence value which contains the sequential order of the location relative to other locations in the route or save locations to the SMART JSON file in the appropriate sequence.

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3.7.3.3.2.2.9.2.5 Location Capture Time Stamp

The system shall provide the capability to store the time that the waypoint GPS location coordinates were captured.

3.7.3.3.2.2.9.2.6 Location Audio

The system shall provide the capability to set a Location Audio for the waypoint.

3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone

The system shall provide the capability to interface with the device microphone to record and save an audio file which provides information and/or instructions for the end user related to reaching the specific geo-location.

3.7.3.3.2.2.9.2.6.2 Interfacing with Local Storage to Select Audio File

The system shall provide the capability to interface with the local storage on the device to select a pre-recorded audio file containing information and/or instructions for the end user related to reaching the specific geo-location.

3.7.3.3.2.2.9.2.7 Not Your Stop Location

The system shall provide the capability to store a setting which indicates whether the specific waypoint is a "not your stop waypoint" which will only activate when two conditions are met: 1) user enters the waypoint location and 2) the user's vehicle is traveling equal to or slower than the designated speed threshold.

3.7.3.3.2.2.9.2.8 Repeat Audio

The system shall provide the capability to store a setting for when the user needs to have the audio message repeated for the location to aid in comprehending the audio message.

3.7.3.3.3.3 Route Editing

Routes shall be able to be edited by selecting the route and then invoking an Edit feature. The most common reasons for editing routes may be to re-record audio instructions to add detail or eliminate environmental noise, or to replace digital pictures associated with each location.

3.7.3.3.3.3.**1** Editing Existing Routes

The system shall provide the capability to modify existing routes and modify all information associated with the route, with the exception of the date the route was created.

3.7.3.3.3.3.1.1 Editing Geo-Location or Waypoints

The system shall provide the capability to capture the user's current geo-location to update the current values for latitude and longitude stored for the waypoint.

3.7.3.3.3.3.1.2 Editing Location Description

The system shall provide the capability to edit the location description for a waypoint.

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3.7.3.3.3.3.1.3 Editing Location Image

The system shall provide the capability to take a new picture and replace the current image with the new photo for a waypoint.

3.7.3.3.3.3.1.3.1 Taking New Photo with Device Camera

The system shall provide the capability to take a new photo and replace the current image with the new photo for a waypoint.

3.7.3.3.3.3.1.3.2 Selecting Image from Stored Location on Device

The system shall provide the capability to select an existing photo available on the device and replace the current image with the selected photo for a waypoint.

3.7.3.3.3.3.1.4 Editing Not Your Stop Setting

The system shall provide the capability to toggle the Not Your Stop setting ON or OFF for the waypoint.

3.7.3.3.3.3.1.5 Editing Repeat Audio Setting

The system shall provide the capability to toggle the Repeat Audio setting ON or OFF for the waypoint.

3.7.3.3.3.3.1.6 Reordering Waypoints

The system shall provide the capability to reorder the waypoints within a route.

3.7.3.3.3.3.2 Reordering Order of Route Presented to User

The system shall provide the capability to reorder the order that routes are presented to the user on the main display.

3.7.3.3.3.4 Route Deletion

3.7.3.3.3.4.1 Deleting Existing Routes

The system shall provide the capability to delete new routes.

3.7.3.3.3.4.2 Confirmation of Route Deletion

The system shall provide a confirmation dialog that the user must acknowledge prior to the route being deleted.

3.7.3.3.3.5 Route Copying

The system shall provide the capability to make a copy of a route which can then be edited and new waypoints added to result in a new route derived from the original route.

3.7.3.3.3.5.1 Copying Existing Routes

The system shall provide the capability to copy an existing route to create a new route with a unique route ID.

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3.7.3.3.3.5.2 Creating New Route ID for the Copied Route

The system shall provide the capability to create a unique route ID for the copied route to distinguish it from the original route.

3.7.3.3.3.5.3 Creating New Route Title for the Copied Route

The system shall provide the capability to enter a new route title for the copied route to distinguish it from the original route.

3.7.3.3.3.6 Route Preview

The system shall provide the capability to preview a route to be able to see the behavior of route waypoints without having to take the route.

3.7.3.3.3.6.1 Selecting a Route to Preview

The system shall provide the capability to select the route to preview on the display that presents the list of routes.

3.7.3.3.3.6.2 Editing a Route that is being Previewed

The system shall provide the capability to edit route waypoint information while in preview mode.

3.7.3.3.4 Component 5: Interfacing with the SMART Route Library

The WayFinder mobile app shall have the capability to interface with the SMART Route Library from within the application.

3.7.3.3.4.1 Default Route Library

The system shall provide the capability to store a default library in settings to allow the user to connect to the route library of routes that is most commonly used by the user.

3.7.3.3.4.2 View Alternate Route Library

The system shall provide the capability to view a list of available alternate travel libraries, if any are available.

3.7.3.3.4.3 Select Alternate Route Library

The system shall provide the capability to select a library from the displayed list of available alternate travel libraries.

3.7.3.3.4.4 Download Route from Route Library

The system shall provide the capability to download a selected route from an online library of routes.

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3.7.3.3.4.5 Upload Route to Route Library

When in Admin mode, the system shall provide the capability to upload a route to an online library of routes.

3.8 Performance Requirements

The following subsection defines the general performance requirements for the host computer which will be used to access the two web-based applications, as well as for the SMART-compliant mobile device.

3.8.1 Minimum Requirements for Host Computer for Accessing Web-based Applications

3.8.1.1 Microprocessor

The Host Computer's microprocessor shall operate at a minimum clock speed of 1.7 GHz.

3.8.1.2 Random Access Memory (RAM)

The Host Computer shall contain a minimum 4GB 800 MHz Dual Channel DDR2 SDRAM.

3.8.1.3 Hard Disk

The Host Computer shall contain a minimum of 10GB free hard disk storage to store any downloaded routes.

3.8.1.4 Network Adapter

The Host Computer shall contain a minimum 10/100mb per second network adapter.

3.8.1.5 Video Adapter

The Host Computer shall contain video adapter operating at 32-bit color with a minimum horizontal resolution of 1024 pixels, a minimum vertical resolution of 900 pixels, and a total area not less than .9216 million pixels.

3.8.1.6 Standard Keyboard

The Host Computer shall contain a standard keyboard.

3.8.1.7 Standard Pointing Device

The Host Computer shall contain a standard pointing device.

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3.8.1.8 Operating System

The Host Computer shall operate with Windows 8 64 bit Professional or Enterprise Operating System or higher.

3.8.1.9 Web-Browser Compatibility

The web-browser used by the Host Computer to operate the web-based application(s) described in this specification shall be compatible with HTML 5 or higher.

3.8.2 SMART Complaint Wayfinding App

A SMART-complaint wayfinding app required to operate WayFinder shall operate on a tablet or smartphone device (mobile device) with the following characteristics.

3.8.2.1 Display Size

The mobile device's microprocessor minimum display size shall be 5".

3.8.2.2 Android Operating System

The Android mobile device shall operate with Android 4.6 or higher.

3.8.2.3 iOS Operating System

The Apple mobile device shall operate with iOS 6.2 or higher.

3.8.2.4 Geo-Location Functions Not Requiring Data Plan

Route travel shall be supported without requiring the mobile device to contain a data plan.

3.8.2.5 Notification and Real-time Location Services Require Data Plan

When notification features, real-time location features or other communication features are needed for the end user, the device used to operate WayFinder shall require a data plan to support these system features.

3.8.2.6 Power Loss

Routes and system settings shall be saved on the device so that if power is lost, the routes are still available on the device when the device is recharged.

3.8.2.7 Storage

The mobile device shall support a minimum of 40 MB of storage for the WayFinder app and routes.

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3.9 Precedence

Not applicable.

3.10 Quality Assurance Provisions

Internal testing of the mobile and server applications will be accomplished by the development team and the AbleLink staff. External testing for the mobile applications will be accomplished with a pairing of data gathering within the mobile applications and distribution via the Apple TestFlight beta distribution system for iOS and the Beta Testing program on Google Play for our Android versions.

Data gathering will be focused on trying to determine signal issues with GPS connections and connections to the cellular network. This information will be used to try and refine thresholds that we set in our apps for when to notify the user of waypoint information and potential connection loss information. It would also be used to illustrate to a caregiver that the customer is traveling in an area troubled with connectivity problems.

Server-side testing methods will also be put in place to verify the integrity of the SMART Wayfinding Specification files (*smart.json*). This will include verifying the consistency of the document markup as well as the proper inclusion of all required fields and attributes that encompass a properly formatted smart.json file.

A syntax and element conformance check will be conducted on newly created routes prior to allowing the route to be added to the SMART Route Library. This will ensure that the completed route contains all required elements needed for a route to be considered a SMART compliant route. This includes testing the *smart.json* file to ensure that it is formatted correctly.

3.11 Software Quality Assurance

3.11.1 Requirements Traceability and Verification Matrix

Included in Appendix A.

3.12 Notes

Reserved for future use.

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Chapter 4. 4 User Definitions

Table 4. User Definitions Table

Term	Definition
JSON	Java Script Object Notation – a commonly used data format that can be interfaced with by common computer software and hardware systems.
SMART	Specialized Media for Assisting Route Travel.
smart.json	Computer data file adhering to the SMART Wayfinding Specification containing all necessary information for presentation of a route in an accessible manner to individuals with cognitive disabilities using a SMART-compliant mobile wayfinding app.
SMART Wayfinding Specification	De facto industry standard for enabling individuals with cognitive disabilities to utilize fixed route public transportation or walking travel.
SMART-complaint mobile wayfinding app	Smartphone or tablet-based application designed to utilize SMART Wayfinding Specification based routes to support independent travel for individuals with cognitive disabilities.
SMART Route Builder	Web-based application used to create SMART-compliant routes for use with a SMART compliant mobile wayfinding app.
SMART Route Library	Cloud-based library of SMART-complaint travel routes for various destinations within a defined geographic area. Used to deliver pre-built routes to individuals with cognitive disabilities to facilitate independent travel.

END OF DOCUMENT

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Table 5. Document Revision History Table

DOCUMENT REVISION HISTORY			
Version Number	**Approved Date**	**Description of Change(s)**	**Created/ Modified By**

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Appendix A. REQUIREMENTS SUMMARY TABLE AND TRACEABILITY TO USER NEEDS

Table 6. Requirements Summary Key

Subsystems	Components
A. SMART Route Builder	1. Web-based Access and Operation 2. Route Management Functions 3. Interface with Online SMART Route Library 4. System Settings 5. Backup, Saving and Restoring Routes
B. SMART Route Library	1. Browser Interaction, Application Updates, and Data Integrity 2. SMART Route Library Administrator Functions 3. Route Management Functions 4. Library Organizational Management Functions
C. WayFinder Mobile App	1. App Installation, Startup and Updates 2. Route Traversal and End User Operation 3. System Settings 4. Route Management 5. Interfacing with the Smart Route Library
P. Performance Requirements	1. Host Computer 2. Mobile Wayfinding App

Status

1. Conceptual
2. Design
3. Development
4. Alpha Test
5. Beta Test
6. Release
7. Deferred

Date

Date status 6 achieved

Table 7. Requirements Summary Table and Traceability to User Needs

SU	COMP	Requirement	Needs	Status	Date
		SMART ROUTE BUILDER RQMTS			
A	1	3.7.1.2.1.1 User Input	1,5,6	6	
A	1	3.7.1.2.1.2 User Output	1,5,6	6	
A	1	3.7.1.3.1.1 Web Browser Requirements	1,5,6	6	
A	1	3.7.1.3.1.1.1 Internet Explorer Support	1,5,6	6	
A	1	3.7.1.3.1.1.2 Microsoft Edge Support	1,5,6	6	
A	1	3.7.1.3.1.1.3 Google Chrome Support	1,5,6	6	
A	1	3.7.1.3.1.1.4 Mozilla Firefox Support	1,5,6	6	
A	1	3.7.1.3.1.1.5 Apple Mobile Device Browser Support	1,5,6	6	
A	1	3.7.1.3.1.1.6 Android Mobile Device Browser Support	1,5,6	6	
A	1	3.7.1.3.1.2 Offline Operation Not Required	1,5,6	6	
A	1	3.7.1.3.1.3 Offline Operation Not Required	1,5,6	6	
A	2	3.7.1.3.2.1 Creation of New Routes	1,2	6	
A	2	3.7.1.3.2.1.1 Creation Date of New Routes	1,2	6	
A	2	3.7.1.3.2.1.2 New Route Title	1,2	6	
A	2	3.7.1.3.2.1.3 New Route Image	1,2	6	
A	2	3.7.1.3.2.1.4 New Route Audio	1,2	6	
A	2	3.7.1.3.2.1.5 New Route Audio Playback	1,2	6	
A	2	3.7.1.3.2.1.6 New Route Audio Deletion	1,2	6	
A	2	3.7.1.3.2.1.7 New Route Description	1,2	6	
A	2	3.7.1.3.2.1.8 Mapping Interface	1,2	6	
A	2	3.7.1.3.2.1.8.1 Direct Entry of Route Starting Geo-Location Coordinates	1,2	7	
A	2	3.7.1.3.2.1.8.2 Selection of Route Starting Geo-Location Coordinates Using Mapping Interface	1,2	6	
A	2	3.7.1.3.2.1.8.3 Depiction of Route Using Mapping Interface	1,2	6	

A	2	3.7.1.3.2.1.9 Save New Route File using SMART Wayfinding Specification	1,2	6	
A	2	3.7.1.3.2.1.9.1 New Route Author Information	1,2	6	
A	2	3.7.1.3.2.1.9.2 Location Information	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.1 Location Description	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.2 Location Image	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.3 GPS Geo-Location Coordinates	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.4 Location Sequence	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.5 Location Capture Time Stamp	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.6 Location Audio	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.7 Not Your Stop Location	1,2,3	6	
A	2	3.7.1.3.2.1.9.2.8 Repeat Audio	1,2,3	6	
A	2	3.7.1.3.2.1.10 Off-Route Support	9	6	
A	2	3.7.1.3.2.1.10.1 Return to Route Instructions	9	6	
A	2	3.7.1.3.2.1.10.2 Off-Route Email Notifications	9	6	
A	2	3.7.1.3.2.1.10.3 Off-Route Text Notifications	9	6	
A	2	3.7.1.3.2.1.10.4 Back On-Route Email Notifications	9	6	
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A	2	3.7.1.3.2.3 Route Deletion	7,8	6	
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A	2	3.7.1.3.2.6.1 Preview Route Feature	2	6	
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A	4	3.7.1.3.4.4 Default SMART Route Library	4,5,6	6	
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B	1	3.7.2.2.1.2 User Output	12	6	
B	1	3.7.2.2.3.1 Delivering Routes from the SMART Route Library to a SMART-compliant Application	6,12	6	
B	1	3.7.2.2.3.2 Filtering Routes Based on User's Current Geo-Location	4,5,12	6	
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B	1	3.7.2.2.3.4 SMART Conformance Testing	6,12	3	
B	1	3.7.2.3.1.1 Installation Requirements	12	6	

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B	1	3.7.2.3.1.2.5 Apple Mobile Device Browser Support	12	6	
B	1	3.7.2.3.1.2.6 Android Mobile Device Browser Support	12	6	
B	1	3.7.2.3.1.3 Offline Operation Not Required	12	6	
B	1	3.7.2.3.1.4 Application Update Requirements	12	6	
B	1	3.7.2.3.1.4.1 Data Integrity with Application Updates	4,5,6,12	6	
B	1	3.7.2.3.1.4.2 Data Conversion	4,5,6,12	6	
B	2	3.7.2.3.2.1 Login Requirements	12	6	
B	2	3.7.2.3.2.2 Password Modification Requirements	12	6	
B	2	3.7.2.3.2.3 Temporary Password Retrieval	12	6	
B	2	3.7.2.3.2.4 New Administrator Account Creation	12	6	
B	2	3.7.2.3.2.5 Assignment of Administrator Privileges	12	6	
B	2	3.7.2.3.2.6 Explicit Logout	12	6	
B	2	3.7.2.3.2.7 Inactivity Logout	12	6	
B	2	3.7.2.3.2.8 Incorrect Password Lockout	12	6	
B	3	3.7.2.3.3.1 Uploading Routes Uploaded from SMART-compliant Apps	6,12	6	
B	3	3.7.2.3.3.2 Selecting Category for Route	6,12	6	
B	3	3.7.2.3.3.3 Upload Date of New Routes	6,12	6	
B	3	3.7.2.3.3.4 Renaming Routes	6,12	3	
B	3	3.7.2.3.3.5 Changing Route Image	6,12	6	
B	3	3.7.2.3.3.6 Route Audio Playback	6,12	3	
B	3	3.7.2.3.3.7 Viewing Routes Online	12	6	
B	3	3.7.2.3.3.8 Reorganizing Routes	12	6	

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B	4	3.7.2.3.4.1 Category Management	12	6	
B	4	3.7.2.3.4.1.1 Creation of New Categories	12	6	
B	4	3.7.2.3.4.1.1.1 Category Name	12	6	
B	4	3.7.2.3.4.1.1.2 Category Description	12	6	
B	4	3.7.2.3.4.1.1.3 Category Image	12	6	
B	4	3.7.2.3.4.1.2 Geographic View of Category	12	3	
B	4	3.7.2.3.4.1.3 Nesting of Categories	12	6	
B	4	3.7.2.3.4.1.4 Editing of Categories	12	6	
B	4	3.7.2.3.4.1.4.1 Editing Category Name	12	6	
B	4	3.7.2.3.4.1.4.2 Editing Category Description	12	6	
B	4	3.7.2.3.4.1.4.3 Editing Category Image	12	6	
B	4	3.7.2.3.4.1.4.4 Editing Geographic View of Category	1	3	
B	4	3.7.2.3.4.1.5 Deletion of Categories	12	6	
B	4	3.7.2.3.4.1.5.1 Deleting Existing Categories	12	6	
B	4	3.7.2.3.4.1.5.2 Confirmation of Category Deletion	12	6	
B	4	3.7.2.3.4.1.6 Moving Categories	12	6	
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C	1	3.7.3.2.1.1 User Input	2	6	
C	1	3.7.3.2.1.1.1 Touch Input Operation	2	6	
C	1	3.7.3.2.1.1.2 Voice Input Operation	2	6	
C	1	3.7.3.2.1.2 User Output	2	6	
C	1	3.7.3.2.1.2.1 Text-based Output	2	6	
C	1	3.7.3.2.1.2.2 Graphical Output	2	6	
C	1	3.7.3.2.1.2.3 Audible Output	2	6	
C	1	3.7.3.2.2 Administrator Interfaces	2	6	
C	1	3.7.3.2.3 Interface with SMART Route Library	2,4,5,6	6	

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C	1	3.7.3.2.3.2 Changing Default SMART Route Library	2,4,5,6	6	
C	1	3.7.3.2.3.3 Search Library of Available Routes	2,4,5	6	
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C	1	3.7.3.2.3.5 Downloading Routes	2,4,5	6	
C	1	3.7.3.2.3.6 Uploading Routes	2,6	6	
C	1	3.7.3.3.1.1 Apple Device Installation	2,12	6	
C	1	3.7.3.3.1.2 Android Device Installation	2,12	6	
C	1	3.7.3.3.1.2.1 Android Device Installation from Google Play Store	2,12	6	
C	1	3.7.3.3.1.2.2 Android Device Installation via .apk File	2,12	6	
C	1	3.7.3.3.1.3 Application Update Requirements	2,12	6	
C	1	3.7.3.3.1.3.1 iOS Version Updates	2,12	6	
C	1	3.7.3.3.1.3.2 Android Version Updates	2,12	6	
C	1	3.7.3.3.1.3.2.1 Android Version Updates via Google Play Store	2,12	6	
C	1	3.7.3.3.1.3.2.2 Android Version Updates via .apk File	2,12	6	
C	1	3.7.3.3.1.3.3 Data Integrity with Application Updates	2,12	6	
C	1	3.7.3.3.1.3.4 Data Integrity Previous Route Versions	2,12	6	
C	1	3.7.3.3.1.3.5 System Startup	2	6	
C	1	3.7.3.3.1.3.5.1 Direct Startup	2	6	
C	1	3.7.3.3.1.3.5.2 Time-based Startup	2	6	
C	1	3.7.3.3.1.4 Daisy Chaining Routes	2	3	
C	1	3.7.3.3.1.4 Launching Instructional Task within Smart Travel Concierge System	2	3	
C	2	3.7.3.3.2.1 System Controls	2	6	
C	2	3.7.3.3.2.1.1 User Interface	2	6	
C	2	3.7.3.3.2.1.1.1 Graphical Representation of User Controls	2	6	

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C	2	3.7.3.3.2.1.1.2 Size of Graphical Controls	2	6	
C	2	3.7.3.3.2.1.1.3 Audible Feedback	2	6	
C	2	3.7.3.3.2.1.2 Main Menu Interface Controls	2	6	
C	2	3.7.3.3.2.1.2.1 GPS Indicators	2	6	
C	2	3.7.3.3.2.1.2.1.1 GPS Connectivity	2	6	
C	2	3.7.3.3.2.1.2.1.2 GPS Signal Strength	2	6	
C	2	3.7.3.3.2.1.2.2 Route Selection	2	6	
C	2	3.7.3.3.2.1.2.2.1 Multi-modal Route Identification Features Routes	2	6	
C	2	3.7.3.3.2.1.2.2.2 Method to Access Full Listing of Available Routes	2	6	
C	2	3.7.3.3.2.1.2.2.3 Visual Indicator When Additional Routes are Available	2	3	
C	2	3.7.3.3.2.1.2.3 Local Routes Feature	2	6	
C	2	3.7.3.3.2.1.2.4 Route Creation/Editor Button	1	6	
C	2	3.7.3.3.2.1.2.4.1 Preventing Accidental Activation of Admin Mode	1,2	6	
C	2	3.7.3.3.2.1.2.5 Settings Button	2	6	
C	2	3.7.3.3.2.1.2.5.1 Preventing Accidental Entry to System Settings	2	6	
C	3	3.7.3.3.3.1 GPS Settings	2	6	
C	3	3.7.3.3.3.1.1 In Range Distance Setting	2,3	6	
C	3	3.7.3.3.3.1.1.1 Modification of In Range Distance	2,3	6	
C	3	3.7.3.3.3.1.1.2 Protection Against Exceeding Available Values	2,3	6	
C	3	3.7.3.3.3.1.2 Out of Range Distance Setting	2,3	6	
C	3	3.7.3.3.3.1.2.1 Modification of Out of Range Distance	2	6	
C	3	3.7.3.3.3.1.2.2 Protection Against Exceeding Available Values	2	6	
C	3	3.7.3.3.3.1.2.3 Auto-return to In Route Travel Display	2	6	
C	3	3.7.3.3.3.1.3 Local Route Distance Setting	2	6	

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C	3	3.7.3.3.3.1.3.2 Hide in Range Routes	2	6	
C	3	3.7.3.3.3.1.4 Not-Your-Stop Threshold Setting	2,3	6	
C	3	3.7.3.3.3.1.4.1 Invoking a Not Your Stop Waypoint	2,3	6	
C	3	3.7.3.3.3.1.4.2 Ignoring a Not Your Stop Waypoint	2,3	6	
C	3	3.7.3.3.3.2 Operational Settings	2,3	6	
C	3	3.7.3.3.3.2.1 Notifications	10	6	
C	1	3.3.1.1 Signal Loss Notifications to User	10	6	
C	1	3.3.1.2 Signal Loss Notifications to Remote Caregivers	10	6	
C	3	3.7.3.3.3.2.1.1 Notification Recipient Address	10	6	
C	3	3.7.3.3.3.2.1.2 User Name	10	6	
C	3	3.7.3.3.3.2.1.3 Standard Route Event Notifications	10	6	
C	3	3.7.3.3.3.2.1.3.1 Starting Route Notification	10	6	
C	3	3.7.3.3.3.2.1.3.2 Route Completion Notification	10	6	
C	3	3.7.3.3.3.2.1.3.3 Notification of Aborted Route	10	6	
C	3	3.7.3.3.3.2.1.3.4 Standard Route Event Notification Content	10	6	
C	3	3.7.3.3.3.2.2 Vibrate Device	2,3	6	
C	3	3.7.3.3.3.2.3 Local Routes	2	6	
C	3	3.7.3.3.3.2.4 Walking Route	2	6	
C	3	3.7.3.3.3.2.5 Show/Hide Route Exit Button	2	6	
C	3	3.7.3.3.3.2.6 Show/Hide Waypoint Preview	2	6	
C	3	3.7.3.3.3.2.7 Auto-Record Audio	2	6	
C	3	3.7.3.3.3.2.8 Text Resizing	2	6	
C	3	3.7.3.3.3.2.9 Contact Me Button	2,9	6	
C	3	3.7.3.3.3.2.10 OK Button	2,9	6	
C	3	3.7.3.3.3.2.11 Periodic Notifications	11	6	

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C	3	3.7.3.3.3.2.11.1 Modification of Periodic Notification Frequency	11	6	
C	3	3.7.3.3.3.2.11.2 Content of Periodic Notifications	11	6	
C	3	3.7.3.3.3.2.12 Use Corridor Data	9	6	
C	3	3.7.3.3.3.3 Route Backup	1	6	
C	3	3.7.3.3.3.3.1 Backing up Routes	1	6	
C	3	3.7.3.3.3.3.2 Route Restore	1	6	
C	4	3.7.3.3.3.1 Types of Route Travel	1	3	
C	4	3.7.3.3.3.2 Creation of New Routes	1,2	6	
C	4	3.7.3.3.2.2.1 Creation Date of New Routes	1,2	6	
C	4	3.7.3.3.2.2.2 New Route Title	1,2	6	
C	4	3.7.3.3.2.2.3 New Route Image	1,2	6	
C	4	3.7.3.3.2.2.4 New Route Audio	1,2	6	
C	4	3.7.3.3.2.2.5 New Route Audio Playback	1,2	6	
C	4	3.7.3.3.2.2.6 New Route Audio Deletion	1,2	6	
C	4	3.7.3.3.2.2.7 New Route Description	1,2	6	
C	4	3.7.3.3.2.2.8 Capturing Geo-Location Coordinates	1,2	6	
C	4	3.7.3.3.2.2.8.1 Direct Capture of Geo-Location Coordinates	1,2	6	
C	4	3.7.3.3.2.2.8.2 Automatic Capture of Geo-Location Coordinate	1,2	6	
C	4	3.7.3.3.2.2.9 Save New Route File using SMART Wayfinding Specification	1,2	6	
C	4	3.7.3.3.2.2.9.1 New Route Author Information	1,2	6	
C	4	3.7.3.3.2.2.9.2 Waypoint Information	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.1 Location Description	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.2 Location Image	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.2.1 Default Location Images	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.2.2 Taking New Photo with Device Camera	1,2,3	6	

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C	4	3.7.3.3.2.2.9.2.2.3 Selecting Image from Stored Location on Device	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.3 GPS Geo-Location Coordinates	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.4 Location Sequence	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.5 Location Capture Time Stamp	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.6 Location Audio	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Local Storage to Select Audio File	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.7 Not Your Stop Location	1,2,3	6	
C	4	3.7.3.3.2.2.9.2.8 Repeat Audio	1,2,3	6	
C	4	3.7.3.3.3.3 Route Editing	7,8	6	
C	4	3.7.3.3.3.3.1 Editing Existing Routes	7,8	6	
C	4	3.7.3.3.3.3.1.1 Editing Geo-Location or Waypoints	7,8	6	
C	4	3.7.3.3.3.3.1.2 Editing Location Description	7,8	6	
C	4	3.7.3.3.3.3.1.3 Editing Location Image	7,8	6	
C	4	3.7.3.3.3.3.1.3.1 Taking New Photo with Device Camera	7,8	6	
C	4	3.7.3.3.3.3.1.3.2 Selecting Image from Stored Location on Device	7,8	6	
C	4	3.7.3.3.3.3.1.4 Editing Not Your Stop Setting	7,8	6	
C	4	3.7.3.3.3.3.1.5 Editing Repeat Audio Setting	7,8	6	
C	4	3.7.3.3.3.3.1.6 Reordering Waypoints	7,8	6	
C	4	3.7.3.3.3.3.2 Reordering Order of Routes Presented to User	7,8	6	
C	4	3.7.3.3.3.4 Route Deletion	7,8	6	
C	4	3.7.3.3.3.4.1 Deleting Existing Routes	7,8	6	
C	4	3.7.3.3.3.4.2 Confirmation of Route Deletion	7,8	6	
C	4	3.7.3.3.3.5 Route Copying	7,8	6	
C	4	3.7.3.3.3.5.1 Copying Existing Routes	7,8	3	

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C	4	3.7.3.3.3.5.2 Creating New Route ID for the Copied Route	7,8	3	
C	4	3.7.3.3.3.5.3 Creating New Route Title for the Copied Route	7,8	3	
C	4	3.7.3.3.3.6 Route Preview	1	6	
C	4	3.7.3.3.3.6.1 Selecting a Route to Preview	1	6	
C	4	3.7.3.3.3.6.2 Editing a Route that is being Previewed	1	6	
C	5	3.7.3.3.4.1 Default Route Library	4,5,6	6	
C	5	3.7.3.3.4.2 View Alternate Route Library	4,5,6	6	
C	5	3.7.3.3.4.3 Select Alternate Route Library	4,5,6	6	
C	5	3.7.3.3.4.4 Download Route from Route Library	4,5	6	
C	5	3.7.3.3.4.5 Upload Route from Route Library	6	6	
P	1	3.8.1.1 Microprocessor	1,4,5,6	6	
P	1	3.8.1.2 Random Access Memory (RAM)	1,4,5,6	6	
P	1	3.8.1.3 Hard Disk	1,4,5,6	6	
P	1	3.8.1.4 Network Adapter	1,4,5,6	6	
P	1	3.8.1.5 Video Adapter	1,4,5,6	6	
P	1	3.8.1.6 Standard Keyboard	1,4,5,6	6	
P	1	3.8.1.7 Standard Pointing Device	1,4,5,6	6	
P	1	3.8.1.8 Operating System	1,4,5,6	6	
P	1	3.8.1.9 Web-Browser Compatibility	1,4,5,6	6	
P	2	3.8.2.1 Display Size	1,4,5,6	6	
P	2	3.8.2.2 Android Operating System	2	6	
P	2	3.8.2.3 iOS Operating System	2	6	
P	2	3.8.2.4 Geo-Location Functions Not Requiring Data Plan	2	6	
P	2	3.8.2.5 Notification and Real-time Location Services Require Data Plan	2	6	
P	2	3.8.2.6 Power Loss	2	6	

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Appendix B. NEEDS TO REQUIREMENTS TRACEABILITY MATRIX

Need # -- User need number

Table 8. Requirements Summary Key

Subsystems	Components
A. SMART Route Builder	1. Web-based Access and Operation 2. Route Management Functions 3. Interface with Online SMART Route Library 4. System Settings 5. Backup, Saving and Restoring Routes
B. SMART Route Library	1. Browser Interaction, Application Updates, and Data Integrity 2. SMART Route Library Administrator Functions 3. Route Management Functions 4. Library Organizational Management Functions
C. WayFinder Mobile App	1. App Installation, Startup and Updates 2. Route Traversal and End User Operation 3. System Settings 4. Route Management 5. Interfacing with the Smart Route Library
P. Performance Requirements	1. Host Computer 2. Mobile Wayfinding App

Cross Reference -- Indicates cross-reference to other needs for which the requirement applies.

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Table 9. Needs to Requirements Traceability Matrix Table

Need #	SUB	COMP	Requirement	Cross-Reference
			User Need 1 - The need to create, preview and manage new routes that comply with the SMART Wayfinding Specification.	
1	A	1	3.7.1.2.1.1 User Input	1,5,6
1	A	1	3.7.1.2.1.2 User Output	1,5,6
1	A	1	3.7.1.3.1.1 Web Browser Requirements	1,5,6
1	A	1	3.7.1.3.1.1.1 Internet Explorer Support	1,5,6
1	A	1	3.7.1.3.1.1.2 Microsoft Edge Support	1,5,6
1	A	1	3.7.1.3.1.1.3 Google Chrome Support	1,5,6
1	A	1	3.7.1.3.1.1.4 Mozilla Firefox Support	1,5,6
1	A	1	3.7.1.3.1.1.5 Apple Mobile Device Browser Support	1,5,6
1	A	1	3.7.1.3.1.1.6 Android Mobile Device Browser Support	1,5,6
1	A	1	3.7.1.3.1.2 Offline Operation Not Required	1,5,6
1	A	1	3.7.1.3.1.3 Offline Operation Not Required	1,5,6
1	A	2	3.7.1.3.2.1 Creation of New Routes	1,2
1	A	2	3.7.1.3.2.1.1 Creation Date of New Routes	1,2
1	A	2	3.7.1.3.2.1.2 New Route Title	1,2
1	A	2	3.7.1.3.2.1.3 New Route Image	1,2
1	A	2	3.7.1.3.2.1.4 New Route Audio	1,2
1	A	2	3.7.1.3.2.1.5 New Route Audio Playback	1,2
1	A	2	3.7.1.3.2.1.6 New Route Audio Deletion	1,2
1	A	2	3.7.1.3.2.1.7 New Route Description	1,2
1	A	2	3.7.1.3.2.1.8 Mapping Interface	1,2
1	A	2	3.7.1.3.2.1.8.1 Direct Entry of Route Starting Geo-Location Coordinates	1,2
1	A	2	3.7.1.3.2.1.8.2 Selection of Route Starting Geo-Location Coordinates Using Mapping Interface	1,2

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1	A	2	3.7.1.3.2.1.8.3 Depiction of Route Using Mapping Interface	1,2
1	A	2	3.7.1.3.2.1.9 Save New Route File using SMART Wayfinding Specification	1,2
1	A	2	3.7.1.3.2.1.9.1 New Route Author Information	1,2
1	A	2	3.7.1.3.2.1.9.2 Location Information	1,2,3
1	A	2	3.7.1.3.2.1.9.2.1 Location Description	1,2,3
1	A	2	3.7.1.3.2.1.9.2.2 Location Image	1,2,3
1	A	2	3.7.1.3.2.1.9.2.3 GPS Geo-Location Coordinates	1,2,3
1	A	2	3.7.1.3.2.1.9.2.4 Location Sequence	1,2,3
1	A	2	3.7.1.3.2.1.9.2.5 Location Capture Time Stamp	1,2,3
1	A	2	3.7.1.3.2.1.9.2.6 Location Audio	1,2,3
1	A	2	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3
1	A	2	3.7.3.3.2.2.9.2.6.1 Interfacing with Local Storage to Select Audio File	1,2,3
1	A	2	3.7.1.3.2.1.9.2.7 Not Your Stop Location	1,2,3
1	A	2	3.7.1.3.2.1.9.2.8 Repeat Audio	1,2,3
1	A	2	3.7.1.3.2.4 Route Copying	1
1	A	2	3.7.1.3.2.4.1 Copying Existing Routes	1
1	A	2	3.7.1.3.2.4.2 Creating New Route ID for the Copied Route	1
1	A	2	3.7.1.3.2.4.3 Creating New Route Title for the Copied Route	1
1	A	2	3.7.1.3.2.5 Auto-save Feature	1
1	A	3	3.7.1.3.3.5 Contribute Route to Route Library	1,6
1	C	2	3.7.3.3.2.1.2.4 Route Creation/Editor Button	1
1	C	2	3.7.3.3.2.1.2.4.1 Preventing Accidental Activation of Admin Mode	1,2
1	C	3	3.7.3.3.3.3 Route Backup	1
1	C	3	3.7.3.3.3.3.1 Backing up Routes	1
1	C	3	3.7.3.3.3.3.2 Route Restore	1
1	C	4	3.7.3.3.3.1 Types of Route Travel	1

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1	C	4	3.7.3.3.3.2 Creation of New Routes	1,2
1	C	4	3.7.3.3.2.2.1 Creation Date of New Routes	1,2
1	C	4	3.7.3.3.2.2.2 New Route Title	1,2
1	C	4	3.7.3.3.2.2.3 New Route Image	1,2
1	C	4	3.7.3.3.2.2.4 New Route Audio	1,2
1	C	4	3.7.3.3.2.2.5 New Route Audio Playback	1,2
1	C	4	3.7.3.3.2.2.6 New Route Audio Deletion	1,2
1	C	4	3.7.3.3.2.2.7 New Route Description	1,2
1	C	4	3.7.3.3.2.2.8 Capturing Geo-Location Coordinates	1,2
1	C	4	3.7.3.3.2.2.8.1 Direct Capture of Geo-Location Coordinates	1,2
1	C	4	3.7.3.3.2.2.8.2 Automatic Capture of Geo-Location Coordinate	1,2
1	C	4	3.7.3.3.2.2.9 Save New Route File using SMART Wayfinding Specification	1,2
1	C	4	3.7.3.3.2.2.9.1 New Route Author Information	1,2
1	C	4	3.7.3.3.2.2.9.2 Waypoint Information	1,2,3
1	C	4	3.7.3.3.2.2.9.2.1 Location Description	1,2,3
1	C	4	3.7.3.3.2.2.9.2.2 Location Image	1,2,3
1	C	4	3.7.3.3.2.2.9.2.2.1 Default Location Images	1,2,3
1	C	4	3.7.3.3.2.2.9.2.2.2 Taking New Photo with Device Camera	1,2,3
1	C	4	3.7.3.3.2.2.9.2.2.3 Selecting Image from Stored Location on Device	1,2,3
1	C	4	3.7.3.3.2.2.9.2.3 GPS Geo-Location Coordinates	1,2,3
1	C	4	3.7.3.3.2.2.9.2.4 Location Sequence	1,2,3
1	C	4	3.7.3.3.2.2.9.2.5 Location Capture Time Stamp	1,2,3
1	C	4	3.7.3.3.2.2.9.2.6 Location Audio	1,2,3
1	C	2	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3
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1	C	4	3.7.3.3.2.2.9.2.8 Repeat Audio	1,2,3
1	C	4	3.7.3.3.3.6 Route Preview	1
1	C	4	3.7.3.3.3.6.1 Selecting a Route to Preview	1
1	C	4	3.7.3.3.3.6.2 Editing a Route that is being Previewed	1
1	P	1	3.8.1.1 Microprocessor	1,4,5,6
1	P	1	3.8.1.2 Random Access Memory (RAM)	1,4,5,6
1	P	1	3.8.1.3 Hard Disk	1,4,5,6
1	P	1	3.8.1.4 Network Adapter	1,4,5,6
1	P	1	3.8.1.5 Video Adapter	1,4,5,6
1	P	1	3.8.1.6 Standard Keyboard	1,4,5,6
1	P	1	3.8.1.7 Standard Pointing Device	1,4,5,6
1	P	1	3.8.1.8 Operating System	1,4,5,6
1	P	1	3.8.1.9 Web-browser Compatibility	1,4,5,6
1	P	2	3.8.2.1 Display Size	1,4,5,6
Need #			User Need 2 – The system needs to provide cognitively accessible routing and navigation capabilities on a mobile device including visual, auditory, and textual prompts for each step in the process of taking a transit vehicle (such as bus or light rail) from point of origin to a desired destination.	
2	A	2	3.7.1.3.2.1 Creation of New Routes	1,2
2	A	2	3.7.1.3.2.1.1 Creation Date of New Routes	1,2
2	A	2	3.7.1.3.2.1.2 New Route Title	1,2
2	A	2	3.7.1.3.2.1.3 New Route Image	1,2
2	A	2	3.7.1.3.2.1.4 New Route Audio	1,2
2	A	2	3.7.1.3.2.1.5 New Route Audio Playback	1,2
2	A	2	3.7.1.3.2.1.6 New Route Audio Deletion	1,2
2	A	2	3.7.1.3.2.1.7 New Route Description	1,2
2	A	2	3.7.1.3.2.1.8 Mapping Interface	1,2

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2	A	2	3.7.1.3.2.1.8.2 Selection of Route Starting Geo-Location Coordinates Using Mapping Interface	1,2
2	A	2	3.7.1.3.2.1.8.3 Depiction of Route Using Mapping Interface	1,2
2	A	2	3.7.1.3.2.1.9 Save New Route File using SMART Wayfinding Specification	1,2
2	A	2	3.7.1.3.2.1.9.1 New Route Author Information	1,2
2	A	2	3.7.1.3.2.1.9.2 Location Information	1,2,3
2	A	2	3.7.1.3.2.1.9.2.1 Location Description	1,2,3
2	A	2	3.7.1.3.2.1.9.2.2 Location Image	1,2,3
2	A	2	3.7.1.3.2.1.9.2.3 GPS Geo-Location Coordinates	1,2,3
2	A	2	3.7.1.3.2.1.9.2.4 Location Sequence	1,2,3
2	A	2	3.7.1.3.2.1.9.2.5 Location Capture Time Stamp	1,2,3
2	A	2	3.7.1.3.2.1.9.2.6 Location Audio	1,2,3
2	A	2	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3
2	A	2	3.7.3.3.2.2.9.2.6.1 Interfacing with Local Storage to Select Audio File	1,2,3
2	A	2	3.7.1.3.2.1.9.2.7 Not Your Stop Location	1,2,3
2	A	2	3.7.1.3.2.1.9.2.8 Repeat Audio	1,2,3
2	A	2	3.7.1.3.2.6 Previewing Routes	2
2	A	2	3.7.1.3.2.6.1 Preview Route Feature	2
2	A	2	3.7.1.3.2.6.2 Editing Route Information During Route Preview	2,7,8
2	C	1	3.7.3.2.1.1 User Input	2
2	C	1	3.7.3.2.1.1.1 Touch Input Operation	2
2	C	1	3.7.3.2.1.1.2 Voice Input Operation	2
2	C	1	3.7.3.2.1.2 User Output	2
2	C	1	3.7.3.2.1.2.1 Text-based Output	2
2	C	1	3.7.3.2.1.2.2 Graphical Output	2
2	C	1	3.7.3.2.1.2.3 Audible Output	2

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2	C	1	3.7.3.2.3.2 Changing Default SMART Route Library	2,4,5,6
2	C	1	3.7.3.2.3.3 Search Library of Available Routes	2,4,5
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2	C	1	3.7.3.2.3.5 Downloading Routes	2,4,5
2	C	1	3.7.3.2.3.6 Uploading Routes	2,6
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2	C	1	3.7.3.3.1.2 Android Device Installation	2,12
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2	C	1	3.7.3.3.1.3.5 System Startup	2
2	C	1	3.7.3.3.1.3.5.1 Direct Startup	2
2	C	1	3.7.3.3.1.3.5.2 Time-based Startup	2
2	C	1	3.7.3.3.1.4 Daisy Chaining Routes	2
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2	C	2	3.7.3.3.2.1 System Controls	2
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2	C	2	3.7.3.3.2.1.1.1 Graphical Representation of User Controls	2
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2	C	2	3.7.3.3.2.1.1.3 Audible Feedback	2
2	C	2	3.7.3.3.2.1.2 Main Menu Interface Controls	2
2	C	2	3.7.3.3.2.1.2.1 GPS Indicators	2
2	C	2	3.7.3.3.2.1.2.1.1 GPS Connectivity	2
2	C	2	3.7.3.3.2.1.2.1.2 GPS Signal Strength	2
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2	C	2	3.7.3.3.2.1.2.2.3 Visual Indicator When Additional Routes are Available	2
2	C	2	3.7.3.3.2.1.2.3 Local Routes Feature	2
2	C	2	3.7.3.3.2.1.2.4 Route Creation/Editor Button	1
2	C	2	3.7.3.3.2.1.2.4.1 Preventing Accidental Activation of Admin Mode	1,2
2	C	2	3.7.3.3.2.1.2.5 Settings Button	2
2	C	2	3.7.3.3.2.1.2.5.1 Preventing Accidental Entry to System Settings	2
2	C	3	3.7.3.3.3.1 GPS Settings	2
2	C	3	3.7.3.3.3.1.1 In Range Distance Setting	2,3
2	C	3	3.7.3.3.3.1.1.1 Modification of In Range Distance	2,3
2	C	3	3.7.3.3.3.1.1.2 Protection Against Exceeding Available Values	2,3
2	C	3	3.7.3.3.3.1.2 Out of Range Distance Setting	2,3
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2	C	3	3.7.3.3.3.1.2.2 Protection Against Exceeding Available Values	2
2	C	3	3.7.3.3.3.1.2.3 Auto-return to In Route Travel Display	2
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2	C	3	3.7.3.3.3.1.3.1 Show in Range Routes	2

2	C	3	3.7.3.3.3.1.3.2 Hide in Range Routes	2
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2	C	3	3.7.3.3.3.1.4.1 Invoking a Not Your Stop Waypoint	2,3
2	C	3	3.7.3.3.3.1.4.2 Ignoring a Not Your Stop Waypoint	2,3
2	C	3	3.7.3.3.3.2 Operational Settings	2,3
2	C	3	3.7.3.3.3.2.2 Vibrate Device	2,3
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2	C	3	3.7.3.3.3.2.6 Show/Hide Waypoint Preview	2
2	C	3	3.7.3.3.3.2.7 Auto-Record Audio	2
2	C	3	3.7.3.3.3.2.8 Text Resizing	2
2	C	3	3.7.3.3.3.2.9 Contact Me Button	2,9
2	C	3	3.7.3.3.3.2.10 OK Button	2,9
2	C	4	3.7.3.3.3.2 Creation of New Routes	1,2
2	C	4	3.7.3.3.2.2.1 Creation Date of New Routes	1,2
2	C	4	3.7.3.3.2.2.2 New Route Title	1,2
2	C	4	3.7.3.3.2.2.3 New Route Image	1,2
2	C	4	3.7.3.3.2.2.4 New Route Audio	1,2
2	C	4	3.7.3.3.2.2.5 New Route Audio Playback	1,2
2	C	4	3.7.3.3.2.2.6 New Route Audio Deletion	1,2
2	C	4	3.7.3.3.2.2.7 New Route Description	1,2
2	C	4	3.7.3.3.2.2.8 Capturing Geo-Location Coordinates	1,2
2	C	4	3.7.3.3.2.2.8.1 Direct Capture of Geo-Location Coordinates	1,2
2	C	4	3.7.3.3.2.2.8.2 Automatic Capture of Geo-Location Coordinate	1,2
2	C	4	3.7.3.3.2.2.9 Save New Route File using SMART Wayfinding Specification	1,2
2	C	4	3.7.3.3.2.2.9.1 New Route Author Information	1,2

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2	C	4	3.7.3.3.2.2.9.2 Waypoint Information	1,2,3
2	C	4	3.7.3.3.2.2.9.2.1 Location Description	1,2,3
2	C	4	3.7.3.3.2.2.9.2.2 Location Image	1,2,3
2	C	4	3.7.3.3.2.2.9.2.2.1 Default Location Images	1,2,3
2	C	4	3.7.3.3.2.2.9.2.2.2 Taking New Photo with Device Camera	1,2,3
2	C	4	3.7.3.3.2.2.9.2.2.3 Selecting Image from Stored Location on Device	1,2,3
2	C	4	3.7.3.3.2.2.9.2.3 GPS Geo-Location Coordinates	1,2,3
2	C	4	3.7.3.3.2.2.9.2.4 Location Sequence	1,2,3
2	C	4	3.7.3.3.2.2.9.2.5 Location Capture Time Stamp	1,2,3
2	C	4	3.7.3.3.2.2.9.2.6 Location Audio	1,2,3
2	C	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3
2	C	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Local Storage to Select Audio File	1,2,3
2	C	4	3.7.3.3.2.2.9.2.7 Not Your Stop Location	1,2,3
2	C	4	3.7.3.3.2.2.9.2.8 Repeat Audio	1,2,3
2	P	2	3.8.2.2 Android Operating System	2
2	P	2	3.8.2.3 iOS Operating System	2
2	P	2	3.8.2.4 Geo-Location Functions Not Requiring Data Plan	2
2	P	2	3.8.2.5 Notification and Real-time Location Services Require Data Plan	2
2	P	2	3.8.2.6 Power Loss	2
			User Need 3 - The need for periodic landmarking prompts to provide positive orientation to users during travel, such as "There's the lake outside the window across the street – you are half-way to work."	
3	A	2	3.7.1.3.2.1.9.2 Location Information	1,2,3
3	A	2	3.7.1.3.2.1.9.2.1 Location Description	1,2,3
3	A	2	3.7.1.3.2.1.9.2.2 Location Image	1,2,3
3	A	2	3.7.1.3.2.1.9.2.3 GPS Geo-Location Coordinates	1,2,3
3	A	2	3.7.1.3.2.1.9.2.4 Location Sequence	1,2,3

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3	A	2	3.7.1.3.2.1.9.2.5 Location Capture Time Stamp	1,2,3
3	A	2	3.7.1.3.2.1.9.2.6 Location Audio	1,2,3
3	A	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3
3	A	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Local Storage to Select Audio File	1,2,3
3	A	2	3.7.1.3.2.1.9.2.7 Not Your Stop Location	1,2,3
3	A	2	3.7.1.3.2.1.9.2.8 Repeat Audio	1,2,3
3	C	3	3.7.3.3.3.1.1 In Range Distance Setting	2,3
3	C	3	3.7.3.3.3.1.1.1 Modification of In Range Distance	2,3
3	C	3	3.7.3.3.3.1.1.2 Protection Against Exceeding Available Values	2,3
3	C	3	3.7.3.3.3.1.2 Out of Range Distance Setting	2,3
3	C	3	3.7.3.3.3.1.4 Not-Your-Stop Threshold Setting	2,3
3	C	3	3.7.3.3.3.1.4.1 Invoking a Not Your Stop Waypoint	2,3
3	C	3	3.7.3.3.3.1.4.2 Ignoring a Not Your Stop Waypoint	2,3
3	C	3	3.7.3.3.3.2 Operational Settings	2,3
3	C	3	3.7.3.3.3.2.2 Vibrate Device	2,3
3	C	4	3.7.3.3.2.2.9.2 Waypoint Information	1,2,3
3	C	4	3.7.3.3.2.2.9.2.1 Location Description	1,2,3
3	C	4	3.7.3.3.2.2.9.2.2 Location Image	1,2,3
3	C	4	3.7.3.3.2.2.9.2.2.1 Default Location Images	1,2,3
3	C	4	3.7.3.3.2.2.9.2.2.2 Taking New Photo with Device Camera	1,2,3
3	C	4	3.7.3.3.2.2.9.2.2.3 Selecting Image from Stored Location on Device	1,2,3
3	C	4	3.7.3.3.2.2.9.2.3 GPS Geo-Location Coordinates	1,2,3
3	C	4	3.7.3.3.2.2.9.2.4 Location Sequence	1,2,3
3	C	4	3.7.3.3.2.2.9.2.5 Location Capture Time Stamp	1,2,3
3	C	4	3.7.3.3.2.2.9.2.6 Location Audio	1,2,3
3	C	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Device Microphone	1,2,3

3	C	4	3.7.3.3.2.2.9.2.6.1 Interfacing with Local Storage to Select Audio File	1,2,3
3	C	4	3.7.3.3.2.2.9.2.7 Not Your Stop Location	1,2,3
3	C	4	3.7.3.3.2.2.9.2.8 Repeat Audio	1,2,3
			User Need 4 - The need to easily select a desired pre-built route containing visual and auditory prompts from the cloud-based SMART Route Library by anyone desiring use of a SMART compliant wayfinding route.	
4	A	3	3.7.1.3.3.1 Default Route Library	4,5,6
4	A	3	3.7.1.3.3.2 View Alternate Route Library	4,5,6
4	A	3	3.7.1.3.3.3 Select Alternate Route Library	4,5,6
4	A	3	3.7.1.3.3.4 Transfer Route from Route Library	4,5
4	A	4	3.7.1.3.4.4 Default Public SMART Route Library	4,5,6
4	B	1	3.7.2.2.3.2 Filtering Routes Based on User's Current Geo-Location	4,5,12
4	B	1	3.7.2.2.3.3 Receiving Routes from a SMART-compliant Application by the SMART Route Library	4,5,12
4	B	1	3.7.2.3.1.4.1 Data Integrity with Application Updates	4,5,6,12
4	B	1	3.7.2.3.1.4.2 Data Conversion	4,5,6,12
4	C	1	3.7.3.2.3 Interface with SMART Route Library	2,4,5,6
4	C	1	3.7.3.2.3.1 Auto-Loading Default SMART Route Library	2,4,5,6
4	C	1	3.7.3.2.3.2 Changing Default SMART Route Library	2,4,5,6
4	C	1	3.7.3.2.3.3 Search Library of Available Routes	2,4,5
4	C	1	3.7.3.2.3.4 Search Library of Available Routes Based on Current Location	2,4,5
4	C	1	3.7.3.2.3.5 Downloading Routes	2,4,5
4	C	5	3.7.3.3.4.1 Default Route Library	4,5,6
4	C	5	3.7.3.3.4.2 View Alternate Route Library	4,5,6
4	C	5	3.7.3.3.4.3 Select Alternate Route Library	4,5,6
4	C	5	3.7.3.3.4.4 Download Route from Route Library	4,5
4	P	1	3.8.1.1 Microprocessor	1,4,5,6

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4	P	1	3.8.1.4 Network Adapter	1,4,5,6
4	P	1	3.8.1.5 Video Adapter	1,4,5,6
4	P	1	3.8.1.6 Standard Keyboard	1,4,5,6
4	P	1	3.8.1.7 Standard Pointing Device	1,4,5,6
4	P	1	3.8.1.8 Operating System	1,4,5,6
4	P	1	3.8.1.9 Web-browser Compatibility	1,4,5,6
4	P	2	3.8.2.1 Display Size	1,4,5,6
			User Need 5 - The need to download/transfer a desired pre-built route from the cloud-based SMART Route Library.	
5	A	1	3.7.1.2.1.1 User Input	1,5,6
5	A	1	3.7.1.2.1.2 User Output	1,5,6
5	A	1	3.7.1.3.1.1 Web Browser Requirements	1,5,6
5	A	1	3.7.1.3.1.1.1 Internet Explorer Support	1,5,6
5	A	1	3.7.1.3.1.1.2 Microsoft Edge Support	1,5,6
5	A	1	3.7.1.3.1.1.3 Google Chrome Support	1,5,6
5	A	1	3.7.1.3.1.1.4 Mozilla Firefox Support	1,5,6
5	A	1	3.7.1.3.1.1.5 Apple Mobile Device Browser Support	1,5,6
5	A	1	3.7.1.3.1.1.6 Android Mobile Device Browser Support	1,5,6
5	A	1	3.7.1.3.1.2 Offline Operation Not Required	1,5,6
5	A	1	3.7.1.3.1.3 Offline Operation Not Required	1,5,6
5	A	3	3.7.1.3.3.1 Default Route Library	4,5,6
5	A	3	3.7.1.3.3.2 View Alternate Route Library	4,5,6
5	A	3	3.7.1.3.3.3 Select Alternate Route Library	4,5,6
5	A	3	3.7.1.3.3.4 Transfer Route from Route Library	4,5
5	A	4	3.7.1.3.4.4 Default Public SMART Route Library	4,5,6

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5	B	1	3.7.2.2.3.2 Filtering Routes Based on User's Current Geo-Location	4,5,12
5	B	1	3.7.2.2.3.3 Receiving Routes from a SMART-compliant Application by the SMART Route Library	4,5,12
5	B	1	3.7.2.3.1.4.1 Data Integrity with Application Updates	4,5,6,12
5	B	1	3.7.2.3.1.4.2 Data Conversion	4,5,6,12
5	C	1	3.7.3.2.3 Interface with SMART Route Library	2,4,5,6
5	C	1	3.7.3.2.3.1 Auto-Loading Default SMART Route Library	2,4,5,6
5	C	1	3.7.3.2.3.2 Changing Default SMART Route Library	2,4,5,6
5	C	1	3.7.3.2.3.3 Search Library of Available Routes	2,4,5
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5	C	1	3.7.3.2.3.5 Downloading Routes	2,4,5
5	C	5	3.7.3.3.4.1 Default Route Library	4,5,6
5	C	5	3.7.3.3.4.2 View Alternate Route Library	4,5,6
5	C	5	3.7.3.3.4.3 Select Alternate Route Library	4,5,6
5	C	5	3.7.3.3.4.4 Download Route from Route Library	4,5
5	P	1	3.8.1.1 Microprocessor	1,4,5,6
5	P	1	3.8.1.2 Random Access Memory (RAM)	1,4,5,6
5	P	1	3.8.1.3 Hard Disk	1,4,5,6
5	P	1	3.8.1.4 Network Adapter	1,4,5,6
5	P	1	3.8.1.5 Video Adapter	1,4,5,6
5	P	1	3.8.1.6 Standard Keyboard	1,4,5,6
5	P	1	3.8.1.7 Standard Pointing Device	1,4,5,6
5	P	1	3.8.1.8 Operating System	1,4,5,6
5	P	1	3.8.1.9 Web-browser Compatibility	1,4,5,6
5	P	2	3.8.2.1 Display Size	1,4,5,6
			User Need 6 - The need to share/upload newly created routes to a cloud-based SMART Route Library (for those with administrator access to the SMART Route Library)	
6	A	1	3.7.1.2.1.1 User Input	1,5,6

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6	A	1	3.7.1.2.1.2 User Output	1,5,6
6	A	1	3.7.1.3.1.1 Web Browser Requirements	1,5,6
6	A	1	3.7.1.3.1.1.1 Internet Explorer Support	1,5,6
6	A	1	3.7.1.3.1.1.2 Microsoft Edge Support	1,5,6
6	A	1	3.7.1.3.1.1.3 Google Chrome Support	1,5,6
6	A	1	3.7.1.3.1.1.4 Mozilla Firefox Support	1,5,6
6	A	1	3.7.1.3.1.1.5 Apple Mobile Device Browser Support	1,5,6
6	A	1	3.7.1.3.1.1.6 Android Mobile Device Browser Support	1,5,6
6	A	1	3.7.1.3.1.2 Offline Operation Not Required	1,5,6
6	A	1	3.7.1.3.1.3 Offline Operation Not Required	1,5,6
6	A	3	3.7.1.3.3.1 Default Route Library	4,5,6
6	A	3	3.7.1.3.3.2 View Alternate Route Library	4,5,6
6	A	3	3.7.1.3.3.3 Select Alternate Route Library	4,5,6
6	A	4	3.7.1.3.4.4 Default Public SMART Route Library	4,5,6
6	B	1	3.7.2.3.1.4.1 Data Integrity with Application Updates	4,5,6,12
6	B	1	3.7.2.3.1.4.2 Data Conversion	4,5,6,12
6	B	3	3.7.2.3.3.1 Uploading Routes Uploaded from SMART-compliant Apps	6,12
6	B	3	3.7.2.3.3.2 Selecting Category for Route	6,12
6	B	3	3.7.2.3.3.3 Upload Date of New Routes	6,12
6	B	3	3.7.2.3.3.4 Renaming Routes	6,12
6	B	3	3.7.2.3.3.5 Changing Route Image	6,12
6	B	3	3.7.2.3.3.6 Route Audio Playback	6,12
6	C	1	3.7.3.2.3 Interface with SMART Route Library	2,4,5,6
6	C	1	3.7.3.2.3.1 Auto-Loading Default SMART Route Library	2,4,5,6
6	C	1	3.7.3.2.3.2 Changing Default SMART Route Library	2,4,5,6
6	C	1	3.7.3.2.3.6 Uploading Routes	2,6
6	C	5	3.7.3.3.4.1 Default Route Library	4,5,6

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6	C	5	3.7.3.3.4.2 View Alternate Route Library	4,5,6
6	C	5	3.7.3.3.4.3 Select Alternate Route Library	4,5,6
6	C	5	3.7.3.3.4.4 Download Route from Route Library	4,5
6	C	5	3.7.3.3.4.5 Upload Route from Route Library	6
6	P	1	3.8.1.1 Microprocessor	1,4,5,6
6	P	1	3.8.1.2 Random Access Memory (RAM)	1,4,5,6
6	P	1	3.8.1.3 Hard Disk	1,4,5,6
6	P	1	3.8.1.4 Network Adapter	1,4,5,6
6	P	1	3.8.1.5 Video Adapter	1,4,5,6
6	P	1	3.8.1.6 Standard Keyboard	1,4,5,6
6	P	1	3.8.1.7 Standard Pointing Device	1,4,5,6
6	P	1	3.8.1.8 Operating System	1,4,5,6
6	P	1	3.8.1.9 Web-browser Compatibility	1,4,5,6
6	P	2	3.8.2.1 Display Size	1,4,5,6
			User Need 7 - The need for travel trainers, family members, caregivers or other travel support professionals to easily delete or modify the route to change the starting or ending point of the route and add new waypoints as needed for a particular user.	
7	A	2	3.7.1.3.2.2 Route Editing	7,8
7	A	2	3.7.1.3.2.2.1 Editing Existing Routes	7,8
7	A	2	3.7.1.3.2.2.2 Canceling Changes to Edited Route	7,8
7	A	2	3.7.1.3.2.3 Route Deletion	7,8
7	A	2	3.7.1.3.2.3.1 Deleting Existing Routes	7,8
7	A	2	3.7.1.3.2.3.2 Confirmation of Route Deletion	7,8
7	A	2	3.7.1.3.2.3.3 Restoring Deleted Routes	7,8
7	A	2	3.7.1.3.2.6.2 Editing Route Information During Route Preview	2,7,8
7	C	4	3.7.3.3.3.3 Route Editing	7,8
7	C	4	3.7.3.3.3.3.1 Editing Existing Routes	7,8

7	C	4	3.7.3.3.3.3.1.1 Editing Geo-Location or Waypoints	7,8
7	C	4	3.7.3.3.3.3.1.2 Editing Location Description	7,8
7	C	4	3.7.3.3.3.3.1.3 Editing Location Image	7,8
7	C	4	3.7.3.3.3.3.1.3.1 Taking New Photo with Device Camera	7,8
7	C	4	3.7.3.3.3.3.1.3.2 Selecting Image from Stored Location on Device	7,8
7	C	4	3.7.3.3.3.3.1.4 Editing Not Your Stop Setting	7,8
7	C	4	3.7.3.3.3.3.1.5 Editing Repeat Audio Setting	7,8
7	C	4	3.7.3.3.3.3.1.6 Reordering Waypoints	7,8
7	C	4	3.7.3.3.3.3.2 Reordering Order of Routes Presented to User	7,8
7	C	4	3.7.3.3.3.4 Route Deletion	7,8
7	C	4	3.7.3.3.3.4.1 Deleting Existing Routes	7,8
7	C	4	3.7.3.3.3.4.2 Confirmation of Route Deletion	7,8
7	C	4	3.7.3.3.3.5 Route Copying	7,8
7	C	4	3.7.3.3.3.5.1 Copying Existing Routes	7,8
7	C	4	3.7.3.3.3.5.2 Creating New Route ID for the Copied Route	7,8
7	C	4	3.7.3.3.3.5.3 Creating New Route Title for the Copied Route	7,8
			User Need 8 - The need for family members or caregivers to easily delete or modify the route to personalize it with additional prompts for describing relevant landmarks and reminders, such as a message that says, "Remember Sue, don't forget your backpack!"	
8	A	2	3.7.1.3.2.2 Route Editing	7,8
8	A	2	3.7.1.3.2.2.1 Editing Existing Routes	7,8
8	A	2	3.7.1.3.2.2.2 Canceling Changes to Edited Route	7,8
8	A	2	3.7.1.3.2.3 Route Deletion	7,8
8	A	2	3.7.1.3.2.3.1 Deleting Existing Routes	7,8
8	A	2	3.7.1.3.2.3.2 Confirmation of Route Deletion	7,8
8	A	2	3.7.1.3.2.3.3 Restoring Deleted Routes	7,8

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8	A	2	3.7.1.3.2.6.2 Editing Route Information During Route Preview	2,7,8
8	C	4	3.7.3.3.3.3 Route Editing	7,8
8	C	4	3.7.3.3.3.3.1 Editing Existing Routes	7,8
8	C	4	3.7.3.3.3.3.1.1 Editing Geo-Location or Waypoints	7,8
8	C	4	3.7.3.3.3.3.1.2 Editing Location Description	7,8
8	C	4	3.7.3.3.3.3.1.3 Editing Location Image	7,8
8	C	4	3.7.3.3.3.3.1.3.1 Taking New Photo with Device Camera	7,8
8	C	4	3.7.3.3.3.3.1.3.2 Selecting Image from Stored Location on Device	7,8
8	C	4	3.7.3.3.3.3.1.4 Editing Not Your Stop Setting	7,8
8	C	4	3.7.3.3.3.3.1.5 Editing Repeat Audio Setting	7,8
8	C	4	3.7.3.3.3.3.1.6 Reordering Waypoints	7,8
8	C	4	3.7.3.3.3.3.2 Reordering Order of Routes Presented to User	7,8
8	C	4	3.7.3.3.3.4 Route Deletion	7,8
8	C	4	3.7.3.3.3.4.1 Deleting Existing Routes	7,8
8	C	4	3.7.3.3.3.4.2 Confirmation of Route Deletion	7,8
8	C	4	3.7.3.3.3.5 Route Copying	7,8
8	C	4	3.7.3.3.3.5.1 Copying Existing Routes	7,8
8	C	4	3.7.3.3.3.5.2 Creating New Route ID for the Copied Route	7,8
8	C	4	3.7.3.3.3.5.3 Creating New Route Title for the Copied Route	7,8
			User Need 9 - The need to provide route correction or error recovery features to help individuals return to routes when they deviate from them or to receive needed help from others.	
9	A	2	3.7.1.3.2.1.10 Off-Route Support	9
9	A	2	3.7.1.3.2.1.10.1 Return to Route Instructions	9
9	A	2	3.7.1.3.2.1.10.2 Off-Route Email Notifications	9
9	A	2	3.7.1.3.2.1.10.3 Off-Route Text Notifications	9
9	A	2	3.7.1.3.2.1.10.4 Back On-Route Email Notifications	9

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9	A	2	3.7.1.3.2.1.10.5 Back On-Route Text Notifications	9
9	C	3	3.7.3.3.3.2.9 Contact Me Button	2,9
9	C	3	3.7.3.3.3.2.10 OK Button	2,9
9	C	3	3.7.3.3.3.2.12 Use Corridor Data	9
			User Need 10 - The need to automatically send notifications to family members or caregivers when the individual leaves from home to go to work, when they arrive at their destination, or if the individual deviates from his or her route or aborts the route for some reason.	
10	C	3	3.7.3.3.3.2.1 Notifications	10
10	C	3	3.3.1.1 Signal Loss Notifications to User	10
10	C	3	3.3.1.2 Signal Loss Notifications to Remote Caregivers	10
10	C	3	3.7.3.3.3.2.1.1 Notification Recipient Address	10
10	C	3	3.7.3.3.3.2.1.2 User Name	10
10	C	3	3.7.3.3.3.2.1.3 Standard Route Event Notifications	10
10	C	3	3.7.3.3.3.2.1.3.1 Starting Route Notification	10
10	C	3	3.7.3.3.3.2.1.3.2 Route Completion Notification	10
10	C	3	3.7.3.3.3.2.1.3.3 Notification of Aborted Route	10
10	C	3	3.7.3.3.3.2.1.3.4 Standard Route Event Notification Content	10
			User Need 11 - The need to automatically send periodic notifications while an individual is traveling to provide family members or caregivers ongoing feedback as to the individual's progress during the individual's travel activity.	
11	C	3	3.7.3.3.3.2.11 Periodic Notifications	11
11	C	3	3.7.3.3.3.2.11.1 Modification of Periodic Notification Frequency	11
11	C	3	3.7.3.3.3.2.11.2 Content of Periodic Notifications	11

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			User Need 12 - The need for a local transit authority to implement a SMART Wayfinding service within their geographic area to provide standardized routes for their locale at no cost to the end user (if desired) to facilitate access to specialized travel support technology and readily available routes that can be downloaded and used to facilitate independent travel.	
12	B	1	3.7.2.2.1.1 User Input	12
12	B	1	3.7.2.2.1.2 User Output	12
12	B	1	3.7.2.2.3.2 Filtering Routes Based on User's Current Geo-Location	4,5,12
12	B	1	3.7.2.2.3.3 Receiving Routes from a SMART-compliant Application by the SMART Route Library	4,5,12
12	B	1	3.7.2.3.1.4.1 Data Integrity with Application Updates	4,5,6,12
12	B	1	3.7.2.3.1.4.2 Data Conversion	4,5,6,12
12	B	3	3.7.2.3.3.1 Uploading Routes Uploaded from SMART-compliant Apps	6,12
12	B	3	3.7.2.3.3.2 Selecting Category for Route	6,12
12	B	3	3.7.2.3.3.3 Upload Date of New Routes	6,12
12	B	3	3.7.2.3.3.4 Renaming Routes	6,12
12	B	3	3.7.2.3.3.5 Changing Route Image	6,12
12	B	3	3.7.2.3.3.6 Route Audio Playback	6,12
12	B	3	3.7.2.3.3.7 Viewing Routes Online	12
12	B	3	3.7.2.3.3.8 Reorganizing Routes	12
12	B	3	3.7.2.3.3.9 Route Modification Disallowed	12
12	B	4	3.7.2.3.4.1 Category Management	12
12	B	4	3.7.2.3.4.1.1 Creation of New Categories	12
12	B	4	3.7.2.3.4.1.1.1 Category Name	12
12	B	4	3.7.2.3.4.1.1.2 Category Description	12
12	B	4	3.7.2.3.4.1.1.3 Category Image	12
12	B	4	3.7.2.3.4.1.2 Geographic View of Category	12

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12	B	4	3.7.2.3.4.1.3 Nesting of Categories	12
12	B	4	3.7.2.3.4.1.4 Editing of Categories	12
12	B	4	3.7.2.3.4.1.4.1 Editing Category Name	12
12	B	4	3.7.2.3.4.1.4.2 Editing Category Description	12
12	B	4	3.7.2.3.4.1.4.3 Editing Category Image	12
12	B	4	3.7.2.3.4.1.4.4 Editing Geographic View of Category	12
12	B	4	3.7.2.3.4.1.5 Deletion of Categories	12
12	B	4	3.7.2.3.4.1.5.1 Deleting Existing Categories	12
12	B	4	3.7.2.3.4.1.5.2 Confirmation of Category Deletion	12
12	B	4	3.7.2.3.4.1.6 Moving Categories	12
12	C	1	3.7.3.3.1.1 Apple Device Installation	2,12
12	C	1	3.7.3.3.1.2 Android Device Installation	2,12
12	C	1	3.7.3.3.1.2.1 Android Device Installation from Google Play Store	2,12
12	C	1	3.7.3.3.1.2.2 Android Device Installation via .apk File	2,12
12	C	1	3.7.3.3.1.3 Application Update Requirements	2,12
12	C	1	3.7.3.3.1.3.1 iOS Version Updates	2,12
12	C	1	3.7.3.3.1.3.2 Android Version Updates	2,12
12	C	1	3.7.3.3.1.3.2.1 Android Version Updates via Google Play Store	2,12
12	C	1	3.7.3.3.1.3.2.2 Android Version Updates via .apk File	2,12
12	C	1	3.7.3.3.1.3.3 Data Integrity with Application Updates	2,12
12	C	1	3.7.3.3.1.3.4 Data Integrity Previous Route Versions	2,12

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