Title: Accessible Transportation Technology Research Initiative (ATTRI) Application Development

Broad Agency Announcement
A. INTRODUCTION

This Broad Agency Announcement (BAA) is written in support of the Accessible Transportation Technology Research Initiative (ATTRI) of the U.S Department of Transportation (USDOT). ATTRI is a joint multi-modal, multiagency USDOT initiative, co-led by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), with support from the Intelligent Transportation Systems Joint Program Office (ITS-JPO), National Institute on Disability, Independent Living and Rehabilitation Research (NIDILRR) and other Federal partners. Transportation is crucial for living in today’s society. However, for people with disabilities (mobility, vision, hearing, and cognitive) inadequate transportation can hinder them from living a full life. The ATTRI improves the mobility of travelers with disabilities through research, development, and implementation of transformative technologies, applications, or systems for people of all abilities to effectively plan their personal and independent travel. ATTRI research focuses on the needs of three stakeholder groups: persons with disabilities, older adults, and veterans with disabilities.

The objective of ATTRI is to: (a) advance technology applications that enhance accessible transportation and independent mobility choices for travelers with disabilities; and (b) to improve opportunities for a seamless and complete trip that meets the diverse needs of travelers with mobility, vision, hearing and cognitive disabilities and provides them the ability to plan and execute an on-demand trip anytime of the day and from any location.

The acceptance and deployment of advanced transportation technologies is a complex process. Technology initiatives can address barriers and concerns related to independent travel documented by stakeholder user needs. For example, a network of ITS technologies can be used to reduce or eliminate the safety risks associated with street crossings by communicating to vehicles the presence and needs of a crossing pedestrian through communication between vehicles, pedestrians, and infrastructure. Accessible data can act as the foundation of many ATTRI applications by creating new and innovative solutions for users needing real-time, personalized information to conduct travel. These technologies should serve to reduce difficulty in commuting and be tailored to each individual’s unique set of abilities and challenges through personalized portfolios. ATTRI, through continued research and application development continues to work toward improving the mobility of travelers with disabilities and provide enhanced capabilities for all travelers to reliably and safely execute independent travel.

A.1 LEGISLATIVE AUTHORITY

This BAA is jointly funded by the ITSJPO and the FTA. Specific statutory authorities are found in the Intelligent Transportation Systems Research Program in 23 U.S.C. §516(a), which authorizes the Secretary of Transportation to “…carry out a comprehensive program of intelligent transportation system research and development, and operational tests of intelligent vehicles, intelligent infrastructure systems, and other similar activities.”, as well as in the FTA Research, Development, Demonstration and Deployment Program in 49 U.S.C. §5312, which authorizes the Secretary to “… make grants and enter into contracts, cooperative agreements, and other agreements for research, development, demonstration, and deployment projects, and
Evaluation of research and technology of national significance to public transportation, that the Secretary determines will improve public transportation.”

Funds are authorized under Section 6002(a) of Public Law 114-94, the Fixing America’s Surface Transportation Act (FAST Act) (for ITSJPO funds), and under Section 20011 of Public Law 112-141, the Moving Ahead for Progress in the 21st Century (MAP-21) Act (for FTA funds).

The authority to enter into a cooperative agreement for this effort is found under 23 U.S.C. § 502 - Surface Transportation Research, Development, and Technology, paragraph (b), which states: cooperation, grants, and contracts. — The Secretary may carry out research, development, and technology transfer activities related to transportation—

(A) Independently;
(B) In cooperation with other Federal departments, agencies, and instrumentalities and Federal laboratories; or
(C) by making grants to, or entering into contracts and cooperative agreements with one or more of the following: the National Academy of Sciences, the American Association of State Highway and Transportation Officials, any Federal laboratory, Federal agency, State agency, authority, association, institution, for-profit or nonprofit corporation, organization, foreign country, or any other person.

Assistance agreement awards will be subject to a 20 percent cost sharing requirement (The authority to enter into assistance agreements for this effort and the costs sharing requirements is found under 23 U.S.C. § 502 - Surface Transportation Research, Development, and Technology, paragraph (b), which states: cooperation, grants, and contracts (see attached)).

A.2 OBJECTIVES AND DESCRIPTION

The FHWA in association with ITSJPO is soliciting proposals under the ATTRI program for technology applications that will lead to transformational changes and truly revolutionary advances in accessible transportation, personal mobility, and independent travel for all travelers, and lead to offering a totally new travel experience in intermodal surface transportation in the United States. These procurements will support scientific investigations, studies and application development, prototyping, demonstration and evaluation to advance the current knowledge and state-of-the-art in the sciences and technologies employed in the planning, design, construction, operation, maintenance and management of accessible transportation. Strategically, this research will enable and expedite the development of revolutionary approaches, methodologies, and breakthroughs required to drive innovation and greatly improve the efficiency of independent mobility options for people with disabilities and provide greater accessible transportation choices for all travelers.
A.3 PURPOSE

Under this BAA, ATTRI will award funds for the development of applications in each of the ATTRI priority application areas identified through robust stakeholder outreach and user needs assessment. Application areas (also referred to as topics) are broadly described as:

1. Smart Wayfinding and Navigation Systems
2. Pre-Trip Concierge and Virtualization
3. Safe Intersection Crossing

Each application developed should consider the four foundational considerations described below in section C.1. Awardees will also be expected to adequately collaborate with other application development areas under the ATTRI program including Smart Wayfinding and Navigation Systems, Pre-Trip Concierge and Virtualization, Safe Intersection Crossing, and Automation and Robotics. Awardees are also encouraged to coordinate with other relevant USDOT programs.

A.4 PROGRAM SCOPE

ATTRI conducts research to improve the mobility of travelers with disabilities through the use of ITS and other advanced technologies. ATTRI leads the research, development, and implementation of transformative technologies, solutions, applications, or systems for people of all abilities to effectively plan their personal and independent travel. ATTRI will identify, develop, and deploy new transformative technologies, applications or systems, along with supporting policies and institutional guidance, to address mobility challenges of all travelers, in particular, travelers with disabilities. ATTRI research focuses on the needs of three stakeholder groups: people with disabilities, Veterans with disabilities, and older adults. ATTRI will also develop technological solutions to lower or remove barriers to transportation according to four functional disabilities: visual, hearing, cognitive, and mobility.

ATTRI leverages recent advances in vehicle, infrastructure, and pedestrian-based technologies, as well as accessible data, mobile computing, robotics, artificial intelligence, object detection, and navigation. Visualize personalized technology applications, enabled by wireless communications that connects travelers and their mobile devices; vehicles; and infrastructure. Technologies conceived, developed and used by ATTRI should provide almost ubiquitous access to a wealth of real-time situational data sources, including data specific to transportation, municipalities, points of interest, crowd-sourced information, and, above all, accessible data.

Five technology areas have emerged as ATTRI focus areas: wayfinding and navigation, assistive technologies, automation and robotics, data integration, and enhanced human service transportation.

In conducting research on accessible technology applications it is essential to document and consider in the development of new technological applications barriers experienced by potential stakeholders of these applications. For example, in 2010, the U.S. Census reported that approximately 56.7 million people in the U.S. (18.7 percent of the U.S. population) had some type of disability. In a similar study, researchers found that over 6 million people with...
disabilities have difficulties obtaining the transportation they need and nearly one-third of people with disabilities reported having inadequate access to transportation. This is an important consideration for transportation agencies and officials as transportation has long been thought to be instrumental in enhancing access to education, jobs, healthcare, and the overall economic health of a community. This extends to persons with access and functional needs, including persons with disabilities, Veterans with disabilities, and older adults; a correlation that has been noted by many researchers including Rosenbloom, 2007. Currently within this segment of the population there is a 63 percent unemployment rate, with half of the household income and three times the poverty rate of people without disabilities, lending some credence to the relationship between disability and economic indicators. A robust user needs assessment on challenges faced by people with disabilities, Veterans with disabilities, and older adults regarding independent travel, conducted by the United States Department of Transportation’s ATTRI, observed that needs and barriers vary by sub-population and type of disability, however, several themes emerged regarding mobility needs of these populations including the needs for more information, options, assistance, and access. Particularly, the top barriers identified by stakeholders include lack of or inaccessible signage, maps and announcements navigation difficulties due lack of information on arrival times, transfer times and travel distance, and inconsistent accessible pathway infrastructure. Similarly, the top user needs identified were lack of amenity information, lack of real-time transportation information and lack of safety, security and emergency information.

During the exploratory phase of the program, ATTRI conducted technology scans, a comprehensive user needs analysis of target populations and functional disabilities, solicited information through a Request for Information and conducted extensive stakeholder outreach. Based on this information, the USDOT has determined four priority areas (also referred to as topics) for the development of ATTRI applications:

1. Smart Wayfinding and Navigation
2. Pre-Trip Concierge and Virtualization
3. Safe Intersection Crossing
4. Shared Use, Automation, and Robotics (proposals are not being accepted for this priority area.)

Note: One note of importance is that a fourth application area identified by ATTRI research is that of shared use automation and robotics, which will be developed under coordination and resources with the Department of Health and Human Services through the Disability and Rehabilitation Research Projects (DRRP) Program of the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR). NIDILRR is seeking to fund research on the use of automated and robotic technologies to improve transportation options for individuals with disabilities. In recent years, NIDILRR has supported the ATTRI through various collaboration and will continue this collaboration in carrying out and overseeing this research initiative, which will lead to the development, prototyping, demonstration, and evaluation of accessible transportation technologies in the field of automation and robotics.
In addition, ATTRI determined four foundational considerations that should be explored and considered for any application being developed under the ATTRI program. These foundational considerations are described in the section below.

A. APPLICATION AREA DESCRIPTIONS

The FHWA in association with ITS-JPO is soliciting proposals under the ATTRI program for technology applications that will lead to transformational changes and truly revolutionary advances in accessible transportation, personal mobility, and independent travel for all travelers, and lead to offering a totally new travel experience in intermodal surface transportation in the United States. These procurements will support scientific investigations, studies and application development, prototyping, demonstration and evaluation to advance the current knowledge and state-of-the-art in the sciences and technologies employed in the planning, design, construction, operation, maintenance and management of accessible transportation. Strategically, this research will enable and expedite the development of revolutionary approaches, methodologies, and breakthroughs required to drive innovation and greatly improve the efficiency of independent mobility options for people with disabilities and provide greater accessible transportation choices for all travelers.

Application Area 1: Smart Wayfinding and Navigation Systems

Applications developed within the smart wayfinding and navigation realm will provide real-time, en-route assistance and situational awareness to ensure travelers can safely reach their destinations while traveling independently. These technologies could include, but are not limited to: wayfinding and navigation systems for indoor and outdoor use, beacons or electronic tags to interact with the built and pedestrian environment, transmittable data in multiple communication formats (visual, audible, haptic) including multiple languages, wearable technologies acting as discreet assistive navigation tools, connection with assistive mobile devices already in use (e.g. white cane, wheelchairs, smartphones), and the use of community volunteers providing accessibility data on neighborhoods, buildings, and infrastructure elements, including crowd sourced public/private maps for indoor and outdoor spaces for the real-time use of travelers with disabilities. Processes that affect wayfinding and navigation include: familiarization, localization and orientation, path planning, path traversal (locomotion), guidance, annotation, update and communication.\textsuperscript{vi}

Wayfinding and Navigation solutions will assist with waypoint navigation, path planning, advanced warning of events, recovery from route mistakes, navigation in unfamiliar locations and changes in environment by using Global Positioning System (GPS), geographic information system (GIS), Information and Communication Technology (ICT), and intelligent transportation system (ITS) equipment and technologies. These applications will then recognize and detect stationary objects (e.g., doors, elevators, stairs, crosswalks, and traffic lights), read and recognize important text and signage based on a user’s query, and detect, track, represent moving objects and dynamic changes to a traveler’s environment (e.g., people, shopping carts, doors opening, and moving vehicles), and provide one button push notification to send location information from a smartphone to a van or bus. Wearable sensors, such as cameras, three-dimensional
orientation devices, and pedometers, may be used in conjunction with a display unit to provide auditory and tactile guidance.\textsuperscript{vii}

While there is useful data in existing map systems, they often lack critical data relevant to ATTRI stakeholders. For example, a Points of Interest database may give the location of a store, but not where the entry door is, whether there are steps at the door, or if a restaurant has an accessible bathroom. In addition, wayfinding and navigation systems can support the transition from paratransit to fixed route transit services.

**Application Area 2: Pre-Trip Concierge and Virtualization**

Technology solutions focusing on providing pre-trip concierge services and route virtualization could include, but are not limited to: providing pre-trip and en-route traveler information throughout the trip, design for people with blindness, low vision, cognitive and mobility issues, passengers having the ability to “see” their entire routes on an app with landmarks (to remove fear and facilitate independent mobility) and contextual details with augmented voice overlays, and virtual caregiving technology which helps plan routes, track travelers movement and provide connectivity to caregiver and family members.

Applications in this area could include new technology solutions that assist travelers with activities in everyday life such as walking or getting to work seamlessly with unique traveler mobility needs and human transportation services to provide concierge services at different stages of travel. Applications could include improved personal mobility including the ability to learn and remember routes across the transportation network by integrating data, personal needs and profiles alongside available services. Applications could also relay traveler information for multiple transportation choices including cost, accessibility accommodations, distances, travel times, and integration with other modes for first mile, last mile options. Machine vision, Artificial Intelligence, assistive robots, and facial recognition software could help solve a variety of travel related issues for people with disabilities in vehicles, through the use of devices or at terminals creating virtual caregivers or concierge services helping guide travelers and assisting with decision making while connecting with their caregivers and family members. For example, if applications in this area were applied to transit systems and stations, virtual exploration devices could have the potential to help visually impaired travelers familiarize themselves with the layout of a building or of the overall transportation network.\textsuperscript{viii} In addition, for users of paratransit and taxicab type services, applications could track vehicle location and how long it would be before it arrives at the pickup location.

Additional examples of applications in this area could include: planning, reservations, and travel itinerary solutions for people with disabilities, pre-trip and en-route crowd-sourced traveler information, technical design solutions for people with blindness, low vision, cognitive and mobility issues, technologies which enable passengers “see” their entire routes on an app with landmarks, or virtual caregiver applications which help plan routes and track travelers movements including creation of voice assistant applications (such as Apple’s Siri) with a voice overlay of a family member to help those with cognitive disabilities. Applications in this area may leverage use of emoji’s for accessible transportation solutions for easier interpretation of information on smartphone apps and transportation infrastructure.
Application Area 3: Safe Intersection Crossing

Safe navigation of crosswalks can be a key challenge for people who need more time to traverse an intersection. If there is no safe island zone mid-intersection then signal light duration becomes very important, for example. Within this application area, providing safe intersection crossing assistance for all unique travelers as they interface with existing traffic, signals, all types of vehicles and assistive devices are key focus areas. It is imperative, then, that technological solutions including design, focus on assistive tools for people with blindness, low vision, cognitive and mobility issues. Assistive tools may be in the form of personal nomadic devices, wearable technologies and kiosks on streets corners to allow for ubiquitous access to connected services.

Applications in this area should, for example, provide guidance, notifications and alerts in various communication formats that assist pedestrians and all users of the transportation system, navigate safely through intersections and focus on providing precise and concise information when it is needed and at the right moment to promote decision making and actions. These applications should address and could include, but are not limited to the following components: pedestrians interface with traffic signals, vehicles, nomadic devices, and automated intersection crossing assistance, beacons or electronic tags to interact with the built and pedestrian environment including support for multiple languages and sharing of real-time information. It should provide contextual information including GIS and crowdsourced based information on curb cuts, bus stop locations, side walk grade and slope, and any disruption of the built environment (damaged infrastructure, dead ends, potholed) to aid all travelers. Additional examples could include; futuristic and innovate approaches to solving this issue with automated intersection crossing assistance, technical design solutions for people with blindness, low vision, cognitive and mobility issues, or integrated beacons or electronic tags to interact with the built environment.

C.1 FOUNDATIONAL CONSIDERATIONS

The ATTRI application developmental process seeks to spur innovation among accessible transportation concepts to provide inclusive and seamless door through door independent mobility to all travelers including those with disabilities. These awards are expected to develop three specific applications (one from each priority areas described above). Foundational considerations should be considered together as elements of each application and work tangentially to the degree possible. Foundational considerations are listed below:

1. Standard Accessible Data Platform
   Data standardization and interoperability is critical in developing applications which aspire to enhance the personal mobility of those with the greatest needs. Data must begin to work across service providers, utilize available real-time data sources and communicate in an efficient, succinct, and adaptable manner to meet individual user needs with various degrees of abilities. Technology applications to be considered for ATTRI development will provide almost ubiquitous access to a wealth of real-time, situational data sources, including data specific to transportation systems, municipalities,
points of interest, crowd-sourced information in accessible formats utilizing inclusive information and communications technology (ICT). Applications may consider standardized data to create user profiles allowing smoother access and transferring between accessible transportation services.

2. Universal Design Standards
Universal design standards incorporate a philosophy that espouses to maximize the applicability of a technical solution to the needs of all user groups. In relationship to ATTRI application development, it is presumed that all work attributed to building applications for the use by ATTRI stakeholder groups pursue universal design principles including inclusive ICT solutions. Implementation of such principles in development could include leveraging existing solutions and enhancing them to meet the needs of all users, as such user center and responsive design approaches, personalization techniques are expected to be followed for applications including implementing multiple communication formats (visual, audible, haptic) where possible. Likewise, consideration should be given to incorporate user profiles and documented needs from all stakeholder and ability groups, and creating user experiences with information sharing on any display associated with such applications in built and pedestrian environments including wearable and nomadic devices. The feasibility of mainstream adoption of such technological solutions being developed for ATTRI should also be considered for all functional disabilities types.

3. Integrated Payment Solutions
Integrated payment systems typically incorporate interoperable electronic fare payment media and technologies that can be utilized across all modes of transportation, at all times, perhaps for multiple consumer purposes, including leisure, recreational and healthcare expenses. The vision for a multimodal integrated payment system is to deliver, for travelers in the transportation ecosystem, the ease of use and convenience that comes from one real-time electronic payment system and extend that ease across modes and through institutional and technical collaborations. Integrated payment solutions should accommodate all users, including those with mobility, vision, hearing, and cognitive disabilities. In such cases where possible, consideration should be given to integrate payment solutions with any application or device such as embedding it on a power wheelchair or on a robotic device.

4. Leverage Existing Technologies
To maximize the impacts of ATTRI and to respond most effectively to the needs of all users and stakeholders, any application being developed under ATTRI should leverage, to the degree possible, existing technologies, including but not limited to ITS-JPO, Application Program Interface (API), Software Development Platform, Software Development Kit, on-demand technologies, data standards, innovative smartphone and mobile technology, wearable technology, accessible transportation technologies, and other assistive and enabling technologies, operations, and/or techniques whether currently being pursued in research, or readily available in the market.
For additional information on the ATTRI program please visit the program website: 
http://its.dot.gov/attri/.
D. ATTACHMENTS

1. Attachment 1 – Three Phase Development Sample

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vi Accessible Transportation Technology Research Initiate (ATTRI): Assessment of Relevant Research, FHWA-JPO-16-352.

vii Accessible Transportation Technology Research Initiate (ATTRI): Innovation Scan, FHWA-JPO-16-351.

viii Accessible Transportation Technology Research Initiate (ATTRI): Assessment of Relevant Research, FHWA-JPO-16-352

ix Accessible Transportation Technology Research Initiate (ATTRI): Assessment of Relevant Research, FHWA-JPO-16-352